

# **Information Links and Electronic Marketplaces: The Role of Interorganizational Information Systems in Vertical Markets**

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## **ABSTRACT**

Interorganizational information systems, i.e., systems spanning more than a single organization, are proliferating as companies become aware of the potential of these systems to affect interorganizational interactions in terms of economic efficiency and strategic conduct. This new technology can have far-reaching impacts on the structure of entire industries. This article identifies two types of interorganizational information systems, information links and electronic markets. It then explores how economic models can be employed to study the implications of information links for the coordination of individual organizations with their customers and their suppliers, and the implications of electronic market systems for efficiency and competition in vertical markets. Finally, the strategic significance of interorganizational systems is addressed, and certain potential long-term impacts on the structure of markets, industries and organizations are discussed.

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This research was supported in part with funding from an Irvine Faculty Research Fellowship and from the National Science Foundation (Grant Number IRI-9015497). The author is grateful to the three anonymous referees for their valuable comments during the review process.

## Introduction

Information systems linking different organizations (interorganizational information systems) can create economic value as well as being used as strategic weapons in industrial competition. This strategic potential creates problems and opportunities for firms in industries where such systems have been, or are about to be introduced. Furthermore, the theoretical analysis and practical understanding of interorganizational systems is complicated by the involvement of several organizations, each pursuing its own self-interest.

Researchers and practitioners are increasingly turning to economics as a reference discipline in their attempt to answer questions about the economic impact and the strategic potential of information technology [5]. The purpose of this article is to illustrate how economic models can provide insights into the role and impact of information systems linking multiple organizations. First, a classification of these systems into two types based on their economic functionality is developed; then, models for each type of system are proposed, and finally the implications of these models motivate a discussion comparing the practical significance and the strategic potential of the two types of interorganizational information systems. It should be emphasized that several alternative approaches to the modeling of interorganizational systems are possible, and they are likely to highlight different economic and strategic characteristics of these systems; e.g., see Clemons and Kleindorfer [15].

### Interorganizational information systems

Interorganizational information systems (IOS) are *systems based on information technology that cross organizational boundaries*; a typical IOS is an information system that links one or more firms to their customers or their suppliers and facilitates the exchange of products and services. Traditionally information systems have been restricted to a single organization due to organizational and technological limitations. This situation is changing as organizations are improving their ability to comprehend, utilize and manage information technology, and as they become aware of its potential to create and exploit interorganizational efficiencies. This has resulted in an increasing interest in the structure and impacts of these systems (e.g., see [8], [10], [29]).

Identifying appropriate organizational boundaries between the participants of an IOS is often a difficult and ambiguous task. In this article we do not address this issue directly but instead adopt an economic criterion: we consider two organizations separate if they can be viewed as distinct economic agents. This condition typically requires separation of authority in primary budgetary and policy matters [22], and implies that we cannot expect full cooperation among system participants. In the case of intraorganizational systems with participants from a single organization it is customary to assume that the managerial control mechanisms motivate all participants to cooperate in maximizing organizational benefits. Interorganizational systems, however, involve several organizations each pursuing its own self-interest, and we can no longer assume their full cooperation.

Interorganizational information systems are not a new phenomenon; the mail and telephone networks can be considered as long-standing examples of interorganizational systems. These systems have become indispensable because interorganizational transactions play a central role in our economic system. The difficulty in administering control and coordination mechanisms across organizational barriers often makes these transactions subject to substantial inefficiencies [40], creating opportunities for successful applications of IOS. This article identifies two types of interorganizational information systems, information links and electronic markets. The benefits of these systems in a vertical market setting are assessed, and their implications for industrial structure and strategic conduct are discussed.

### **Information links and electronic markets**

IOS are usually encountered between two stages in a linear value-added chain, and thus can be thought as having two primary types of participants, which we call *suppliers* (sellers) and *customers* (buyers). Systems are operated by *intermediaries*; a customer or a supplier in the market may operate a system and thus function as an intermediary as well. One or more systems may compete in the same market, and potential intermediaries may exist, with the ability to introduce new systems in the future. Two types of vertical market IOS can be distinguished in this setting, which we call *information links* and *electronic marketplaces*.

An interorganizational *information link* is an IOS at the interface of the value-added chains of a supplier and a customer in a vertical market; thus it represents an investment in *bilateral* integration. An *electronic marketplace* (or *electronic market system*), on the other hand, is an IOS that allows the participating buyers and sellers to exchange information about market prices and product offerings; thus it represents an investment in *multilateral* information sharing. The key distinction between information links and electronic marketplaces is that the former exist in a bilateral setting where a relationship between a supplier and a customer has already been established, while the latter function in a multilateral setting with the goal to establish bilateral buyer-seller relationships.

Information links improve the efficiency of gathering and communicating information across the participating organizations, an impact that can be modeled as an increase in the performance of interorganizational information channels. The introduction of an information link can improve coordination at the interface between a customer and its suppliers, creating efficiencies such as better management of inventory levels or improved data exchange between the organizations involved. Interorganizational information systems may thus promote a substitution of information exchange for inventories, resulting in higher levels of interorganizational communication and lower overall coordination costs.

Electronic market systems are likely to reduce the cost that buyers incur to acquire price and product information. Economic theory has demonstrated that this search cost enables sellers to extract monopolistic rents in otherwise competitive markets [2, 38]. Electronic marketplaces may thus promote price competition and reduce sellers' market power. Buyers are likely to benefit from these systems in two ways: first, they may enjoy lower prices because of the

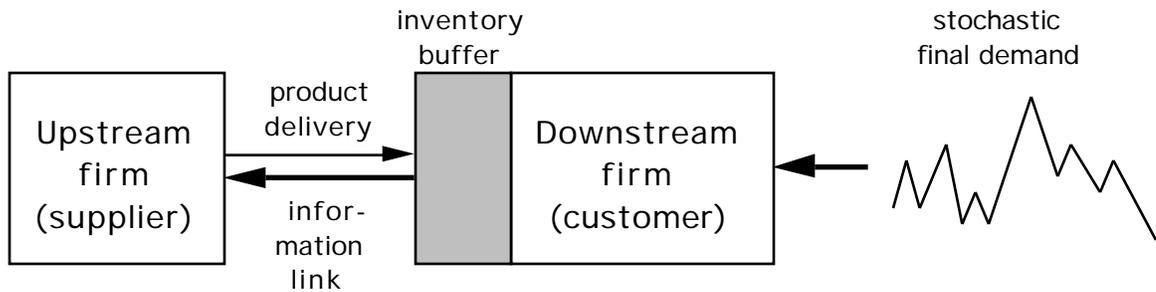
increased competition among sellers; and second, they will be better informed about the available products and thus may choose sellers which better suit their needs. Such efficiencies would make the introduction of electronic market systems socially desirable for certain markets and would create a profit potential for the right intermediaries.

The role of an electronic market system as defined in this article is limited to the matching of a buyer and a seller; this market-making focus limits the scope of this definition compared to the more general use of the term “electronic market” in the study of the corresponding economic *governance mechanism* (e.g., by Malone *et al* in [29]). Furthermore, any benefits from information technology that are generated after a bilateral relationship has been established (via an electronic market or by any other means) are in the realm of interorganizational information links. The concepts of an information link and an electronic market are introduced as abstractions that distinguish between the two primary types of functionality offered by interorganizational systems, and thus facilitate the study of their corresponding benefits. Real-world systems typically are hybrids exhibiting characteristics of both an information link and an electronic market. Stock trading systems, for example, offer account maintenance and settlement features beyond their market-related functionality, and in deed a significant portion of customer benefits come from such services [20].

The next section of this article discusses the role of interorganizational information links for the coordination of individual organizations with their customers and their suppliers. This is illustrated in a setting where an improved information link allows better management of inter-process inventories and facilitates the collection of monitoring data. The following section considers the implications of electronic marketplaces for efficiency and competition in vertical markets, by looking at the impacts of lowering the search costs faced by buyers in markets with commodity and differentiated products. The impact of interorganizational systems on vertical integration is discussed next, based on Williamson’s transaction cost theory. Subsequently, the strategic role of interorganizational systems is addressed, focusing on issues such as their potential use as competitive weapons, the significance of their economies of scale, economies of scope and network externalities, their ability to create and sustain competitive advantage, and the sharing of system payoffs among the system participants. Finally, the article offers some concluding remarks and suggestions for further research.

### **Modeling the Role of Interorganizational Information Links**

An interorganizational information link is an IOS at the interface of the value-added chains of a supplier and a customer, or an upstream firm and a downstream firm. Such an information link can be modeled as a communication channel characterized by a certain capacity (bits of information that can be reliably transmitted per unit of time) and response time (units of time needed for the channel to become ready after a transaction is initiated). In this setting, the use of information technology is assumed to result in reduced response time and increased capacity of this communication channel. The first impact comes from the ability of IOS to speed up the information processing required before the system can respond, as well as their ability to set up a connection faster than conventional systems such as the mail or telephone systems. The



**Figure 1:** An information link in an inventory management setting

second impact comes from the superior capabilities of IOS to transmit large amounts of information with speed and accuracy.

The introduction of IOS is likely to reduce the cost of interorganizational coordination. In several vertical market settings, inventory and monitoring costs can be used as a reasonable proxy for coordination costs. In this section we discuss the benefits of information links in the context of reducing inventory and monitoring costs, drawing on certain models of the corresponding economic setting. A detailed description of these models and the ensuing analysis can be found in [3].

### Inventory models

In a typical inventory setting, the downstream firm faces a stochastic demand for the intermediate good provided by the upstream firm. Stockout is costly for the downstream firm, which is thus obligated to keep a certain level of buffer (inter-process) inventory and to transmit periodic orders to the upstream firm via the information link. Stockout costs may represent lost sales, the opportunity cost of idle capital equipment, goodwill losses due to customer dissatisfaction, or the cost of restarting a production process once it stops. In this setting, shown in Figure 1, the cost of interorganizational coordination can be represented by the inventory handling costs and the stockout costs.

Information theory can be used to relate the transmission capacity of the interorganizational information link to the lead time between orders transmitted to the supplier. Assuming that the limiting constraints come from the information processing rather than the physical delivery component of the system, it can be shown that increasing the capacity of the information link and decreasing its response time results in reduced lead times to fill an order and thus in decreased total coordination costs [3]. If the lead time becomes small enough, the optimal inventory capacity of the downstream firm eventually becomes less than its in-process inventory. At that point, the downstream firm may dispose of its inter-process inventory buffer altogether: the coordination between the two firms has changed from a buffered inventory link to a just-in-time system. Thus, in the setting described above, and assuming that physical delivery does not impose binding constraints to the performance of the system, the exchange of information and the holding of inventories can be viewed as substitute means for coordinating

organizational processes; this result is in agreement with the conclusions reached by Milgrom and Roberts [30]. The assumption that the critical constraints come from information processing rather than from physical delivery is realistic in several interorganizational settings, and allows us to focus on the efficiencies generated by improving the performance of the information link. In real-world situations, however, it is likely that a concerted effort to improve both the capacity of the information link and the performance of the physical delivery system will be appropriate.

### **Monitoring models**

Alternatively, information links can be studied in a setting emphasizing the monitoring of a downstream organizational process. An upstream process monitors and controls a stochastic downstream process based on the information that arrives through the information link. Monitoring costs can be modeled in terms of the ability of the controller to respond to changes generated by the downstream stochastic process. Monitoring costs can be assumed to be quadratic\*, *i.e.*, they can be modeled as the square of the difference between the actions taken and the “ideal” actions that would have been taken if perfect data was available for the monitored process. Under this assumption, the mean square error of data collection provides a measure of the monitoring costs.

When the stochastic process being monitored satisfies certain fairly non-restrictive requirements, it can be shown that the performance of the information link becomes a valuable resource. Increasing the capacity of this link allows more frequent sampling of the downstream process, and results in decreased monitoring costs [2]. Hence, in this monitoring setting, as the information processing and communication capacities of the information link increase, the cost of coordination decreases, similar to the inventory setting discussed earlier.

### **Discussion**

The inventory and monitoring settings considered above provide two examples of the potential benefits of interorganizational information links in vertical markets. Interorganizational systems are therefore likely to increase interorganizational communication and lower overall coordination costs. For example, if information technology improves the efficiency of interorganizational information exchanges by several orders of magnitude, and provided that the performance of the physical delivery systems is adequate so that they do not become the limiting factor, it may be possible to eliminate inter-process inventories and switch to just-in-time systems based on timely delivery of intermediate goods, or *kanban* systems driven by the vertical flow of information about demand at each stage of production [1]. Improvements in interorganizational monitoring are likely to translate into substantial benefits for the organizations involved, as well. Sellers, for example, can limit potential surprises by acquiring more accurate and timely information about developments in their markets. Buyers can benefit from planning with confidence that suppliers will be able to meet their needs.

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\* in this setting it is typical to assume quadratic costs so that observations that overestimate and underestimate actual data do not cancel out, and large errors are proportionally costlier than small errors.

A much publicized example of an information link is provided by the Analytic Systems Automatic Purchasing (ASAP) system introduced in the mid 1970's by American Hospital Supply Corporation (AHS), now owned by Baxter Corporation. The complexity of the buying process for hospital supplies and the need to negotiate the prices of 30,000 items and to administer 50,000 purchase orders per year for a typical 800-bed hospital resulted in one dollar being spent for order administration and inventory management for each dollar spent on actual supplies. AHS began automating its order entry and billing system as early as 1957, and offered a number of follow-up systems, leading to the introduction of ASAP in the mid-1970's [24]. Five generations of ASAP have been introduced with the latest, ASAP/Express, announced in 1987.

In line with the arguments presented above, ASAP reduced time delays in placing orders and led to reduced inventories, decreased coordination costs and faster response times. In deed, ASAP allowed hospitals purchasing supplies to order from AHS with minimal effort and reduced the time necessary to place an order and get a confirmation from several days to 10 seconds. The speed and accuracy of the information link allowed AHS to guarantee prompt delivery and the hospitals (usually with AHS' help) were able to reduce their inventory management and entry costs by as much as 80% [27].

Naturally, interorganizational information links are not always the best way to reduce coordination costs between suppliers and customers. Substantial gains may be realized by restructuring and streamlining operations to reduce the need for information processing, or by redesigning systems and improving coordination strategies to better use the capacity of existing information links. This strategy may be cheaper to implement, and before resorting to technology-intensive solutions a reevaluation and redesign of existing systems and procedures may be appropriate. The models discussed above suggest, however, that the information capacity of the interorganizational links will eventually become a limiting factor imposing constraints on further performance improvements; at this point information technology can prove valuable by increasing the performance of these links, thus relaxing any binding constraints.

Galbraith captured the essence of the above results as they apply in an intraorganizational setting when he argued that a central factor in the design of effective organizations is the degree of uncertainty with which organizational processes must cope, resulting in a tradeoff between organizational slack and vertical information processing [25, 26]. In fact, although the preceding discussion focused on similar issues in an interorganizational setting, its conclusions are applicable within a single organization as well, as the employed settings are of a cooperative nature.

### **Modeling the Role of Electronic Markets**

As discussed earlier, interorganizational information systems can create "electronic marketplaces" by serving as intermediaries between the buyers and the sellers in a vertical market. In that capacity, they are likely to reduce buyers' search costs, *i.e.*, the costs buyers must incur to acquire information about seller prices and product offerings.

### **Models of commodity markets**

In commodity markets, all sellers offer the same product, possibly differing only in the price they charge for it. Stigler [37] and Rothschild [33] pioneered the study of the impact of search costs in these markets. Search costs are central in allowing the sellers to enjoy excess (“monopoly”) profits, as it is a well known tenet of economic theory that in competitive markets with efficient (*i.e.*, free and complete) information sellers achieve no profits beyond a fair return on the employed capital resources. Hence reducing buyer search costs typically results in lower market prices and smaller seller profits. The nature and magnitude of the impact depends on the precise assumptions about the market and the behavior of buyers and sellers, and under certain conditions can be quite dramatic (see [4]).

### **Models of differentiated markets**

The economic literature suggests that the heterogeneity of consumers and product offerings is central to the ability of sellers to exploit buyer preferences, limit price competition, and thus extract positive monopolistic rents [32, 35]. A model for the costs of search in a spatially differentiated market was proposed by Bakos to analyze the impact of introducing electronic intermediation in a market with differentiated products [2]. In that model sellers offer a variety of products; buyers, who differ in their preferences, incur a search cost in order to be informed about the product offering and the price of some seller, and then decide whether to purchase among the sellers already located, keep searching, or give up.

In this setting, sellers can exploit the cost of information acquisition and thus extract some monopolistic rents. Reducing the cost of search, *e.g.*, by introducing an electronic market system, results in lower prices and reduced seller profits. Efficiency and societal welfare are increased by reducing the cost of unproductive buyer searches and by enabling buyers to locate products better matching their needs. If the search cost is low enough, buyers look at all product offerings and purchase the one best serving their needs, resulting in a socially optimal allocation. Very high search costs, on the other hand, lead to efficiency losses and eventually cause the market to break down. For example, although it may be known that products exist in the market that would satisfy every buyer, it may be too costly for any buyer to locate an acceptable product.

### **Discussion**

Electronic markets are likely to promote price competition and reduce sellers’ market power. Buyers are likely to benefit from these systems in two ways: first, they may enjoy lower prices because of the increased competition among sellers; and second, they will be better informed about the available products and thus may choose sellers that better suit their needs. Such efficiencies would make the introduction of electronic market systems socially desirable for markets with high information costs and create a profit potential for the right intermediaries.

Conversely, electronic markets can put sellers in a prisoner’s dilemma situation. Sellers as a group will be made worse off by a market system offering price and product information. Yet

each of them would like to introduce such a system individually since the revenues that can be derived by charging buyers for the services of such a system outweigh the loss of individual monopolistic rents. This may account for the puzzling observation that sellers are the ones most likely to precipitate the introduction of electronic market systems in concentrated industries despite the potential of these systems to reduce monopoly power.

Airline reservation systems in the United States fit well the above model of electronic markets: there is a plethora of airline flight offerings, and travellers are heterogeneous in terms of their needs and preferences. The systems have played an increasingly important role in recent years and they have substantially reduced the cost for buyers to obtain information about seller offerings. The three systems that have dominated the market are offered by American (SABRE), United (Covia, usually referred to by its original name Apollo), and Delta, Northwest and TWA (Worldspan). These systems have greatly increased the ability of travel agents to compare travel alternatives, and have evolved in a major marketplace responsible for about 80% of airline bookings [9]. It was proposed that electronic markets increase price competition, reduce seller monopoly power, and result in more demanding customers who are less willing to compromise on their preferred product. Airlines eventually experienced all the above effects. In deed, as the systems' growth potential among travel agencies and large corporate accounts has been exhausted, these systems have started to compete among themselves and operating margins have been falling [36], although the systems have remained quite profitable. Air travelers and travel agents are the only groups made unambiguously better off as a result of these systems.

### **IOS, Transaction Costs and Vertical Integration**

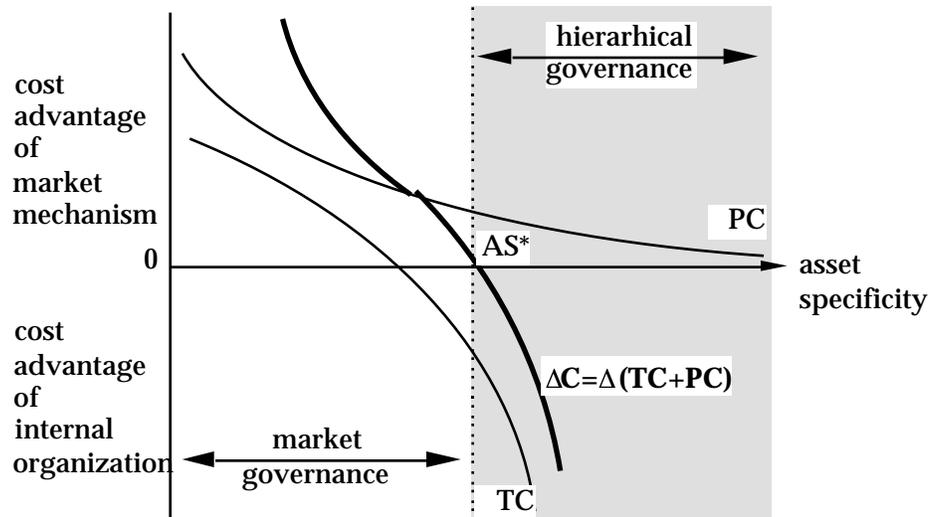
There is a recent trend in the Information Systems literature to emphasize the potential impact of information technology in general, and interorganizational systems in particular, on transaction costs [11, 14, 17, 28]. According to Williamson [40] transaction costs arise from the bounded rationality and opportunistic behavior of economic agents coupled with

environmental uncertainty and small-number exchange situations<sup>\*\*</sup>. Thus market-mediated transactions (which involve inter-firm relationships, but are not necessarily carried in a spot market) are characterized by a tradeoff between costs that could be avoided if these transactions were administered through the hierarchical governance mechanism of a single firm, and the production efficiencies of market relationships. Williamson proposed that this phenomenon can be used to explain the actual boundaries between organizations as they are observed in different industries.

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\* adapted from Williamson [41].

\*\* small-number exchange situations are the ones that involve few potential trading partners, and thus limit the alternatives available to the organizations involved and the ability of the "invisible hand" of the market to discipline their conduct; multilateral market settings may lead to *ex post* small-number situations after a relationship is established and trading with alternative partners becomes less feasible.



**Figure 2: Williamson's efficient boundaries model\***

This “efficient boundaries” hypothesis suggests that as asset specificity<sup>†</sup> increases, the transaction cost superiority of the internal organization outweighs the market's advantage in production efficiency, thus driving some exchanges out of the market and leading to internalization of the related transactions [41]. As Figure 2 illustrates, beyond a certain point of asset specificity ( $AS^*$ ) the production cost advantage of market mechanisms vs. internal organization (  $PC$ ) declines and is overshadowed by the lower transaction cost of internal organization, denoted by a negative transaction cost advantage of markets (  $TC$ ).

Interorganizational information systems affect transaction costs through their impact on asset specificity, contracting and monitoring costs, and small-number situations, while their impact on production technologies is more ambiguous.

### **Information links**

Information links represent bilateral investments in integration; as such they are likely to be tailored to fit particular institutional arrangements, increasing the asset specificity of organizational interfaces. Furthermore, the organizational and technological investment necessary to implement an information link is likely to encourage customers to concentrate their orders to the smallest feasible number of suppliers, even leading to sole sourcing arrangements.

<sup>†</sup> asset specificity refers to the ability of an asset to find an alternative productive use: the value of assets with high specificity is greatly diminished if they must be redeployed; acquiring highly specific assets may thus create small-number exchange situations.

These aspects of information links are likely to increase transaction costs, creating an incentive for organizations to internalize functions offering the potential for high integration.

On the other hand, information links reduce the cost of interorganizational monitoring and coordination, allowing firms to outsource functions tightly integrated into their value-added chains and to monitor effectively the performance of contractual relations. In that process, they are likely to reduce the transaction cost advantage of vertical integration, favoring the markets instead.

Although it is difficult to predict which effect will be stronger, it should be noted that as firms gain experience with bilateral relationships such as single sourcing arrangements, they are likely to improve their ability to prevent costs such as opportunistic behavior, for example by ensuring that they maintain the ability to switch to alternative suppliers, should that become necessary. Furthermore, standards are likely to develop, so that, at least within a specific industry, investments in information links become less idiosyncratic, making it easier to establish new relationships with customers and suppliers. Thus, in the long run, information links could favor an increased role for markets over hierarchical arrangements.

### **Electronic marketplaces**

By reducing search costs, electronic marketplaces typically reduce problems arising from small-number situations. Similarly, the ability to post and receive product and price information from several market participants is likely to reduce asset specificity by providing alternative uses for productive assets. On the other hand, depending on the design and the characteristics of their particular systems, intermediaries may be able to impose substantial specific investments on system participants. Taking into account the allocational efficiencies of electronic markets, it is likely that these systems will favor organizations with a lower degree of vertical integration, as predicted in [29].

In summary, IOS may shift the efficient boundaries of organization, affecting the transaction cost differential between markets and hierarchies and, according to Williamson's theories, affecting vertical integration, thus creating new markets and causing others to disappear. One result could be a decrease in vertical integration, as in the case of firms contracting out their manufacturing operations because interorganizational systems facilitate the interchange of product descriptions and provide better monitoring information. Alternatively, vertical integration may increase, as in the case of firms acquiring a financial interest in their suppliers to reduce the transaction costs in implementing tightly integrated organizational interfaces. Finally, IOS may cause changes in the partition of the value-added chain, *i.e.*, vertical realignment. Since IOS may affect impacts in either direction, and the final outcome is likely to be context specific, aggregate measures of vertical integration could fail to capture these impacts by canceling out the individual effects.

## **Implications for the Competitive Role of IOS**

A well known result of microeconomic theory is that firms in competitive markets earn no profits in the long run, except a fair return on their capital assets. Excess profits are possible, however, under such deviations from long-run competitive equilibrium as the ability of some firms to create and exploit barriers to entry, or the technological sophistication that allows some firms to enjoy rents from innovation even if they lack any significant monopoly power.

The efficiencies of information links and electronic marketplaces, aggregated over the entire economy, make the provision of electronic intermediation services a business holding large rewards for the players that will successfully exploit its potential. On the other hand, it may be difficult to hold on to these efficiency gains, which, together with seller profits, may be competed away to the benefit of customers. Similarly, the increasing use of IOS as an element of the competitive game, creates a number of strategic problems for participants in industries where such systems have been or are about to be introduced. Four of these issues are reviewed below, after discussing strategic moves to protect the economic benefits of information links and electronic markets: (1) the economies of scale enjoyed by system providers; (2) the timing of IOS introduction; (3) the sustainability of competitive advantage; and, (4) the sharing of system benefits among its participants.

### **Competing with information links**

In our earlier discussion we illustrated two types of benefits from interorganizational information links: (a) the possibility to reduce physical inventories, and, (b) the improved ability to monitor organizational processes downstream the value-added chain. This type of efficiencies are often contingent on the characteristics and needs of the participating customers and suppliers. Consequently, firms that have introduced information links must closely monitor changes in their customer base, which could either enhance or reduce the opportunities for IOS offerings. In the hospital supplies case, for example, the potential benefits from quick availability and proper management of supplies are likely to be much less important to a private physician than to a hospital.

The opportunity to gain market power can be pursued by one's customers and suppliers to the firm's disadvantage unless tactics are devised to avoid the problem. These tactics typically require actions opposite to the ones discussed in the previous paragraph, such as avoiding to become dependent on customer and supplier-controlled information and services, creating an efficient electronic marketplace between one's own organization and its suppliers, and trying to avoid or control such an electronic marketplace on the customers' side [6].

Every supplier is a customer of another supplier in an unbroken value-added chain. A number of interesting research questions arise in this type of setting. It is possible, for example, that the efficiencies generated by an information link that allows a downstream firm to reduce its inventories are partially offset by higher costs up the value-added chain, *e.g.*, because the cushioning effect of the extra inventory is lost and upstream firms must respond by increasing their inventories. It has been argued in the business press, for example, that the decision of the

Big Three auto makers to increasingly require just-in-time delivery, has burdened their suppliers with higher inventory costs. In a related issue, the opportunity may exist to introduce information links between several stages of the value-added chain. Whether the returns from these additional systems are increasing, constant or decreasing, and the conditions under which inter-process inventories could be eliminated in the entire system, are open research questions.

### **Competing with electronic marketplaces**

It was suggested that electronic market systems generally favor buyers and reduce seller monopoly power. System revenues may compensate for this profit reduction in the short-run but, as several systems are introduced, their profits are likely to be competed away. In the long run it may be impossible for sellers to avoid some loss in market power, especially when this power is based on high information costs. Yet colluding to prevent an electronic market may be illegal, may induce buyers to introduce such a system themselves, or may invite a third-party intermediary into the picture, thus depriving sellers of system revenues. Clemons provides an example of these considerations in the context of Merrill Lynch's decision on whether to make allow Bloomberg to make its trading system for fixed income securities available to other dealers, in the process creating an electronic market [13].

The best strategy for sellers may be to control the type of system eventually introduced; a system emphasizing product over price information may allow sellers to keep much of their monopoly power while giving buyers access to the allocation efficiencies and for which buyers could be charged user fees. Such systems may "provide a good example," inducing future entrants to cooperate by developing systems that emphasize aspects other than price information and comparison, thus delaying or even avoiding non-cooperative, price-oriented systems that can ruin seller profits. Airline reservation systems, for example, have traditionally facilitated search based on product features (such as departure time) while providing no support for search based on price. Another tactic, frequently seen in the airline industry, is to compensate for the effect of the systems by making it difficult for the buyers to extract price information or to compare alternative product offerings. Airlines, for example, have implemented extremely complicated and ever-changing fare structures, flight restrictions and ticket availability, typically offering several hundred thousand possible fares at any one time, and sometimes hundreds of fares for travel between certain pairs of destinations [21]. A third possibility is to increase the differentiation of product offerings, possibly using the technology to help differentiate what would normally be a commodity product. Frequent flyer programs have been very successful in achieving this goal.

Buyers obviously have the opposite incentives and would like to encourage an electronic market that facilitates comparisons among sellers' prices and product offerings. If individual buyers lack adequate resources or incentive to introduce a market system or do not have the clout to induce seller participation, they may form coalitions and introduce jointly owned systems, or form an alliance with a third party organization with the necessary technological sophistication and financial resources. Another interesting strategy is the use of information technology to counter the bias of supplier-owned systems. Rosenbluth Travel, for example,

downloads and reprocesses data from multiple airline reservation systems to eliminate any display, search and selection bias and thus best support the information needs of its customers [18].

### **Economies of scale, scope and network externalities**

Interorganizational systems can themselves offer substantial economies of scale (cost advantage for the operators of large systems), economies of scope (cost advantage for the operators of multiple systems), and network externalities (increased individual benefits for the participants of large systems). For example, IOS typically require large investments in hardware, system development and system maintenance. Once a system is in place, however, marginal costs are small, creating economies of scale for systems with a large number of participants. American Hospital Supply's development effort for ASAP cost over \$30 million, with an additional \$3 million/year for maintenance, not including customer premises hardware which was provided by the hospitals [27]. The marginal cost of placing an order eventually was as little as 10 seconds of connect time. In contrast, the cost of manual systems based on existing infrastructures is already sunk; as a result, setup costs are low while marginal costs are still substantial as when each order must be manually coordinated and processed through the telephone and mail networks.

#### *Information links*

Developers of information links can realize economies of scale by replicating these systems across several customers or suppliers. In addition to providing a potentially unique and valuable service to these customers or suppliers, processing, communications, development and maintenance costs will be leveraged across a large number of participants, and learning will further reduce the cost of developing additional systems. Furthermore, offering information links to several customers and suppliers may create certain network externalities, for example by allowing the collection of data which can be aggregated and analyzed to provide valuable information to system participants. ASAP, for example, provides participating hospitals with reports comparing their utilization of supplies to the norm among system participants.

Occasionally, economies of scale and additional revenue can be realized by marketing an information link to other firms in one's industry. This possibility can create interesting strategic problems, where the revenues generated from the system must be weighted against the potential loss of competitive advantage from proprietary use of the system.

#### *Electronic marketplaces*

Four areas offer economies that may favor big players in the provision of electronic market systems and intermediation services: (a) the cost and expertise required to build and manage systems of substantial size and functionality relying on complex communication networks can become very large; big intermediaries can leverage this investment over a larger number of system participants; (b) system development is often characterized by a steep learning curve that allows the development of subsequent systems at a smaller cost; (c) electronic marketplaces

can create economies of scope, especially in development expertise, in the sharing of operational facilities, and in data collection, where data collected during system operation becomes a valuable asset; and, (d) as the number of participants to an electronic market increases, the market becomes more successful, providing more benefits (e.g., liquidity) to its individual participants, *i.e.*, it enjoys network externalities.

The major strategies to secure economies of scale in intermediating electronic markets are to achieve dominant market share in an industry, or to provide intermediation services across a number of industries. As traditional technology with low entry costs is replaced by systems based on information technology which have large development costs, the new economics of intermediation are likely to favor players with access to a wealth of resources, who can leverage their know-how in different industries and defray their development expenses among several systems.

Smaller firms may individually lack the resources for a system large enough to achieve the economies of scale necessary to take on established IOS competitors. In these situations, an alliance with a larger information intermediary or a coalition of the smaller competitors may provide an appropriate response. In the Philadelphia retail banking market, for example, Girard Bank pioneered the introduction of automated teller machines (ATMs) and achieved an early advantage in terms of the size of its network. Within a year, however, Philadelphia National Bank had launched its competing Money Access Center (MAC) network, and attracted enough banks to join for MAC to dominate the Pennsylvania market [12]. An empirical study by Banker and Kauffman failed to establish any competitive advantage from these ATM networks [7].

### **Timing of system introduction and sustainability of competitive advantage**

Firms that are among the first to adopt IOS technology may be able to obtain an early mover advantage. Furthermore, it is often quite difficult to unseat entrenched early movers once they establish their leadership in a market.

#### *Information links*

Early adopters of information links may enjoy efficiencies that allow them to establish a strong presence and leadership in their industry. The interorganizational information link between Merrill Lynch and Banc One of Columbus was central in making it possible for the former to introduce its cash management account (CMA) in 1979. Merrill Lynch enjoyed a substantial first mover advantage in that venture; although several similar products were introduced by competing brokers, Merrill Lynch maintained a dominant position in the CMA business for several years and it was able to command impressive loyalty from its customers [23].

Firms that are first to put in place information links to their customers may enjoy first mover advantage as well; for example, by capturing large market share, thus realizing economies of scale, moving down the learning curve, and, assuming switching is costly for their customers, limiting the potential market available to competitors that enter at a later stage. On the other

hand, early movers will sometimes be stranded with a bad technology as the firm that most grossly overestimates the value of the new technology is the one most likely to attempt to be the first to exploit it. This possibility makes potential adopters conservative, and offers a competitive advantage to the ones with sophisticated capabilities for technology assessment.

Finally, early movers must be prepared to continuously respond to technological and competitive developments in order to sustain any advantage obtained from their early timing. In the travel industry, for example, Rosenbluth Travel gained advantage as a result of being an early mover in the use of information technology to support its customers, and yet it never stopped innovating, consistently stayed ahead of its competitors, and continued to capture market share [18].

#### *Electronic marketplaces*

A firm that moves early in introducing an IOS can capture a large market share, thus realizing substantial economies of scale which may deter later entrants. Furthermore, the installed base of early systems may help them to attract more participants because of the associated network externalities. Finally, future entrants will be at a disadvantage in attracting customers already signed up to early systems because of the cost of switching; this may lock out new entrants after the market has reached a certain level of saturation. If the technology does not evolve in a way that penalizes firms which deployed an earlier generation, late movers are at a disadvantage [2, 14].

#### *Sustainability of competitive advantage*

The sustainability of any competitive advantage achieved through IOS is a major concern for intermediaries. The investment of early movers may prove strategic and prevent later entry into the market. For example, if early systems capture enough market share, and keep user fees low enough, it may be difficult for later movers to achieve the necessary economies of scale and network size that would allow them to operate profitably. Given the favorable economies and learning enjoyed by the early movers, entry can often be discouraged even while the existing players earn substantial profits themselves, as seems to be the case with airline reservation systems.

In most industries, however, any advantage gained through an IOS system will most likely open only a window of opportunity. Clemons and Kimbrough [14] have pointed out that advantage based purely on technological sophistication is difficult to sustain because of the open and rapidly evolving nature of the technology. When IOS technology becomes commonplace, profits will be competed away for those intermediaries who have not achieved some form of unique advantage. Firms can try to exploit opportunities for superior profits for as long as they last, however, and may attempt to control the transition to a more competitive environment by biasing the final outcome in their favor.

Teece advanced the view that sustained advantage can be achieved through the control of critical resources or the development of unique organizational competence in key areas which

cannot be duplicated by competitors [39]. In agreement with Teece, Clemons and Row argue that sustainable advantage through information technology typically requires leveraging on unique resources that cannot be easily replicated or leapfrogged by potential competitors [16]. In the case of IOS, specific industry expertise, a locked-in customer base or the ability to deal with certain organizational and system complexities are promising areas to look for sustainable advantage. Alternatively, intermediaries could rely on continuous innovation that will keep the system a moving target beyond the reach of its competitors.

Overall, it seems that neither size nor early entry can guarantee a sustainable advantage or the appropriation of a favorable share of system payoffs. In fact, the view that sustainable advantage requires the control of unique resources has been supported by a number of case studies of interorganizational systems, such as the ones by Clemons [12] and Clemons and Weber [19, 20].

### **Sharing of system payoffs**

The ability to appropriate system benefits is an important strategic consideration for all system participants. The actual distribution of the benefits is not constrained by their place of origination, as a number of mechanisms can be employed to implement a particular allocation of payoffs. These mechanisms include fixed and variable system charges, rebates, commissions paid by the participants, or even passing costs or rebates to the participants in indirect ways, such as raising or lowering market prices.

Game theory postulates that the distribution of benefits is determined by certain strategic characteristics of the situation which establish the relative “power” of the players participating in the ensuing bargaining game. A number of different approaches have been proposed to analyze bargaining games, such as Nash bargaining [31] or the Shapley value [34], which emphasize different aspects of the bargaining environment, such as the ability to form coalitions, the set of alternatives available to the players, or the structure of the bargaining game. Game theoretic approaches generally agree in predicting that a larger share of benefits accumulates to players who can create most value by cooperating and can damage the other players most by breaking ranks with them.

### *Information links*

In this light, an important tactic for improving the strategic value of an information system to a supplier is to provide unique and valuable information and services which require idiosyncratic changes to the customer’s organization and, thus, make switching to a competitor more costly [14]. Interorganizational systems can facilitate unique information or service offerings previously unattainable and of great value to customers. The higher the perceived value of these offerings, and the more complex and idiosyncratic the interface is for the customer, the higher will be the imposed switching costs. Correspondingly, information links can increase a customer’s power against its suppliers if they reduce the cost of locating alternative suppliers, the dependence on unique supplier products, and the costs of switching suppliers [6].

Suppliers operating interorganizational information links to multiple customers seem to be able to capture a large share of the benefits generated by the system by imposing switching costs and inducing system-specific investments. Hospitals that have joined the ASAP system, for example, are finding themselves captives to Baxter, which is appropriating a large share of the benefits generated by the system in the form of higher prices. The threat of competition from alternative systems, avoiding system-specific investments, using information technology to reduce switching costs, or forming coalitions to negotiate with the supplier/intermediary, are promising ways out of such a situation. Pharmacies using McKesson's Economost system, for example, do not face high switching costs or system-specific investments, and thus have avoided paying monopoly rents to McKesson.

#### *Electronic marketplaces*

A major factor that determines a player's ability to appropriate system benefits is the importance for that player of its participation to the system, and the value generated by that player. Typically participation is more critical for sellers than it is for buyers or the intermediary. When a seller drops out from the system buyers have fewer choices, and thus the value generated by the system is reduced, which results in some loss both to the buyers and the intermediary. On the other hand, the impact to the seller that drops out can be devastating since his customer base could be substantially reduced. The criticality of participating in the system may explain the observation that in some electronic marketplaces a substantial share of the benefits seems to be captured by the intermediaries (e.g., in the case of airline reservation systems), while in other cases most benefits seem to accumulate to the final consumer (e.g., in the case of ATM networks).

Clemons proposed system topology as an important determinant of the power of intermediaries [12]; this power is likely to be large in systems where they control the market transactions (such as airline reservation systems); it will be smaller in systems where the suppliers keep control over individual transactions and provide the link to the intermediary (as is the case with inter-bank ATM networks). As electronic interorganizational information systems become commonplace, however, competition among intermediaries is likely to increase, putting a pressure on the profits they can appropriate.

### **Concluding Remarks**

Interorganizational information systems are becoming more prevalent every day. It was argued that these systems hold great promise for improving interorganizational coordination in bilateral and market settings. Their economic efficiencies can create opportunities for information intermediaries, yet when IOS technology becomes commonplace, profits will be competed away for intermediaries who have not achieved some form of sustainable advantage. The underlying economies of scale may enable certain firms to leverage their system development expertise, installed networks, customer bases and proprietary databases, and thus dominate the provision of intermediation services.

It was seen that IOS can affect the structure and efficiency of a vertical market in the following three ways:

- (a) The introduction of an improved information link as a separate system or as part of a wider market system can increase the capacity and decrease the response time of interorganizational communication. The result will be improved coordination at the interface between the value-added chains of a supplier and a customer which will allow, for example, better management of inventory levels or switching from inter-process inventory management to a just-in-time system.
- (b) A market intermediation system can lower the cost buyers and sellers must incur to locate each other. This decrease is likely to reduce sellers' monopoly profits in a vertical market which is moved "on-line" by the introduction of an interorganizational information system, reduce the cost of unproductive search activity, and improve the market's effectiveness in matching buyers and sellers.
- (c) The economics of developing, introducing and operating interorganizational systems may affect the structure of individual markets. These systems may promote a shift from decentralized markets without major intermediaries to centralized markets where certain organizations dominate the information exchange between buyers and sellers, as has been the case, for example, with Reuters' FX 2000 dealing system in the foreign exchange markets. Alternatively, IOS may allow big players to trade directly, reducing the importance of intermediaries, as seems to be the case with institutional investors increasingly trading off the floor of the New York Stock Exchange.

In the long run, industry standard systems or specific applications running on top of the infrastructure provided by these systems are likely to replace bilateral information links, except in the more idiosyncratic settings. Market systems will play an increasing role in the economy at large, offering efficiencies from improved coordination. In information-intensive industries, electronic market systems are likely to be introduced by existing firms in the industry, often initiated as links between a firm and its customers or suppliers. Other competitors, being put at a disadvantage, will typically attempt to respond with alternative systems. However, early movers may be able to enjoy a lasting advantage, or even prevent new entry altogether, if they can secure exclusive access to key resources. In certain industries, the final result may be an industry-wide electronic market, possibly operated by an independent intermediary, as in the case of the insurance industry and its Insurance Value-Added Network (IVANS) system, which allows member insurance companies to exchange customer, policy, claim and rate data with the participating agents.

Interorganizational systems are likely eventually to become a strategic necessity and part of the industry's infrastructure; systems involving an alliance with an information services intermediary are likely to gain advantage because of the latter's economies of scale and scope. Information intermediaries are likely to capitalize on their accumulated know-how and initiate the introduction of IOS in less sophisticated industries. Such systems are likely to involve an alliance with an industry participant providing expertise on the specific market, as intermediation needs vary across industries. The relative bargaining position of the parties, determined by their payoffs under available alternative strategies, is likely to determine the share of system payoffs appropriated by each participant, while advantage based on IOS will be

typically sustainable only when the systems leverage some unique firm resources that cannot be easily duplicated by actual or potential competitors.

This article focused on the implications of interorganizational systems that follow from the efficiency-oriented economic models discussed in the beginning. There are several other theoretical aspects of interorganizational systems that can offer interesting and important implications. Clemons and Kleindorfer, for example, develop models better suited to analyze the distribution of payoffs between system participants and the dynamics of system introduction [15]. Alternatively, the ability of IOS to increase the bandwidth and reduce the response time of information exchanges with customers and suppliers, can support competitive strategies targeted at revenue enhancement, rather than cost reduction. Such strategies, for example, may include time-based competition (such as the reduction of the time-to-market for new products), or improving product design and quality through the increased involvement of customers and suppliers. Formalizing and analyzing the potential of interorganizational systems to support such strategies is a very interesting direction for future research.

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