THIRD-PARTY LOGISTICS: LEVERAGING INFORMATION TECHNOLOGY

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Global competition and the rapid evolution of information technology (IT) have led to a significant trend toward outsourcing of logistics services among major U.S. firms. The market for third-party logistics in the U.S. is expected to grow from $25 billion in 1996 to perhaps $50 billion by 2000.[1] Third-party logistics (also called contract logistics) has been defined as multiple logistics services provided by a single vendor on a contractual basis. As service providers, the mission of third-party logistics firms is to help their customers become tougher competitors.[2]

The increasing use of third-party logistics providers is a part of general trend toward an emphasis on markets rather than hierarchies to accomplish corporate goals. By outsourcing logistics activities, firms can better focus on their core competencies, such as manufacturing and retailing, while allowing third-party specialists to take care of functions such as transportation, distribution, and warehousing.

The movement to outsource distribution also is consistent with a tendency to reduce the number of suppliers and establish closer, longer-term relationships with those that remain. These partnerships encourage mutual investment in IT in order to support innovation and responsiveness.[3] In light of these trends, this article examines the influence of IT on outsourcing from the perspective of the customer.

La Londe and Masters have described the implementation of powerful and inexpensive information technology as the environmental factor that has had the greatest positive influence on the operation of logistics systems over the past decade. A Council of Logistics Management study finds that the value of the logistics function is significantly enhanced through "the capability to integrate product, information, and cash flows for decision-making purposes that link both internal and external processes."[4]

The type of IT known as an interorganizational system (IOS) lies at the heart of the ability of IT to support the outsourcing of logistics activities to third-party firms. Such outsourcing means that firms whose core competencies lie elsewhere can concentrate on activities best managed internally and gain access to superior logistics performance at equal or lower cost.[5]

Firms tend to choose transactions that economize on coordination costs.[6] These include the costs of the information processing necessary to coordinate the work of people and machines that perform a primary process, such as manufacturing a product or providing a service.[7] IT allows buyers and sellers to communicate directly over data-rich, easy-to-use information channels, which reduces coordination costs faster than in-house production costs and promotes the trend toward outsourcing. For example, in the textile industry, IT has allowed disaggregation of procurement, spinning, weaving, finishing, logistics, and retailing, with each function contracted out to a specialist in the field.[8]

This article will discuss how the evolution of IT has allowed the largest users of logistics services, typically manufacturers and retailers, to focus on their core competencies and contract out logistics services. We will also review research in IOS that supports the trend toward third-party logistics. Finally, we will demonstrate the structural efficiencies of IOS and information-driven structures compared to traditional distribution structures.

INFORMATION TECHNOLOGY AND OUTSOURCING

Information technology refers to the hardware, databases, software, and other devices that support an information system. The term is often used interchangeably with information system, which is a collection of components that collects, processes, stores, analyzes, and disseminates information for a specific purpose. We are concerned here with computer-based information systems that use IT to automate the input, processing, output, and transmission of information.[9] Information systems perform three vital roles in any type of organization: they support business operations, managerial decision-making, and strategic competitive advantage.[10]

The speed, cost, accuracy, and reliability of IT makes capturing, analyzing, and sharing information much easier. For example, the exchange of large amounts of data between shippers and carriers allows both to understand traffic patterns and trends and develop strategic partnerships based on mutually agreed goals. "The logistics integration activity typically involves the sharing of very timely and very sensitive demand and sales data, inventory data, and shipment status data. Data sharing often involves a firm giving direct access to its computerized data bases to its supply chain partners."[11]

The core competencies of third-party logistics firms are in fields such as inventory management, distribution, and transportation. With IT these companies can develop an understanding of their clients' activities, such as manufacturing, retailing, or marketing, that previously would have been infeasible due to the workload involved in manually collecting and analyzing large quantities of data. According to Sink and Langley:

> The customer of a third-party logistics firm must be careful to identify accurately the activity or process for which the corporation is core competent. For example, a firm that outsources its transportation and warehousing/distribution activity may not have core competence in that area but in its ability to manage the relationships with firms that do excel in that activity.[12]

Accordingly, the outsourcing of logistics leads to the emergence of new structures for the coordination of logistics functions. Coordination has been defined as "the management of dependencies between activities," and the IT-enabled partnerships that have developed between shippers and third-party providers are coordination-intensive structures for managing the supply chain.[13]

As firms contract out activities, the degree of risk increases because of the potential for opportunistic behavior by partners. This type of behavior, known as agency, can be moderated by IT. By allowing access to performance-related data by all partners in the supply chain, IT can create the conditions for sharing that are in the interests of all. For example, IT monitoring capabilities can be used to moderate the tendency for just-in-time supply systems to simply shift inventory upstream in the supply chain.[14]

THIRD-PARTY LOGISTICS AND INTERORGANIZATIONAL SYSTEMS

Supply chains represent an example of business process change enabled by an interorganizational system. Bakos defines an IOS as "an information system that links one or more firms to their customers or their suppliers, and facilitates the exchange of products and services."[15] The key enabler of an IOS is telecommunications network, such as the Internet or private network provided by Electronic Data Interchange (EDI) vendors, that links the terminals and computers or businesses with their customers and suppliers, resulting in new business alliances and partnerships.[16] According to Handfield and Nichols, appropriate IOS use provides decision-makers with timely access to all required information, in an appropriate format, from any location within the supply chain.[17]

The essential requirement for an IOS is a computer-based, electronic link between two or more members of a supply chain, such as manufacturers, distributors, transportation firms, retailers, or customers. This link automates some element of the logistics workload, such as order processing, order status inquiries, inventory management, or shipment tracking. Without IOS, these activities are carried out by personal visits, mailing of paper documents, phone, or fax.[18]

A simple example of an IOS is the online book retailer amazon.com, which allows a customer's PC to connect to its Web site. A customer can search the database of titles, order and pay for books, check on order status, and request notification of new books by author or subject. At the same time, shipment instructions are provided by amazon.com to one of its distributors who sends the book to the customer by the method of transportation (mail or FedEx) indicated by the customer. When FedEx is used, a shipment number is generated and passed to the distributor (to be placed on the shipping label) and the customer (for tracking purposes). The amazon.com IOS links the company customers, book distributors, FedEx, and the banks that process credit-card orders.

An IOS can be categorized in a number of different ways; there are two broad classifications. The first type is an electronic hierarchy, and the organizations involved have a long-term contract and align their internal processes with one another. An example is series of entities along a supply chain that are electronically connected to each other (but only to the neighboring nodes).

The second type is a market designed to match buyers and sellers who generally do not share a long-term relationship. Markets can be centralized or decentralized. Centralized markets utilize brokers. Buyers and sellers need only connect to one or more of these intermediaries to carry out a transaction; a stock exchange is a good example. In a decentralized market, all the participants can contact one another directly, and no intermediaries are present. The direct relationship between multiple industrial buyers and suppliers is an example.

Essentially, the relationship between a client firm and third-party provider is like a centralized market with a limited number of connections. The client communicates with just one or a very small number of third-party providers. These third-party firms act as brokers. Interaction between the third party and other firms (such as independent motor carriers) is more fully connected. Given that the quality of information available to decision-makers at all levels (including the third-party providers or brokers) is high, centralized (or brokered) markets make it efficient to negotiate contracts under favorable conditions. If the third party is not well positioned to obtain or process information in the marketplace, the client firm would do better to use hierarchical alternatives for each shipment. In other words, the shipper can deal more efficiently with carriers and other suppliers directly, using in-house staff.[19]

BASIS FOR COMPARING STRUCTURES

Distribution structures traditionally consist of two hierarchical substructures. One gathers inputs and channels them through a set of intermediaries toward an internal logistics department. The other distributes the output/goods to consumers through another set of intermediary layers. Figure 1 provides an example of the conceptual input and output substructures that are mirror images.

Goods have traditionally followed this pattern, but information need not. Optimization of information storage and use requires that the organization and storage of data throughout the supply chain be consistent so that the data are accessible to multiple entities at different levels. Accordingly, the information substructure can be star-shaped, such that all nodes are directly connected to the information medium. Figure 2 provides an example of a structure in which each node of the corresponding goods structure is linked to an IT-based node.

Logistics structures can be contrasted through complexity comparison[20] of their basic organizational characteristics. Our methodology is adapted from the criteria previously applied to organizational structure comparisons by Baligh and Richartz,[21] Malone,[22] and Talalayevsky and Hershauer.[23] We use the following as the basis of comparison: (1) number of nodes within each structure, (2) number of connections for each structure, (3) number of intermediaries/managers/information systems used within the structure, and (4) number of levels for each structure. Initially, each structure is described using the following dimensions:

n = number of leaf (end nodes in figures 1 and 2) nodes or structure breadth

sc = span of control

This small set of variables allows comparison of each structure's behavior and characteristics using a realistic, quantitative method. The formulation assumes, however, that the magnitudes of the organizational dimensions remain the same throughout the structures.

The total number of nodes within a hierarchy varies with the number of leaf nodes (n) and the span of control (sc) and is formalized by Talalayevsky and Hershauer as $n(sc/(sc\text{-}1))$.[24] Given the mirrored hierarchical structure, the total number of nodes for the whole structure becomes $2n(sc/(sc\text{-}1))$. A flat information substructure would also reduce the number of information nodes within a structure from $2n(1/(sc\text{-}1))$ to only one. As intermediate information processing levels are eliminated, the span of control is effectively increased. For hierarchical structures, the number of connections is the same as the number of nodes.

The number of levels within a simple hierarchical structure is a derived variable that varies with the span of control (sc) and the number of leaf nodes (n). The resulting formulation is $\log_{sc}n$. The number of levels in the mirrored structure depicted in Figure 1 requires doubling that amount to quantify the number of levels for both hierarchies resulting in $2(\log_{sc}n)$.

FIGURE 1

LOGISTICS COORDINATION STRUCTURE

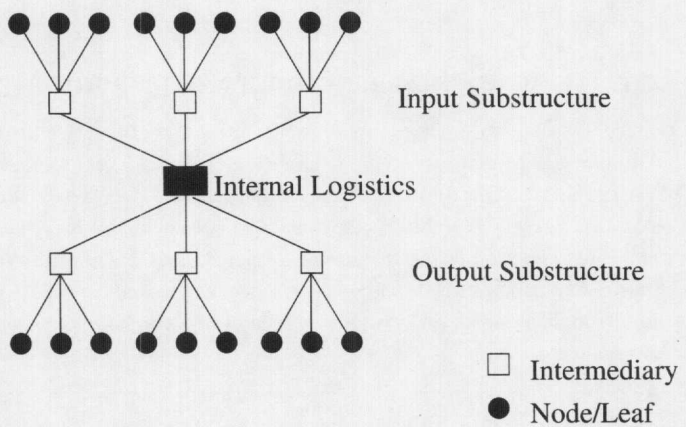


Table 1 contrasts the differences for the two structural alternatives within the four evaluation criteria. Traditional distribution (Figure 1) has the characteristics of a goods distribution substructure for both the goods and information distribution substructures. In other words, both the goods and the information associated with those goods follow the same routes.

TABLE 1

COMPARISON OF DISTRIBUTION STRUCUTURES

Criterion of Comparison	Traditional Distribution	Information-Driven Distribution
Number of nodes	$2n(sc/(sc\text{-}1)$	$2n(sc/(sc\text{-}1)) + 1$
Number of connections	$2n(sc/(sc\text{-}1)$	$2n(sc/(sc\text{-}1)) + 1$
Number of intermediary information forms/systems	$2n(1/(sc\text{-}1))$	1
Number of levels	$2(\log_{sc}n)$	2

Advantages of the information-driven structures over the traditional structures are apparent in the last two dimensions of comparison(in Table 1): number of intermediary information forms/systems and the number of levels. Fewer forms are a result of the standardization that is driven by the involvement of a third party. With IOS, a direct link is established between supply chain entities, which traditional structures chose to isolate through intermediaries.

Additional benefits may result from an IOS and the configurations and relationships it creates. Over time, there may be a secondary effect of disintermediation for the information-driven structure (right-hand column in Table 1): the number of actual nodes and connections may decline. This reduction will take place as a result of a decrease in the value that intermediaries provide within the supply chain.

SEARCH EFFECIENCY DIFFERENCES BETWEEN STRUCTURES

Reconfiguration of distribution structures not only changes the fixed cost and size of configurations but also has the potential to improve variable or search costs. Figure 3 demonstrates the results of an analytical proof for comparing the use of decentralized and centralized markets with an in-house hierarchy in terms of search costs.[25] It highlights the tradeoffs between markets and hierarchies by comparing search alternatives for the full range of information possibilities. Traditionally, firms tended to buy (instead of make) or outsource goods and services when they lacked the skill to produce on their own. The right-hand side of Figure 3 provides a scenario in which decentralized markets outperform other alternatives.

Driven by inter-organizational systems, firms have found another reason to gravitate towards the brokered systems epitomized by third-party logistics firms. The perfect information side of Figure 3 depicts that area of opportunity for brokered markets. A third-party logistics firm can only provide value to a client and compete with other structural alternatives if it not only has access to many alternatives but can also effectively discriminate among its choices. In other words, access and information are the key issues.

Additional economies result from reducing the number of intermediaries (or brokers). When these decrease within a centralized structure, the area of dominance (i.e., lowest cost) for centralized markets as compared to hierarchies becomes larger. As the number of intermediaries declines, the decentralized market structure loses all its advantages over the centralized structure: Brokered structures may make open (decentralized) market transactions obsolete.

Structures enabled by electronic connection provide additional motivation for outsourcing and explain the shift toward IT-enabled intermediaries. An example of this trend is the use of EDI systems to connect shippers with third-party logistics providers.[26] Electronic structures have two effects: (1) reduce transaction cost between organizational entities and (2) reduce duplication within the structures in terms of contacts (or the number of connections) and information processing requirements. In summary, IT allows client firms ready access to external logistics resources through electronic, brokered centralized markets in a more cost-efficient manner. That IT-enabled access paves the way for extensive outsourcing opportunities.

INTERORGANIZATIONAL SYSTEM APPLICATIONS IN LOGISTICS

Traditional research on how IT affect the firm has concentrated on *intra*organizational issues, and the environment (including other firms in the supply chain) is treated as a given, or an exogenous variable. There is also a need for research that links functional integration (such as that achieved by and IOS) to measures of logistics performance.[27]

Only recently has the research focus expanded to include an IOS such as that used to implement supply chain management.[28] As explained by Gustin, Daugherty and Stank:

"The dynamics of today's competitive environment require interorganizational information exchange and coordination to achieve common goals. Relationships such as partnerships and alliances are highly dependent upon information support. It is especially critical that supply chain partners have access to information on activities that they do not directly control."[29]

In the past, effective control depended on a hierarchical chain of command. IT has allowed for the development of relationships that ensure the execution of logistics activities without it being necessary for a firm to have physical control over logistics assets. In fact, many third-party logistics firms do not control any logistics-related assets themselves. Their core competencies reside in purchasing and integrating services from transportation, warehousing, and related operators.[30]

A study of the use of EDI by Japan Air Lines (JAL) and its suppliers found that outsourcing of logistics functions using an IOS allowed JAL to transform its physical value chain into a virtual one. JAL developed new capabilities as it reduced customer response times and pursued joint new product development with suppliers. A key enabler was the integration of EDI with JAL's internal information systems. The study concluded that the "embeddedness" of the IOS allowed EDI to play a central role in JAL's supply chain coordination. The increased speed and flexibility of information and knowledge transfer allowed for more efficient coordination, and eventually higher revenues and profits, for all members of the supply chain.[31]

IOS allows for flexible, nonhierarchical communications among members of the supply chain. The resulting exchange of knowledge facilitates outsourcing of the logistics function. In effect, the type of collaboration that previously could only take place within a single corporate structure now can be extended to outside partners using IOS. As Bowersox and Daugherty explain, "given available information technology, it is no longer necessary to support centralized operations to maintain adequate control" in logistics.[32]

The implementation of information networks through IOS improves the efficiency of gathering and communicating information among the participating organizations, which creates such efficiencies as better management of inventory levels, higher levels of interorganizational communication, and lower coordination costs. A survey of 122 purchasing managers found that the implementation of EDI reduced the number of buyers and the required degree of supplier performance monitoring. The authors concluded that EDI tends to promote long-term buyer-supplier relationships.[33] Another survey of 292 contract warehouse operators found a direct relationship between information availability, responsiveness to customer requests, and operating performance. These findings support the importance of IT to third-party logistics firms. For example, information sharing should allow firms to reduce their inventory levels across the supply chain.[34]

Implementing networked organizations remains a major managerial challenge. There is a need to learn how to manage interdependence in networked firms, such as those that are members of integrated supply chains. The partnership approach is not suitable for all interfirm relationships, some of which are best managed at arm's length. Extensive management time and commitment are needed to develop and maintain close partnerships. Given the critical role that logistics plays in corporate strategy, outsourcing of logistics functions requires a great deal of information exchange and shared creativity. This imposes a limit on the number of third-party firms with which a company that wishes to outsource its distribution functions can coordinate simultaneously.[35]

The effect of IT on firms extends not only to how tasks are performed but also to how firms organize the flow of goods and services through the supply chain. Advances in IT will result in increasing use of markets rather than hierarchies by firms to carry out their responsibilities.[36] Furthermore, by allowing the collection, analysis, and dissemination of large amounts of information, IT can support the use of market-like mechanisms to evaluate the performance of internal logistics operations.[37]

CONCLUSION

The development of IOS will lead to greater use of centralized markets for logistic structures. Third-party logistics firms are an example of a broker or intermediary in a centralized market. Such markets feature more direct access for the different entities in the supply chain such as shippers, and consumers. Acting as a broker, third-party firms standardize communication within the supply chain. In addition, the emergence of third parties in logistics supports a reduction in the number of intermediaries necessary to carry out routine transactions. As the quality and availability of information continues to improve through advances in IT, firms will increasingly shift to centralized or electronic markets.

The evolution of IT has promoted the growth of third-party logistics firms. As products proliferate and product life cycles get shorter, efficient distribution becomes more complex and beyond the reach of many firms, whose core competencies reside in other areas, such as marketing, manufacturing, or retailing. Centralized markets, such as those offered by third-party logistics providers, are becoming increasingly feasible. The principal reason is that significant improvements in information technology are leading to lower transaction costs and allow all the participants in a supply chain to deal with increased complexity.

FIGURE 2

INFORMATION-DRIVEN SUBSTRUCTURE

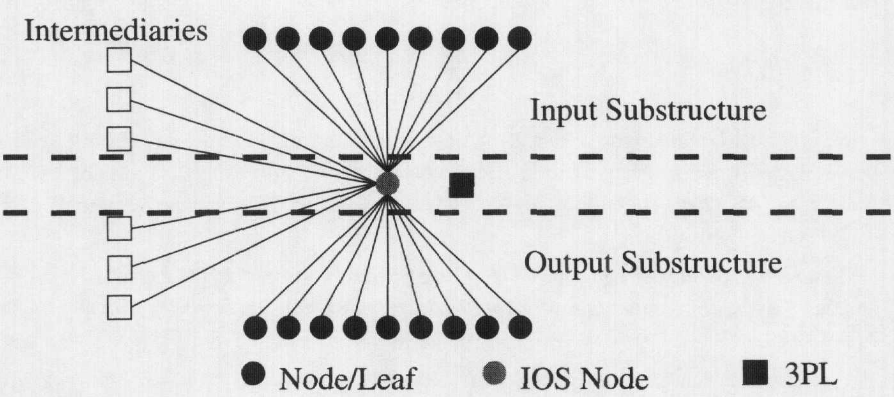
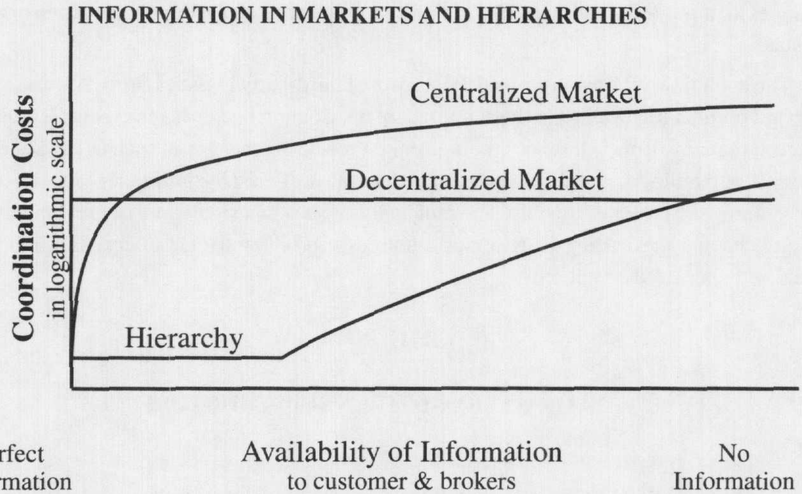


FIGURE 3



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