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STRUCTURAL DIFFERENCES AMONG FIRMS: A POTENTIAL SOURCE OF COMPETITIVE ADVANTAGE IN THE APPLICATION OF INFORMATION TECHNOLOGY

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ABSTRACT

Information systems are seen as strategic business tools, frequently essential to a firm and central to its competitive strategy. Their importance is now acknowledged. But information technology -- equipment and services -- is available to all firms, and most applications can be duplicated; often the copying firm enjoys the advantages of newer and better technology, learns from the experience of the innovator, and offers comparable services at reduced costs. When can an information system convey sustainable competitive advantage?

We believe that the benefits resulting from an innovative application of information technology can be defended if:

- o they are so closely tied to the strategy of the innovating firm that competitors do not wish to copy them
- o they exploit unique structural characteristics of the innovating firm -- aspects of vertical integration, degree of diversification, or unique skills and resources -- so that competitors do not benefit from copying them

We introduce here a model of the firm, based on value chain analysis, that highlights differences among firms; the model then guides the search for defensible opportunities for competitive advantage that exploits these differences.

1. INTRODUCTION

1.1 Strategic Necessity or Competitive Advantage

There is widespread and continuing interest in information systems and their effects on business strategy; there is particular interest in information systems that can convey sustainable competitive advantage for innovative and aggressive firms. But there is a growing realization that competitive advantage may be more difficult and more elusive than initial reports have led industry practitioners to expect.

Our hypothesis, first presented at the 1986 International Conference on Information Systems (Clemons and Kimbrough 1986), is that many strategic applications of information systems have proved to be *strategic necessities*. Such systems

must be developed to match a threat from a competitor; they are clearly necessities. But since competitors often develop equivalent systems at about the same time, they seldom convey competitive advantage. Many applications we have examined in corporate finance, retail banking, and distribution systems have proved to be strategic necessities (Clemons and Kimbrough 1987) despite our initial expectations to the contrary. Perhaps the earliest example we have been able to locate of a strategic technology not conveying advantage was the first battle involving armor plated warships: Somehow the image of the Monitor and the Merrimack futilely slugging it out in an inconclusive naval battle conveys precisely what we want; neither the North nor the South gained any advantage from this innovation, at least in this first battle, yet it was immediately clear that the days of traditional wooden warships were numbered.

Vitale (1986) extends this notion, suggesting that in many cases the initial innovator may in fact place his firm in a disadvantaged position. Where there are no first mover effects to give advantage to the innovator, if the innovation becomes a necessity, and if the innovating firm lacks any special skill in producing this necessity, it may actually find itself in a weakened competitive position. To return to our graphic image of naval battles, the South gained no advantage from introducing the ironclad warship, since the North matched it at the same time; however, given the South's more limited industrial base, this new necessity further weakened her military position.

1.2 Structural Differences Among Firms

We believe that structural differences among firms produce a primary source of competitive advantage through information technology; in fact, they form a primary source of competitive advantage for any means through which this advantage is pursued.

Applications of information technology may convey some advantage, assuming that they are good ideas and that the marketplace will demand them. They will convey *sustainable* advantage if any of the following conditions is met:

- o *Your competitors cannot duplicate your innovation* or, through constant improvement, *you can remain ahead* of your competition
- o *You have preempted the marketplace*; customers will accept only one system and will not switch, and the adoption of your system was so rapid that there is simply no market left to compete for by the time your competitors can act
- o Competitors *do not want to copy your innovation*
- o Competitors *cannot benefit from copying your innovation*

Examples of sustainable advantage through the first two means do exist, but they are far less common than a trusting first scan of the MIS literature would imply. After some thought, this is probably not surprising: it is difficult to keep an idea secret; it is difficult to keep improving an idea faster than competitors not tied to an older technology; it is difficult to get a product adopted fast enough to preempt a market.

We have not seen in the MIS literature references to advantage protected through the third or fourth means, yet these seem to us after some thought to be far more promising. And examples are available: When American Airlines first introduced its travel agent reservation system, no other major airline was willing to cooperate in its development. Each had a reason: TWA, for example, relied heavily on through-traffic originating in Europe, while Eastern relied heavily on its shuttle services, which required no reservations.¹ This clearly is an example of an innovation that competitors *did not want to copy*.

Competitors will not benefit from copying an innovative application if its benefits do not derive directly from the information systems, but rather from ways in which the application exploits unique resources possessed by the innovator but not by its competitors. This in essence converts an untapped *comparative advantage* of the innovating firm into a *competitive advantage*; such advantages can be defended because competitors lack the non-MIS resources needed for duplication and often cannot readily obtain these resources.

As an example, we consider the introduction of a new financial instrument, such as the Cash Management Account (CMA) developed by Merrill Lynch in the mid-1970s. The CMA involved a money market account, a checking account, brokerage services, a credit card, and a line of credit. This instrument can be matched only by firms able to offer all services; it can provide competitive advantage only to firms able to offer these services cost effectively.

1.3 A Structural Model of the Firm

In the following section, we begin to develop a structural model of the firm and we then use this to begin to see how organizations use information technology. We find this useful for several reasons:

- o as a *motivator* for finding opportunities to use information technology effectively
- o as an *evaluator* for determining areas in which these applications are most likely to produce significant benefits
- o perhaps most importantly, as a *predictor* of those areas in which competitors can not readily or effectively duplicate the benefits of an innovative application

2. A STRUCTURAL MODEL OF THE FIRM

Again, we introduce the following model of the firm because it serves as an indicator of where to look for promising uses of information technology and as an evaluator of candidate applications; also, it has proved effective as an evaluator after the fact of attempted applications and as a partial explanation of observed effects. We are convinced that differences among firms are likely to indicate where benefits of an information technology application can be successfully retained by the innovating firm.

2.1 The Model Itself

The model is based on the *value chain*,² which illustrates the production of a good or service as a directed, attributed graph. Nodes in the graph represent activities performed to add value. Arcs represent the flow of goods or information and are labeled with attributes that indicate what is flowing in what volume.

Firms differ in their degree of *vertical integration*; that is, they differ in how far they extend their value chains. In this model, we represent *industry value chains*, rather than value chains of individual firms; thus, for less than fully integrated producers, the value chain for a product will be shown as a sequence of value chains for suppliers, the manufacturer, distributors, and customers.

Firms differ in their degree of *diversification*. Firms that produce several goods or services will be represented by multiple parallel value chains.

2.2 The Role of Information Technology

Information technology has always done the following things well:

- o produced speed in communications, reducing uncertainty or financial float
- o handled large volumes of information
- o managed complexity -- for example, in individual Cash Management Accounts, where monthly balances reflect the value of trades, net commissions; the value of money market funds, including deposits, withdrawals, sweep of idle funds between trades, and interest earned; and automatic debits to cover credit card balances due

- o managed interactions -- for example, in large, geographically distributed manufacturers, where production scheduling must be coordinated to deliver work in process inventory where needed while still reducing quantities; where individual facilities must schedule production; where orders from suppliers must be coordinated; and where the entire process must ultimately be driven by sales data and marketing information. Not surprisingly, this is related to the previous point; Lawrence and Lorsch (1967) have shown that increasing environmental complexity leads to more complex interactions requirements

Given these capabilities, we expect to see information technology used in the following ways:

- o to manage interactions within the firm, particularly those not handled by the firm's existing hierarchical control structures
- o to manage interactions with organizations outside the firm

2.2.1 Managing vertical interactions

Information systems can be used to manage the vertical interactions within a single value chain of a single firm, coordinating inventories, scheduling production to meet demand, and permitting coordination and control of geographically dispersed facilities. Information systems can also be used within a single value chain, across the boundaries of a firm, where traditional hierarchical control structures break down; these inter-organizational information systems can facilitate sales, order entry, and service and support functions.

2.2.2 Managing horizontal interactions

Information systems have proved especially effective in managing the horizontal interactions within a firm which cross the boundaries of individual strategic business units; again, traditional hierarchical control structures have generally been insufficient. The benefits that result from facilitating these interactions frequently are generated by portfolio effects, in which benefits result from novel combinations, and economies of scope, in which costs are reduced by combining related functions from different business units.

2.2.3 Creating synergies

Perhaps the most valuable use of information technology is in the creation of synergies that exploit portfolio effects. Firms can create new products, or can add value to existing products, by leveraging the combination of business units in the portfolio. Cash management accounts, mentioned above, are an excellent example of creating a new product, with real value to customers, by combining offerings from several business units.

3. EXPLOITING DIFFERENCES AMONG FIRMS

Untapped differences among firms may be *potential* or *comparative advantages*; they become *competitive advantages* when firms find some way to exploit them, developing a product or service that customers will demand and that competitors cannot readily match or cannot match at comparable prices. Well conceived strategies can exploit differences among firms such as manufacturing excellence, differences in distribution networks, or differences in access to strategic resources. These are competitive advantages that can be sustained, since real structural differences among firms are not readily eliminated.

Information systems applications that exploit these differences among firms similarly may yield sustainable advantages. Unless the competitor can somehow eliminate the comparative disadvantage of his firm, copying the innovator's information system will be of only limited value.

As usual, even a single naive example should help to make these concepts clear. We consider here a vertically integrated manufacturer of sweaters, which manufactures and distributes sweaters and sells them through its own retail outlets. The manufacturer has an information system that provides very timely and very accurate sales information. It exploits this by maintaining very limited finished goods inventory; instead, *semi-finished* inventory is kept. For example, an inventory of sweaters is kept finished but not yet colored; they can then be dyed to meet demand, rather than manufactured for inventory, and they can be shipped where stock is needed, rather than where demand is expected. Clearly, this reduces cost and could not be done by a less integrated manufacturer. Copying the sales information system -- even copying the sales, manufacturing, inventory control, and distribution systems -- would be of

limited benefit to a less integrated manufacturer. The manufacturer here has converted a potential, comparative advantage into a competitive one; the manufacturer's unique position makes it impossible for competitors to erode this advantage simply by duplicating the information systems.

We expect the manufacturer in this example to do well, as it in fact appears to be doing. Is it doing better than all its competitors? Probably not. An information system that exploits differences among firms still yields only potential advantages. If these advantages are real they are likely to be sustainable. But there are other strategies possible, and some may be just as effective in exploiting another firm's structural differences, converting them into different, equally sustainable sources of competitive advantage.

4. USING THE MODEL IN THE SEARCH FOR ADVANTAGE

We use the model just introduced to guide the search for competitive opportunities in the following areas:

- o opportunities presented by differences in degree of vertical integration
- o opportunities presented by differences in diversification
- o opportunities presented by differences in competence in a basic value-adding operation

Additionally, though less directly, we find the model helpful in relating the search for opportunities to the strategy pursued or niche occupied by a firm, when these can be a means of defending any competitive advantage derived. We treat each of these in more detail below.

4.1 Opportunities Resulting from Differences Among Firms in Vertical Integration

Firms differ in their degree of vertical integration; that is, their value chains are of different lengths, reflecting which of their primary value-adding activities they directly perform and which they achieve by purchasing goods or services from other firms.

- o Xerox sells through an internal sales force, while Savin sells through independent dealers. Links

to customers may benefit Xerox more than Savin, while links to dealers may be more necessary for Savin than for Xerox.

- o Merrill Lynch has the largest "Main Street" distribution network of any Wall Street investment house. This may offer a unique distribution channel for Merrill to move products developed by their capital markets group; alternatively, if other firms can develop electronic links directly to potential retail customers for many types of trades, this may represent an enormous expense to Merrill not incurred by their competitors.

The model highlights this class of differences among firms, showing it as differences in the lengths of firms' value chains and as differences in the arcs representing flow of goods, services, or information along these chains. Not all differences will indicate opportunities for information technology. Interfaces -- those places where the value chain crosses the boundary between firms -- are especially promising as opportunities to exploit information technology to manage interactions, reduce complexity, or reduce uncertainty. Other possible important characteristics likely to indicate opportunities include the technology of the activity, the volume of information transmitted and the need for speed in moving it, customer transaction costs, and alternative mechanisms available for managing interactions.

Possible competitive uses include:

- o by-passing activities where you have a disadvantage; e.g., constructing an alternative distribution channel, like an effective ATM network to combat the lack of branches
- o providing services that are more expensive for competitors than they are for your firm

Primary assets in the value chain are relatively static, at least compared to introducing or dropping software systems. Application systems are relatively inexpensive, at least when compared to a network of factories. Thus, differences among firms' value chains, if they offer opportunities for competitive advantage, generally offer opportunities for sustainable advantage.

We offer one final example of strategic differences, based on differences in value chains. General

Motors manufactures more of the components in its automobiles than either Ford or Chrysler, which both out-source close to half the value of the materials in their automobiles. This captive manufacturing capability, and its assured customer demand, used to be a strategic advantage for GM. Now, as Chrysler and Ford use information technology to manage their relationships with suppliers, gaining assured quality, flexibility in service and delivery, and the cost advantage that comes from their suppliers' uniformly lower wage scales, GM's advantage has been converted into a disadvantage.³

4.2 Opportunities Resulting from Differences in Degree of Diversification

Clearly, firms differ in the number of activities they pursue as well as in their degree of vertical integration. Unrelated diversification -- moving into unrelated lines of business by acquiring firms -- yields conglomerates. These were intended either to exploit managerial expertise of the holding company or to reduce risk by entering into businesses with uncorrelated cyclical behavior. Recent evidence indicates that unrelated diversification produces firms with profitability less than that of firms that diversified around some core area of competence (Rumelt 1982), and in this paper we will consider only related diversification.

- o McKesson -- McKesson Corporation is a distributor for several lines of products, among them pharmaceuticals, liquor, and business forms. They would be expected to enjoy scope advantages when competing against firms in a single line of business, particularly in the development of software applicable to these several lines.
- o American Hospital Supply -- AHS enjoys an advantage when competing against companies that distribute fewer lines of product; for the customer, single source shopping greatly reduces transaction costs.
- o Allegi -- Real synergies should be available by combining the different components of business travel within a single firm: air travel, rental cars, and hotels. It is already possible to return your Hertz rental car, check your bags in for your United flight, and receive your boarding card. Ultimately, you may be able to do this at your Westin or Hilton International hotel.⁴

The model highlights differences in the breadth of a firm's system of value chains, the potential for interaction among them, and the strength of individual interactions. Again, the value of information systems in exploiting the possibilities for interactions between business units will depend on the marketplace, the value chains, the business units, and the overall structure of the firm. We believe that interactions among business units within a firm frequently are not handled nearly as well today as interactions within a single business unit; the latter are generally handled by a firm's existing hierarchical control structure. Thus, facilitating interactions is frequently an untapped potential resource. This, of course, is the type of activity for which information systems are especially appropriate.

Advantages may result from economies of scope by combining different products of different value chains to add value. They may come from economies of scale by merging related functions within different value chains (e.g., centralized purchasing, centralized advertising or marketing research functions) to gain cost reductions and gain leverage negotiating with suppliers. They may come from creating synergies, combining activities from several value chains to greatly increase the value of the resulting whole; full service financial institutions frequently attempt to accomplish this. Since acquiring entire business units is costly, time consuming, and difficult, any strategic advantage that results from exploiting portfolio differences among firms is likely to be sustainable.

4.3 Opportunities Resulting from Differences in Competence in a Primary Value-Adding Activity

Look for activities that figure prominently in your value chain, either internally, within the firm, or externally, relating to customers and suppliers.

- o Are there activities that you perform poorly where improvement is likely to be significant? Can information technology yield this improvement, either by facilitating your current value-adding activity or by-passing it entirely? Information systems can reduce costs by facilitating inventory and distribution functions. They can improve service by allowing customers to enter their own orders, to initiate their own transactions, or to perform some of their own services.

- o Look at the activities currently considered essential in your industry. Can the unique skills or technical infrastructure of your firm produce improved means of performing these activities? Can they be used to develop products or services difficult for competitors to match? American Airlines' skills in communications-based information systems has led to improved systems for real-time control of aircraft schedules and of flight and cabin crews. The firm's existing reservation system was used as the basis for frequent flyer programs difficult for competitors to match as effectively, though of course they have been duplicated by all major airlines.

4.4 Opportunities Resulting from Differences in Strategy Pursued or Niche Occupied

Strategy affects the importance of various links or interactions, and thus the importance of information systems to support them. A strategy of "design to manufacture" requires close interactions between product development and manufacturing (Rhein 1986). A strategy of customer service requires close links between sales and the customer (Ives and Learmonth 1984). This last point is amplified as the firm attempts to move "up scale" into more demanding and more expensive products.

Comparing heavily discounted coach air fares with full fare business class on trans-Atlantic flights, we note that the business class ticket is frequently four times as expensive; this may appear to be a great deal of money to pay for free drinks. First class may be twice again as expensive, but fully reclining sleeper seats and labor-intensive service make this costly for the airline as well. SAS decided years ago to focus on the profitable, full fare business class traveler; ideally, they envisioned a plane made up almost entirely of business class sections.

Servicing demanding business class travelers to Europe and within Europe would benefit from the following:

- o Check-in and baggage pick-up at your SAS hotel rather than at airport counters
- o Baggage claim at your SAS hotel rather than at airport baggage counters
- o Easy, reliable limousine service between your SAS hotels and the airport

- o In-flight electronic mail to link you to your office
- o Hotel based electronic mail to link you to your office

Much of this is now realized. Competitors with different strategies would have no reason to copy the information systems. This approach seems to have yielded SAS a comparative advantage. The complexity of this type of analysis is unfortunately clear: is this comparative advantage a competitive advantage, producing higher profits? We cannot yet tell.

5. MANAGERIAL IMPLICATIONS

As we have noted previously (Clemons 1986; Clemons and Kimbrough 1986) major shocks and discontinuities yield strategic opportunities. Often these weaken the comparative advantage of existing dominant players in the marketplace and open opportunities for alert, aggressive competitors with different sets of skills and different potential or comparative advantages. Deregulation, change in the price of strategic resources, change in customer preferences, and entry of new international competitors are among the most frequent marketplace discontinuities encountered.

Sometimes the response to the discontinuity will rely heavily on information technology, as when United Airlines successfully contested Frontier for control of Denver's Stapleton Airport. On other occasions, the victorious firm will rely on other technologies, as when Japanese automobile manufacturers successfully contested United States manufacturers for a share of the domestic United States automobile market. The model introduced above should be a useful tool in determining when the opportunity generated by a major discontinuity can in fact be an opportunity to use information technology.

Information technology can be used competitively in the following ways:

- o to *create an advantage* for the innovating firm
- o to *reduce a disadvantage* that the firm currently faces
- o to *create a disadvantage* for a competitor

American Airlines' reservation system certainly has been a source of competitive advantage for the airline; it is perhaps the best example we know of sustainable competitive advantage through information technology.⁵ Chrysler's and Ford's use of information technology to manage relationships with suppliers, mentioned above, is an example of information technology used to reduce or eliminate a disadvantage faced by the innovating firm; similarly, CitiBank's early introduction of ATMs to respond to the impact of lengthy lines on the quality of their customer service had some measure of this function as well. American Airlines' reservation system is well integrated with their frequent flyer program, so that on crowded flights preferred travelers can be given complimentary upgrades if seats are available. Some other airlines, lacking this integration, did not know who their frequent flyers were until after the flights; some have responded to American's ability by giving frequent flyers the right to a free upgrade at the time reservations are made, and this probably has an impact on their ability to sell these more expensive seats. Probably this represents not an advantage for American but a disadvantage for some of their competitors.

We believe that looking at the totality of a firm is important. An approach that examines only individual business units will miss many opportunities, particularly the most promising ones generated by information technology's ability to integrate across business units.

We strongly believe that, in the absence of differences among firms, innovative uses of information technology will frequently be duplicated.⁶ Even if the innovations were good ideas, they are likely to end up as strategic necessities rather than as sources of competitive advantage for the innovating firm.

6. CONCLUSIONS

Information systems are seen as strategic business tools. We have found little firm evidence that they have conveyed competitive advantage in any but a few instances, despite our initial expectations; after some analysis, this is less surprising:

- o Information technology -- equipment, software, services, and personnel -- is available to all firms. While these resources may be expensive for small firms competing where scale economies

exist, they are seldom prohibitively expensive for major players of comparable size

- o Often the innovator is at a slight disadvantage with his initial application. Later entrants often benefit from his experience, duplicate his system with newer technology and newer software architecture, and offer comparable services at lower costs. There is evidence that learning between firms is accomplished very quickly and that copying firms enjoy significantly lower costs.

It is still possible to defend advantages from first mover effects, if customer adoption is very rapid, competitor response is relatively slow, and customers face real switching costs. This does occur, but it has been far less common than expected.

We believe that the benefits resulting from an innovative application of information technology can be more readily defended if:

- o they are so closely tied to the strategy of the innovating firm that competitors do not wish to copy them
- o they exploit unique structural characteristics of the innovating firm so that competitors do not benefit from copying them

The model of the firm introduced here highlights significant differences among firms to suggest opportunities that may be exploited and defended. It also indicates which of these are likely to be opportunities for application of information technology.

As the model presented here is extended and supported through additional field studies, it should prove to be a useful tool.

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look at interaction effects across the portfolio of a firm's business units.

And thanks are due to our Jones Center colleague, Steven Kimbrough, for many useful discussions while developing the ideas presented here.

ENDNOTES

¹ The discussion of airline reservation systems benefitted greatly from private conversations with Professor Richard Meyer of the Harvard Business School.

² Numerous references exist. Several authors have introduced their own versions of the value chain; perhaps the most popular one today is due to Michael Porter (1985).

³ This is at least partly acknowledged even by General Motors. Roger Smith, Chairman of GM, recently admitted that their degree of vertical integration had ceased to be an advantage. "What had been an advantage for us turned out to be a semi-disadvantage," he says (Hampton and Norman 1987).

⁴ Recent events have made it quite clear that Wall Street is not nearly as impressed with this strategy as the authors of this paper.

⁵ For a detailed analysis of competitive advantage through reservation systems, see earlier papers by Clemons (1986) and Clemons and Kimbrough (1986, 1987). See these papers also for an extensive list of references.

⁶ This has been observed extensively in financial services, including brokerage and trading services, commercial banking, and retail banking. It also appears to be true in many of the most frequently cited examples of strategic distribution systems. See Clemons and Kimbrough (1986, 1987) for supporting data, including published reports and the results of site visits.

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