Information Specificity and Environmental Scanning: An Economic Perspective\(^1, \)\(^2\)

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Abstract

This paper addresses two questions. First, how does an organization allocate its environmental scanning resources among all the potential sources of information in the environment? Second, how does an organization allocate responsibility for acquiring environmental information? Specifically, when does an organization choose to monitor an environmental source within its hierarchy, and when does it outsource the task? In the former case, when does the responsibility for acquiring information rest with the ultimate user, and when is it delegated, either to a subordinate or to a central environmental scanning unit?

The paper proposes a set of economic arguments to answer these questions. Borrowing from transaction cost theory, the paper develops the concept of information specificity to parallel the idea of asset specificity. Information specificity has two dimensions—knowledge specificity and time specificity. The paper uses transaction cost theory and agency theory to propose that the information acquisition choices made by managers and organizations are based on the specificity of the desired information. In making its arguments, the paper introduces the notion of cognitive transaction and agency costs to complement the behavioral costs that are the focus of traditional transaction cost and agency theory logic.

Keywords: Information acquisition, information specificity, transaction cost theory, agency theory, specific and general knowledge, cognitive transaction costs, cognitive agency costs

ISRL Categories: AC0303, AD0102, AD05, AM02

Introduction

As the transition is made from the industrial age to the information age, many corporations are undergoing radical reengineering (Champy 1995), rejuvenation (Baden-Fuller and Stopford 1994), or transformation (Gouillart and Kelly 1995). Driving much of this change agenda is a fundamental shift in the competitive environment and the arrival of what has been variously termed the third wave (Toffler 1981), the post-industrial society (Bell 1973), or the age of unreason (Handy 1989).

The rapidly increasing pace of environmental change is making it imperative for businesses to develop strategic and organizational flexibility. Environmental analysis and information

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acquisition are typically the first steps in organizational adaptation (Hambrick 1982). Firms are, therefore, feeling increasing pressure to make greater investments in personnel and systems for gathering environmental information (Lenz and Engledow 1986). In addition, new technologies such as the Internet are making it easier to acquire environmental information. The convergence of these trends means that, in order to avoid information overload (Huber and Daft 1987), managers and organizations must develop effective strategies for acquiring relevant environmental information in a timely fashion (Dollinger 1984; Keegan 1974; Kurke and Aldrich 1983; Mintzberg 1975).

The importance of good environmental information has long been stressed by researchers (for example, Radford 1978). As Keegan (1974, p. 411) notes, "how organizations obtain relevant information is crucial to the development of an empirical theory of organizations." Yet, only limited research has been done on how environmental trends become known to decision makers (Hambrick 1982). In particular, while there exist descriptive empirical studies (for example, Aguilar 1967; Collings 1968; Ghoshal 1988; Hambrick 1982; Kefalas and Schoderbek 1973), "no clear determinants of scanning behavior have been found" (Hambrick 1982, p. 160). Thus, there does not exist a sound theoretical framework that managers and organizations can use to develop a strategy for environmental scanning.

The purpose of this paper is to develop such a framework. In particular, two questions are addressed: (1) How does an organization allocate scarce environmental scanning resources among all the potential information sources in the environment? (2) How does an organization allocate responsibility for acquiring environmental information? Specifically, when does an organization outsource the task of acquiring environmental information and when does it retain the responsibility internally? In the latter case, when does the responsibility rest with the ultimate user of the information and when is it delegated, either to a subordinate or to a central environmental scanning unit?

The paper proposes a set of economic arguments to answer these questions. Borrowing the construct of asset specificity from transaction cost theory, it develops the concept of information specificity. Using arguments from transaction cost and agency theories, it proposes that the information acquisition choices made by managers and organizations are based on the specificity of the desired information. In building the arguments, the paper introduces the notion of cognitive transaction and agency costs, based on individuals' bounded rationality, to complement the behavioral costs, driven by opportunism, that are the focus of traditional transaction cost and agency theory logic.

The organization of this paper is as follows. In the next section, a distinction is made between reactive information acquisition in order to solve a specific problem and proactive environmental scanning. The focus in this paper is on the latter. Transaction cost theory is briefly described, and the concept of information specificity is developed, distinguishing between knowledge and time specificity and between specificity in use and specificity in acquisition. Next, the costs of information acquisition are discussed. Following this, the notion of time specificity of information is used to present a simple economic analysis of how organizations allocate environmental scanning resources. The concept of knowledge specificity of information and transaction cost theory is then used to analyze when an organization outsources the task of acquiring environmental information, and agency theory is used to address the delegation of responsibility for environmental scanning within the organization. In each case, to the extent possible, support for the propositions is offered with empirical findings from existing literature on environmental scanning. Finally, areas of interaction between information technology and information specificity are examined, and some suggestions for future research are offered.
The Research Questions

Reactive and proactive information acquisition

Managers and organizations acquire information for two reasons. In the "reactive" mode (El Sawy and Pauchant 1988), also termed "problemistic" (Cyert and March 1963) or "decision-oriented" search (Fahey and King 1977), information is acquired to solve a specific problem. In the "proactive" mode (El Sawy and Pauchant 1988), also referred to as environmental scanning or surveillance (Aguilar 1967; Collings 1968; Hambrick 1982; Huber 1984), the purpose of the information acquisition is exploratory, to detect potential problems and opportunities. From this perspective, "instead of seeing an organization as seeking information in order to choose among alternatives in terms of prior preferences, we can see an organization as monitoring its environment for surprises (or for reassurances that there are none)" (Feldman and March 1981, p. 176).

Many authors have proposed information acquisition typologies that can be mapped to these two broad categories. For instance, the typology of managerial information acquisition activity proposed by Aguilar (1967) includes four categories: (a) undirected viewing: general scanning in which the viewer does not have a particular purpose in mind; (b) conditioned viewing: directed exposure, but not active search, of an identified area or type of information; (c) informal search: relatively limited and unstructured effort to obtain particular information for a particular purpose; and (d) formal search: deliberate, planned search to obtain specific information for a particular purpose. Although Aguilar does not say so himself, the formal and informal search modes seem to correspond to reactive information acquisition, while undirected and conditioned viewing refer to proactive environmental scanning. Similarly, the typologies proposed by Zmud (1990)—scanners, trackers, and probers—and Collings (1968)—viewing, monitoring, investigation, and research—can also be mapped to these two categories.

Allocating environmental scanning resources

In the case of problemistic information search, although the information acquired can vary with individual biases, particularly for unstructured decisions, the overall scope of the information search is largely bounded by the problem. In the case of proactive environmental scanning, however, an organization must choose how to allocate its scanning resources among the overwhelming number of potential information sources in the environment. It has been suggested that managers use three strategies to limit the scope of environmental scanning (El-Sawy and Pauchant 1988): (1) limiting the consulted information sources to a handful of key sources (El-Sawy 1985), (2) limiting the types of environmental signals by just monitoring key trends, and (3) limiting the number of emerging issues being tracked. To adopt these strategies, an organization must decide which key trends and issues it is going to track.

Previous research in environmental scanning (Aguilar 1967; Ghoshal 1988; Hambrick 1982; Kefalas and Schoderbek 1973) is largely descriptive and offers little help for organizations and managers trying to decide, ex-ante, how much effort to expend on each potential source of information in the environment. In this paper, the notion of time specificity of information is developed and used to address the allocation of environmental scanning resources.

Allocating responsibility for environmental scanning

Early researchers viewed environmental scanning primarily as an informal, unstructured activity with individual managers acquiring information in the course of their daily activities (for example, Aguilar 1967). Later research has suggested, however, that for large corporations, scanning is often formally organized and coordinated (for example, Ghoshal 1988; Stubbart 1982). In particular, organizations need to make two sets of choices. First, "a company can now purchase an array of CA
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(competitor analysis) services: competitor profiles, ongoing scanning of public information on competitors" (Ghoshal and Westney 1991, p. 30). Thus, an organization must decide when to retain the responsibility for environmental scanning in-house and when to outsource it.

Second, many organizations have a central environmental scanning unit consisting of professional boundary spanners (Aldrich and Herker 1977; Leifer and Huber 1977; Tushman and Katz 1980), responsible for gathering, analyzing, and distributing competitive information (Dieffenbach 1983; Engledow and Lenz 1985; Fahey and King 1977; Gilad and Gilad 1986; Porter 1980; Stubbart 1982). Thus, for those sources it monitors internally, an organization must decide which ones will be assigned to a central unit and which ones will be the responsibility of the line units. Further, users in line units can monitor some sources personally and delegate others to subordinates.

Previous research offers little guidance to managers and organizations on making these choices. As Zmud (1990, p. 113) notes, "More comprehensive examinations of managers' personal information behaviors are desirable. Of particular importance are studies aimed at understanding which of these behaviors tend to be delegated, the extent they are delegated, and why they are delegated." In this paper, the concept of knowledge specificity of information is developed and used to build a theoretical framework for the allocation of responsibility for acquiring environmental information.

The specificity of information is based on the notion of asset specificity in transaction cost economics. This is discussed next.

Transaction Cost Theory and Information Specificity

Transaction cost economics (TCE) (Coase 1937; Williamson 1975; 1985) examines the appropriate governance structures to conduct transactions. TCE argues that in choosing between acquiring an asset by producing it internally, over a hierarchy, versus acquiring it over a market, a company will select the alternative that minimizes the sum of the production and transaction costs. It further states that under the assumptions of uncertainty in the exchange process, and bounded rationality and opportunism on the part of economic actors, this choice is determined by the level of asset specificity, or the extent to which an exchange is supported by transaction-specific investments. Asset specificity "refers to durable investments that are undertaken in support of particular transactions, the opportunity cost of which investments is much lower in best alternative uses or by alternative users" (Williamson 1985, p. 55). Transactions that are supported by high levels of asset specificity should be governed by hierarchical structures whereas transactions that require only general purpose investments will most efficiently be conducted over markets.

The assumptions of TCE are valid in our problem setting. The transaction we are concerned with is the acquisition of information that is commonly accepted as an asset (King 1984). All organizations face uncertainty in their information requirements (Ackoff 1967). All managers are boundedly rational (March and Simon 1958) and it is widely accepted that individuals frequently engage in opportunistic behavior by deliberately misrepresenting information or restricting others' access to information for personal gain (Feldman and March 1981; Pettigrew 1972; Zmud 1990). Finally, just as asset specificity in TCE defines the extent to which the value of an asset is restricted to specific transactions, information specificity is defined as the extent to which the value of information is restricted to its use and/or acquisition by specific individuals or during specific time periods.

Forms of information specificity

There are many different forms of asset specificity, such as human specificity, site specificity, physical specificity, and time specificity (Williamson 1985). In the context of information, two forms of specificity are defined—
knowledge specificity and time specificity. The value of information is based largely on its ability to affect decisions, although in the case of proactive scanning, the problem, and hence the decision, has not been identified yet. Rather, “systems for surveillance are justified in terms of the expected decisions and environments to be faced” (Feldman and March 1981, p. 176, emphasis added). Knowledge and time are both important influences on the way information is acquired and used in the context of decision making.

In addition, there is ample support in previous literature to suggest that the act of acquiring information can be separated from the act of using the information in a decision context. For instance, Huber (1982) defines four functions for organizational information systems: monitor the organization’s environment, transmit the resulting observations and interpretations to organizational decision-making units, relay the decisions to implementing units, and transmit implementation results. There are seven different kinds of processing nodes in an organizational information system: sensor, filter, router, carrier, interpreter, learner, modifier (Zmud 1990). The implication of these typologies is clearly that the individual or artifact (Zmud 1990) monitoring the environment (the sensor node) can be different from the decision-making unit (the interpreter node). This distinction is also implicit in the literature suggesting the establishment of dedicated environmental scanning units (Leifer and Huber 1977; Stubbart 1982; Tushman and Katz 1980).

Thus, within each category of knowledge and time specificity, we further distinguish between specificity in use and specificity in acquisition (Table 1). In the next two sections, the concepts of knowledge and time specificity are developed in greater detail.

### Knowledge Specificity

Early studies in decision making assumed perfect rationality, based on complete information, on the part of decision makers (O’Reilly 1983). Subsequent behavioral decision-making researchers, recognizing that decision makers operate under conditions of bounded rationality (March and Simon 1958), have sought to understand the impacts of heuristics and biases on the decision process (e.g., Schwenk 1984), primarily by exploring differences between the behavior of experts and novices (Chase and Simon 1973; Chi, et al. 1981; Chi, et al. 1982). The differences noted include attention to different aspects of the problem (Chase and Simon 1973; Chi, et al. 1982) and different manners of storing knowledge (Chi, et al. 1981). In a similar vein, in the realm of information acquisition, many researchers (e.g., Kiesler and Sproull 1982; Schwenk 1984) have stressed that the nature of the information retained from managerial sensing is largely a function of the filters that are applied (Bourgeois and Eisenhardt 1988; Isenberg 1986; Staw, et al. 1981; Ungson, et al. 1981; Zmud 1990). The term absorptive

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### Table 1. The Specificity of Information

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<th>Specificity in Acquisition</th>
<th>Time Specificity</th>
<th>Knowledge Specificity</th>
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<tr>
<td></td>
<td>Information that must be acquired immediately, or very shortly, after it first originates or becomes available</td>
<td>Information that can be acquired only by someone with the required specific knowledge</td>
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<tr>
<td>Specificity in Use</td>
<td>Information that decreases in value unless used immediately, or very shortly, after it becomes available</td>
<td>Information that can be effectively used only by someone with the required specific knowledge</td>
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capacity is used to refer to the idea that an individual's capacity to evaluate and utilize outside knowledge is constrained by the body of prior related knowledge that the individual possesses (Cohen and Levinthal 1990). That is, an individual's conceptualization of a problem, and hence the information the person chooses to acquire and use, is based on the individual's previous experiences and knowledge base (Cowan 1986; Lyles and Mitroff 1980; Volkema 1983; 1986). Thus, the first type of information specificity defined is knowledge specificity.

**Knowledge specificity in acquisition and use**

Information has *high knowledge specificity in use* if it can be interpreted and used effectively only by individuals possessing "specific knowledge" (Jensen and Meckling 1992). Information is high in *knowledge specificity in acquisition* if it can be acquired only by individuals possessing specific knowledge. The knowledge specificity in acquisition of information is tied to the need for information filtering (Belkin and Croft 1992; Foltz and Dumais 1992), that is, the need to discern relevant information from the large amount of data to which an individual is exposed. To the extent that this filtering process requires specific knowledge, information has high specificity in acquisition.

Information that is high in knowledge specificity in use need not necessarily be high in specificity in acquisition. That is, specific knowledge may be needed to use the information; however, the initial acquisition of this information may not require the same specific knowledge. On the other hand, information that is highly knowledge specific in acquisition is also usually knowledge specific in use: if being able to capture the information requires specific knowledge, the same knowledge is probably necessary to use the information.

Specific knowledge has two attributes: (1) it is possessed by a very limited number of individuals and (2) it is expensive to transfer. The more costly knowledge is to transfer, the more general it is (Jensen and Meckling 1992). Specific knowledge is expensive to transfer because (1) it cannot be aggregated meaningfully (Christie 1993; Hayek 1945) and (2) there is no common vocabulary or procedure for transferring it. This is similar to the difficulties in transferring tacit knowledge (Kogut and Zander 1992; Nonaka 1994; Polanyi 1966). Knowledge is codifiable and easy to transfer (non-specific) if it can be structured into "a set of identifiable rules and relationships...Coded knowledge is alienable from the individual who wrote the code" (Kogut and Zander 1992, p. 387). Not all knowledge is, however, amenable to codification, such as experiential knowledge acquired by an individual as a byproduct of doing his/her job. Thus, "drafting a recipe for the manufacturing of a musical instrument is unlikely to capture the requisite skills of a craftsperson" (Kogut and Zander 1992, p. 387).

There are two forms of specific knowledge: (a) scientific or technical knowledge, for example, the professional medical knowledge possessed by a doctor, and (b) knowledge of context, or knowledge of particular circumstances of time and place (Hayek 1945; O'Reilly and Pondy 1979), for instance, the detailed knowledge that a doctor possesses about the idiosyncrasies of a particular patient that he/she has treated for a number of years.

It is important to stress the distinction between knowledge, and information that adds to, restructures, or changes knowledge (Machlup 1983). "Information is a flow of messages, while knowledge is created and organized by the very flow of information, anchored on the commitment and beliefs of its beholders" (Nonaka 1994, p. 15). That is, while knowledge is the stock of information possessed by an individual, based on previous experience and/or training, information is the regular, ongoing flow of data to which the individual is exposed (Dretske 1981). Two points should be noted. First, the distinction between information and knowledge is time dependent: what is information at one point in time can become part of the individual's or organization's knowledge base at a future point in time. Second, following the literature, the terms data and
information are distinguished—the former is used to refer to raw, unfiltered data and the latter to refer to data that is useful or meaningful to the recipient (Davis and Olson 1985).

**Examples of knowledge specificity of information**

There is an interesting example of knowledge specificity from the field of product design (Brickley, et al. 1996). Apple's initial portable computer offering weighed over 17 pounds. Needless to say, it was not well received by the market. As the first step in redesigning the machine, Apple sent out a team of product developers, including industrial designers and engineers, to acquire information on customer preferences by observing potential customers using other products. Their observations enabled the team to improve the product significantly, both in usability and design, including such distinctive features as the trackball pointer and the palm rest in front of the keyboard.

Why was the design team sent out to observe customers rather than, for instance, some salespeople? Perhaps because observing customers at work is a highly unstructured data gathering technique that generates a large number of signals. Filtering through these signals to distill the relevant information, or recognizing what aspects of a customer's use of the product were relevant, from a design perspective, required the specific knowledge possessed by the design team. That is, the information was high in knowledge specificity in acquisition. This is analogous to the distinction between a professional coach and a typical fan watching a football game. The coach has the specific knowledge needed to filter, from the chaos of the game, the specific information needed to evaluate, and help, players. Most fans probably do not have the knowledge to do this. In addition, the information collected by the design team (the coach), is also knowledge specific in use because translating this information into a product design (using the information in player development) requires the specific knowledge of the design team (the coach).

Consider another example, this time from the investment industry. Many investment firms have designated analysts responsible for developing investment reports on specific stocks, projecting future earnings, evaluating product offerings and market positioning, and formulating an overall "buy or sell" recommendation. In developing this report, the stock analyst often has a staff to whom the task of collecting basic financial data and other relevant information reported in such public documents as press releases and annual reports can be delegated. Gathering this information does not require the specific knowledge of the stock analyst, that is, it is low in knowledge specificity in acquisition. However, the analyst usually personally collects some information, such as the quality of management, which can be obtained only by visiting the company. This information is often highly knowledge specific in acquisition, because gathering it requires the expertise, as well as the historical contextual knowledge, that the analyst has accumulated over years of monitoring the company. In addition, both this information as well as the basic financial data are knowledge specific in use because integrating these various pieces of information into a meaningful investment report requires specific knowledge possessed only by the stock analyst.

**Intra- and interorganizational knowledge specificity**

We also distinguish between knowledge specificity at the intra- and interorganizational levels of analysis. At the intraorganizational level, the specificity of information depends on the extent to which the knowledge required to interpret the information is shared by individuals within an organization. Three degrees of knowledge specificity are defined at this level.³

³Conceptually, knowledge specificity is a continuous, rather than a discrete, variable—the fewer the number of individuals that possess the knowledge required to acquire and/or use some information, the more knowledge specific it is. However, defining three discrete levels facilitates the flow of argument, without loss of generality.

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Information is high in intraorganizational knowledge specificity when only one or two isolated individuals in the organization have the requisite specific knowledge to acquire and/or use it. These individuals may be, for instance, a senior manager, a project manager, or a highly specialized technician or researcher. Medium knowledge specificity defines the situation where members of a specific organizational unit possess the needed knowledge, for instance, a new product development team. Finally, low knowledge specificity of information means that the needed knowledge is widely shared by members of the organization across different units and specialties.

At the interorganizational level, information is high in knowledge specificity if the knowledge required to interpret the information is restricted to members of a single organization, for instance, knowledge of standard operating procedures and norms of conduct, or knowledge of impending product introductions. Information is low in interorganizational knowledge specificity if the knowledge required to interpret the information is widely prevalent among members of society (or at least an industry) and is not restricted to members of a specific organization.

For convenience of presentation, in the rest of this paper, the term knowledge specificity, used by itself, refers to intraorganizational knowledge specificity. The term organizational knowledge specificity is used to refer to knowledge specificity at the interorganizational level.

Time Specificity

Traditional rational decision-making models believed that problems were attended to in order of importance and expected value (Newell and Simon 1972; Simon 1965). In contrast, the garbage can model asserted that attention to problems and the alternatives selected depend greatly on the arrival time of problems (Cohen, et al. 1972). The idea of temporal importance was extended by Saunders and Jones (1990), who suggested that various sources of information and media are more appropriate at different phases of the decision making process. Others have suggested that time may be the only sustainable source of advantage an organization possesses (Keen 1988; Stalk and Hout 1990). Given the significance of time in the acquisition, use, and value of information, the notion of time specificity of information is also developed.

Time specificity in acquisition and use

Time specificity in use is the extent to which information loses value if not used very soon after it first becomes available. An example is a stock quote to an arbitrageur; there is usually a very short window of time during which this information can be exploited. The time specificity in use of the same information can vary for different users and in different contexts. For instance, information on stock trades is much higher in time specificity to an arbitrageur than to an individual investor who adjusts his/her portfolio, say, monthly. The same information is lower still in time specificity to a researcher studying historical trends in the valuation of stocks.

Information is highly time specific in acquisition if it must be captured when, or very shortly after, it first originates. High time specificity in acquisition may be an inherent property of the data, for instance, if the data is generated by an event, and must be captured at the time the event occurs. Thus, the magnitude of an earthquake must be captured at the time the earthquake strikes: it will never be available again. In addition, information that is high in time specificity in use is, by extension, also high in time specificity in acquisition: to use information immediately after it becomes available, one must acquire it first. Information that is highly time specific in acquisition need not, however, be highly time specific in use. Once data on the magnitude of an earthquake is captured, it may quite effectively be used at a later date, depending on the purpose.
Costs of Acquiring Information

The economic analysis presented in this paper is based on the relative costs of different environmental scanning strategies. The specific costs included in the analysis are the following:

Surveillance costs: These include the time, effort, and money required to monitor, and procure information from, an environmental source. These costs can vary with the location of the responsibility for surveillance and rise with the frequency of monitoring.

Opportunity costs: These are the costs of missed opportunities or losses suffered because the relevant information was not available to the right person at the right time. Three primary sources of opportunity costs are considered. First, the organization may have completely failed to capture relevant and useful information because it did not monitor a source in the environment with sufficient frequency. Second, the organization may have chosen to monitor the appropriate sector of the environment but the responsible individual (or vendor, in case of an outsourced contract) failed to recognize the significance of a relevant environmental signal. Finally, the responsible individual captured the relevant information but failed to send it on to the decision maker in time, that is, there was an unacceptably long delay in routing the message (Huber 1982).

Knowledge transfer costs: These are the costs of transferring knowledge from the user to the acquirer in order to allow the latter to interpret, and acquire, the relevant information.

Verification costs: These are the costs incurred by a user to verify the accuracy of the information acquired by the individual (or vendor) to whom the task was delegated. Verification costs can be attributed to two factors. Behavioral verification costs are incurred to guard against strategic information behavior, or intentional message modification (Huber 1982) motivated by the self-interest of the entity acquiring the information. Cognitive verification costs are necessary to guard against the possibility that because of cognitive limitations, the information acquirer may have captured incorrect or incomplete information, or may have inappropriately summarized the message (Huber 1982).

When the information is acquired directly by the ultimate user, the surveillance and opportunity costs (other than those attributable to delays in message routing) are relevant. When the task of acquiring information is delegated, we must also include the knowledge transfer and verification costs, as well as the opportunity costs from delays in message routing.

Finally, there are other potential costs, for example, search costs, storage costs, and information transmission costs, that an organization incurs in the process of environmental scanning. However, in the interests of limiting the scope of the paper, these costs have been excluded from explicit discussion in this section. Instead, the points at which these costs may influence propositions in later sections of the paper are noted. Further research should be conducted to clarify these relationships.

Allocating Environmental Scanning Resources

Given the almost infinite number of potential sources of information in the environment, organizations must decide how they are going to allocate their limited scanning resources. Surveillance strategies may range from the continuous monitoring associated with a process control system, to weekly visits to selected customers, to monthly meetings with key employees. Or a firm may adopt a research strategy, where a source is never monitored proactively, only reactively in response to a specific need for information. The key decision, therefore, is the frequency with which an organization chooses to monitor proactively each potential source of environmental information.

It is hypothesized that this will depend on (1) the expected value of the information from the
source, and (2) the expected time specificity of the information generated by the source. The word expected is used because clearly the actual time specificity and value of any information cannot be ascertained until the exact content of the information becomes apparent. Thus, organizations have to make decisions about monitoring based on their ex-ante expectations.

The tradeoff is between the surveillance and opportunity costs. Increasing the frequency of monitoring a source increases the surveillance costs but reduces the expected opportunity costs by lowering the probability of missing relevant information. Following traditional economic logic, therefore, the following is proposed:

**Proposition 1**: An organization will increase the frequency with which it monitors a potential source of information in the environment until the point at which either (1) the marginal increase in surveillance costs is equal to the marginal reduction in the expected opportunity costs or (2) the probability of capturing the information is 1, whichever comes first.

Further:

Expected opportunity costs of failing to capture information from a source =

\[ \text{(Expected value of the information)} \times \text{(Probability of failing to capture the information in a timely manner)} \]

and

\[ \text{Probability of failing to capture the information in a timely manner} = \frac{f}{T} \times \text{(Frequency with which the source is monitored, Time specificity in acquisition of the information)} \]

The Appendix illustrates, with two hypothetical numerical examples, the implications for allocating environmental scanning resources. As shown in example 1, for information sources whose value is sufficiently high in relation to the surveillance costs, the frequency of monitoring is directly, and positively, related to the time specificity of the information. However, as shown in example 2, for information whose value is not as high relative to the surveillance costs, it may be desirable for the organization to monitor the information source with lower time specificity with greater frequency.

In previous research on environmental scanning, the typical approach has been to divide the environment into multiple sectors and ask executives how much of their time they spend monitoring each sector. For instance, Kefalas and Schoderbek (1973) include five sectors: market sector, technology sector, external growth sector, government sector, and other sectors. There is no attempt to measure either the exact value of the information or the cost of surveillance. This makes it difficult to map the results from these studies directly to proposition 1. However, the findings in the previous literature do seem to be consistent with one implication of proposition 1, as illustrated in example 1 in the Appendix: the positive relationship between time specificity and proportion of environmental scanning resources expended (assuming that the information is sufficiently high in value).

Most previous studies have reported that executives spend a majority of their time scanning the marketing sector—33.3% in the study by Kefalas and Schoderbek (1973), 37% in Keegan's study (1974), 58% in the study by Aguilar (1967), and 48% in the study by Ghoshal (1988). No clear explanation is offered for these findings. A possible reason may be that the marketing sector is the one likely to yield the most highly time-specific information. This sector includes information on the market potential, structural changes, competitive products, pricing, sales plans, channels of distribution, and consumer/customer relations (Kefalas and Schoderbek 1973). Changes in these elements of the competitive environment typically require a swift response in order to avoid loss of competitive position. As Smith, et al. (1992, p. 4) note,

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4Ghoshal differentiates between the market and competitive sectors. The figure reported in this instance is a summation of the two, for comparability with the other studies.
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"sometimes the key to competitive advantage is not the appropriateness of action but rather its timing or the speed with which a firm acts or reacts."

For instance, in the airline industry, there are frequent examples where one airline reduces fares, and other airlines are forced to match the fares within a very short timeframe in order to avoid loss of market share on the affected routes. If an airline were to find out about price changes by a competitor only a week later, any action it takes may be superfluous. Therefore, the information on competitive fare changes is very high in time specificity in acquisition and use.

It has also been found that executives in dynamic environments spend more time acquiring external information than executives in stable environments (Kefalas and Schoderbek 1973). This can be explained by the fact that the time specificity of environmental information is higher in dynamic environments, both in acquisition because the information changes more frequently and so must be captured within a very short time frame, and also in use because of the need to react faster.

Before concluding this section, it should be noted that the frequency of environmental scanning may, in some cases, also be affected by other costs not included in the analysis above, such as the search costs of locating the source of information and the storage costs. However, to limit the scope of this paper, it is assumed that the search costs are incurred once, whether as a prelude to a program of regular surveillance, or in accessing the source once in response to a need for specific information, and are, therefore, unaffected by the frequency of scanning. Similarly, it is assumed that storage costs will usually not be significant enough in relation to the value of the information acquired, particularly with the availability of inexpensive information technology, to affect the frequency of scanning. Future research can extend the framework presented here by relaxing these assumptions and explicitly including these costs in the analysis.

Allocating Responsibility for Environmental Scanning

As noted earlier, organizations must make two choices in this regard: when to outsource the task of acquiring environmental information and when to retain the responsibility internally, and, in the latter case, where in the organization to locate the responsibility for acquiring the information.

Make or buy: outsourcing the acquisition of environmental information

Whether to outsource the task of monitoring an environmental source is effectively the choice between a market and hierarchy. In TCE, this choice is based on tradeoffs among the production and transaction costs discussed below:

1. Production costs: TCE assumes that markets usually have an advantage in production costs: the surveillance costs in our problem setting. As Ghoshal and Westney (1991, p. 30) observed, "external contractors may even have an advantage in surveillance, since they can reap the benefits of scale and scope." But, as Williamson (1985, p. 92) notes, "The production cost penalty of using internal organization is large for standardized transactions for which market aggregation economies are great.... As goods and services become very close to unique, however, aggregation economies of outside supply can no longer be realized." Similarly, the advantage that external contractors have in surveillance costs, of being able to aggregate demand for the same information by multiple companies, declines with the organizational knowledge specificity of the information.

2. Transaction costs: These can be divided into the coordination costs and the contractual costs (Gurbaxani and Whang 1991). The coordination costs are the costs of the...
information processing necessary to coordinate the work of the contracting parties (Malone, et al. 1987), for instance, search costs, inventory holding costs, and communication costs. These costs are generally assumed to be higher in a market than in a hierarchy.

The contractual costs include the ex-ante costs of drafting, negotiating, and safeguarding a contract and the ex-post costs of enforcing the contract. In TCE, high asset specificity is presumed to increase the potential threat of opportunism, thereby increasing the behavioral contractual costs of market-based exchanges. This is also true in this problem setting. If a firm outsources the task of acquiring information that is high in organizational knowledge specificity, a vendor who makes the transaction-specific investment in acquiring the needed organization-specific knowledge is more vulnerable to ex-post opportunistic behavior.

In addition, outsourcing the acquisition of information that is high in organizational knowledge specificity also entails significant cognitive transaction costs. These costs are attributable, not to the threat of opportunism, but to bounded rationality. Classical TCE does not include cognitive costs because it does not consider inherent differences in ability among actors in the market and within the hierarchy. In fact, one of the criticisms of TCE is that it assumes that the same productive activity can be carried on equally effectively either within the firm or by a collection of autonomous contractors (Conner 1991). However, when organization-specific knowledge is required to acquire information, there is an inherent ex-ante difference in ability between the firm, which already possesses this knowledge, and the market, which must acquire it. This gives rise to the following cognitive transaction costs (Table 2):

1. **Knowledge transfer costs**: To allow an external vendor to acquire information that is high in organizational knowledge specificity, the organization must transfer specific knowledge to the vendor before the contract which, by definition, is expensive to do.

2. **Cognitive verification costs**: These costs increase with the organizational knowledge specificity of the information because it becomes more important—to assure itself that the specific knowledge was properly transferred—and more difficult—because of the lack of a comparison point—for the

<table>
<thead>
<tr>
<th>Source of Costs</th>
<th>Behavioral Costs</th>
<th>Cognitive Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex-ante transaction costs</td>
<td>Costs of negotiating and drafting a contract</td>
<td>Knowledge transfer costs</td>
</tr>
<tr>
<td>Ex-post transaction costs</td>
<td>Costs of enforcing the contract (including behavioral verification costs)</td>
<td>Cognitive verification costs</td>
</tr>
<tr>
<td>Underlying assumption</td>
<td>Opportunism</td>
<td>Opportunity costs</td>
</tr>
<tr>
<td>Primary Factor Driving Cost</td>
<td>Asset specificity</td>
<td>(Inter) Organizational knowledge specificity of information</td>
</tr>
</tbody>
</table>

Table 2. Cognitive and Behavioral Transaction Costs

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organization to verify the vendor's performance on the contract.

3. **Opportunity costs:** Since specific knowledge is difficult to transfer, there is increased probability that the vendor will fail to acquire relevant environmental information that the firm itself may have captured.

This argument can be summarized as follows. In standard TCE, the transaction is organized to minimize the sum of the production costs, the coordination costs, and the behavioral contractual costs. This is modified slightly. In deciding between outsourcing the task of monitoring an environmental information source and retaining the responsibility internally, an organization will choose the option that minimizes the sum of the surveillance costs, the coordination costs, the behavioral contractual costs, and the cognitive transaction costs. As the organizational knowledge specificity of information increases, both the behavioral and the cognitive transaction costs of outsourcing rise. In addition, for highly organization-specific information, external vendors have little advantage in the surveillance costs. Thus, the following is proposed:

**Proposition 2:** Organizations will outsource the acquisition of environmental information that is low in organizational knowledge specificity but will retain internally the responsibility for acquiring information that is high in organizational knowledge specificity.

Finally, when the task of information acquisition is delegated by the user, either internally or to an external vendor, there is a cost of information transfer, or message routing (Huber 1982), from the acquirer to the user. However, this has been excluded from our analysis under the assumption that the cost will usually not be significant enough, particularly with the availability of inexpensive information technology, to affect the choices analyzed in this paper. Future research can extend the analysis presented here by relaxing this assumption and explicitly considering these costs.

**Allocating responsibility internally for environmental scanning**

Within an organization, the responsibility for acquiring information may remain with the user (decision maker), or it may be delegated, either to a subordinate in the same organizational unit (hereafter referred to as just a subordinate) or to a central environmental scanning unit.

The advantage of delegation is a reduction in the surveillance costs, both to the individual user and, if it is assumed that the delegatee's time is likely to be less expensive than that of the user's, to the organization as well. In addition, when there are multiple potential users of some information, delegation to a central unit allows the organization to leverage internal economies of scale and eliminate potential duplication in the firm's business intelligence efforts (Gilad and Gilad 1986).

Delegating the information acquisition task, however, creates a principal-agent relationship between the user and the delegatee and gives rise to the attendant agency costs (Jensen and Meckling 1986). As with TCE, agency theory is concerned primarily with behavioral agency costs, based on the assumption that agents are opportunistic, work averse, and maximize their own self interests, often in conflict with those of the principal (Baiman 1982; 1990). In addition, cognitive agency costs, which are based on the bounded rationality and cognitive limitations of the agent and on inherent differences in ex-ante ability between the principal and the agent, are also considered.

There are two primary sources of agency costs incurred by the principal:

1. **Monitoring costs:** These are the costs of verifying that the agent is acting in the best interests of the principal and not shirking—the behavioral verification costs in the terminology used here. In addition, the cognitive verification costs must also be considered.

2. **Residual loss:** These are the costs of the loss in welfare suffered by the principal.
because, in spite of contractual incentives, there is usually some divergence between the agent's decisions and the decisions that would maximize the welfare of the principal (Gurbaxani and Whang 1991; Jensen and Meckling 1986). In this problem setting, these are the incremental opportunity costs from the possibility that the delegatee may not capture some information that the principal would have acquired. These could be because of shirking and opportunism, as is the focus in traditional agency theory, or because of the agent's cognitive limitations. Finally, the focus in much of the agency literature has been on the design of the optimum contract to minimize behavioral agency costs, partly because agency theory originally addressed situations with existing relationships, for example, between shareholders and managers. As a result, the agency literature typically does not consider the costs of establishing the agency relationship. The focus of this paper is whether the principal-agent relationship should be created at all by delegating the acquisition of environmental information. In analyzing this question, the costs of establishing the agency relationship must also be considered. From a cognitive perspective, these are the knowledge transfer costs, that is, the costs of transferring knowledge from the principal to the agent to allow the latter to acquire relevant information.

Table 3 lists the behavioral and cognitive agency costs. Our argument is that the task of information acquisition will be delegated if the savings in the surveillance costs are greater than the sum of the behavioral and the cognitive agency costs, including the costs of establishing the agency relationship.

The magnitude of the behavioral agency costs is a function of the level of information asymmetry between principal and agent. Information asymmetry is not affected by the knowledge specificity of information. Even when the specificity is high, any specific knowledge that is needed by the delegatee (agent) is, in fact, obtained from the delegator (principal), who also retains possession of the knowledge. Thus, following agency theory, it is assumed that organizations will attempt to minimize behavioral agency costs contractually by creating incentives for the agent not to behave opportunistically. Cognitive agency costs, on the other hand, cannot be finessed with a contract. The magnitude of these costs depends on the need to transfer specific knowledge from the principal to the agent. Specifically, we propose that cognitive agency costs increase significantly, and delegation is not an efficient choice when it requires the transfer of specific knowledge from the decision maker to the delegatee so that the latter can acquire the needed information, that is, when the information is high in knowledge specificity and the delegatee does not possess the needed specific knowledge. Since specific knowledge, by definition, is expensive to transfer, knowledge transfer costs are high. The opportunity costs are higher because of the possibility that the transfer of specific knowledge to the delegatee may not be perfect, and, as a result, there is increased likelihood that the latter will fail to acquire relevant information. Finally, the cognitive verification costs are higher because there is more pressure on the decision maker to check that the delegatee understood the transferred specific knowledge and captured all relevant information.

On the other hand, cognitive agency costs will be low, and delegation will be efficient when no specific knowledge needs to be transferred from the decision maker to the delegatee, that is, either when the information is low in knowledge specificity in acquisition or when the information is high in knowledge specificity but the delegatee already possesses the needed specific knowledge. Since no specific knowledge is being transferred, knowledge transfer costs are

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4 Using agency theory to examine the question of whether or not to delegate (and create an agency relationship) is not without precedent. For instance, agency costs have been used to analyze whether decision rights should be delegated within a firm (Baiman 1982; 1990; Brickley, et al 1996). Anderson (1985) used agency variables in her transaction cost analysis to examine whether a firm should use a corporate sales force or a manufacturer's representative (which would create an agency relationship).
Table 3. Cognitive and Behavioral Agency Costs

<table>
<thead>
<tr>
<th>Source of Costs</th>
<th>Behavioral Costs</th>
<th>Cognitive Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs of establishing agency relationship</td>
<td>Typically not considered by classical agency theory</td>
<td>Knowledge transfer costs</td>
</tr>
<tr>
<td>Agency costs</td>
<td>Monitoring costs (behavioral verification costs) Residual loss</td>
<td>Cognitive verification costs Opportunity costs</td>
</tr>
<tr>
<td>Underlying assumption</td>
<td>Opportunism</td>
<td>Bounded rationality Ex-ante difference in ability between principal and agent</td>
</tr>
<tr>
<td>Primary factor driving cost</td>
<td>Information asymmetry</td>
<td>(Intraorganizational) Knowledge specificity of information</td>
</tr>
</tbody>
</table>

low. Because the delegatee possesses the same relevant knowledge as the user, the probability of failing to capture relevant information, and hence the opportunity costs, should be no higher than if the user were to acquire the information personally. Similarly, the cognitive verification costs are low because the user can be confident in the delegatee's ability to acquire relevant information.

The three cases of information with high, medium, and low knowledge specificity in acquisition are now considered individually.

1. High knowledge specificity in acquisition: In this case, if a decision maker wishes to delegate the task of acquiring information, it will most likely have to be to someone without the needed specific knowledge. The logic proposed above would, therefore, suggest the following proposition.

Proposition 3a: Decision makers will personally acquire information that is high in knowledge specificity in acquisition.

2. Medium knowledge specificity in acquisition: In this case, the decision maker should be able to delegate the information acquisition task to a subordinate without needing to transfer specific knowledge since medium knowledge specificity implies that the needed specific knowledge is shared by members of an organizational unit. On the other hand, since the needed knowledge is not widely shared across multiple units in the organization, specific knowledge would need to be transferred if the information acquisition task was delegated to central environmental scanning unit. Thus:

Proposition 3b: Decision makers will delegate the task of acquiring information with medium specificity in acquisition to subordinates.

3. Low knowledge specificity in acquisition: In this case, both the central environmental scanning unit, as well as subordinates of the decision maker, should possess the required knowledge so that no specific knowledge transfer would be required for delegation to either of them. The choice between them depends on the knowledge specificity in use of the information. Information that is low in knowledge specificity in use is relevant to multiple individu-
als, potentially located in different organizational units. For such information, as noted earlier, assigning the information acquisition task to a central unit leverages internal economies of scale.

On the other hand, information that is high in knowledge specificity in use is relevant to only one or two individuals, typically within a single organizational unit. Hence, the task of acquiring the information should be delegated to a subordinate in the same unit to reduce the potential opportunity costs from long delays in routing the message. The probability of delay increases with the number of sequential links in the chain between the acquiring and using units (Huber 1982). There should be fewer links between two individuals in the same unit than between a central information gathering unit and a decision maker in a line department.

**Proposition 3c:** For information that is low in knowledge specificity in acquisition, managers will delegate the task of acquiring information to (a) a central environmental scanning unit if the knowledge specificity in use of the information is low and (b) to a subordinate if the knowledge specificity in use of the information is high.

The discussion above is summarized in Table 4. Empirical findings in previous literature offer some support for the above propositions. For instance, a study of Korean firms found that central environmental scanning units were largely responsible for monitoring the general economic environments in key markets (Ghoshal 1988). Further, in high technology businesses, for technology monitoring, "the central scanning unit does not play a significant role and most of the activities (monitoring new models introduced by competitors including reverse engineering and patent monitoring) are carried out in the product development department" (Ghoshal 1988, p. 79). Similarly, Stubbart (1982) also states that the information collected by environmental scanning units is usually broad in scope. This is consistent with the propositions presented in this paper. The knowledge specificity in acquisition and use of broad-based economic information are typically low. Thus, the central unit provides an efficient way to acquire and distribute the information. On the other hand, information about

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**Table 4. Allocating Responsibility for Environmental Scanning**

<table>
<thead>
<tr>
<th>(Inter) Organizational Knowledge Specificity in Acquisition</th>
<th>(Intraorganizational) Knowledge Specificity in Acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>User/Decision-Maker</td>
</tr>
<tr>
<td></td>
<td>Central Unit (for low specificity in use)</td>
</tr>
</tbody>
</table>

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specific competitive products, including reverse engineering, is higher in knowledge specificity, and therefore acquired directly by the line unit.

It has been found that line managers preferred to collect their own information rather than delegate to analysts in a central scanning unit partly because of the "relatively low level of line or product management experience among the analysts," that is, because line managers felt that the analysts did not possess the needed specific knowledge to "understand and interpret competitor information" (Ghoshal and Westney 1991, p. 22).

Experienced managers favor internal sources significantly more than inexperienced managers (Aguilar 1967). This may be a reflection of the argument in proposition 3b above. Experienced managers recognize the efficiency of using subordinates to collect information that is not high in knowledge specificity, which explains their greater use of internal sources.

Finally, Keegan (1974), in his research on multinational companies, found that when a headquarters executive needed environmental information about operations in a foreign country, the most likely source was the corporation's own staff abroad. This may be because headquarters executives understood that to acquire environmental information effectively in a foreign country requires specific knowledge of norms, culture, and sources possessed only by executives in that country. These foreign executives could then convey relevant information to headquarters executives along with any specific knowledge needed by the latter to interpret the information.

An integrative view

A comparison of Tables 2 and 3 reveals a strong overlap between cognitive transaction and agency costs. This is because, from a cognitive perspective, they both represent the costs of delegation—whether it is one organization delegating to another, or one individual delegating to another within the same organization—when there is an ex-ante difference in ability between the delegator and the delegatee, that is, when specific knowledge is required to perform an activity and this specific knowledge is possessed by the delegator but not by the delegatee. In each case, therefore, three categories of costs must be incurred: the cost of trying to overcome the ex-ante difference in ability (the knowledge transfer costs), the cost of verifying how successfully the difference in ability was overcome (the cognitive verification costs), and the potential loss in welfare from inferior performance on the part of the delegatee because of any remaining differences in ability (the opportunity costs).

There are, however, significant differences which make it important to retain the two separate theoretical perspectives. First, cognitive transaction costs are a function of the (inter)organizational knowledge specificity of the information while cognitive agency costs rise with the (intraorganizational) knowledge specificity of information. Second, the behavioral transaction and agency costs that must also be considered in deciding whether or not to outsource or delegate within the organization respectively are different. Although they are both a consequence of opportunism, the magnitude of behavioral transaction costs increases with the level of asset specificity while behavioral agency costs rise with the level of information asymmetry between principal and agent (Tables 2 and 3). Finally, the market mechanisms that are presumed by TCE to mitigate some of the behavioral transaction costs are not available for internal delegation. As a result, agency theorists have concentrated solely on contractual incentives to minimize behavioral agency costs.

Information Specificity and IT: Implications for Research and Practice

The concept of information specificity can be usefully applied to examine a wide range of topics of interest to both practitioners and researchers, including both the use and the
Information Specificity

management of information technology in organizations. A few of these are discussed below.

**Strategies for information acquisition, transfer and storage, and use**

Managers in organizations perform three basic functions with regard to information: acquisition, transfer and storage, and use. Information specificity provides a single lens through which an organization can view, and build, appropriate strategies for all three stages.

**Acquisition**

The acquisition of information was, of course, the primary focus in this paper. The use of automated information systems for environmental scanning is probably most appropriate for information that is high in time specificity but low in knowledge specificity. Intelligent agents (Elofson and Konsynski 1991), or computer systems that incorporate the specific knowledge required to filter information, are still extremely complex and relatively uncommon. On the other hand, the value of the increased frequency of monitoring possible with IT, which can reduce the marginal cost of surveillance, is likely to be greatest for highly time specific information.

An interesting example of this is in the travel industry. Airlines continually adjust the number of discounted fares on different flights based on shifting demand. Many travel agents have developed software to monitor airline reservation systems every few minutes to search for these fares and make them available to their customers before they are changed or booked. Given the frequency of change, the information on these fares is very high in time specificity in acquisition and the frequent monitoring required to capture it would likely have been economically infeasible without IT. At the same time, it is IT that makes it possible for airlines to monitor and respond to demand patterns as fast as they do. This, in turn, reduces the time window within which the agents must locate the fares, thereby necessitating the frequent monitoring. Thus, the widespread use of IT is not only enabling but, in many cases, forcing organizations to acquire and process information faster, that is, *IT is increasing the time specificity in acquisition and use of information.*

**Transfer and Storage**

Merely acquiring relevant information is not enough if it is not communicated to the appropriate decision makers in a timely fashion (Smith, et al. 1992). Two well-publicized events dramatically illustrate the importance of having appropriate strategies in place for the communication of information (Jones and Neuborne 1996). The first is the crash of the Valu Jet aircraft in the Florida everglades in early 1996. It has since come to light that for months before the crash, the FAA had the safety data that it later used to ground the airline. But the information was not communicated to the appropriate decision makers. The second incident is the 1996 bombing of the residential complex of American troops in Saudi Arabia that killed 19 people. Before the bombing, the Saudis had turned down a U.S. request to widen the security zone around the towers housing the troops. Yet, then Defense Secretary William Perry, who may have been able to act on the information, was not informed about the denial until four days after the bombing.

In particular, information with high time specificity in use must be communicated as soon as possible to the appropriate user(s). IT may be able to help by providing mechanisms that allow an information acquirer to communicate and, more importantly, get the immediate attention of a decision maker when faced with highly time specific information. Special filters may be built into the electronic mail system to alert users to highly time specific information. Databases can be designed to include fields that record the time specificity of the information. IT may also be able to help by building a database of the distribution of specific knowl-
edge in an organization, so that boundary spanners, when faced with new information, can decide who the appropriate recipient(s) is (are).

Information that is low in time specificity in use can potentially be stored until the decision maker is ready to use it, in what King and Cleland (1978) term a "strategic database" of intelligence information. This strategic database can then be logically partitioned so that information that is high in knowledge specificity in use is located in a personal view for the appropriate user, information with medium knowledge specificity is stored in a departmental database, while information with low knowledge specificity is available to users throughout the organization.

Use

To use information effectively, an individual needs both the knowledge to interpret the information correctly and the decision authority to act on the information. Thus, in general, the decision rights for activities that require highly knowledge specific information should be assigned to the individuals who possess the specific knowledge. Otherwise, the organization will incur the high costs of transferring specific knowledge to the decision maker and/or the opportunity costs of inferior decisions if the transfer of specific knowledge is not perfect. For information that is low in knowledge specificity in use but high in time specificity, the decision rights should be located as close to the point of information acquisition as possible, in order to avoid potentially long delays in message routing. Finally, for information that is low in both time and knowledge specificity, the organization has greater flexibility in the allocation of decision rights. One option may be to colocate the decision rights for these activities with those for complementary activities that require highly specific knowledge in order to minimize interactivity coordination costs.

An information specificity perspective may explain why the extensive research on the impact of IT on the degree of centralization (George and King 1991; Leavitt and Whisler 1958; Robey 1981) has failed to produce conclusive results. The logic presented above suggests that a contingency perspective that explicitly considers the nature of the information being automated—which the existing research does not do—may be appropriate.

Consider the case of decisions that require highly knowledge specific information, and the decision rights, as suggested above, are assigned to the individuals with the specific knowledge. If IT is to change the location of the decision rights, it must change the flow not just of the information required to make the decision, but also of the specific knowledge needed to interpret the information. Expert systems, shared discretionary databases, and systems designed to capture organizational memory (Ackerman and Malone 1990; Walsh and Ungson 1991) are all attempts to make specific knowledge more widely accessible throughout the organization. Where IT is able to facilitate the sharing of specific knowledge, the specific impact will depend on whether management uses the technology to make specific knowledge, formerly possessed only by the upper echelons, accessible to lower levels in the hierarchy (decentralization), or vice-versa (centralization). This is the managerial action imperative noted by George and King (1991). However, since specific knowledge is difficult to codify, it is often difficult to incorporate in a system. This may explain why researchers have found that, in many cases, IT has been used to reinforce the existing assignment of decision rights by improving the flow of information to the current holders of the decision rights.

For activities that require information with low knowledge specificity but high time specificity, technology may be able to reduce the costs of message routing by building more efficient communication channels, thereby allowing the location of decision rights further away from the point of initial information acquisition, and leading to greater centralization.
Information specificity and firm boundaries

TCE has often been criticized for assuming opportunism as the prevailing behavioral norm in every relationship. Many authors have argued that relationships are often based on trust (e.g., Arrow 1974; Hill 1990). For instance, Granovetter (1985, p. 490) argues that economic transactions become “ overlaid with social content that carries strong expectations of trust and abstention from opportunism.” In addition, many authors have argued for the importance of the role of knowledge in determining the boundary of the firm (for example, Conner and Prahalad 1996; Kogut and Zander 1992). Demsetz (1988, p. 159) states, “The vertical boundaries of a firm are determined by the economics of conservation of expenditures on knowledge.”

An important contribution of the construct of information specificity is that it allows explicit incorporation of the role of knowledge, and cognitive costs, within the TCE framework. Generalizing the argument presented in the analysis of outsourcing environmental scanning, it is proposed that, in choosing between markets and hierarchies, firms will choose the option that minimizes the sum of the production costs, the coordination costs, the behavioral contractual costs, and the cognitive transaction costs. Cognitive transaction costs rise with the organizational knowledge specificity of the information required to execute an activity. Thus, irrespective of whether trust, opportunism, or some combination of the two is assumed as the behavioral norm, the conclusion is that activities based on highly organizationally knowledge-specific information should be located inside the firm.

This also extends the current research on the role of IT in promoting vertical disintegration (Malone, et al. 1987). Most of these arguments have been based on the ability of IT to reduce the coordination costs, or the behavioral contractual costs, either by reducing the monitoring costs or by reducing the specificity of the investment required to manufacture a product. The cognitive perspective suggests that if the activity requires organizationally knowledge specific information, reducing the behavioral contractual costs or the coordination costs may not be sufficient to promote vertical disintegration. Rather, in such cases, IT needs to be able to reduce the cognitive transaction costs of market-based exchanges by facilitating the sharing of organization-specific knowledge. One way to do this may be by capturing organizational memory in systems that can be made available, selectively, to outside vendors.

Another useful area for future research should be the role of information specificity in determining the boundary of the information systems function in an organization. For instance, recently a number of organizations have selectively outsourced some IS services (Cross 1995; Lacity, et al. 1995; 1996). The construct of information specificity should be a useful basis for identifying the best candidate services for outsourcing. The management of the technology infrastructure has been distinguished from the management of the use of technology (Dixon and John 1989). The notion of information specificity should be useful in deciding where in the organization the primary responsibility for these tasks should be located.

Other areas for further research

The ideas presented in this paper clearly need to be subjected to empirical verification. The primary challenge in this regard may be operationalizing the construct of knowledge specificity of information. At least initially, this may have to be done merely by asking individual managers about the knowledge required to interpret the various items of information they acquire and use, and how widely distributed that knowledge is throughout the organization.

In addition, the analysis presented in this paper can be extended in many ways. Specifically, some of the costs excluded from explicit consideration in this paper, such as information transfer costs and storage costs, could be included in an expanded model.
Further, in this paper, knowledge transfer costs were considered from the perspective of a one-time capture of information. However, in many cases, the costs of transferring specific knowledge may be viewed more as training costs, to be leveraged over multiple information gathering events. Future research may be able to account for this possibility.

The diffusion of specific knowledge can also be viewed from an organizational learning perspective. Cohen and Levinthal (1990) argue that the absorptive capacity of an organization is based on a delicate balance between overlap and diversity in the knowledge possessed by the members of the organization, the “ideal knowledge structure for an organization should reflect only partially overlapping knowledge complemented by non-overlapping diverse knowledge” (p. 134). An interesting research question, therefore, may be to examine empirically the relationship between the distribution of specific knowledge in an organization and its ability to innovate and learn. The concern is with the distribution of specific knowledge only because general knowledge, by definition, is widely available and/or easily transferred and thus does not really represent a constraint on absorptive capacity.

Finally, another avenue for further research may be to define other forms of information specificity that are useful in different contexts. For instance, in the realm of communication behavior and media choice, it may be useful to consider the transfer specificity of information, that is, the extent to which the information must be transferred over rich channels. Information is likely to be high in transfer specificity if it is high in knowledge specificity and the recipient does not possess the needed specific knowledge. In this case, the sender must transmit not only the information but also the needed specific knowledge which, by definition, is difficult to codify and therefore probably requires a rich medium. The concept of transfer specificity may offer one explanation for the equivocality of a message (Daft and Lengel 1984; 1986).

Conclusion

A central contribution of this paper is the development of the constructs of knowledge and time specificity of information. The knowledge specificity of information is the extent to which specific knowledge is required to acquire and/or use the information. The time specificity of information is the extent to which the information must be acquired and/or used within a very short time frame after it becomes available or it decreases in value significantly. While the scope of this paper was limited to the relatively narrow domain of environmental scanning, the construct of information specificity should be useful to researchers studying a wide range of subjects related to the use and management of information, and information technology, in organizations.

Recent literature has stressed that a primary challenge for organizations is effectively creating, using, and coordinating knowledge. The knowledge specificity of information can serve as a single, unifying theoretical construct that allows the incorporation of a knowledge-based perspective into multiple theories that address different aspects of organization design.

For instance, a question that has received much attention in the recent literature is the tradeoff between knowledge and opportunism in determining the boundary of the firm (Conner and Prahalad 1996). This paper argues that by considering cognitive transaction costs, based on the (inter) organizational knowledge specificity of information, in conjunction with traditional behavioral transaction costs, based on opportunism, it is possible to incorporate the role of knowledge within the TCE framework without having to assume either opportunism or trust as the behavioral norm for every transaction. Similarly, cognitive agency costs, based on the (intraorganizational) knowledge specificity of information, can be used to augment traditional agency theory arguments about the delegation of responsibility and authority within organizations.

Considering a different perspective, the information processing view of organizations stresses that a central concern is the need to
match an organization's information processing needs and capabilities, of which information systems are one component (Galbraith 1973). However, both the need and the ability to process information are defined only in terms of the quantity of information. The premise underlying the specificity of information is that it is important to consider also the nature of the information. Thus, an interesting research question may be whether the effectiveness of different information processing and coordination mechanisms, such as lateral relations or vertical information systems, varies with the specificity of the information.

For practitioners, too, the primary implication of the ideas in this paper is that, in designing their organizations' information architectures, they need to consider not only what information is needed by which activity, as is the focus of most traditional business systems planning methodologies, but also the nature of such information. The explicit focus of this paper has been on how the specificity of information can inform managers' decisions about the allocation of resources and responsibilities for the acquisition of environmental information. Information technology resources should be directed first at the acquisition of information that is low in knowledge specificity but high in time specificity. In addition, the paper discusses briefly the implications of information specificity for policies about the storage and transmission of information, and for the assignment of decision rights in the organization, arguing that information systems would be most effective if used to channel information to the individuals with the specific knowledge needed to interpret the information. Finally, it has been noted how the allocation of responsibilities for the management of the information systems function, both within the organization and to outside vendors, can benefit from explicitly considering the knowledge requirements of various activities.

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References


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Appendix

Allocating Resources for Environmental Scanning

Example 1

A firm has a choice between monitoring two sources of information A and B. Assume, for simplicity, that each piece of information becomes available once every month (30 days) but the firm does not know when. The rest of the parameters are as follows:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected value</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>Time specificity in acquisition (number of days after origination within which the information must be captured or it becomes unavailable)</td>
<td>1 day</td>
<td>3 days</td>
</tr>
<tr>
<td>Cost of monitoring</td>
<td>$5/attempt</td>
<td>$5/attempt</td>
</tr>
<tr>
<td>Probability of acquiring information if source is monitored N times every month = (No. of days the information is available after origination x N)/30</td>
<td>N/30</td>
<td>3N/30</td>
</tr>
<tr>
<td>Probability of failing to acquire information if source is monitored N times every month</td>
<td>1 - N/30</td>
<td>1 - N/10</td>
</tr>
<tr>
<td>Expected opportunity cost (if source is monitored N times)</td>
<td>300 (1 - N/30) = 300 - 10N</td>
<td>500 (1 - N/10) = 500 - 50N</td>
</tr>
<tr>
<td>Marginal decrease in opportunity cost for each increase in N</td>
<td>10, for N &lt;= 30 0, for N &gt; 30</td>
<td>50, for N &lt;= 10 0, for N &gt; 10</td>
</tr>
<tr>
<td>Net increase in expected value to firm of increasing frequency of monitoring from N-1 to N = marginal decrease in opportunity cost (above) - marginal increase in surveillance cost ($5/attempt)</td>
<td>5, for N &lt;= 30 -5, for N &gt; 30</td>
<td>45, for N &lt;= 10 -5, for N &gt; 10</td>
</tr>
<tr>
<td>Suggested frequency of monitoring (times/month)</td>
<td>30</td>
<td>10</td>
</tr>
</tbody>
</table>

In this example, the expected values of both sources of information A and B are high relative to the surveillance costs. As a result, the frequency of monitoring is determined by the point at which the probability of capturing the information is 1 and the source with the higher time specificity in acquisition, A, is monitored more frequently.

In the above case, we assumed a constant cost of monitoring. What if we assume that marginal surveillance costs increase with the number of attempts per month, as reflected in the table below?

<table>
<thead>
<tr>
<th># of attempts/month</th>
<th>Marginal cost/attempt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 4</td>
<td>5</td>
</tr>
<tr>
<td>5 – 10</td>
<td>10</td>
</tr>
<tr>
<td>11 – 20</td>
<td>20</td>
</tr>
<tr>
<td>21 – 25</td>
<td>30</td>
</tr>
<tr>
<td>26 – 30</td>
<td>50</td>
</tr>
</tbody>
</table>
In this case, the suggested frequency of monitoring for B remains the same (10 times/month). The marginal cost of the 10th attempt per month is $10, which is still less than the marginal reduction in expected opportunity cost of $50.

On the other hand, for A, the suggested frequency of monitoring changes to 25 times per month. The marginal increase in surveillance cost of increasing the frequency to 26 times per month would be $50, which is higher than the marginal reduction in opportunity cost of $30.

Note, however, that A is still monitored more frequently than B.

**Example 2**

A firm has a choice between monitoring two sources of information A and B. Assume, for simplicity, that each piece of information becomes available once every month (30 days) but the firm does not know when. The rest of the parameters are as follows:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected value</td>
<td>120</td>
<td>60</td>
</tr>
<tr>
<td>Time specificity in acquisition (number of days after origination within which the information must be captured or it becomes unavailable)</td>
<td>1 day</td>
<td>3 days</td>
</tr>
<tr>
<td>Cost of monitoring</td>
<td>$ 5/attempt</td>
<td>$ 5/attempt</td>
</tr>
<tr>
<td>Probability of acquiring information if source is monitored N times every month = (No. of days the information is available after origination x N)/30</td>
<td>N/30</td>
<td>3N/30</td>
</tr>
<tr>
<td>Probability of failing to acquire information if source is monitored N times every month</td>
<td>1 - N/30</td>
<td>1 - N/10</td>
</tr>
<tr>
<td>Expected opportunity cost (if source is monitored N times)</td>
<td>120 (1 - N/30) = 120 - 4N (for N &lt;= 30)</td>
<td>60 (1 - N/10) = 60 - 6N (for N &lt;= 10)</td>
</tr>
<tr>
<td>Marginal decrease in opportunity cost for each increase in N</td>
<td>4, for N &lt;= 30</td>
<td>6, for N &lt;= 10</td>
</tr>
<tr>
<td>Net increase in expected value to firm of increasing frequency of monitoring from N to N+1 = marginal decrease in opportunity cost (above) - marginal increase in surveillance cost ($5/attempt)</td>
<td>-1, for N &lt;=30</td>
<td>1, for N &lt;= 10</td>
</tr>
<tr>
<td>Suggested frequency of monitoring (times/month)</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

This example is the same as example 1 in all respects except that we have lowered the expected values of the information so that they are not as high relative to the surveillance costs. The results are quite different from those in example 1. Now, the net gains from surveillance are always negative for A—thus, this source should not be monitored at all. For B, the net gains from surveillance are positive up to N <= 10. As a result, the optimal frequency of monitoring for B is 10 times/month, at which point the probability of capturing the information from B is 1.

In the above case, we again assumed a constant cost of monitoring. As in example 1, what if we assume that marginal surveillance costs increase with the number of attempts per month, as reflected in the table below?
In this case, the suggested frequency of monitoring for B remains the same (10 times/month). The marginal cost of the 10th attempt per month is $2, which is less than the marginal reduction in expected opportunity cost of $6.

On the other hand, for A, the suggested frequency of monitoring changes to 25 times per month. The marginal surveillance cost of the 25th attempt is $4, which is equal to the marginal reduction in expected opportunity cost. However, increasing the frequency to 26 times per month would add $5 to the surveillance cost, which is higher than the marginal reduction in opportunity cost of $4.

Thus, when the cost of monitoring is relatively high compared to the expected value of the information, the information source with the lower time specificity (B) is monitored more frequently. However, when we lower the cost of monitoring, the information source with the higher time specificity (A) is monitored more frequently.