Strategic Information Systems Revisited: A Study in Sustainability and Performance

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Abstract

Sustainability of competitive advantage may be achieved by leveraging unique firm attributes with information technology to realize long-term performance gains. Information systems that cannot sustain competitive impact have only transient strategic value or may offer negative value if matched by a superior response by competitors. A research review of sustainability was conducted that resulted in the development of a framework depicting factors effecting sustainable competitive advantage. This study evaluates longitudinal changes in performance measures of 30 firms that have been cited as "classic" cases of strategic use of information technology. The results of this analysis indicate that not all of these classic cases can be touted as "sustained winners." Differences among strategic "sustainers" and "non-sustainers" were formally tested to determine those firm and/or industry factors that may be antecedents to sustained IT competitive advantage. Results indicate that managers must do more than simply assess the uniqueness or availability of emerging technological innovations in developing strategic IT plans. Specifically, the establishment of technological base along with substantial capital availability seem to be important prerequisites for "technologically derived" sustainability. Recognizing the need for a stronger prescriptive orientation to strategic IS, future research is outlined in an effort to develop a comprehensive framework that would link combinations of sustainability factors to actual performance.

Keywords: Sustainability, competitive use of IS, strategic impact, organizational strategies, longitudinal study

ISRL Categories: AI0113, AI0605, DA08, EI0225, GA01

Introduction

Competitive advantage is dependent upon unique characteristics that enable a firm to maintain a dominant position within its respective industry. Thinking on information technology-derived competitive advantage (ITCA) has been strongly influenced by conceptual frameworks

(Bakos and Treacy, 1986; Cash, et al., 1992; Ives and Learmonth, 1984; Johnston and Vitale, 1988; McFarlan, 1984; Porter and Millar, 1985; Rackoff, et al., 1985; Wiseman and MacMillan, 1984). In addition, many researchers have used case studies to illustrate the strategic effect of information technology (IT). Cases such as Merrill Lynch's CMA, McKesson's Economost (Clemons and Row, 1988) and American Airlines SABRE system (Copeland and McKenney, 1988; Doll, 1989) have become "part of the executive's folklore" (Clemons, 1991, p. 24). It is now a commonly held belief that the competitive use of IT has the potential to provide easier access to markets; to change products through differentiation; to provide cost efficiencies; and, to change the nature of a firm's industry. Finally, much of the information systems (IS) literature suggests that strategic users of IT should expect increases in "bottom-line" measures such as profitability and market share (Clemons, 1986; Weill and Olson, 1989).

Sustainability of competitive advantage, or the ability to maintain an initial gain in business performance from strategic IT, is a concept that has grown in importance. Information systems that facilitate competitiveness in both the short and long run have a premium value to initiating firms. Conversely, systems that cannot sustain their business impact have only transient value or offer negative value if they lead to a "bigger and better" response from competitors. Past literature has focused on those firm strategies and industry conditions that sustain competitive advantage over time (Clemons and Row, 1991; Feeny and Ives, 1990). Strategic IT decisions can present risks by changing the basis of competition, and what may have been a short-term advantage can soon become "obligatory for continued competitive viability" (Vitale, 1986, p. 338). This occurs because many IT investments are easily duplicated by competitors resulting in the same industry competitive situation but at an increased level of cost. True opportunities to achieve sustainable competitive advantage are rare and, more often than not, introduction of IT may be a "strategic necessity" to maintain current competitive position (Clemons, 1986).

Growing skepticism among practitioners and academics has surfaced suggesting that opportunities for achieving sustained competitive advantage from early use of IT may be more difficult than originally conceived and that the number of "silver bullets" are few (Brady, et al., 1992; Cecil and Goldstein, 1990). For example, one of the most celebrated cases of using information systems as a competitive weapon has been American Airlines' SABRE system. Yet, Max Hopper (1990) CIO of American Airlines, stated that "while SABRE represents a billion dollar asset to the corporation . . . I have felt that the folklore surrounding SABRE far exceeded its actual business impact" (p. 122). This contemporary view holds that the competitive use of IT must be a component of overall business strategy and that its application depends more on understanding unique business opportunities than competitive benefits achieved through technological features.

Over the past 10 years, the list of "popularized" cases of strategic systems has grown long (see Appendix A). However, even given this level of interest, there has been little empirical research to determine whether these systems have resulted in sustained competitive advantage. Although some important work has been undertaken (e.g., Banker and Kauffman, 1988; Clemons, 1986; DeSantos and Pfeffer, 1991; Harris and Katz, 1991), the development and application of measures to evaluate strategic IT are not adequately represented in current IS research. This study attempts to explore longitudinal changes in performance measures of these widely cited cases of strategic systems. We believe that segregation of these cases based on changes in competitive position will facilitate further research into firm and/or industry factors that contribute to sustained competitive advantage as well as provide a basis for determining the contributed value of strategic IT to the bottom line.

In other words, this study undertakes an examination of the notion of sustainability on *both* a conceptual and empirical basis in an effort to provide a better understanding of sustainability, its antecedents, and its impact on performance. Specifically, there are three distinct study objectives: (1) Identification of factors considered important in establishing sustainability through synthesis of research on sustainability and competitive advantage; (2) Determination of those firms, from the widely acknowledged "classic" cases of strategic IT, that have sustained im-

provement in competitive position ("sustainers") and those that have not ("non-sustainers"); and (3) Distinguish through empirical analysis, those factors most important in differentiating sustainers from non-sustainers.

Factors Facilitating Sustainable Competitive Advantage

There is a growing body of theoretical work on sustainable advantage in the IS field (Clemons, 1986; Clemons and Row, 1991; Feeny, 1988; Feeny and Ives, 1990). There has also been a burgeoning of theoretical and empirical research work in economics, industrial organization (IO), marketing, and strategic management that provides models, factors, and operationalized variables to understand competitive advantage and sustainability. Much of this research suggests that the ability to leverage distinctive internal competencies relative to environmental situations affects business performance and ultimately the sustainability of competitive advantage (Ginsberg and Venkatraman, 1985; Glazer, 1985; Lambkin, 1988; Lieberman and Montgomery, 1988; MacMillan, 1983; Schendel and Hofer, 1979). In fact, strategic management literature has defined strategy in terms of the match between the opportunities and risk inherent in the environment and internal competencies (resources and skills) possessed by the firm (Hofer, 1975; Miles and Snow, 1978; Schendel and Hofer, 1979; Venkatraman and Camillus, 1984).

Based on a selective review of literature from the disciplines previously mentioned, it was determined that identified sustainability factors do not all fall into the same "type"—some are content oriented, while others are process oriented, some are contingency factors, while others are deliberate actions taken by the firm. Figure 1 shows the relationships among these categories of factors and represents a framework for explaining sustainable competitive advantage. While the list of factors identified is diverse, their dimensions have been captured, and some operationalized, in past strategic management models. In particular, this framework is consistent with normative models of strategic planning in organizations. These models identify environmental and firm-specific contingencies that influence strategic choice. Similar models have been outlined that include environmental and firm resource analysis in strategy formulation and draw a direct causal relationship to firm performance (Grant, 1985; Schendel and Hofer, 1979). This normative relationship has been further identified in the IS literature. For example, "strategic resource differences among firms are important in explaining and predicting the competitive outcomes of strategic applications of IT" (Clemons and Row, 1991, p. 276).

In general, three sets of factors are observed:

1. **Environmental Factors**—Factors that reflect environmental and unique situations that could affect sustainability (i.e., unique industry characteristics, changes in regulatory environment, political changes, etc.);
2. **Foundation Factors**—Factors that exist by virtue of the firm's infrastructure and that have evolved over time; and,
3. **Action Strategies**—Factors that require definitive actions/strategies by the initiating firm to leverage the foundation factors through the strategic IS application to create sustainable competitive advantage.

Upon strategic system launch, these factors influence the ability of competitors to effectively respond. Collectively, the ability of a firm to leverage its environmental and foundation factors through effective IS strategies and actions should inhibit competitor response and subsequently nurture sustainability. It should be noted that the factors identified are not intended to be mutually exclusive, and several factors may show interdependence.

Environmental factors

Several environmental factors, principally industry characteristic and competitor restrictions, influence a firm's capability to achieve and sustain a competitive advantage (Porter, 1980; Scherer, 1980). The amount of industry competition, strategic groupings, process or product orientation, capital intensity, information intensity, and the current financial situation of an industry as a whole have all been offered as industrial contingencies in the realization and preservation of competitive advantage resulting from IT (Banker

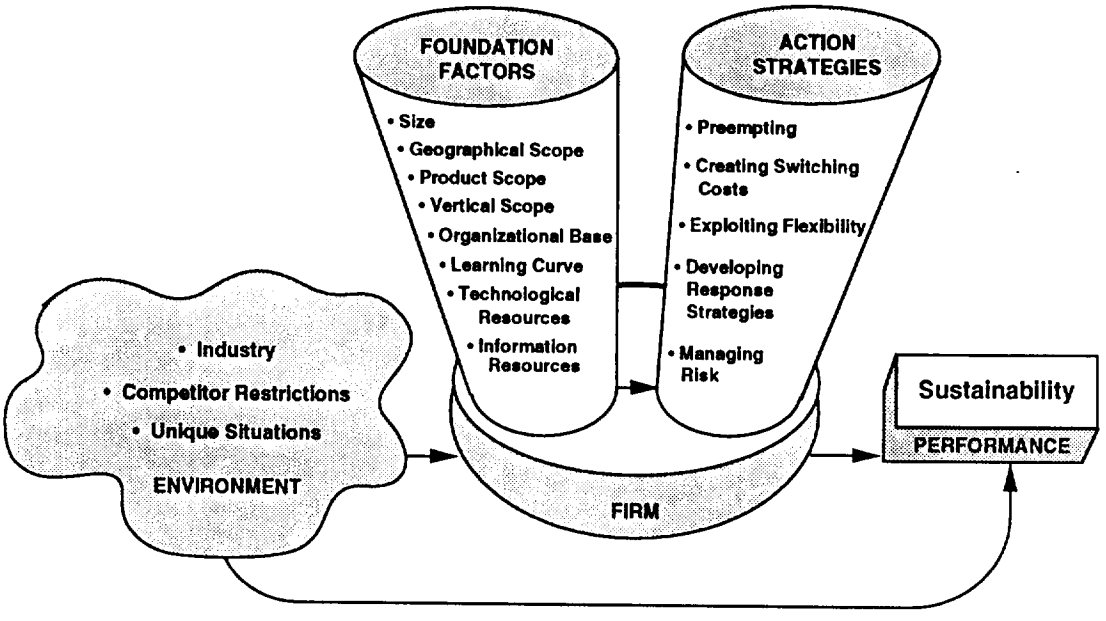

Figure 1. Model of Sustainability

and Kauffman, 1988; Cash, et al., 1992; Clemons and Row, 1991; Jarvenpaa and Ives, 1990; Parsons, 1984; Porter and Millar, 1985).

The prevailing industry structure within which the firm competes is perhaps the most influential of *industry characteristics*. Within the area of strategic management, numerous measures have been developed in an effort to model industry structure and its impact upon prevailing strategic orientation and performance (Cool and Schendel, 1987; Dess and Davis, 1984, Ginsberg, 1984). One of the most consistently used measures of industry structure is the degree of industry competition (Venkatraman and Grant, 1986). Measured as the number of direct competitors in terms of size and market strength, this variable objectively conveys information regarding the levelness of the competitive playing field. Many competitors may be indicative of an industry with generic products, low entry barriers, and competition based on cost. Few competitors may signal more oligopolistic structures in which differentiation dictates competition, and entry barriers are high (Porter, 1985).

Competitive restrictions and unique situations such as macro-economic, political, and regulatory factors may also all have the potential to influence sustainability. Such restrictions can hamper a competitor from responding to a threat that it would otherwise answer. A company that is on the right side of public policy can exploit its position to build sustainability (Ghemawat, 1986). Government intervention, patents, and anti-trust laws are examples of inhibitors to a competitor's ability to initiate a pre-emptive strategy. There have been a number of incidents in which companies used IT as a means of responding to competitive restrictions (e.g., deregulation, foreign competition, and trade barriers) (Johnston and Carrico, 1988). However, it can be extraordinarily difficult to protect innovative applications of IT through patents, trade secrets, or the use of proprietary technology (Clemons and Knez, 1988).

Foundation factors

Unique assets, alliances, and expertise may provide the firm with a competitive edge in the marketplace. When leveraged with IT, these foundation factors may become almost proprietary for the initiating firm (Clemons and Row, 1991). Within the areas of strategic management and IO, such foundation factors have been studied for their impact on sustained profitability (Chakravarthy, 1986; Cool and Schendel, 1987; Fiegenbaum, et al., 1990; Hatten, et al., 1978; Snow and Hrebiniak, 1980).

Size

While economies of scale can work on a national, regional, or even on a local level, size is only an advantage if there are compelling economies to being large. Benefits of size exist because markets are finite. An imitating firm (follower) may fear that matching the leader's size will cause supply to exceed demand. Additionally, the investment asymmetry created would yield a penalty to the follower (Ghemawat, 1986). Common operationalizations of firm size include gross sales or gross value of assets. Such measures are thought to indicate the scope of the firm's operations and its power to influence the nature of industry structure (Porter, 1985). IT scale advantage is present where the superiority in size and investment of a firm makes it prohibitively expensive for competitors to imitate the strategic IT user (Clemons and Row, 1991). Because the development of strategic information systems tends to involve large fixed costs and low variable costs, there exists the possibility of significant scale economies as well as significant penalty for failure. Access to resources, economies of scale, and value chain alliances commonly associated with larger firms may prohibit smaller players from directly competing with larger-scale IT innovators.

Geographic Scope

Geographic scope involves strategic factors such as infrastructure, location, and telecommunications. Infrastructure includes physical assets such as equipment and property. Location involves strategic decisions such as whether the production and sales facilities are located at customer sites or at some other advantageous geographic location. Technology has grown into an important geographical scope concern because of the use of wide area networks to connect sales locations with operations facilities (Keen, 1988). In fact, Feeny (1988) identifies the concept of "the Network as a Competitive Variable" (p. 112) and speculated that telecommunication networks would become a key component of geographic scope.

Product Scope

Product scope is defined as the breadth of products or services offered. This includes the range of customers/buyers served by the strategic system. It also includes the range and variety of services provided by the system. MacMillan (1983) suggests that product scope comes from the ability to introduce new products, dominate product design, establish product positioning, accelerate product approval in regulated industries, and capitalize on product skills.

Vertical Scope

Vertical scope is the degree of vertical integration (backward and/or forward) relative to competitors—for example, the firm's capability to integrate supply base or to bring customer service in-house (Ghemawat, 1986). This is accomplished when supply is bounded or is of varying quality. Some means of capturing the input chain include backward integration, low cost suppliers, tying up contracts in a market, growing reputation, and maximizing established relationships. IT can be used to exploit vertical integration by creating a closed loop system between the firm and its external constituents.

Organizational Base

Organizational base is defined as a source of competitive asymmetry (Feeny and Ives, 1990). Organizational base may be viewed as the fit between a firm's capability to act on, and its competence to exploit, IT opportunities (Keen, 1991). Capability to act on an identified IT opportunity is largely influenced by the availability of organizational slack. In IO literature, organizational slack resources refer to a firm's "internal capital" or the ability to generate cash flow for the purpose of reinvestment. This capability may be crucial for the firm if it is to halt system obsolescence and/or the strategic responses from competitors (Clemons and Row, 1991; Vitale, 1986). Variables such as cash flow, working capital, and net income have been used to represent "internal capital" in past studies (Chakravarthy, 1986).

Competence to exploit an IT opportunity is influenced by the prevailing management culture, experience, and satisfaction with IT. For instance, it is important for senior management to understand and be involved in the use of IT for competitve advantage (Bakos and Treacy, 1986; Benjamin, et al., 1984; Parsons, 1984; Rockart, 1988). In order to significantly moderate the rela-

tionship between IT investment and performance, there must be top management commitment to IT, managerial vision (willingness to take risk), managerial adaptability (willingness to redesign the organization), previous experience with IT, and user satisfaction (Clemons and Row, 1991; Weill, 1989). One measure extensively used in prior studies that represents a powerful indicator of how well a company manages and utilizes its asset base is capital efficiency (Cool and Schendel, 1987). Lower measures of this variable relative to competitors may indicate an overabundance of fixed assets. Such firms may be inept at managing their production and technological bases. Conversely, higher measures may be indicative of effective management and utilization of assets including large-scale strategic IT. Such management practices may provide a key indicator of management's competence in exploiting and subsequently sustaining technology-based market initiatives.

Learning Curve

The curve of organizational learning affects both a firm's ability to acquire and maintain knowledge (Lieberman, 1987). A firm's sophistication in managing the "human side of IT in terms of skill base, education, relevant experience, and career development" is a key criterion in gaining and maintaining competitive advantage (Keen, 1991, p. 119). Experience has been shown to increase the operating reliability, the success rates of product introduction, and the marketability of high-tech products (Ghemawat and Spence, 1985). The ability of the firm to effectively utilize employees and/or produce its product or service at low cost has been considered indicative of organizational learning (Cool and Schendel, 1987; Hatten, et al., 1978). In essence, firms with higher measures along these operationalized dimensions are further along the competitive learning curve than other industry participants and may be rewarded with asymmetric and sustainable competitive gains.

The ability to copy a strategic thrust is dependent on a competitor's ability to understand and assimilate the strategic product or service. Diffusion occurs rapidly in most industries through mechanisms of workforce mobility, research publication, professional conferences, informal technical communication, reverse engineering, and plant tours (Lieberman and Montgomery, 1988). The learning curve is a more important factor in industries that depend critically on information diffusion (Lieberman, 1987). Mechanisms to keep product experience proprietary include: integrating backward, customizing production, and low worker turnover.

Technological Resources

The development of technological resources and expertise can distinguish an innovating organization. The uniqueness of both IT in use and under development may be a source of sustainability (Feeny and Ives, 1990; McFarlan, 1984). Packaging and selling of sophisticated, internally developed IT services and applications also creates an opportunity for additional value from an IT investment (Clemons and Weber, 1990). In fact, internal needs and technical capability can be the principal facilitators in the use of IT for competitive advantage (King and Grover, 1991). In addition, the existence of a strong technological infrastructure and competence facilitates rapid building of complex and flexible systems and technical products. Within the strategic management and innovation literature, the extent of the firm's innovative technological resources is commonly measured through expenditures in research and development (R&D) (Cool and Schendel, 1987; Douglas and Rhee, 1989). Other studies use a measure of invested capital relative to sales for this operationalization (Chakravarthy, 1986; Fiegenbaum, 1990; Hatten, et al., 1978). These variables have been consistently found to be important determinants of firm profitability within industries that compete on the basis of technological superiority (Cool and Schendel, 1987; Fiegenbaum, 1990). The underpinning of these operationalizations is that firms with more extensive and advanced technological resources would be expected to devote relatively more financial resources to developmental and technology investments than other industry participants.

Information Resources

The richness and content of the firm's knowledge base have been viewed as a contributor to competitive advantage (King, et al, 1988). A rich database may translate into the development of sophisticated analytic tools to enhance the ser-

vice and development of strategic systems (Feeny and Ives, 1990). The extent to which intelligence is embedded in the firm's existing databases, decision support systems, and expert systems may determine its ability to exploit opportunities (Sabherwal and King, 1991). The mere existence of this information or the ability to access this information reflects benefits of scale or experience (Ghemawat, 1986). Generally, knowledge must be proprietary and secret to yield advantage. Maintaining the corporate knowledge base typically includes non-disclosure agreements, superior education and training, and low personnel turnover.

Action strategies

Actions/strategies are definitive actions or strategies by an initiating firm to leverage IT and the foundation factors in light of environmental conditions to create sustainable competitive advantage. Based on our review of the literature it was determined that most factors relating to actions/strategies have thus far not been operationalized in past empirical research.

Pre-Empting

It is commonly held that early entrants into a market enjoy an enduring competitive advantage over late entrants. This notion is supported by the concepts of barriers to entry (Bain, 1956), economies of scale, learning curve, technology leadership, pre-emption strategies, and establishing buyer's switching costs. Such advantages have been reinforced by past studies in strategic management (Lambkin, 1988; MacMillan, 1983), strategic marketing (Robinson and Fornell, 1985), consumer behavior (Urban, et al., 1986), economics (Dixit, 1979; Eaton and Lipsey, 1979), and IS competitive advantage (Ives and Learmonth, 1984; Porter and Millar, 1985; Wiseman and MacMillan, 1984). Lambkin (1988) found that pioneer strategies and structures outperformed later entrants. Montgomery (1975) found that product newness was a key variable necessary to gain acceptance for products with low switching costs. However, other researchers have suggested that advantages of early entry are "not as automatic" because of technological and economic uncertainties (Aaker and Day, 1986; Cooper; 1979; Dillon, et al., 1979; Glazer, 1985; Wensley, 1982).

First (or early) movers gain advantage by controlling existing assets via a *pre-emption strategy.* A pre-emptive move is defined as a major move by a focal business, ahead of moves by its adversaries, which allows it to secure an advantageous position that is difficult to dislodge because of the advantage it has captured by being first (MacMillan, 1983). Three broad categories of pre-emption strategies have been suggested: (1) Pre-emption in input factors allowing first-movers to purchase assets cheaper and secure better terms; (2) Pre-emption in geographic and product characteristic's space, creating barriers to entry; and (3) Pre-emption in capacity of early entrants allowing greater output following entry (Lieberman and Montgomery, 1988). In applying these basic concepts to IT, first-movers are encouraged to follow a classification of pre-emption stages (Feeny and Ives, 1990). These include: (1) *Finding the exploitable link* within the supply chain where resources are finite and where a limited number of participants control the link in the chain. Exploitable resources may be enhanced services for qualified customers such as travel agents in the airline industry; (2) *Capturing the pole position* within the supply chain by providing IT applications that provide a unique and superior relationship with targeted customer groups; (3) *Keeping the gate closed* involves taking advantage of high switching costs. The focus here is on maintaining product loyalty to the IS user interface, the database, and the community of system users.

Creating Switching Costs

Switching costs enhance the value of the market share obtained early in the development of a successful market (Lieberman and Montgomery, 1988). Followers must invest extra resources to attract customers away from their competitors. This stems from initial transaction costs or investments that the buyer makes in adopting the seller's product. The burden lies on the buyer in the form of time and resources spent in qualifying a new supplier, cost of ancillary products (new software, hardware, etc.), and disruption and financial burden of training employees. Supplier-specific learning by the buyer is the category of switching cost most cited in the IT literature concerning first-mover advantage. User friendliness and user training are two components of sustained competitive advantage whereby the buyer

becomes accustomed to the first-mover's IS service and finds it costly to switch (Feeny, 1988). Another form of switching cost is contractual in nature similar to the frequent-flyer programs or software licensing agreements.

Exploiting Flexibility

Flexibility allows firms to overcome entry barriers in growth industries and exit barriers in declining industries and unprofitable markets. Divisibility and expandability are opportunities for IT to maintain competitive advantage (Clemons and Weber, 1990). IT has the capability of expanding geographical reach or extending levels of operation. The flexibility to quickly respond to changing market demands and improve service quality is an important factor in the first-mover's ability to enhance the system and "keep the pole position" (Feeny and Ives, 1990).

Developing Response Strategies

Response lag or lead time is defined as the amount of time from first-mover project launch until a competitor's substantive response. The longer the competitor's response lag, the greater the chances the first-mover will achieve a longer period of sustainability. This time lag is defined as "generic lead time" (Feeny and Ives, 1990). There are four pre-emptive moves that extend the period of response from competitors (MacMillan, 1983): (1) cannibalizing competitive advantage; (2) damaging the opponent's image, tradition, or strategy; (3) threatening a major investment; and (4) antagonizing powerful third parties (e.g., government, unions). These response strategies can be useful because competitors are highly reluctant to react to moves that dilute their strengths, force them to relinquish a major commitment, or precipitate antagonistic responses from powerful vested interest groups. Clemons and Kimbrough (1986) state that there usually is a "small window of opportunity" and that the ratio of customer adoption time to competitor copy time should be small to attain sustainable competitive advantage.

Managing Risk

Managerial risk disposition is concerned with the willingness of corporate leaders to utilize financial or operating leverage in pursuit of competitive goals (Miller and Bromiley, 1990). Strategic IT moves are inherently risky and often involve taking calculated risk. A framework was proposed (Vitale, 1986) to assess this risk whereby a firm considers whether IT will result in competitive advantage or whether a more likely outcome is extension of the current competitive situation at an increased level of cost. Firms can reduce risk or "shape one's luck" by capitalizing on a pre-emptive opportunity (MacMillan, 1983). This responsibility depends heavily on the strategic foresight and maneuvering of top management. Unlike the other actions/strategies, a great deal of research attention has been focused on successfully operationalized "managing risk." As argued by many authors, the aggressive use of financial leverage may be indicative of deeper managerial traits such as innovativeness and risk-taking. Such traits may directly influence the timing and nature of adoption in regards to riskier projects including strategic IT. Measured in terms of financial risk, these operationalizations may indicate a conservative or risk-averse managerial posture or a more liberal, risk-taking managerial posture.

Even if a proposed application offers attractive benefits, if it "cannot be defended against the competition, management should forgo the excitement (and cost) of pioneering the idea and settle for a fast, cheap, and effective follower role" (Feeny and Ives, 1990, p. 43-44). Down-side risks are associated with rejection of IT projects that may become a strategic necessity through another firm's strategic initiative (Clemons and Weber, 1990). In fact, cooperation among firms in the development of costly information systems may be the dominant alternative under industry conditions of strategic necessity (Clemons and Knez, 1988, Clemons and Row, 1992; Hopper, 1990).

Determination of Sustainability: The Classic Strategic IS Cases

Research on the strategic use of IT and the sustainability of competitive advantage has been heavily dominated by case studies. While these cases provide excellent insight into the context of individual occurrences, there has been little

attempt to empirically analyze these cases collectively to determine changes in firm competitive position after implementing these strategic systems.

Gaining a competitive advantage should result in a long-term financial benefit for the firm even if benefits are difficult to quantify (Cooper and Kaplan, 1988). Some researchers believe that a competitive advantage has been achieved when a firm receives a return of investment that is greater than industry norms and is sustained for a long enough period to alter the nature of industry competition (Clemons and Kimbrough, 1986; Porter, 1985). This concept suggests that a strategic IS should reduce cost, add value, and create significant switching costs that result in financial benefit before the system is copied by competitors. This quantitative definition of competitive advantage assumes that sustainable competitive advantage of IT can be identified and can be related to changes in business performance and industry structure. This definition is closer to the thinking of many CEOs who seek economic justification for large IT investments. Strassman has proposed that investment in IT can be justified based on a Return on Management (ROM). ROM is the delineation of economic value of IT as it impacts management (Strassman, 1988). It has been argued that competitive advantage can be measured not only in financial terms but in terms of market share and new customers (Wiseman, 1988b). In addition, sometimes strategic IT investments must be justified on a "leap of faith" that has no immediate short-term financial payoff (e.g., Diebold, 1987).

Early research on the effect of IT on organizations concentrated on surrogate measures of performance (system utilization, user attitudes, system success) because of the difficulty involved in accurately determining the effect of information processing on actual business performance. Past literature on the financial impact of IT primarily focused on optimal levels of investment in IT (Bender, 1986; Cron and Sobol, 1983). However, little consistent relationship has thus far been established between levels of IT investment and performance (Turner, 1985; Weill, 1989). More recent IS literature has been devoted to assessing the financial implications of strategic IT investments (Alpar and Kim, 1990; Banker and Kauffman, 1988; Clemons, 1991; Clemons and Weber 1990; Kauffman, et al., 1989; Weill, 1989). These studies have attempted to identify changes in financial measures such as ROA, ROI, and sales growth that result from specific or a group of IT investments. While this research shows much promise, its focus thus far has been primarily limited to individual case studies, specific technologies, or single industries and, more importantly, has tended to emphasize cross-sectional data. Surprisingly, little empirical research has explored the relationship between strategic IT and financial performance over time, which typically requires longitudinal data. While assessing short-term impact of strategic IT is an important research question, a more significant issue is the long-term impact of strategic IT decisions.

Weill and Olson (1989) point to the importance of tracking the impact of IT over time and to match IT investments with measures of organizational performance. Further, they suggest that strategic investments should be measured by "revenue growth" rates (p.15). Banker and Kauffman (1988) have argued that the linkage between IT and firm performance should be constructed with the locus of value in mind. Weill and Broadbent (1990) define strategic IT as an "investment made to gain a competitive advantage and gain market share via sales growth" (p. 206). Clemons (1986) states that strategic systems have "two sources of benefits to the firm: increased profit margins and increased market share" (p. 134). Lieberman and Montgomery (1988) argue that economic profits are the appropriate measure of competitive advantage and that "advantage exists when the pioneering firm earns positive present value of profits because of early entry" (p. 51). This leads to our fundamental research questions and subsequent propositions: *Have those much cited early strategic users of IT achieved sustained profitability and/or market share growth? Are there significant differences in sustainability factors between those firms that sustained improvement in these measures and those that have not?*

Research propositions

This study attempts to analyze competitive position based on relative measures of profitability and market share of selected firms identified as

employing strategic information technology. Specifically, the following widely held assumptions regarding strategic IT are tested:

Proposition 1: Strategic users of IT will realize sustained gains in profitability and/or market share relative to competitors in their respective industries.

Proposition 2: Strategic users of IT that realize sustained improvement in performance will exhibit differences in sustainability factors from those that do not.

Methodology

It has been recommended that research on the effect of IT on firm performance is still in its "adolescence," and theory building research is needed (Kaufmann and Weill, 1989). There is a lack of studies of the effect of IT at the firm and industry level (Bakos, 1987). Measurement at this level of analysis "has the advantage of high validity but confounding factors and extraneous variance make the task of establishing an impact due to information technology extremely difficult" (Bakos, 1987, p. 19). To reduce these problems it is recommended that analysis of firm effect be controlled within its respective industry, thus reducing these variances. In this type of research it is recommended that, when feasible, control for contextual variables should be undertaken—for example, controlling for industry disturbances such as mergers and acquisitions, selective economic conditions, and/or governmental policy changes. This study controlled for extraneous variables through a thorough screening during sample selection and data collection and by analyzing each firm as an individual case measured against its respective industry's performance.

Sample Selection—The Strategic IS Cases

"Strategic IS cases" form the sample population for this study. A literature review of the relevant IS research and the "trade press" was undertaken to locate these cases. As a starting point, a 1986 (Brady) *Information Week* article that asked a panel of 11 IS experts (Emery, Ives, Johnson, King, McFarlan, McLean, Millar, Scott Morton, Thompson, Wetherbe, Wiseman) to select the top strategic IS systems was used to develop an initial sample set. Many of these cases were included by Neo (1988) in a content analysis of 14 strategic IS cases. Next, popularized cases were identified based on a review of additional published materials, including: *MIS Quarterly, Communications of the ACM,* ICIS Proceedings; *Information & Management, JMIS, Harvard Business Review; Planning Review,* the *Harvard Business School Cases, Computerworld, CIO, Information Week,* and popular IS text books. On the basis of this search, 60 well-documented cases were identified as strategic applications of IS (see Appendix A). These information systems range across several industries and represent both process and product-oriented systems.

Data Collection

Content analysis was used to determine the launch dates of each of the 60 identified strategic systems. Content analysis has grown in importance as a methodology in IS research (Culnan, 1986; Jarvenpaa and Ives, 1990; Neo, 1988). Launch dates were designated as the date that it was announced that the IT or IS was generally available in the case of a product, or widely in use in the case of a process technology. Systems development and pilot and/or limited testing were not included in the launch date. The initial process of determining launch dates involved copying 25 years of annual listing of bibliographic references in the *Funk and Scott* listings of corporate bibliographical references. This time period was chosen because it was believed that none of the 60 cases was launched prior to 1966. This search resulted in excess of 1000 pages of bibliographical citations. These references were read and all titles of the references that related to IS or IT were highlighted.

A second researcher reviewed these citations and determined whether a phase was relevant enough to warrant referring to the actual magazine and journal articles cited in a bibliographical reference. A file for each case was established. In some cases the *Funk and Scott* reference specifically announced the launch of a system. In other cases, it was necessary to review the referenced article to determine the date. In several cases, it was necessary to telephone company representatives to determine the appropriate date. In eight cases, it was im-

possible to determine the launch dates from any source, so these cases were eliminated from the sample.

Next, the authors reviewed the directory of the COMPUSTAT II financial data set of industrial firms. COMPUSTAT II was selected because of its widespread use in the finance, strategy, and accounting literature. Based on this review, an additional 17 firms were dropped from the sample because all or some of the years of annual financial data were missing. Reasons for this data not being included within COMPUSTAT II include acquisitions or mergers, existence of subsidiaries in which a clear stream of financial data could not be determined, and missing or unreported data. Based on this review, 35 firms with launch dates and complete COMPUSTAT II data sets remained for further analysis.

Industry data was then gathered via the COMPUSTAT II financial database. COMPUSTAT aggregates firms within industries based on the Standard Industrial Classification (SIC) code. SIC is the U.S. governmental standard for classification of firms based on the primary product(s) and/or service(s) produced. Determination of these product(s)/service(s) is made from the firm's mission statement of the 10K report filed annually with the U.S. Securities and Exchange Commission (SEC). In addition to mission statement, the SEC requires all firms to list major competitors. These listings were used in conjunction with product/service descriptions in determination of SIC groupings. Defined in terms of the SIC scheme, the "industry" is generally the accepted unit of analysis in industrial organization economics and strategic management (Bain, 1956; Fiegenbaum, et al., 1990; Jacquemin and Berry, 1979; Montgomery, 1982; Palipu, 1985; Scherer, 1980). For each firm, the authors carefully checked the face validity of other firms classified within the same SIC. Inconsistencies, possible mis-classification, or potential cross classification resulted in the removal of 5 additional firms from the sample. The remaining sample tended to have a strong banking representation and lacked non-U.S. firms. However, other attributes such as size and scope and a diversity of industries tended to be fairly consistent across the selected and non-selected samples.

Performance Measurement by Stages

For each firm, analysis of return on sales and market share relative to industry measures was made in three stages:

Stage 1 (Pre Launch): The five-year period before system launch.

Stage 2 (Post Launch 1): The period from system launch to five years post system launch.

Stage 3 (Post Launch 2): The period from five years post system launch to 10 years post system launch.

Five-year intervals were chosen as the most appropriate time frame because typically strategic systems have a 1-2-year start-up period. Thus, a shorter time horizon would not control for implementation and initial enhancements. In addition, five years is typical of the longer strategic planning horizons of many firms. Measurement of performance at these time intervals facilitates analysis of competitive position at various stages of system life. Specifically, initial impact can be measured by observing changes in competitive position from stage 1 to stage 2. Sustained competitive advantage can be identified through comparison of stages 2 and 3 relative to stage 1 (see Figure 2).

Measurement of Relative Profitability

Relative profitability (i.e., profitability relative to the industry) is used as a measure to control confounding factors such as general economic conditions, growth stage of the industry, and legal/regulatory considerations. Relative profitability measures also conform to accepted frameworks of competitive advantage (Porter, 1980; Porter and Millar, 1985). Various measures of profitability exist in both the strategic management and IS literature. Research by Woo and Willard (1983) of performance criteria used in strategic management resulted in identification of 14 distinct quantitative measures. Factor analysis of these measures resulted in four orthogonal factors that Woo and Willard (1983) named profitability, relative market position, change in profitability, and cash flow. Of these factors, profitability demonstrated the highest factor magnitude. The primary variables that loaded on this factor were return on investment (ROI), return on sales (ROS), and cash flow to

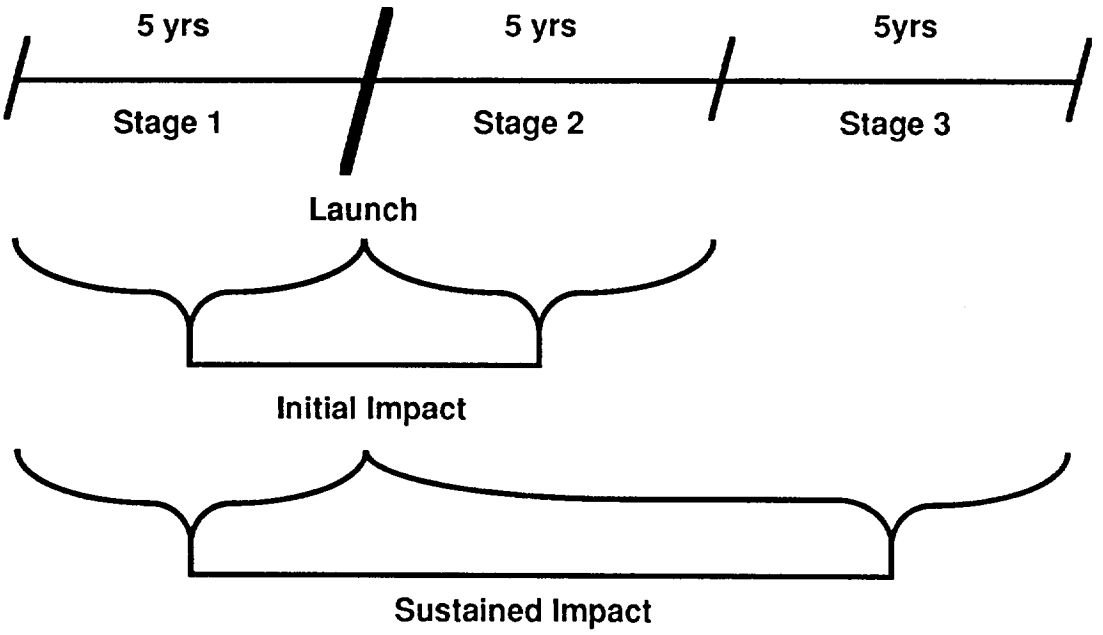

Figure 2. Performance Measurement by Stages

investment, with the first and third variables being highly correlated. Woo and Willard (1983) conclude that ROS and ROI are important measures of firm performance despite their many limitations.

In a subsequent study, Chakravarthy (1986) notes that ROS provides a more distinguishable criterion than other profitability measures in determining firm performance. Clemons (1986) identifies return on sales as an important economic indicator of strategic system effectiveness. In addition, Jarvenpaa and Ives (1990) use ROS as a profitability measure in examination of IT-related phrases in presidents' letters to shareholders. Although other measures of profitability have been employed in previous research, we define profitability as ROS based on its widespread use in the strategic management literature and reduced susceptibility (as opposed to ROA, ROE, and ROI) to variation in accounting procedures (Price and Mueller, 1986).

In this study, *relative profitability was calculated by taking the average ROS*[1] *of the firm in a given stage and dividing it by its respective industry average.* For example, if the five-year average ROS[2] for a firm before system launch was 10.8 percent while the industry average was 7.2 percent, relative profitability for that time frame would be 1.50. In other words, on average, the firm would be earning 1.5 times as much on sales as the industry average. The volatility in earnings suggests use of industry average as a relative base to provide a more accurate view of firm profitability position within an industry.

Measurement of Relative Market Share

Market share has been demonstrated empirically to be a key factor affecting performance. Hofer

[1] For financial firms, the measure *net income* divided by *net sales* was used in calculation of relative profitability. Analogous to the *sales* figure found on corporate income statements, *net sales* is an aggregation of interest income, income on investments, commissions fees, and other income less interest paid on deposits (*Standard & Poors Industry Surveys*, January 1991, S&P, Inc., New York, NY). Other measures, such as return on assets (ROA) and return on equity (ROE), which are sometimes used to gauge the performance of financial firms, were tested within the context of our performance analysis; however, this analysis yielded the same result as return on net sales (RONS). Therefore, we use RONS in this study for financial firms because of its consistency with the ROS figure used for non-financial firms.

[2] The use of performance averages over time is not without precedent; research by Hambrick, et al. (1982) and MacMillian, et al. (1982) employ average measures to examine strategic attributes and profitability over time.

(1975) lists market share as dominant among all attributes he would include in contingency models for all except brand new businesses. MacMillan, et al. (1982) include market share as an important dimension in differentiating businesses based on strategic attributes and profitability measures. Clearly, the primary intent of high profile systems such as American Airlines' SABRE, UAL's APOLLO, and Merrill Lynch's CMA is enhancing market share by offering a unique service or process to customers through IT (Clemons, 1986; Weill and Broadbent, 1990).

Relative market share is most widely defined within the context of the Boston Consulting Group's (BCG) product portfolio matrix (Henderson, 1979). Within the BCG matrix, *relative market share is formulated as the ratio of firm market share to its largest competitor's market share.* The "largest competitor" is defined as the competitor with the highest market share exclusive of the firm under analysis.[3] When viewed over time, changes in this ratio provide unique insight into competition for sales within industries. Relative market share was calculated for each of the sample firms within the given stages. For example, if firm market share prelaunch averaged 16 percent while that of the largest competitor averaged 20 percent, then relative market share for that time frame would be .80. On average, the firm's market share would be equivalent to 80 percent of its largest competitor's share.

Although other confounding factors certainly contribute to changes in firm profitability and market share, the thorough screening during sample selection and data collection, the time order of events, use of relative measures, and use of SIC codes for definition of industry improve upon past methodologies that have sought a linkage between strategic IT and firm performance (see Appendix B for an outline of measurement issues encountered and control mechanisms used).

Identification of "sustainers"

In addressing Proposition 1, this research sought to observe changes in competitive position of the study sample as measured by relative profitability and market share. Movement from stage 1 to stage 2 is classified as initial performance impact. This movement records changes in competitive position from system prelaunch to five years post launch. Table 1 illustrates the movement between cells from initial impact to sustained impact. In other words, comparison of stage 2 and 3 competitive position relative to stage 1 is made within the table. Thus, it is possible to determine which firms were able to sustain competitive position. Highlighted firms located on this matrix represent firms that either sustained performance improvement in profitability or market share or in both measures and were classified as "sustainers" for subsequent analysis. Firms that did not achieve or sustain an initial impact were deemed "non-sustainers."

Segregating the measures of Table 1 yields interesting results in terms of sustained profitability and market share from stage 1 to stages 2 and 3. Initial improvements in relative profitability were realized by 15 firms. Of these 15, eight were able to maintain improved position in stage 3, while seven were unable to sustain initial gains. In terms of relative market share, 13 firms realized initial improvement from stage 1 to stage 2. Interestingly, all firms that realized initial improvements in market share were able to sustain this advantage in the longer term. Six firms achieved sustained improvement in both measures. Based on this analysis, 15 firms were designated sustainers including: AP&C, AMR, Banc One, Baxter, Bergen, CIGNA, Dow Jones, DEC, Federal Express, Gannett, IBM, McKesson, Nucor, Owens, and Toys 'R' Us.

Factors That May Influence Sustainability: A Discriminant Analysis

This paper has proposed a framework for analyzing the many industry and firm-specific factors commonly cited as facilitators in creating and sustaining competitive gains with IT. In addition, the performance over time of popularly cited IT innovators has been compared with their industry counterparts in terms of market share and profitability. In essence, we believe that important groundwork has been laid for determination of

[3] The largest competitor was determined as the firm with the highest average market share within the same industry (SIC code). In no case within this study did the largest competitor within any industry change over the three stages.

Table 1. Change in Competitive Position: Initial vs. Sustained Impact

Change in Performance Stage 1 to Stage 3

Change in Performance Stage 1 to Stage 2	Marketshare Down Profitability Down	Marketshare Up Profitability Down	Marketshare Down Profitability Up	Marketshare Up Profitability Up
Marketshare Up Profitability Up				Air Products & Chemicals, AMR, Bergen, DEC, Federal Express, Toys 'R' Us
Marketshare Down Profitability Up	Corestates, GE, McGraw-Hill, Xerox, 1st Chicago	Deere, Mfg. Hanover	IBM	McKesson
Marketshare Up Profitability Down		Banc One, Cigna, Dow Jones, Gannett, Nucor		Baxter, Owens
Marketshare Down Profitability Down	Chase, Mellon, UAL	Citicorp, Merrill Lynch, P & G	American Express, Chemical	

Note: Shaded cells represent "sustainers."

an even larger practitioner and academic issue: *What factors, both environmental and organizational, are most important in differentiating sustainers and non-sustainers of strategic IT?* This section attempts to statistically test for differences in sustainability factors between those firms that have realized sustained enhancement of market share, profitability, or both after system launch and those that have not. In essence, our goal, as stated in Proposition 2, is to determine if significant differences exist prior to systems launch that may influence subsequent levels of performance sustainability.

Discriminant analysis

Discriminant analysis involves deriving the linear combination of independent variables that will discriminate best between a priori defined groups (Hair, et al., 1992). This is accomplished through the statistical decision rule of maximizing the ratio of between-group variance to within-group variance. Within this study, we formulate a two-group analysis. The first we classify as *sustainers* and include those firms that have realized and sustained an initial gain in either or both measures of market share and profitability after the launch date of the system. As shown in Table 1, this group encompasses the 15 firms in the shaded boxes. The remaining 13 firms comprise the second group termed *non-sustainers*.[4] A statistically significant discriminant function can be utilized to determine the relative importance of particular sustainability factors in determining membership between these dichotomous groups. In essence, if the distance between group means across a set of operationalized sustainability fac-

[4] As shown in Table 1, two firms, Deere and Manufacturers Hanover, realized initial, but unsustained, improvement in relative profitability and delayed improvement in market share between stages 1 and 3. Therefore, they were not considered winners based on the definition of sustainability adopted in this paper. However, as noted by many IO researchers (e.g., Hambrick, et al., 1982; Woo and Willard, 1983) these firms may be experiencing some prolonged benefit due to the interaction of profitability and market share. To avoid confounding of interpretation, these firms were subsequently removed from the analysis.

tors is large, then the discriminant function should be able to accurately classify observations within their respective groups. If the distance is small, then the function will be of little use in discriminating between groups. Since sustainability factors are thought to exist prior to systems launch (Clemons and Row, 1991; Feeny and Ives, 1990), we constructed the discriminant function using the data collected in phase 1 of our study. Thus, conditions that existed prior to systems launch were used to explain the subsequent changes in financial measures (group membership) of the latter two stages.

Variable selection and operationalization

Having developed the dichotomous dependent variable (sustainers and non-sustainers) necessary for the analysis, attention was next turned to operationalization of the independent measures (sustainability factors). Based on our review of the literature, it became clear that a complete operationalization of all the factors included in the developed framework were not available. In particular, action strategies such as pre-empting, creating switching costs, and developing response strategies have traditionally proven to be difficult to operationalize in a meaningful manner (Ginsberg and Venkatraman, 1985). These same considerations along with data availability further restrict the determination of geographic, product, and vertical scope of the sample firms over the examined time period. However, as previously discussed in the review of literature from IO and strategic management, many of the remaining factors included in the proposed model have been successfully operationalized using widely available financial measures. These operationalizations have the virtue of widespread use in this literature and can provide a solid foundation for operationalizing key sustainability factors. For the purpose of this study, these operationalizations were relied on as the independent variables to help explain membership in either the sustainable advantage or non-sustainable advantage groupings. Table 2 provides a summary of the variables utilized, their operationalizations, and supporting literature.

Results

In deriving a discriminant function, two methods can be utilized (Hair, et al., 1992). The simultaneous method involves computing the discriminant function such that all independent variables are considered concurrently regardless of their discriminating ability. The second method, stepwise, involves entering the independent variables into the discriminant function one at a time on the basis of discriminating power. In this method, variables that share variance or are not significant discriminators will not be included in the final solution. Given the rather large number of variables developed, possible multicollinarity between variables, and exploratory intent, the stepwise method was deemed more appropriate in this analysis. Thus, each of the 14 variables of Table 2 were evaluated sequentially for their ability to discriminate between the two developed groups (sustainers, non-sustainers).

As shown in Table 3, the stepwise solution retained eight of the 14 original variables. The resulting discriminant function derived from these variables is highly significant (chi square, 36.81, $P < .001$) suggesting small overlap in the distributions of discriminant scores among the groups. Table 3 summarizes the standardized weights of the included variables as well as the discriminant loadings and univariate F-ratios.

Examination of Table 3 reveals important insight into the relative importance of the operationalized sustainability factors in explaining group membership. The standardized discriminant weights assigned to each variable are analogous to the beta weights of regression analysis. In general, variables with relatively larger weights contribute more to the discriminating power of the function than do variables with smaller weights. However, like regression coefficients, standardized discriminant weights can be subject to misinterpretation and instability (Hair, et al., 1992). Therefore, also included in Table 3 are the discriminant loadings (i. e., structure correlations) of the independent variables as well as univariate F-ratios. These loadings reflect the variance the measures share with the discriminant function. Thus, these measures can be interpreted like factor loadings in assessing the relative contribution of each sustainability factor in the discriminant function.

Table 2. Sustainability Variables and Measures

Dimension	Variable(s)	Operationalization(s)	Citation(s)
Environmental Factors			
Industry Structure	Competitiveness	Number of Direct Industry Competitors	Porter (1985), Dess and Davis (1984).
Foundation Factors			
Size	Asset Base	Gross Value of Assets	Fiegenbaum, et al. (1990)
	Sales	Firm's Total Sales	Cool & Schendel (1987)
Organizational Base			
• Slack Resources	Cash flow	Firm Cash flow/Investment	Chakravarthy (1986)
	Working Capital	Working Capital/Sales	Bourgeois (1981)
	Net Income	Income After Interest & Expenses	Douglas & Rhee (1989)
• Capital Efficiency	Asset Turnover	Sales/Fixed Assets	Cool & Schendel (1987)
Learning Curve	Employee Efficiency	Sales/Employees	Hatten, et al. (1978)
	Cost Efficiency	Sales/Cost of Goods Sold	Dess and Davis (1984) Hambrick (1980)
Technological Resources	R&D Intensity	R&D Expenses/Sales	Cool & Schendel (1987)
	Investment Intensity	Invested Capital/Sales	Hatten, et al. (1978) Fiegenbaum, et al. (1990) Chakravarthy (1986)
Action/Strategy Factors			
Managing Risk	Current Ratio	Current Assets/Current Liabilities	Fiegenbaum, et al. (1990)
	Times Interest Earned	Operating Income/Interest Expense	Cool and Schendel (1987)
	Equity to Debt	Owners Equity/Debt	Hatten, et al. (1978)

The ranked loadings suggest that Investment Intensity, Cash Flow, and Competitiveness are major determinants of group membership within the sample groups. Specifically, sustainers demonstrated lower scores on the measure of industry competitiveness and higher scores on the remaining variables. R&D Intensity, Times Interest Earned, and Cost Efficiency were moderate discriminators between the sample groups. For each of these measures, sustainers demonstrated higher variable scores. Weaker discriminators were Asset Base and Working Capital.

While interesting, the statistics developed thus far give little or no indication of how well the discriminant function *predicts* group membership. The method most commonly employed for determining this important characteristic is the classification or "hit" matrix. Table 4 contains the classification results for our analysis. As shown, the discriminant function was able to correctly classify 82.14 percent of cases in both the majority and minority groups. This figure far exceeds the acceptable level of 50.26 percent suggested by the proportional chance criterion (Morrison, 1969), suggesting a rather high practical significance of the discriminant function.

The findings of this analysis suggest that fundamental differences between sustainers and non-sustainers in environmental, foundation, and actions/strategies do exist prior to systems launch. Although exploratory in nature, such findings seem to substantiate the arguments of Clemons and Row (1991) that the pre-existence of unique structural characteristics are an important determinant of strategic IT outcomes. Our evidence suggests that a variety of factors, rather than a single factor, may be important ante-

Table 3. Summary of Interpretive Measures

Variable	Standardized Weight	Discriminant Loading		Univariate F Ratio
	Value	Value	Rank	Value
Competitiveness	.583	−.638	3	9.05**
Asset Base	.359	.371	7	5.07**
Sales	NI	NI	NI	1.60
Cash Flow	.692	.715	2	11.52**
Working Capital	.321	.353	8	6.07**
Net Income	NI	NI	NI	8.81**
Asset Turnover	NI	NI	NI	10.17**
Employee Efficiency	NI	NI	NI	2.86*
Cost Efficiency	.377	.391	6	6.58**
R&D Intensity	.601	.521	4	7.61**
Investment Intensity	.701	.731	1	12.31**
Current Ratio	NI	NI	NI	1.09
Times Interest Earned	.401	.437	5	7.53**
Equity to Debt	NI	NI	NI	.28

NI - Not Included in Stepwise Discriminant Solution.
* $p < .05$.
** $p < .01$.

cedents of sustainable competitive advantage through IT. In each of the dimensions operationalized in Table 2, at least one of the variables tested significant in differentiating between sustainers and non-sustainers.

We have found that sustainability seems more likely to flourish in industries with few significant competitors. In essence, when market share is concentrated among a few firms, "first mover effects" of IT-based strategy may be more significant. This may be partially attributable to "specialized niches" that can be carved out by industry competitors and subsequently leveraged with IT. As Porter (1980) points out, less competitive industries are more stable. Stability, and the oligopolistic power of less competitive industries, may provide the "time cushion" necessary to successfully develop and implement strategic IT innovations before "IT cannibalism" begins.

Technological and organizational "slack resources" also seem to be important "foundation factors" in the quest for sustained competitive advantage. The existence of a technological platform provides "competitive flexibility" in meeting the ever-changing requirements of customers and suppliers (Keen, 1991). However, to "build in" both flexibility and integration it is important to establish adequate levels of financial investment. Each of the sustainers identified in this analysis generate and invest significantly greater amounts of financial capital than their industry peers. Importantly, the establishment of investment capital is an evolutionary process. This may imply that beyond technological feasibility and customer demand, there must be an organizational infrastructure capable of developing and moving innovations to market quickly. A very important aspect of this infrastructure seems to be the availability of financial resources for investment and research and development.

Although not as strong in discriminating between groups, measures of risk management, learning curve, and size may also be important strategic antecedents. Along these measures, sustainers were, in general, more risk taking, lower cost producers, and larger in size. These findings tend to confirm those discussed above. Particularly, larger firms are typical of less competitive in-

Table 4. Classification Results

		Predicted Group: Sustainers	Non-Sustainers	Total
Actual Group	Sustainers	12 **(80.00%)**	3 (20.00%)	15 (100%)
	Non-Sustainers	2 (15.38%)	11 **(84.62%)**	13 (100%)

Total Percent Correctly Classified 23/28 = **82.14%**
Morrison's Proportional Chance Criterion = $(.5357^2) + (1 - .5357^2) = .5026$

dustry structures and tend to compete on the basis of cost (Porter, 1985). Additionally, the higher risk-taking propensity of these firms seems directly attributable to their superior ability to generate "slack" financial resources.

Summary and Conclusions

This study has addressed three main objectives. First, a useful conceptualization of sustainability factors was constructed. Second, the "classic cases" of strategic IT were analyzed to determine which firms in fact sustained competitive benefits. Third, differences among strategic "sustainers" and "non-sustainers" were formally tested to determine those sustainability factors that may be antecedents to sustained competitive advantage from strategic IT. The findings of this study should serve as healthy reminders to strategic planners that "technological wizardry" and "innovating first" may not necessarily be the complete path to competitive success. As implied here, an established technological base along with substantial capital availability may be a prerequisite for effective technology-based competition. Managers must do more than simply assess the uniqueness or availability of emerging technological innovations in developing strategic plans. Existing firm resources as well as those of competitors must also be considered. Importantly, many of these resources are rather slow to develop. Hence, the attainment of sustained IT-based competitive advantage may be more of a process of building organizational infrastructure in order to enable innovative action strategies as opposed to "being first on the scene."

Limitations

As with most research of this nature, limitations in scope, methodology, and external validity must be noted. Perhaps the most severe limitation of this research concerns the cause and effect relationship between strategic systems and subsequent performance measures. Obviously, factors other than strategic use of IT contribute to variation in profitability and market share. It should also be noted that while SIC codes are widely used for industry analysis, the diversified nature of some firms may preclude the clear identification of industry boundaries. This may confound results. However, through use of time order of events and relative measures of performance, this study has significantly reduced much of the "noise" inhibiting cause and effect generalizations and provides objective evaluation of "classic" examples of strategic IT within the framework of accepted performance criteria (see Appendix B). Further, a rather simplistic but powerful argument can be made in the form of the following question: If five and 10 years after system launch, 1/2 of these widely acclaimed innovators of competitive systems did not realize significant improvement in the bottom line or market share (as measured within their industry

and with respect to their competitors), then are these systems as "strategic" as is widely accepted?

Another limitation worthy of note concerns the performance measures used to classify "sustainers" and "non-sustainers." Profitability and market share were chosen because of their prominent mention as valid performance measures in past research. While ROS and relative market share are certainly valid proxies of these measures, their reliability may be questioned. Their use in this research is based upon their acceptance in past studies in IS and strategic management as valid indicators of performance. The designation of sustainers and non-sustainers is based on improvements in *either* profitability and/or market share measures. Clearly, certain systems may have as a major focus one or the other measure as its principal objective and therefore may have only minimal initial impact on the other measure. However, as has been cited in the literature, both measures should be related over the long term, and it certainly would seem desirable to target strategic systems that were significant enough to affect both performance measures. Although "sustainers" were classified based on the financial variables mentioned, the existence of firms that used systems successfully in a defensive sense should be noted. For example, the results indicate UAL did not reap the financial benefits classically attributed to strategic systems; however, the firm's existence today may be reflective of the contribution of APOLLO or the revamping of business processes. Based on both these limitations, further research is definitely needed in identification of specific objective measures that are valid and reliable proxies for performance measures of strategic IT.

An additional consideration is the generalization of these results to all strategic systems. Obviously, the selection of these cases was not random, thus eliminating any claims of external validity. However, research of this type does not lend itself to scientific sampling methods. Specifically, industry and firm-specific factors may predetermine those systems eventually classified as strategic. Therefore, research of this type will necessarily continue on a case-by-case basis.

Although certainly not a complete validation of the proposed sustainability model, this research does demonstrate its utility in developing rigorous, empirically driven research questions. Further elaboration and testing of this model using new or different operationalizations of sustainability and its antecedents can only further both managerial as well as academic understanding of this important area of IS research.

Implications for research

Until recently, research in strategic IS has concentrated primarily on qualitative and subjective measures of systems impact. This study deviates from the past studies that have focused on surrogates of system performance such as user satisfaction, system success, and system usage, and instead, analyzes changes in firm-competitive position using relative measures of financial performance over time. Research studies in management, strategy, industrial economics, marketing, organizational behavior, and IS have reinforced this rationale.

From a research standpoint, the results reported are in response to the numerous studies that have repeatedly emphasized the necessity to conduct longitudinal research to understand the impact of IT on firm performance. Longitudinal analysis is an effective means to determine the time effect of the firm's performance as it provides researchers with actual economic and financial trends of performance. Utilizing secondary data resources is also a useful empirical technique and provides IS researchers with a relatively new methodology for data collection. The major advantage of conducting research using secondary data is time savings, availability, and longitudinal and objective measures that have a high degree of accuracy.

Future research on sustainability may be approached in at least two ways. The first approach is to improve and enhance the operationalization of each sustainability factor listed in Figure 1. A significant problem with operationalizing sustainability factors is the availability of relevant performance variables and data from secondary data sources. Currently, PIMS[5] (Profit Impact of Market Strategy) provides a comprehensive list of such variables (Hambrick, et al., 1982;

[5] PIMS is a product of the Boston Consulting Group Inc. and is an annually updated database of environmental, strategic, and performance variables for over 2700 individual business units.

Wensley, 1982), but the access to the PIMS database is very limited. A recommended study is to conduct a longitudinal analysis using such databases and verifying the presence of such variables in sustained strategic systems. It would also be valuable to see the presence of sustainable factors among a selected set of prominent strategic systems and a list of laggards or non-sustainers in the same industries. A second research avenue may be through content analysis. An indepth content analysis of each factor could be conducted at the project launch year from secondary sources (*Funk and Scott*, Letter to Shareholders, 10K, Value-Line, Moody's, cases, documentation, etc.) and subsequently to determine if these factors were maintained over the life of a system. This analysis may also investigate the role of enhancements to the system in maintaining barriers to entry.

In general, studies in the past that have garnished systems for their immense potential for achieving competitive advantage need to be reevaluated to determine if this strategic advantage actually relates to financial performance or is simply a means of achieving strategic necessity. The much heralded cases investigated in this study indicate that not all firms using strategic systems may be classified as true sustained winners. Clearly, there needs to be more research to address the relationship between the adoption of a "strategic system" and positive return on the bottom line of a firm. And, perhaps more importantly, a comprehensive research framework that links combinations of sustainability factors to actual performance must be refined to add a prescriptive orientation to strategic IS.

Implications for practice

Better understanding of sustainability factors and associated financial impacts should help managers reduce the uncertainty in major strategic IT initiatives. Too often in the past, decisions concerning the introduction of strategic IT have been made without a clear frame of reference. The determination of "sustainers" and "non-sustainers" should provide practitioners insights into the past success of firms using the strategic systems. Such an analysis provides a better understanding of the direct "bottom-line" impacts of introducing strategic IT. The proposed sustainability framework may prove to be a useful guide to practitioners in determining which factors need to be considered prior to expensive IT investments.

Careful attention should be paid to both controllable and uncontrollable aspects of the developed framework. While the competitiveness of a firm's industry is beyond the control of a strategic IS planner, the degree of competitiveness may influence the outcome of strategic IT initiatives. Competitive analysis of potential industry reaction and realignment is warranted prior to strategic IS development. Such managerially controllable factors as organizational base and technological resources are also shown to influence the outcomes of strategic IT. Importantly, these factors evolve over long periods of time and may not be readily acquired by the firm. Hence, before a dramatic IT-based strategic initiative is undertaken, it may serve the IS manager well to champion development of a solid technological and financial organizational infrastructure.

The results of this study suggest that a healthy skepticism concerning the competitive advantage payoffs of IT is in order. The introduction of strategic IT has not always resulted in improved competitive position. A more balanced perspective suggests that to be strategic, the information resources of a firm must be driven by business strategy and integrated into the product and process dimensions of the enterprise based on an understanding of core competencies and their relationship to environmental opportunities and risks.

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Appendix A
Sample Selection

List of Firms Included in Study:

Firms	Strategic Systems	System Launch	References
Air Products & Chemicals Inc.	vehicle scheduling	1981	1, 10
American Airlines Inc.	reservation	1976	1, 2, 4, 7, 8, 11, 12, 13, 14, 15
American Express Co.	preferential travel services	1980	1, 8
Banc One Corp.	transaction processing	1977	1, 12, 14
Baxter International	order entry	1980	1, 10, 11, 12, 15
Bergen Brunswig Corp.	order entry	1971	1
Chase Manhattan Bank	credit card processing	1971	2, 15
Chemical Bank of New York	credit card processing	1971	2
Cigna Corp.	risk assessment	1980	10
Citicorp	ATM networking	1977	1, 2, 12, 15
Deere & Co.	parts and inventory	1981	1
Digital Equipment Corp.	expert configurator	1980	1, 12
Dow Jones & Co., Inc.	satellite page transmission	1975	1, 12
Federal Express Corp.	tracking and sorting	1980	1, 12
First National Bank of Chicago	asset management	1983	1
Gannett Co., Inc.	satellite page transmission	1982	1, 12
General Electric Co.	CAD/CAM application	1982	1, 13
IBM Corp.	marketing mgt.	1983	1
Manufacturers Hanover Corp.	global networking	1981	2, 9, 10, 11
McGraw-Hill Inc.	marketing database	1982	1, 6, 10, 12
McKesson Corp.	order entry	1975	1, 4, 5, 6, 12, 14
Mellon Bank	large capacity transaction processing	1972	2, 3
Merrill Lynch & Co. Inc.	cash management	1978	1, 4, 6, 12, 13, 14
Nucor Corp.	cont. manuf., tracking & billing	1982	1
Owens-Corning Fiberglass Corp.	materials selection	1976	1, 10
Philadelphia National Bank	ATM networking	1979	3, 4, 6
Proctor & Gamble Co.	customer response database	1974	1
United Airlines Inc.	reservation	1976	1, 2, 4, 6, 7, 8, 10, 12, 13, 14, 15
Toys 'R' Us Inc.	POS inventory tracking	1981	1, 12
Xerox Corp.	CAD/CAM application	1982	1, 10

List of Firms Considered but Not Included in Study:

Firm	Reason Rejected	References
ARA Services Inc.	Unable to determine launch date	1
B. Dalton Booksellers Inc.	No Compustat data	1
Batterymarch Financial Inc.	No Compustat data	1, 10
Barclay's de Zoete Wedds	No Compustat data	4, 10,15
Bell Canada	Unable to determine launch date	4
Benetton S.P.A.	No Compustat data	10
Child's World Inc.	Incomplete Compustat data	10
Ciba Vision Care Canada	Unable to determine launch date	10

Dunn & Bradstreet Corp.	Incomplete Compustat data	1, 12, 14
Emery Worldwide Inc.	No Compustat data	10
First Boston Mortgage Securities Corp.	No Compustat data	4
French Telecommunication Agency	No Compustat data	1
Frito Lay	No Compustat data	10, 11
Gillette Co.	Unable to determine launch date	1
Hewlett-Packard Inc.	Unable to determine launch date	6
Humana Inc.	Unable to determine launch date	1
Massachusetts Mutual Life Ins.	Unable to determine launch date	10
Metpath Inc.	No Compustat data	14
MBS Textbook Services Inc.	No Compustat data	10
Mrs. Fields Cookies	No Compustat data	10, 11
National Car Rental Inc.	No Compustat data	1
Navistar International Corp.	Incomplete Compustat data	1
Otis Elevator Inc.	No Compustat data	4, 6, 10,15
Pacific International Express	Unable to determine launch date	15
Reuters Inc.	Incomplete Compustat data	1
Sears Roebuck & Co.	Incomplete Compustat data	1
Toyota Motors Inc.	No Compustat data	1
Trane Co.	No Compustat data	1
Woodside Management Systems Inc.	No Compustat data	1
USAA Inc.	No Compustat data	1, 11, 12

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Appendix B
Methodological Issues and Controls

Issues	Control Mechanism / Checks
Selection of strategic IS sample cases.	A combination of an expert panel's recommendation and literature review was used to identify sample cases.
Determination of system launch date and rejection of sample cases.	Content analysis was conducted on 60 strategic systems in a bibliographic search of the *Funk & Scott* listings from 1966 to 1991. A review of over 1000 pages of citations determined the launch date. System development, pilot and/or limited testing were not included as launch dates. Eight cases were dropped due to the unavailability of information.
Impact of mergers, acquisitions, and unreported data.	COMPUSTAT II data for the remaining firms were investigated. Seventeen firms were dropped due to lack of data, which may be accounted for by acquisitions, mergers, existence of subsidiaries, and missing data.
Definition of a firm's industry or market.	Standard Industrial Classification (SIC) codes within COMPUSTAT were used to aggregate firms based on primary product(s) and/or service(s). These primary product(s)/service(s) are filed in the 10K report with the SEC and must list major competitors.
Control for firms involved in multiple industry activities.	Firms that were classified in more than one SIC industrial code were dropped. Possible misclassification or vague industry boundaries were also cause for exclusion. This led to the rejection of five firms (e.g., SEARS).
Control for implementation and enhancements of systems. Evaluation of impact of competitive firms in various stages.	Five-year intervals were averaged to accommodate start-up periods. This time frame is typical of the long-range strategic planning horizons for many firms.
Control for changes in firms across industry.	Direct firm comparisons across industries were not measured. Rather, only the movement of relative measures across time periods was used.
Identification of largest competitor in relative market share measure.	To determine the performance of each firm the largest competitor was identified within its industry as indicated by the SIC code.
Control for the magnitude of change in performance measures necessary to justify movement among grid cells.	The data analyzed did not show trivial shifts in performance measures (ROS or RMS) for any of the firms. For all cases (both profitability and market share), the magnitude of change in measures ranged from a low of .2 to a high of 1.06.
Control for the possibility that the overall average measure may not be indicative of sustainability. Five year averaging of ROS or RMS might indicate a net increase (or decrease) while in actuality individual years are offsetting each other.	All cases were investigated on a yearly basis. In no five-year case was there significant neutralizing effect. All cases had at least four years of changes in the same direction.