

Sustained IT Competitiveness

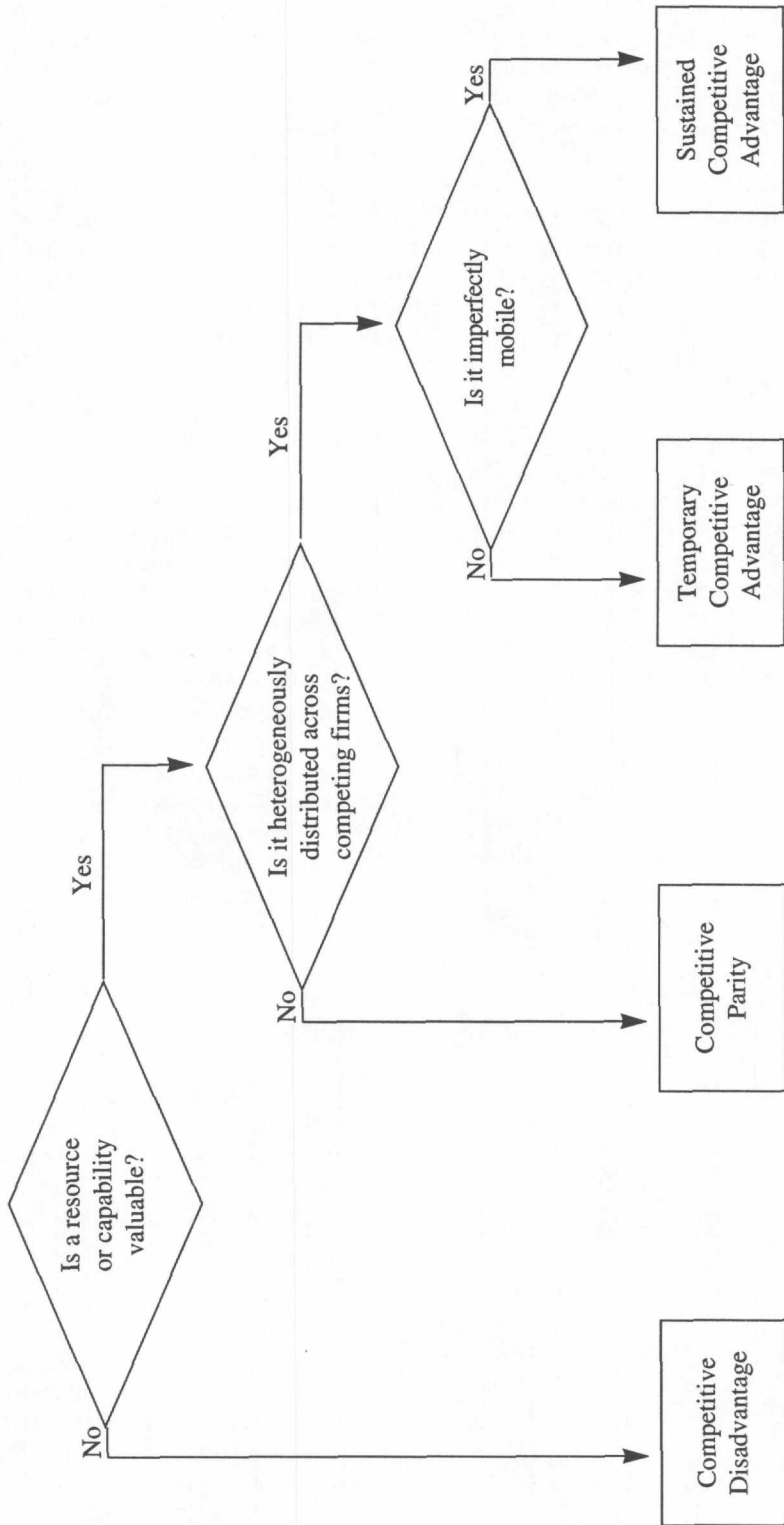


Figure 1. A Resource-Based Model of Competitive Advantage

Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis

literature, yet the sustainability of the competitive advantage provided by IT applications is not well-explained. This work discusses the resource-based theory as a means of analyzing sustainability and develops a model founded on this resource-based view of the firm. This model is then applied to four attributes of IT—capital requirements, proprietary technology, technical IT skills, and managerial IT skills—which might be sources of sustained competitive advantage. From this resource-based analysis, we conclude that managerial IT skills is the only one of these attributes that can provide sustainability.

By: Francisco J. Mata
Department of Business Analysis &
Research
Graduate School of Business
Texas A&M University
College Station, TX 77843-4217
U.S.A.

Keywords: Competitive advantage, resource-based theory, IT resources

ISRL Categories: AF0401, GA01, EI0225, EL03

William L. Fuerst
Department of Business Analysis &
Research
Graduate School of Business
Texas A&M University
College Station, TX 77843-4217
U.S.A.
bfuerst@tamu.edu

Introduction

The field of strategic management focuses on understanding sources of sustained competitive advantages for firms (Porter, 1980; 1985; Rumelt, et al., 1991). A variety of factors have been shown to have an important impact on the ability of firms to obtain sustained competitive advantage, including the relative cost position of a firm (Porter, 1980), a firm's ability to differentiate its products (Caves and Williamson, 1985; Porter, 1980), and the ability of firms to cooperate in strategic alliances (Kogut, 1988).

Jay B. Barney
Department of Management and Human
Resources
Fisher College of Business
Ohio State University
Columbus, OH 43210
U.S.A.
barney@cob.ohio-state.edu

Information technology (IT) has also been mentioned for its possible role in creating sustained competitive advantages for firms (Barney, 1991; Clemons, 1986; 1991; Clemons and Kimbrough, 1986; Clemons and Row 1987; 1991a; Feeny, 1988; Feeny and Ives, 1990). While the assertion that IT might be able to create sustained competitive advantage for firms is provocative, work in this area is relatively underdeveloped, both empirically and theoretically (Jarvenpaa and Ives, 1990). Research on IT and competitive advantage has emphasized "describing how, rather than systematically

Abstract

The concept of IT as a powerful competitive weapon has been strongly emphasized in the

why" IT can lead to such an advantage (Reich and Benbasat, 1990, p. 326).

The purpose of this paper is to capitalize on some relatively recent developments in strategic management theory, in order to develop and apply a model that specifies the conditions under which IT can, and cannot, be a source of sustained competitive advantage. Similar to the work of Clemons (1991) and Clemons and Row (1987; 1991a), we apply the resource-based view of the firm (see Barney (1991) and Conner (1991)) in developing this model. With the model in place, it is possible to anticipate the conditions under which aspects of a firm's IT will be sources of competitive disadvantage, when they will be sources of competitive parity, and when they will be sources of either temporary or sustained competitive advantage (Clemons and Kimbrough, 1986).

The model developed in this paper has implications for both researchers and practitioners. For researchers, the model suggests the types of variables that need to be included in future empirical tests of the relationship between IT and competitive advantage. Consequently, the model extends understanding of what is becoming an increasingly important issue in IT management, the relationship between IT and competitive advantage (see Brancheau and Wetherbe, 1987; Niederman, et al., 1991). Practitioners, on the other hand, can use the model to refine their thinking about IT and their firm's other strategic resources. In particular, the model suggests the types of IT investments that are most likely to be sources of sustained competitive advantage.

IT and Competitive Advantage: Previous Literature

The value of IT

Traditionally, most research in strategic IT has focused on the ability of IT to add economic

value to a firm by either reducing a firm's costs or differentiating its products or services (see Bakos and Treacy, 1986; McFarlan, 1984; Porter and Millar, 1985; Wiseman, 1988). For example, when WalMart adopted its purchase/inventory/distribution system, it was able to reduce its inventory costs (Ghemawat, 1986; Huey, 1989; Stalk, et al., 1992). On the other hand, General Electric has been able to differentiate its service support from its competitors by means of its answer center technology (Benjamin, et al., 1984; Porter and Millar, 1985), and Otis Elevator similarly has differentiated its service operations thanks to its Otisline system (Balaguer, 1990; McFarlan and Stoddard, 1986). In all these cases, the judicious use of IT either reduced these firms' costs of operations or increased their revenues by differentiating their products or services, and therefore was valuable.

There is little doubt that, in a wide variety of circumstances, IT can add value to a firm. However, IT adding value to a firm—by reducing costs and/or increasing revenues—is not the same as IT being a source of sustained competitive advantage for a firm. For example, when WalMart adopted its purchase/inventory/distribution system, it gained a competitive advantage over its closest rival, K-Mart. However, K-Mart has not remained idle and is in the process of developing its own similar system (Steven, 1992). To the extent that K-Mart is able to implement its system and apply it like WalMart has, WalMart's system will have been only a source of temporary, but not sustained, competitive advantage (Barney, 1994). Put another way, WalMart's purchase/inventory/distribution system would have been valuable, but value, per se, is a necessary but not sufficient condition for a sustained competitive advantage.

More generally, a firm is said to have a sustained competitive advantage when it is implementing a strategy not simultaneously implemented by many competing firms and where these other firms face significant disadvantages in acquiring the resources necessary to implement this strategy. A firm has a temporary competitive advantage when it is implementing a valuable strategy currently pursued by few competing firms, but where these competing firms

do not face significant disadvantages in acquiring the resources necessary to implement this strategy. A firm experiences competitive parity when it is implementing a valuable strategy being simultaneously implemented by several competing firms. A firm is at a competitive disadvantage when it is implementing a strategy that is not valuable, i.e., a strategy that does not reduce its costs or increase its revenues.

The create-capture-keep paradigm

Several authors have gone beyond examining the value of IT in reducing a firm's costs and/or increasing its revenues to suggest ways that IT can be a source of sustained competitive advantage. Perhaps the most important of these efforts began with Clemons (1986) and focuses on the role of IT-based customer switching costs as a source of sustained competitive advantage for firms selling IT applications. This set of ideas has come to be known as the "create-capture-keep" paradigm (Clemons and Kimbrough, 1986; Clemons and Row, 1987, 1991b; Feeny and Ives, 1990).

Switching costs are created when customers make investments that are specific to a particular supplier of IT.¹ These investments might include the cost of employee technical training to use a supplier's unique IT, management experience working with a particular supplier's sales and support staff, and familiarity with a particular supplier's business policies and procedures. All these investments can be very valuable for firms in their acquisition of IT, as long as they continue purchasing IT from the same supplier. However, these investments have little or no value in facilitating IT purchases from other suppliers.

A principle argument in this line of reasoning is that the creation of significant customer switching costs in the acquisition of IT creates an eco-

nommic opportunity for IT suppliers (Clemons, 1986; Clemons and Kimbrough, 1986; Clemons and Row, 1987, 1991b). Once these switching costs are created, IT suppliers can increase the price, reduce the level of service, or in other ways extract additional value out of their relationships with their "captured" customers. As long as the cost to customers of switching suppliers is less than the "extra" value that is being extracted from this relationship by a supplier, customers will continue purchasing IT from that supplier. Prescriptively, this argument suggests that IT suppliers should attempt to create unique IT that requires specific investments by customers, to be used by customers. When customers begin using this IT, they become "captured" by their switching costs. Given these switching costs, suppliers are able to "keep" customers despite the extra value suppliers are able to extract from their relationship with their captured customers. Examples of firms that have attempted to use IT switching costs in this manner include Baxter Healthcare, with its proprietary ASAP ordering system (Vitale and Konsynski, 1991; Venkatraman and Short, 1992), and various airline reservation systems (Copeland and McKenney, 1988).

While the "create-capture-keep" paradigm has received some support in the literature, it has also been the object of significant criticism (Hopper, 1990; Malone et al., 1989; Wiseman, 1988). There are at least three reasons why this "create-capture-keep" approach is unlikely to be a source of sustained competitive advantage for IT suppliers (Klein, et al., 1978).

First, customers will usually be able to anticipate the risk of being captured by an IT supplier if investments specific to that supplier are made. Typically, customers will only be willing to make these kinds of specific investments if they receive some form of guarantee that a supplying firm will not take unfair advantage of these investments. For example, the effort to avoid significant switching costs has led many hardware firms to insist on second sources for key hardware components. Rather than designing an entire hardware system around a component supplied by a single firm, these firms insist that suppliers license other firms to act as second suppliers. Second sources have the

¹ An investment is said to be *specific* when its value in a particular exchange, with particular exchange partners, is significantly greater than its value in any alternative exchanges (Williamson, 1989). In this sense, the redeployment of a specific investment in a new exchange, with new exchange partners, has the effect of destroying much of the value of that investment.

effect of reducing a customer's switching costs, and they act as a credible guarantee against suppliers exploiting customers. If switching costs were a significant problem in IT, a similar second-source strategy could be used.

If guarantees cannot be made in a credible way, then customers will attempt to avoid the creation of significant switching costs by pursuing alternative technologies or perhaps by developing their own technologies. For example, many travel agencies have found that using a particular airline's "back-end" IT applications (i.e., accounting services, travel reporting) can create significant switching costs and ties them to the reservation system of that airline. Rosenbluth Travel decided to develop its own back-end IT applications, thereby enhancing its ability to interact with several different reservation systems (Clemons, 1986; Feeny and Ives, 1990; Johnston and Vitale, 1988; McFarlan, 1984).

Whether customers neutralize the threat of switching costs by receiving guarantees up front or by seeking alternative IT suppliers, the effect of these actions will be to reduce the ability of IT suppliers to extract extra value from their relationships with "captured" customers. In an important sense, these customers are not really captured, even if specific investments are made. In this context, the existence of switching costs will not be a source of competitive advantage for a firm selling IT.

Second, IT suppliers that do exploit their customer's switching costs will often gain a reputation for being untrustworthy. The effects of this type of reputation can be devastating. While firms may gain large profits from their currently captured customers, they will be unable to attract future customers. The value of opportunities lost because of a reputation for exploiting captured customers can be much larger than the value extracted from those captured customers. In this setting, rational suppliers will not find it in their best interest to exploit their captured customers, despite the existence of significant customer switching costs. For this reason, significant customer switching costs cannot be a source of competitive advantage for a firm supplying IT.

Third, the number of options for customers to obtain IT has increased over time. Perhaps the only way that customer switching costs could be a source of competitive advantage for a firm selling IT is if the IT in question is absolutely unique, if it is absolutely essential to a customer's business operations, if there are currently no other suppliers of the IT, and if it is very unlikely that there will be any additional suppliers of the IT in the near future. This near monopoly situation may have existed during some periods of time for some IT, especially in the 1960s and early 1970s. However, changes in technology, the emergence of various standards, and the development of intelligent distributed systems have made it virtually impossible for IT firms to enjoy this situation and thus, have further undermined the ability of the "create-capture-keep" paradigm to be a source of competitive advantage for IT firms.

Many of the firms that used "create-capture-keep" in the past have had to change their IT strategies. For example, Baxter Healthcare previously used a proprietary communication standard in its ASAP ordering system. This standard required Baxter customers to make highly specific IT investments. However, in 1988, Baxter was forced by market pressures to adopt the ANSI X.12 standard for electronic data interchange, thus reducing the need for its customers to make specific investments in its ASAP system (Venkatraman and Short, 1992; Vitale and Konsynski, 1991). In a similar way, SABRE and Apollo previously required customers to utilize "black boxes" with fixed functionality for connection to their systems. Now, these systems allow connections through intelligent workstations that have local programming capabilities (Clemons and Row, 1991b; Hopper, 1990). The use of these intelligent workstations makes it easier for travel agencies to convert data from one airline system to another, thus facilitating the ability of agencies to change systems at will.

For these reasons, some authors have concluded, "Companies that try to lock-in customers may lose them instead" (Malone, et al., 1989, p. 166), and "It is increasingly difficult, if not downright impossible, for... [IT] to bind customers to products" (Hopper, 1990, p. 123). Thus, the

search for IT-based sources of competitive advantage must look beyond the “create-capture-keep” paradigm.

The resource-based perspective

Another approach to understanding the relationship between IT and sustained competitive advantage has recently emerged (Clemons, 1991; Clemons and Row, 1991a). In this approach, the ability to use IT to leverage the fundamental resource advantages of firms enables IT to be a potential source of sustained competitive advantage. Fundamental to this paradigm is the resource-based view of the firm, which is used throughout this paper to explain IT's link to sustained competitive advantage. This approach is explained in detail in the next section.

The Resource-Based View of the Firm

The resource based view of the firm is based on two underlying assertions, as developed in strategic management theory (Barney, 1986a, 1991; Rumelt, 1984; Wernerfelt, 1984): (1) that the resources and capabilities possessed by competing firms may differ (resource heterogeneity); and (2) that these differences may be long lasting (resource immobility). In this context, the concepts of a firm's resources and capabilities are defined very broadly,² and could certainly include the ability of a firm to conceive, implement, and exploit valuable IT applications (Barney, 1991).

The conditions of resource heterogeneity and resource immobility are connected to sustained competitive advantage in the following way. If a firm possesses a resource or capability that is possessed by numerous other competing firms, that resource or capability cannot be a source of competitive advantage. In the context of IT, if

several competing firms in an industry all operate the same automated inventory management system, for example, then possessing such a system, by itself, cannot be a source of competitive advantage for any of these firms. Common resources do not meet the resource heterogeneity requirement, and thus are, at best, sources of competitive parity.

On the other hand, if a firm possesses a resource or capability that is not currently possessed by competing firms, the condition of resource heterogeneity is met, and a firm may obtain at least a temporary competitive advantage. This was the situation described earlier for WalMart's purchase/inventory/distribution system. As long as WalMart was the only discount retailer with this system in operation, that system was a source of at least a temporary competitive advantage for WalMart.

The second resource-based condition, the condition of resource immobility, becomes important in understanding when a firm's resources and capabilities will be sources of sustained competitive advantage. A resource is mobile if firms without a resource (or capability) face no cost disadvantage in developing, acquiring, and using that resource compared to firms that already possess and use it. In this case, that resource (i.e., mobile resource) can only be a source of temporary competitive advantage at best. On the other hand, if a firm without a resource or capability does face a cost disadvantage in obtaining, developing, and using it compared to a firm that already possesses that resource (i.e., resource immobility), then the firm that already possesses that resource can have a sustained competitive advantage (Barney, 1991). Thus, if K-Mart was unable to imitate WalMart's purchase/inventory/distribution system, then WalMart's system would be a source of sustained competitive advantage. Also, if K-Mart could imitate WalMart's system (i.e., the hardware and software), but not use it as effectively as WalMart, WalMart's system could still be a source of sustained competitive advantage.

The requirement that firms must face a cost disadvantage in developing, acquiring, and using a resource in order for that resource to be a

² See Barney (1991), Grant (1991), and Wernerfelt (1984) for additional discussion of resource heterogeneity and immobility.

source of sustained competitive advantage does **not** imply that the only way to gain such advantages is through cost leadership strategies (Porter, 1980). For example, it has already been suggested that GE and Otis Elevator use their IT resources to help implement a differentiation strategy. If this IT-based product differentiation is economically valuable, then GE and Otis would have gained at least a temporary competitive advantage over their competition through their product differentiation efforts. Of course, GE's and Otis' competitors are likely to respond to these competitive advantages by attempting to develop their own IT-based product differentiation strategies. If these competitors can develop the same IT resources as GE and Otis, and can do so as efficiently as GE and Otis, then they will be able to implement their own IT-based product differentiation strategy, and GE's and Otis' strategies will no longer be a source of competitive advantage. On the other hand, if it is more difficult (i.e., more costly) for these competitors to develop, acquire, and use them, then GE's and Otis' IT-based product differentiation competitive advantage would be sustained.

More generally, a firm may use its IT resources to help implement a wide range of strategies, including cost leadership, product differentiation, strategic alliance strategies, diversification strategies, and vertical integration strategies (Barney, 1996). If those resources are heterogeneously distributed across competing firms, and if firms without these resources find it more costly to develop, acquire, and use them to implement a strategy than firms that have already used them to implement that strategy, these resources can be a source of sustained competitive advantage.

The importance of resource immobility in creating sustained competitive advantage has led strategic management researchers to ask another question: Under what conditions will firms be at a cost disadvantage in developing, acquiring, and using the resources and capabilities possessed by a firm with a competitive advantage? In other words, under what conditions will a firm's heterogeneously distributed resources and capabilities be a source of sustained competitive advantage?

Several authors have suggested various answers to this question (Dierickx and Cool, 1989; Rumelt, 1984). However, most of these answers tend to fall into one or more of the three broad categories suggested by Barney (1991): the role of history, the role of causal ambiguity, and the role of social complexity.³

The role of history

History can play at least two roles in increasing the cost of imitating a successful firm's resources and capabilities. First, a firm's ability to develop or acquire resources and capabilities in a low-cost way may depend on a firm being in the "right place at the right time" in history. As history moves on, these opportunities can only be recreated at very high (perhaps infinitely high) cost. Consider, for example, Caterpillar, Inc. Caterpillar was able to develop a worldwide service and support network for its heavy construction equipment business because it was the sole supplier of this equipment to Allied forces during World War II. The Allies agreed to subsidize the development of this service and support network because no construction equipment firm had such a service in place, and it was essential for the war effort. After World War II, Caterpillar continued to be the only heavy construction equipment company with such an international service and support network in place. Obviously, such a network was a source of enormous competitive advantage for Caterpillar. In order for competing firms to build this same kind of network, at the same cost as Caterpillar, the unique conditions that existed during World War II would have to be recreated. The cost to a firm of recreating these conditions is obviously high—perhaps infinitely high (Rukstad and Horn, 1989).

History can also play a role in increasing the cost of imitating a firm's resources and capabilities because some of these firm attributes can only be developed over long periods of time. U.S. manufacturers have often coveted the

³ Attributes of firm resources and capabilities that retard imitation have also been referred to as isolating mechanisms (Rumelt, 1984) or barriers to imitation (Mahoney and Pandian, 1992).

close cooperative relations that seem to exist between Japanese firms and their suppliers. However, quick imitation of these relations has been elusive to many U.S. firms. This difficulty is more understandable when it is recognized that many Japanese firms have been working with the same suppliers for over 500 years. The experience that is developed over 500 years is costly to duplicate in a short period of time (Dierickx and Cool, 1989).

Causal ambiguity

A firm can imitate another firm's resources and capabilities at a low cost only if the imitating firm knows what it is about the successful firm that should be imitated. When there is causal ambiguity⁴ about the source of competitive advantage, imitation becomes more costly.

There are at least two reasons why causal ambiguity about the sources of a firm's sustained competitive advantage might exist. First, these sources of advantage may be taken for granted and are unspoken, tacit attributes of a firm (Reed and DeFillippi, 1990). Such organizational attributes have been described as "invisible assets" (Itami, 1987) and can include an organization's culture (Barney 1986a), its standard operating procedures, and its operational routines (Nelson and Winter, 1982). Invisible assets may be valuable for a firm, enabling managers to communicate more effectively, providing guidance to managers in uncertain and complex situations, and in other ways making business decision making more efficient. Moreover, such invisible assets are costly to imitate, since it is not entirely clear what imitating firms should duplicate.

Second, a firm's competitive advantage may depend on a large number of small decisions and actions in a firm, rather than on a few large decisions. For example, firms that successfully implement total quality management end up affecting thousands, or even hundreds of thousands, of decisions made by labor, manage-

ment, and suppliers each day (Blackburn and Rosen, 1993). From a competitive point of view, these numerous little decisions have a distinct advantage over a few large, strategic choices. These little decisions are, again, almost invisible to imitating firms. Moreover, even if an imitating firm is able to duplicate 200 or even 2,000 of these little decisions, it still will not fully imitate the successful firm's full resource and capability advantage. Only by duplicating the hundreds of thousands of little decisions in a firm can complete imitation occur.

Social complexity

Finally, resources and capabilities that are socially complex may also be costly to imitate. Firm attributes such as an organization's culture (Barney, 1986a), its reputation among customers and suppliers (Klein, et al., 1978), its trustworthiness (Barney, 1994), and so forth are generally beyond management's ability to change rapidly. Rather, these socially complex attributes evolve and change over time. The delays associated with changing these complex social relationships suggest that firms with competitive advantages based on these types of resources and capabilities may be immune from low cost imitation in the short run.

A resource-based model of competitive advantage

The impact of resource heterogeneity and immobility on competitive advantage can be organized into the model presented in Figure 1 (Barney, 1991; 1994). This model is organized with reference to a set of three questions about a firm's resources and capabilities. The first question is: Does a particular resource or capability add value to a firm, i.e., does its exploitation reduce a firm's cost below and/or increase its revenues above what would have been the case if these resources or capabilities were not exploited? As suggested previously, resource value is a necessary but not sufficient condition for competitive advantage. Firms that possess resources or capabilities that are not valuable

⁴ *Causal ambiguity* can be defined as "... the ambiguity concerning the nature of the causal connections between actions and results."

will gain a competitive disadvantage from exploiting these resources. On the other hand, firms with valuable resources and capabilities may gain at least competitive parity from exploiting these resources.

The second question is: Is a particular resource or capability heterogeneously distributed across competing firms? Obviously, resources and capabilities possessed by many competing firms cannot be a source of competitive advantage for any of them, although they will be a source of at least competitive parity. On the other hand, if a resource or capability is valuable and heterogeneously distributed across competing firms, then that resource or capability will be a source of at least a temporary competitive advantage for firms that possess that resource.

The final question in this model is: Is a resource or capability imperfectly mobile? If firms without a valuable resource are at no disadvantage in acquiring, developing, and using it compared to firms that already possess this resource, then it will only be a source of temporary competitive advantage for the firms that originally controlled it. On the other hand, when a resource or capability is immobile, then firms without this resource face significant challenges in acquiring, developing, and using it. This resource or capability may then be a source of sustained competitive advantage for firms that control it. A resource or capability may be immobile for any of the reasons mentioned previously, i.e., the role of history, causal ambiguity, and/or social complexity.

Applying the Resource-Based View to Attributes of IT

Armed with the model presented in Figure 1, it is now possible to examine the ability of IT to generate sustained competitive advantages for firms. A review of the IT literature indicates that five specific attributes of IT have been suggested, so far, as possible sources of sustained competitive advantage for firms. The first of

these, customer switching costs, has already been discussed and shown not to be a source of sustained competitive advantage in all but the most unusual circumstances (i.e., when a firm currently is, and is likely to remain, a monopoly supplier of IT that is absolutely essential to the business activities of customers). The other four attributes of IT that have been suggested as possible sources of sustained competitive advantage—access to capital, proprietary technology, technical IT skills, and managerial IT skills—are discussed below.

While these five attributes of IT have all been suggested as possible sources of sustained competitive advantage in the IT literature, they certainly do not represent a comprehensive list of all the attributes of IT that might be sources of sustained competitive advantage. Future work will need to address the competitive implications of these other attributes of IT, using the model presented in Figure 1.

Access to capital

The capital needed to develop and apply IT—whether in the form of debt, equity, or from retained earnings—has been suggested as a source of sustainable competitive advantage for at least some firms (McFarland, 1984). The logic underlying this assertion is straightforward. First, IT investments can be very risky, and thus the capital needed to make these investments can be very costly. Second, IT investments can require huge amounts of this risky capital. It may often be the case that only a few firms competing in a particular product market will have the financial capability needed to acquire the necessary capital to make certain IT investments. Thus, the few firms that are able to acquire the needed capital to make these investments can gain a sustained competitive advantage from them.

Two kinds of uncertainty can be considered as the major sources of risk in IT investments, and are, therefore, determinants of the cost of capital required to make those investments: technological uncertainty and market uncertainty. Technological uncertainty reflects the risk that

an IT investment may not meet its expected performance targets in a timely way. Specific sources of technological uncertainty in IT investments include (McFarlan, 1981): (1) failure to obtain the anticipated IT results because of implementation difficulties, (2) higher than anticipated implementation costs, (3) longer than anticipated implementation time, (4) technical performance below what was anticipated at the outset of the investment, and (5) incompatibility of the developed IT with selected hardware and software.⁵ When they were first developed, airline reservation systems were characterized by high levels of technological uncertainty. Their development required the solution of a number of unforeseen problems, which reflected the technological limitations and scarce experience available at the time. These problems were solved in part by IBM's direct involvement and commitment in the development of these systems (see Copeland and McKenney, 1988, for details).

Market uncertainty, on the other hand, reflects risks related to the customer's acceptance of new IT products or services. Market uncertainty was a major cause of failure for the Pronto and ZapMail systems. Even though these systems met their technical objectives, they were not adopted by customers. The Pronto system, Chemical Bank and AT&T's joint venture in electronic banking, did not attract enough customers in six years to break even and had to be abandoned (Clemons and Weber, 1990; Gunther, 1988). Similarly, insufficient demand was one of the reasons for the failure of Federal Express's ZapMail, a system designed to transmit facsimile documents through a nationwide network (Keller and Wilson, 1986; Wiseman, 1988).

Of course, not all IT investments are large, nor are they all risky. If IT investments are not large and risky, then it is likely that several firms will have access to the capital necessary to make them. In this context, access to capital is not likely to be a source of sustainable competitive advantage. On the other hand, some IT investments may be both large and very risky. However, even in this context, access to capital

for IT investments, per se, is not likely to be a source of sustained competitive advantage for firms. Consider, for example, several firms with identical IT resources and capabilities seeking capital to make particular IT investments. While these investments may be both risky and large and because these firms are about equally skilled in making IT investments, the risks of these investments are not heterogeneously distributed across these firms. According to Figure 1, firm attributes that are not heterogeneously distributed across firms will only be a source of competitive parity. While the capital used by these firms to make these IT investments will be risky and large, it will not be any more so to any one of these firms than it is to the others (Barney, 1986b). Furthermore, technological or market uncertainty is usually resolved once a first-mover has been able to successfully implement a system. Therefore, these risks actually affect first-movers more than followers (Lieberman and Montgomery, 1988), and consequently, in many circumstances, technology followers can have access to lower cost of capital than technology first-movers.

Of course, this simple example makes the strong assumption that competing firms have the same resources and capabilities in making IT investments. Obviously, this will often not be the case. Different firms may be differentially skilled in managing the technical and market risks associated with particular kinds of IT investments. Put another way, firms that are more skilled in managing their IT investments face fewer technical and market risks than less skilled firms. These more skilled firms will have access to lower cost of capital than less skilled firms and will be able to pursue IT investments that are not available to less skilled firms. Consequently, some firms may gain competitive advantages over other firms through their IT investments.

However, again in this situation it is inappropriate to conclude that access to capital, per se, is a source of competitive advantage. Rather, it is the special resources and capabilities of some firms that enable them to manage the technical and market risks more efficiently and allows them to gain an advantage. As suggested in Figure 1, if these resources and capabilities are

⁵ See Clemons and Weber (1990) for a broader classification of technological risks for IT projects.

valuable (which in this case, they are) and heterogeneously distributed across competing firms (again in this case, they are), they can be a source of at least a temporary competitive advantage. Whether the skills needed to manage technical and market risk are imperfectly mobile (i.e., whether they reflect a firm's unique history, are causally ambiguous, or socially complex) and thus sources of sustained competitive advantage, is discussed in later sections of this paper.

Even small firms, with apparently small debt capacity and few retained earnings, can overcome capital market disadvantages if they have access to the required IT investment resources and capabilities. These small firms can cooperate in their IT investments, gaining access to both the needed skills and the required capital (Cash and Konsynski, 1985; Clemons and Knez, 1988; Clemons and Row, 1992; Vitale, 1986). For example, such cooperative efforts were used in the development of the European airline reservation systems, Amadeus and Galileo, to overcome the problems of a single firm acquiring large amounts of capital needed to develop such systems (Etheridge, 1988).

Proprietary technology

Technology that can be kept proprietary has also been suggested as a source of sustained competitive advantage (Bain, 1956; Porter, 1980). Although proprietary technology can be protected through patents or secrecy (Porter, 1980), IT applications are difficult to patent (Jakes and Yoches, 1989). Moreover, even if they could be patented, there is evidence that patents provide little protection against imitation (Mansfield, 1985; Mansfield, et al., 1981). Thus, secrecy is the only alternative for keeping IT proprietary.

Clearly, if a firm possesses valuable proprietary technology that it can keep secret, then that firm will obtain a sustained competitive advantage. The fact that the technology is proprietary suggests that it is heterogeneously distributed across competing firms; the fact that it is secret suggests that it is imperfectly mobile. However, most research indicates that it is relatively diffi-

cult to keep a firm's proprietary technology secret, and thus, it is unlikely that proprietary technology will be a source of sustained competitive advantage. This is especially true for IT (Clemons and Row, 1987).

A wide variety of factors act to reduce the extent to which proprietary IT can be kept secret. Workforce mobility, reverse engineering, and formal and informal technical communication all act to reduce the secrecy surrounding proprietary technology (Lieberman and Montgomery, 1988). Thus, if one firm finds itself at a competitive disadvantage to another because that other firm has some proprietary IT application, the disadvantaged firm can hire away one or more of the individuals who developed the advantaged firm's application; it can purchase that application and discover its character through reverse engineering; it can discover the nature of the application through informal discussions with developers or users; or it can read published reports about the nature of the proprietary application and duplicate it in that way. Put another way, while a particular firm may gain a "head start" (i.e., a temporary competitive advantage) from its proprietary IT application, competing firms are usually not disadvantaged in imitating that technology by history, causal ambiguity, or social complexity. Thus, that technology usually is not a source of sustained competition advantage.⁶

Over the last several years, IT has become, to a large extent, generic and available to most firms (Clemons and Row, 1987; 1991b). Even complex systems that used to be immune from imitation are now broadly available from numerous sources. For example, the software used in airline reservation systems currently can be acquired from the companies that developed them for internal purposes (Etheridge, 1988; Hopper, 1990). As this diffusion of IT continues, the ability of proprietary technology to be a source of competitive advantage—sustained or temporary—continues to erode.

⁶ Indeed, there is even some evidence that suggests that the cost of imitating another firm's proprietary technology is often much less than the cost to the original firm of developing that technology (Lieberman and Montgomery, 1988).

Technical IT skills

A third possible source of sustained competitive advantage from IT may be a firm's technical IT skills (Copeland and McKenney, 1988). Technical skills refer to the know-how needed to build IT applications using the available technology and to operate them to make products or provide services (Capon and Glazer, 1987). Examples of such technical skills might include knowledge of programming languages, experience with operating systems, and understanding of communication protocols and products. These technical skills enable firms to effectively manage the technical risks associated with investing in IT, as discussed previously.

While technical skills are essential in the use and application of IT, they are usually not sources of sustained competitive advantage. Using the language presented in Figure 1, these skills are valuable, but they are usually not heterogeneously distributed across firms. Moreover, even when they are heterogeneously distributed across firms, they are typically highly mobile. For instance, firms without the required analysis, design, and programming skills required to make an IT investment can hire technical consultants and contractors. Specifically, airlines acquired technical expertise for developing their complex airline reservation systems by hiring programmers from other airlines and by making alliances with other carriers and hardware vendors (Copeland and McKenney, 1988).

This mobility of technical IT skills shows that such skills are usually explicit and codifiable by means of equations, procedures, blueprints, etc. Since codifiable knowledge "can be communicated from its possessor to another person in symbolic form, the recipient becomes as much 'in the know' as the originator" (Winter, 1987, p. 171). These codifiable skills are easy to transmit and receive (Teece, 1988). Thus, technical skills can easily diffuse among a set of competing firms.

If a firm is at a competitive disadvantage because of its inadequate technical IT skills, it has a variety of obvious solutions. For example, this firm could train its own employees in the

relevant technical skills, hire new employees that already have the technical skills, ask its employees to take various classes to learn the relevant technical skills, etc. In all these ways, a firm at a competitive disadvantage could solve its technical problems and regain competitive parity in technical IT skills. Consequently, although there's no question that technical IT skills are valuable to the firm, they rarely meet both additional conditions of being heterogeneously distributed across firms and highly immobile. Without meeting these conditions from the resource-based view of the firm as presented in Figure 1, it is unlikely that technical IT skills can be used to sustain a competitive advantage.

Managerial IT skills

Technical skills are not the only skills required to build and use IT applications. A second broad set of skills are managerial skills (Capon and Glazer, 1987). In the case of IT, managerial skills include management's ability to conceive of, develop, and exploit IT applications to support and enhance other business functions. Examples of important IT management skills include: (1) the ability of IT managers to understand and appreciate the business needs of other functional managers, suppliers, and customers; (2) the ability to work with these functional managers, suppliers, and customers to develop appropriate IT applications; (3) the ability to coordinate IT activities in ways that support other functional managers, suppliers, and customers; and (4) the ability to anticipate the future IT needs of functional managers, suppliers, and customers. Managerial IT skills enable firms to manage the market risks associated with investing in IT. Firms can acquire technical IT skills by hiring programmers and analysts. They then use their managerial IT skills to help programmers and analysts fit into an organization's culture, understand its policies and procedures, and learn to work with other business functional areas on IT-related projects.

That these managerial skills are valuable is almost self-evident. Without them, the full potential of IT for a firm will almost certainly not

be realized. How frequently different competing firms will possess similar IT management skills is an empirical question. However, it is reasonable to expect that close working relationships among those in IT and between IT and other business functions are not all that common, and thus, these relationships may be heterogeneously distributed across firms.

Unlike technical IT skills, managerial IT skills are often developed over longer periods of time through the accumulation of experience by trial and error learning (Katz, 1974). Skills developed in this way are called "learning by doing" skills (Williamson, 1975). For example, friendship, trust, and interpersonal communication can take years to develop to the point where IT managers and managers in other business functions are able to effectively work together to create and exploit novel IT applications. Thus, history is important for developing these skills. Managerial skills in many cases are tacit (Castanias and Helfat, 1991) and may involve hundreds to thousands of small decisions that cannot be precisely imitated. As long as these skills are part of the "taken for granted" part of a firm's skill base, they may remain causally ambiguous. Finally, the development and use of many of these managerial skills depends on close interpersonal relationships between IT managers and those working in the IT function, between IT managers and managers in other business functions, and between IT managers and customers. Thus, the development of these skills is often a socially complex process. Therefore, if managerial IT skills are valuable and heterogeneously distributed across firms, then they usually will be a source of sustained competitive advantage, since these relationships are developed over time; and they are socially complex and thus not subject to low-cost imitation.

Of course, while many managerial IT skills are developed over long periods of time and are causally ambiguous and socially complex, not all such skills have the attributes needed to be sources of sustained competitive advantage. In general, when managerial IT skills can be written down, codified, and transferred at low cost and with little loss in richness or understanding, those skills are not likely to be sources of sus-

tained competitive advantage. On the other hand, when managerial IT skills cannot be written down, codified, or transferred at low cost or without significant loss of richness and understanding, those managerial IT skills may be a source of sustained competitive advantage.

Consider two examples. It has been suggested that management's understanding of the potential for IT to be a source of competitive advantage was important for American Airline's ability to develop the SABRE system (Copeland and McKenney, 1988). Moreover, the close relationship between American's IT personnel and personnel in other business functions enabled these groups to work together, to make and learn from mistakes, and to build on successes in a way that led to the SABRE system. If management at American had not been committed to the innovative use of IT, or if relationships between the IT function and other business functions had not been cooperative, the SABRE system may never have been developed or implemented. Imitation of the SABRE system was slowed, while other airlines developed the IT management skills necessary to develop these systems.

WalMart's purchase/inventory/distribution system, which has allowed a reduction in its cost of sales 2-3 percent below the industry average, is another example of the importance of managerial IT skills in creating sustained competitive advantage. A competitively interesting note about this just-in-time system is that it applies very little proprietary technology and uses very few inimitable IT technical skills. Instead, IT is used to support constant and direct communication among WalMart's stores, distribution centers, and suppliers. It is this constant communication and the relationships it builds that has enabled WalMart to retain its competitive advantage despite the successful efforts of many of WalMart's competitors to imitate WalMart's hardware and software (Stalk, et al., 1992). Put differently, while WalMart's technical IT skills have been imitated, its IT management skills have been shown to be a source of sustained competitive advantage.

Part of WalMart's advantage results from its ability to link its IT function with its stores, its

distribution centers, and even with its suppliers. This suggests that managerial IT skills are relevant not only in linking different functions within the same firm, but may also be important in linking different firms in ways that generate IT-based competitive advantages through strategic alliances. It may also be the case that managerial IT skills can be used to link a firm with its customers (Jackson, 1985). In all these cases, if the linkages are valuable, if they are possessed by relatively few competing firms, and if they are socially complex (and thus imperfectly mobile), they may be sources of sustained competitive advantage.

Conclusions and Implications

Of the five attributes of IT studied in this paper, application of the resource-based logic summarized in Figure 1 suggests that only IT managerial skills are likely to be a source of sustained competitive advantage. IT management skills are often heterogeneously distributed across firms. Moreover, these skills reflect the unique histories of individual firms, are often part of the "taken for granted" routines in an organization, and can be based on socially complex relations within the IT function, between the IT function and other business functions in a firm, and between the IT function and a firm's suppliers or customers.

On the other hand, customer IT-based switching costs are usually not even economically valuable, let alone a source of sustained competitive advantage. Customers will generally anticipate the risks associated with such switching costs and will insist on various guarantees before making these kinds of investments. Even if a customer makes these investments without such guarantees, the exploitation of switching costs can lead a firm to gain a reputation as an untrustworthy supplier. Indeed, given the evolution of IT, it is becoming progressively more difficult to "capture" customers through switching costs. Access to capital is also not likely to be a source of sustained competitive advantage, especially for ITs that are neither

large nor particularly risky. Even when these investments are large and risky, differential access to capital, per se, is not a source of sustained competitive advantage. Rather, differential access to capital reflects a firm's differential technical and managerial IT skills. Also, it is becoming increasingly difficult to keep information technology proprietary, and thus, proprietary IT is not likely to be a source of sustained competitive advantage. Finally, while technical IT skills are absolutely essential for a firm to gain even competitive parity in IT, they are, by themselves, not likely to be a source of sustained competitive advantage.

This analysis has important implications for both researchers and managers. For researchers, the resource-based view of the firm suggests that the search for IT-based sources of sustained competitive advantage must focus less on IT, per se, and more on the process of organizing and managing IT within a firm. It is the ability of IT managers to work with each other, with managers in other functional areas in a firm, and with managers in other firms that is most likely to separate those firms that are able to gain sustained competitive advantages from their IT and those that are only able to gain competitive parity from their IT. These skills, and the relationships upon which they are built, have been called managerial IT skills in this paper. Future research will need to explore, in much more detail, the exact nature of these managerial IT skills, how they develop and evolve in a firm, and how they can be used to leverage a firm's technical IT skills to create sustained competitive advantage.

Also, while this paper examined the ability of five widely cited potential IT-based sources of sustained competitive advantage, there may be other attributes of IT whose competitive implications have not been fully evaluated. This paper suggests a framework that can be used to evaluate these competitive implications. Additional conceptual work will be required to describe these other IT attributes and their relationship to the resource-based view of the firm. Moreover, empirical tests of the arguments presented here and other resource-based arguments about IT attributes will also need to be conducted.

This analysis also has important implications for IT managers. First, simply because IT managerial skills are the only likely source of sustained competitive advantage discussed in this paper, it does not follow that other attributes of IT are competitively unimportant. For example, while technical IT skills are not likely to be a source of sustained competitive advantage, they may be a source of temporary competitive advantage. A firm may be able to get an IT-based "head-start" on its competition based on these technical skills (i.e., they may be heterogeneously distributed among competing firms, but not imperfectly mobile). Moreover, even when such a head start is not possible, it is still essential that a firm be as technically skilled in its IT as its competitors. After all, managerial IT skills can only be used to leverage a firm's technical IT skills if those skills exist in a firm. Responsible IT managers will constantly compare their technical skills with their competitors and seek to meet, or exceed, their competition's level of technical competence.

Second, this analysis suggests that firms cannot gain sustained competitive advantages by "playing games" with customers. Prescriptively, the traditional "create-capture-keep" paradigm seemed to imply that it was possible to mistreat your "captured" customers—by raising prices, reducing quality, reducing service, etc.—with impunity. Since captured customers had no options, this seemed like a viable strategic option. However, it is now clear that most customers do have IT options and that even if they do not have them right now, they will probably have them soon. In this more competitive IT world, firms that mistreat their customers to exploit switching costs are likely to see their performance fall.

Third, this analysis suggests that, in addition to developing and maintaining a technically competent IT organization, IT managers also should seek to develop close working relationships with managers in other business functions and even with managers in other firms. Clearly, these relationships are sometimes difficult to build and often difficult to maintain. However, it is these kinds of relationships that will enable the IT function to leverage its technical IT skills to address real business problems. Moreover,

to the extent that these kinds of relationships are heterogeneously distributed across a firm's competitors, they are likely to be a source of at least a temporary competitive advantage. Indeed, since these relationships are, by definition, socially complex, they are also likely to be imperfectly mobile and thus a source of sustained competitive advantage.

Finally, this analysis suggests that using IT to gain sustained competitive advantage is not likely to be easy. Indeed, if it was relatively simple for firms to use IT in this way, then IT would not be imperfectly mobile and therefore not a source of sustained competitive advantage. The fact that it is often difficult to develop IT managerial skills, that relationships between the IT function and other business functions are often slow to evolve, and that the technical orientation of many of those in the IT function can clash with the business orientation of others in a firm is **good** for those firms who have been able to develop these IT managerial skills. This implies that other firms will have a difficult time imitating these skills, and therefore they can be a source of sustained competitive advantage.

References

- Bain, J.S. *Barriers to New Competition*, Harvard University Press, Cambridge, MA, 1956.
- Bakos, J.Y. and Treacy, M.E. "Information Technology and Corporate Strategy: A Research Perspective," *MIS Quarterly* (10:2), June 1986, pp. 107–119.
- Balaguer, N.S. "OTISLINE (B)," Harvard Business School Case 9–190–149, Harvard Business School Publishing Division, Boston, MA, 1990.
- Barney, J.B. "Organizational Culture: Can It Be a Source of Sustained Competitive Advantage," *Academy of Management Review* (11:3), July 1986a, pp. 656–665.
- Barney, J.B. "Strategic Factor Markets: Expectations, Luck, and Business Strategy," *Management Science* (32:10), October 1986b, pp. 1231–1241.
- Barney, J.B. "Firm Resources and Sustained Competitive Advantage," *Journal of*

- Management* (17:1), March 1991, pp. 99–120.
- Barney, J.B. "Competitive Advantage from Organizational Analysis," working paper, Texas A&M University, College Station, TX, 1994.
- Barney, J.B. *Gaining and Sustaining Competitive Advantage*, Addison-Wesley, Reading, MA, 1996 (forthcoming).
- Benjamin, R.I., Rockart, J.F., Scott Morton, M.S., and Wyman, J. "Information Technology: A Strategic Opportunity," *Sloan Management Review* (25:3), Spring 1984, pp. 3–10.
- Blackburn, R. and Rosen, B. "Total Quality and Human Resources Management: Lessons Learned from Baldrige Award-Winning Companies," *Academy of Management Executive* (7), 1993, pp. 49–66.
- Brancheau, J.C. and Wetherbe, J.C. "Key Issues in Information Systems Management," *MIS Quarterly* (11:1), March 1987, pp. 23–45.
- Capon, N. and Glazer, R. "Marketing and Technology: A Strategic Coalition," *Journal of Marketing* (51:3), July 1987, pp. 1–14.
- Cash, J.I. and Konsynski, B. "IS Redraws Competitive Boundaries," *Harvard Business Review* (63:2), March–April 1985, pp. 134–142.
- Castanias, R.P. and Helfat, C.E. "Managerial Resources and Rents," *Journal of Management* (17:1), March 1991, pp. 155–171.
- Caves, R. and Williamson, P. "What is Product Differentiation, Really?" *The Journal of Industrial Economics* (34), 1985, pp. 113–132.
- Clemons, E.K. "Information Systems for Sustainable Competitive Advantage," *Information & Management* (11:3), October 1986, pp. 131–136.
- Clemons, E.K. "Corporate Strategies for Information Technology: A Resource-Based Approach," *Computer* (24:11), November 1991, pp. 23–32.
- Clemons, E.K. and Kimbrough, S.O. "Information Systems, Telecommunications, and their Effects on Industrial Organization," *Proceedings of the Seventh International Conference on Information Systems*, December 1986, pp. 99–108.
- Clemons, E.K. and Knez, M. "Competition and Cooperation in Information Systems Innovation," *Information & Management* (15:1), August 1988, pp. 25–35.
- Clemons, E.K. and Row, M. "Structural Differences among Firms: A Potential Source of Competitive Advantage in the Application of Information Technology," *Proceedings of the Eight International Conference on Information Systems*, December 1987, pp. 1–9.
- Clemons, E.K. and Row, M.C. "Sustaining IT Advantage: The Role of Structural Differences," *MIS Quarterly* (15:3), September 1991a, pp. 275–292.
- Clemons, E.K. and Row, M.K. "Information Technology at Rosenbluth Travel: Competitive Advantage in a Rapidly Growing Service Company," *Journal of Management Information Systems* (8:2), Fall 1991b, pp. 53–79.
- Clemons, E.K. and Row, M.C. "Information Technology and Industrial Cooperation," *Proceedings of the Twenty-Fifth Annual Hawaii International Conference on System Sciences* (4), January 1992, pp. 644–653.
- Clemons, E.K. and Weber, B.W. "Strategic Information Technology Investments: Guidelines for Decision Making," *Journal of Management Information* (7:2), Fall 1990, pp. 9–28.
- Conner, K.R. "A Historical Comparison of Resource-Based Theory and Five Schools of Thought Within Industrial Organization Economics: Do We Have a New Theory of the Firm?" *Journal of Management* (17:1), March 1991, pp. 121–154.
- Copeland, D.G. and McKenney, J.L. "Airline Reservation Systems: Lessons from History," *MIS Quarterly* (12:3), September 1988, pp. 353–370.
- Dierickx, I. and Cool, K. "Asset Stock Accumulation and Sustainability of Competitive Advantage," *Management Science* (35:12), December 1989, pp. 1504–1511.
- Etheridge, J. "Sky Wars Over Europe," *Datamation* (34:3), February 1, 1988, International section, pp. 84–1–84–5.
- Feeny, D. "Creating and Sustaining Competitive Advantage with IT," in *Information Management: The Strategic Dimension*, M.

- Earl (ed.), Oxford University Press, Oxford, U.K., 1988, pp. 98–117.
- Feeny, D.F. and Ives, B. "In Search of Sustainability: Reaping Long-Term Advantage from Investments in Information Technology," *Journal of Management Information Systems* (7:1), Summer 1990, pp. 27–46.
- Ghemawat, P. "Wal-Mart Stores' Discount Operations," Harvard Business School Case 9–387–018, Harvard Business School Publishing Division, Boston, MA, 1986.
- Grant, R.M. "The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation," *California Management Review* (33:3), Spring 1991, pp. 114–135.
- Gunther, R. "Chemical Bank, AT&T to Scrap Home-Bank Service," *Wall Street Journal*, December 5, 1988, p. C21.
- Hopper, M.D. "Rattling SABRE—New Ways to Compete on Information," *Harvard Business Review* (68:3), May–June 1990, pp. 118–125.
- Huey, J. "Wal-Mart: Will It Take the World?" *Fortune* (119:3), January 30, 1989, pp. 52–61.
- Itami, H. *Mobilizing Invisible Assets*, Harvard University Press, Cambridge, MA, 1987.
- Jackson, B.B. *Winning and Keeping Industrial Customers: The Dynamics of Customer Relationships*, Lexington Books, Lexington, MA, 1985.
- Jakes, J.M. and Yoches, E.R. "Legally Speaking: Basic Principles of Patent Protection for Computer Software," *Communications of the ACM* (32:8), August 1989, pp. 922–924.
- Jarvenpaa, S.L. and Ives, B. "Information Technology and Corporate Strategy: A View from the Top," *Information Systems Research* (1:4), December 1990, pp. 351–376.
- Johnston, H.R. and Vitale, M.R. "Creating Competitive Advantage With Interorganizational Information Systems," *MIS Quarterly* (12:2), June 1988, pp. 153–165.
- Katz, R.L. "Skills of an Effective Administrator," *Harvard Business Review* (52:5), September–October 1974, pp. 90–102.
- Keller, J.J. and Wilson, J.W. "Why ZapMail Finally Got Zapped," *Business Week* (:2968), October 13, 1986, pp. 48–49.
- Klein, B., Crawford, R.G., and Alchian, A.A. "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process," *Journal of Law & Economics* (21:2), October 1978, pp. 297–326.
- Kogut, B. "Joint Ventures: Theoretical and Empirical Perspectives," *Strategic Management Journal* (9), 1988, pp. 319–332.
- Lieberman, M.B. and Montgomery, D.B. "First-Mover Advantages," *Strategic Management Journal* (9: special issue), 1988, pp. 41–58.
- Mahoney, J.T. and Pandian, J.R. "The Resource-Based View within the Conversation of Strategic Management," *Strategic Management Journal* (13), 1992, pp. 363–380.
- Malone, T.W., Yates, J. and Benjamin, R.I. "The Logic of Electronic Markets," *Harvard Business Review* (67:3), May–June 1989, pp. 166–170.
- Mansfield, E. "How Rapidly Does New Industrial Technology Leak Out?" *Journal of Industrial Economics* (34), 1985, pp. 217–233.
- Mansfield, E., Schwartz, M., and Wagner, S. "Imitation Costs and Patents: An Empirical Study," *Economic Journal* (91), 1981, pp. 907–918.
- McFarlan, F.W. "Portfolio Approach to Information Systems," *Harvard Business Review* (59:5), September–October 1981, pp. 142–150.
- McFarlan, F.W. "Information Technology Changes the Way You Compete," *Harvard Business Review* (62:3), May–June 1984, pp. 98–103.
- McFarlan, F.W. and Stoddard, D. "OTISLINE," Harvard Business School Case 9–186–304, Harvard Business School Publishing Division, Boston, MA, 1986.
- Nelson, R. and Winter, S. *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge, MA, 1982.
- Niederman, F., Brancheau, J.C., and Wetherbe, J.C. "Information Systems Management Issues for the 1990s," *MIS Quarterly* (15:4), December 1991, pp. 475–495.
- Porter, M.E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Free Press, New York, NY, 1980.
- Porter, M.E. and Millar, V.E. "How Information Gives You Competitive Advantage," *Harvard Business Review* (63:4), July–August 1985, pp. 149–160.

- Reed, R. and DeFillippi, R.J. "Causal Ambiguity, Barriers to Imitation, and Sustainable Competitive Advantage," *Academy of Management Review* (15:1), January 1990, pp. 88–102.
- Reich, B.H. and Benbasat, I. "An Empirical Investigation of Factors Influencing the Success of Customer-Oriented Strategic Systems," *Information Systems Research* (1:3), September 1990, pp. 325–347.
- Rukstad, M.G. and Horn, J. "Caterpillar and the Construction Equipment Industry in 1988," Harvard Business School Case No. 9–389–097, Boston, MA, 1989.
- Rumelt, R.P. "Towards a Strategic Theory of the Firm," in *Competitive Strategic Management*, R.B. Lamb (ed.), Prentice Hall, Englewood Cliffs, NJ, 1984, pp. 566–570.
- Rumelt, R.P., Schendel, D., and Teece, D.J. "Strategic Management and Economics," *Strategic Management Journal* (12), 1991, pp. 5–29.
- Stalk, G., Evans, P., and Shulman, L.E. "Competing on Capabilities: The New Rules of Corporate Strategy," *Harvard Business Review* (70:2), March–April 1992, pp. 57–69.
- Steven, L. "Front Line Systems," *Computerworld* (26), March 2, 1992, pp. 61–63.
- Teece, D.J. "Capturing Value from Technological Innovation: Integration, Strategic Partnering, and Licensing Decisions," *Interfaces* (18:3), May–June 1988, pp. 46–61.
- Venkatraman, N. and Short, J.E. "Baxter Healthcare: Evolution from ASAP to ValueLink in the Hospital Supplies Marketplace," *Proceedings of the Twenty-Fifth Annual Hawaii International Conference on System Sciences* (4), January 1992, pp. 666–677.
- Vitale, M.R. "The Growing Risks of Information Systems Success," *MIS Quarterly* (10:4), December 1986, pp. 327–334.
- Vitale, M.R. and Konsynski, B. "Baxter Healthcare Corporation: ASAP Express," Harvard Business School Case 9–188–080, Revision 2/11/91, Harvard Business School Publishing Division, Boston, MA, 1991.
- Wernerfelt, B. "A Resource-Based View of the Firm," *Strategic Management Journal* (5:2), April–June 1984, pp. 171–180.
- Williamson, O.E. *Markets and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York, NY, 1975.
- Williamson, O.E. "Transaction Cost Economics," in *Handbook of Industrial Organization* (1), R. Schmalensee and R.D. Willig (eds.), Elsevier Science, Amsterdam, Netherlands, 1989, pp. 136–182.
- Winter, S.G. "Knowledge and Competence as Strategic Assets," in *The Competitive Challenge*, D. Teece (ed.), Ballinger, Cambridge, MA, 1987, pp. 159–184.
- Wiseman, C. *Strategic Information Systems*, Irwin, Homewood, IL, 1988.

About the Authors

Francisco J. Mata is currently executive director at the Earth Council headquartered in San Jose, Costa Rica. He received a Ph.D. in management information systems from Texas A&M University and an M.S. in computer science from Case Western Reserve University. He previously worked as assistant professor at the Universidad de Costa Rica and held IS positions at the Tropical Agricultural Research and Training Center and the Inter-American Institute for Cooperation on Agriculture. His areas of interest are international IT management, IS planning, and the use of IT to obtain sustainable competitive advantage.

William L. Fuerst is an associate professor of MIS in the Department of Business Analysis & Research, and Director of the Center for the Management of Information Systems (CMIS), College of Business Administration and Graduate School of Business, Texas A&M University. His research and teaching interests include analysis and use of emerging information technologies, systems analysis and design, strategic impact of information technologies, and software development using CASE technology. He has published in several leading journals, including *MIS Quarterly*, *Decision Sciences*, *Journal of Management Information Systems*, and the *International Journal of Man-Machine Studies*. Dr. Fuerst's practical experience includes a position as senior manager in Management Consulting Services for Price

Waterhouse, as well as additional consulting experiences.

Jay B. Barney is a professor of management and holder of the Bank One Chair for Excellence in Corporate Strategy at the Fisher College of Business, Ohio State University. His research focuses on the relationship between idiosyncratic firm skills and capabilities and sustained competitive advantage. Professor Barney teaches organizational strategy and policy at Ohio State, and has taught in a variety of

executive training programs. He has written two textbooks on organizational economics and managing organizations, and has published over 30 articles in a variety of journals, including the *Academy of Management Review*, *Strategic Management Journal*, *Management Science*, and *Journal of Management*. He has consulted with a wide variety of public and private organizations, focusing on implementing large-scale organizational change and strategic analysis.