BRIE-IGCC E-conomy Project

Tracking a Transformation

E-commerce and the Terms of Competition in Industries

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ELECTRONIC COMMERCE IS changing the competitive landscape of the trucking industry. Trucking firms are using the Internet's strategic building blocks of distributed access to information, quick communication, and boundary-defying connectivity to exploit current resources and capabilities and to explore new Internet-enabled business opportunities.

This chapter proceeds as follows. The first section outlines the trucking industry, concluding that it is highly competitive and volatile. The second section uses several examples to depict the impact of e-commerce on the industry, concluding that information availability is creating demands to exploit existing skills in order to increase efficiency as well as producing opportunities for exploration of new transportation services. The third section provides examples of changes in industry structure, concluding that alliances and acquisition activity will take place on horizontal and vertical dimensions as firms seek greater scale and coordination for both operating efficiency and service innovation. The fourth section reports a survey of firm-level Internet activities, concluding that the Internet is just beginning to become an important source of trucking activity, with intriguing impacts on services, organization, and performance.

We greatly appreciate comments from Steven Weber.
Trucking Industry Background

The trucking industry is the primary mode for freight movement in the United States and is central to the health of the economy. Over 11 billion tons of freight were transported in the United States in 1997. Of these shipments, trucks provided for 60 percent in shipment volume and 81 percent in revenue.

The trucking industry has gone through a long cycle of regulation and deregulation, causing high industry volatility. The Motor Carrier Act of 1935 required that commercial interstate companies obtain operating authority from the Interstate Commerce Commission. Most carriers set prices through a collective rate-making process made legal by federal antitrust exemption. The federal Motor Carrier Act of 1980 initiated substantial changes in interstate services by allowing easier entry, providing greater pricing flexibility, eliminating restrictions on how many customers a contract carrier could serve, and reducing restrictions on private fleets. After the 1980 act, increased industry capacity quickly resulted from rapid expansion by entrants and incumbents. Competition has led to lower rates and high efficiency; typical operating ratios (operating expenses divided by operating revenues) average in the mid to high 90 percent range. About 48,000 carriers went out of business from 1980 to 1999, following deregulation, including seventy-four of the top 100 firms from 1984.

The trucking industry is highly segmented and extremely fragmented. Within the industry, freight movement is distributed among truckload (TL), less than truckload (LTL), and private fleet segments. A reasonable approximation of the number of U.S. trucking firms is that there were almost 500,000 interstate motor carriers in 1998; this number includes about 30,000 for-hire carriers, while the remainder were private fleets. Of the 30,000 for-hire carriers, about 21,000 (69 percent) were TL specialists, about 8,000 (28 percent) handled both LTL and TL shipments, and 1,000 (3 percent) were LTL specialists. Most firms are quite small. Over 70 percent of the interstate carriers operated six or fewer trucks, and nearly two-thirds of the 30,000 for-hire carriers had annual revenues of less than $1 million.²

TL carriers specialize in hauling large shipments (typically over 10,000 pounds) for long distances. An owner-operator or a driver employed by a

² See, for example, American Trucking Associations (1999); Standard & Poor's (1999); Newport Communications, "The Structure of the US Trucking Industry," 1999 (www.heavytruck.com/newport/facts/structure [April 14, 2000]).
TL firms will pick up a load from a shipper and carry the load directly to the consignee without transferring the freight from one trailer to another at a terminal. The TL segment moves about 45 percent of primary shipment volume and 37 percent of revenue (1997 figures).

LTL carriers haul shipments that tend to weigh between 150 and 10,000 pounds for moderate distances (about 250 to 650 miles). LTL carriers operate networks of consolidation centers and satellite terminals. A pickup and delivery truck will transport an LTL shipment from the shipper's dock to the trucking firm's local terminal, where dock workers will unload and recombine the shipment with other shipments that are going to destination terminals (transporting shipments from one terminal to another terminal is a part of what the industry calls "line haul" operations). Once the shipment arrives at its destination terminal, the load is processed and then hauled to the consignee as part of the "pickup and delivery" operations. LTL shipments account for about 3 percent of shipment volume and 16 percent of revenue.3

Private fleets operated by manufacturers or distributors account for about half of U.S. volume (52 percent) and revenue (47 percent) of general freight shipments. Private fleets focus on medium to short hauls, outsourcing lengthier hauls. The private trucking share has been declining recently due to the availability of low-price alternatives and to the complexity of the logistics process involving increased imports and exports. The growing availability of Internet-based commercial trucking services may lead to further outsourcing if the services facilitate communication between shippers and commercial trucking firms.

In summary, the trucking industry is critically important to the economy, is highly competitive, faces high demands for efficiency, has frequent entry and exit, and consists of many small carriers with a few larger firms. This is the industry setting in which the opportunities and challenges of e-commerce arise.

3. In the past few years, largely as a result of the emergence of the Internet economy, package express (PX) companies such as UPS have become a highly visible part of the LTL segment, and many of the larger package express firms have merged with "traditional" LTL companies. There are several key differences between PX and the rest of LTL. One is the equipment needed to move goods; PX has more items to deliver but the goods are lighter and PX pickup and delivery vehicle (PUD) drivers do not need to operate forklifts. Another difference is the volume of material to pick up and deliver; PX usually has ten to fifteen pickups or deliveries an hour, while LTL has about two to five an hour. PX and the rest of LTL share key similarities, though, in aggregating shipments from multiple sources and then disaggregating them to multiple consignees.
The Impact of E-Commerce on the Trucking Industry

The Internet has both direct and indirect influences on the trucking industry. The direct impact centers on information brokers, which traditionally have managed the flow of shipment information in the industry. The indirect impact of the Internet arises because e-commerce is changing the competitive landscape in which the customers of trucking firms must operate, owing to the availability of greater information about goods and services, prices, and timing. The changes are causing pricing pressure in traditional transportation activities. Increased information is also leading to more fine-grained market segmentation as well as to demands for new goods and services by trucking companies.

With the dual demands for greater efficiency and innovative services, the Internet is causing substantial pressure on the capabilities of trucking companies. Firms are able to respond to some demands through incremental expansion of their existing expertise. Many changes, though, require major changes in routines and resources. In some cases, the new skills will destroy firms’ existing competencies, as in the case of freight brokers (discussed later in this section), causing internal resistance to change. In other cases, the new skills require routines that the firms cannot create from their existing repertoires, as in the case of integrated logistics services (discussed in the next section).

In either case, whether due to internal resistance or lack of existing routines, many changes are far beyond the ability of the firms to develop internally within the available time and cost constraints. As a result, acquisition and alliance activity is becoming increasingly common in the industry, with the interfirm activities arising from the need to gain access to new resources and coordinate the use of heterogeneous resources. Thus through combinations of internal development, alliances, and acquisitions, firms are attempting to exploit their existing skills while also exploring new business opportunities.

4. Richardson (1972); Langlois and Robertson (1995).
Changes Driven by the Availability of Shipment Information for Freight Brokerage

The key direct impact of electronic information involves load matching and volume discounts. The strongest challenges are arising for freight brokers, which traditionally have provided these services to trucking companies and their customers.

Load-matching services provide information that matches available shipments with trucks that have available cargo space in order to increase trailer utilization and decrease waiting times. Load-matching information is valuable to small trucking firms and owner-operators as well as to large firms that are interested in increasing productivity by reducing empty back-hauls. Load matching traditionally has been the business of freight brokers (freight forwarders). New types of electronic brokers such as Transplace.com and Freightquote.com are threatening the future of traditional information brokers both from within the industry and through entry to the industry.

Transplace.com is an example of how industry incumbents are gaining efficiencies by combining asset rationalization and information management. The company plans to create a high volume freight network that will increase equipment utilization for fleets and reduce waiting time for drivers. Transplace.com serves as an information aggregator in the fragmented truckload sector by helping both shippers and carriers to match loads and rationalize capacity.

Transplace.com was formed when six of the largest publicly held TL carriers agreed to combine their logistics operations into the new Internet-based transportation logistics marketplace (Covenant Transport, J.B. Hunt Transport Services, M.S. Carriers, Swift Transportation, US Xpress, and Werner Enterprises). In addition to providing logistics services, Transplace.com will negotiate discounts for fuel, equipment, maintenance and parts, insurance, credit, and other services for its equity partners and other carriers. The founding firms plan to leverage their experience, physical assets, industry-specific information technology expertise, brand equity, and customer relations in the electronic marketplace. Such moves in the trucking industry parallel attempts to create market-specific mega-marketplaces such as those that are being established by auto industry firms, consumer products companies, and retail stores.

While Transplace.com leverages its traditional transportation asset base in the e-business environment, a new genre of information brokers is
emerging on the Internet. In early 2000 there were at least twelve online load-matching exchanges either in operation or in prototype stages, most planning to charge small monthly usage fees. These exchanges arise owing to the geographic dispersion of the industry and the small size of most carriers. The new exchanges challenge traditional freight brokers in managing the coordination of information and freight. At the annual convention of the Transportation Intermediaries Association in March 2000, the dominant topic of discussion was the threat posed by the Internet and new load-matching software.

Freight brokers note that the Internet is challenging them in two ways. First, in brokerage substitution, the Internet enables many shippers to post loads and solicit competitive bids directly from carriers that use the Internet to identify back-hauls. This process combines load matching with competitive pricing. In the process, the shipper receives a low bid and the carrier increases productivity by reducing empty miles. In this scenario, the traditional freight broker has no role, because shippers function as their own brokers and deal directly with freight companies.

Second, the Internet allows new intermediaries to aggregate loads and obtain volume discounts. Freightquote.com is an example of an Internet-based trucking industry info-mediair. Freightquote.com targets smaller shippers that do not have enough volume to negotiate discounts on their shipments. Freightquote.com leverages the volume generated from smaller shipments to gain discounted rates. On its Internet site, shippers can identify prices and order deliveries. Membership is free for shippers (membership information provides Freightquote.com with shipper and carrier data). Shippers pay a fee each time they use the service to ship goods. Freightquote.com handles arrangements for pickup, paperwork, and billing online. This scenario provides a critical role for freight brokers in the changing industry, unlike brokerage substitution, but requires brokers with new information technology skills and management abilities.

To take advantage of the information-based brokerage opportunities, brokers and trucking firms require new skills. Key capabilities include information technology skills, including capability to use many types of hardware and to develop and deploy many types of software, and organizational skills, especially the ability to integrate information technology personnel and systems with other elements of the businesses. In parallel, trucking companies must develop skills that allow them to identify and negotiate shipments that are now available because of the increased information. The new information-based brokerages allow some incumbents to
exploit new opportunities with their existing capabilities and open the door for entrants that are exploring new business models.

Responses to Changes in the Competitive Environments of Shippers and Consignees

In addition to changing the competitive environment of freight brokerage in the trucking industry, shippers and consignees are placing new demands on trucking companies as they face changes in their own competitive environments. These new customer demands are arising in all customer industries as the increased availability of information has reduced distance constraints in terms of market reach and is transforming processes for the creation of goods and services. More specifically, the emergence of electronic commerce in many consumer and commercial markets has created new shipment requirements for customers of the trucking industry.

The impact of changes in customers' competitive environments on trucking companies is twofold. First, shippers and consignees are demanding refinements of existing trucking services. For instance, manufacturing firms are adopting practices such as just-in-time delivery and production and electronic data interchange (EDI), which in turn require the timely movement of raw materials to the production location and to appropriate distribution areas as finished goods. Similarly, wholesale and retail distributors are increasingly demanding more frequent delivery of goods and services, often supported by extensive EDI. Trucking firms have had to alter existing practices to ship goods more quickly, cheaply, and with increased service quality. Second, as an integral part of the supply chain, trucking firms are exploring new information-enabled opportunities to expand existing services and create new transportation services. Both types of changes require that trucking firms undertake a combination of exploitation and exploration as they improve their use of existing skills and acquire new capabilities.

Arnold Industries and UPS are illustrative cases in which trucking companies are redefining the boundaries of the services they offer in the Internet-enabled economy. Arnold Industries has long been a profitable LTL company. Over the past decade, the company has expanded into the regional TL segment by acquiring TL firms. The company is now combining its trucking and warehouse operations to offer one-stop order fulfillment services for e-tailers and mail-order catalog companies. These services include order processing, inventory management, and small-
package shipping. In this process, the company has transformed its business to improve its ability to fill orders quickly and precisely. The firm has turned its warehouses into logistics hubs for the order fulfillment process: receiving goods from manufacturers or suppliers and processing, packaging, and delivering to customers. Arnold Logistics also provides value added services by comparing freight rates and handling customer returns. Further, Arnold Logistics takes online orders on behalf of its shippers and also provides live chat and e-mail support for customers. The traditional LTL and TL segments of Arnold Industries have benefited from the new business activities, because shipments to the logistics warehouses use TL and LTL services. In addition, and at least as important, the company has substantially expanded into new transportation services that emphasize information management rather than physical handling of goods. Thus Arnold Industries has transformed its definition of the transportation business to extend far beyond movement of freight. It has leveraged its knowledge and expertise to become an information transfer point for transportation services.\(^{10}\)

Several examples involving UPS further illustrate how trucking companies are integrating themselves into the web of Internet activities. UPS dominates shipping from Internet retailers. For instance, UPS delivered 55 percent of the goods ordered online in the 1998 Christmas season. UPS’s relationship with Nike demonstrates the basis of UPS’s success. In order to expedite the order-to-delivery process for Nike.com, UPS stocks Nike shoes and warm-ups in its Louisville warehouse and fulfills customer orders hourly. Indeed, UPS plays a direct role in the order process as well as in delivery, because a UPS call center in San Antonio handles Nike.com customer orders. Consequently, Nike saves on overhead costs and, most important, achieves quick sales turnaround. A second UPS example is the company’s relationship with the fashion website Boo.com, for which UPS handles batches of supplier shipments, inspects the merchandise, and packs it in Boo.com-branded boxes for shipment.\(^ {11}\)

An initiative with the Ford Motor Company provides a third UPS example. In early 2000, UPS and Ford announced an alliance in which


UPS will oversee the delivery networks for Ford vehicles. A key element of the system that UPS will establish for Ford is a vehicle tracking system that will allow Ford to track the location of each vehicle from production through delivery. Eventually, customers may be able to use the system to track the vehicle that they have ordered. The alliance with UPS is an attempt by Ford to move from a mass distribution system to a virtual delivery plan for each vehicle. UPS will use its technological expertise and logistics capabilities to help create this transition. The two firms' goal for the new delivery system is to reduce delivery times by about 40 percent while increasing reliability and reducing costs.

In each of these examples, similar to the Arnold Industries case, UPS is extending its activities far beyond traditional movement of goods. Rather than simply being a package express shipper, UPS is undertaking many business processes: receiving customer orders, warehousing goods, and coordinating after-sales services. UPS, like other established package express carriers, is well positioned to take on additional outsourcing of activities that private fleets have traditionally handled themselves or to substitute for traditional LTL services.

Such business transformations mark a redefinition of trucking industry boundaries. Until recently, most analysts omitted companies such as logistics providers and package express carriers from the trucking industry. As the boundaries between transportation services become increasingly blurred, firms that provide these services clearly are now central to the industry.

At the same time, though, the nature and even the name of the industry have changed substantially. Rather than simply being "trucking" companies, many of the firms in the industry have become "asset-based transportation management" service providers. This new term means that the companies own and operate physical assets—such as trucks and other vehicles, warehouses, and information systems—but in addition they provide a broad range of information-based transportation management services that emphasize coordinating many steps in the production-to-customer value chain. These additional services range from warehousing goods to order taking to logistics management to after-sales services.

Responses to the new demands of the changing competitive environment are arising both from entrants to the industry and from incumbents. New entrants are emphasizing relatively fine-grained services such as Internet-based information brokerage. By contrast, industry incumbents are taking the lead in the development of the more complicated set of asset-
based transportation management services. These early observations of industry dynamics are consistent with the fact that incumbents often lead the industry in developing and adopting new technologies as long as the technologies address customer needs within the value network in which they competed. As industry incumbents expand their services, enter new markets, and create new services, their diversification choices reflect the relative applicability of their resources in the new technological environment.

Change in Industry Structure: Virtual Trucking and Consolidation

Major changes in structure are taking place in the trucking industry as a result of changes in the Internet information environment. For instance, some industry analysts predict that the share of primary freight shipments carried by for-hire operations will increase, substituting for private fleet, and that package express shipments will increase drastically, possibly in substitution of LTL carriers.

In the e-commerce environment, customers now often view transportation as a continuous value proposition with no regard to segments or length of haul. This view has led to at least three types of changes that are affecting industry structure. First, as we noted in our discussion of freight brokerage, some firms are exploiting the connectivity and access to information that the Internet allows by offering “virtual trucking” services, in which the transportation companies serve as system integrators. Second, faced with stringent demands for shipment time and quality, shippers would like to deal with one company for most or all of their inbound and outbound shipping needs. As we noted above, many incumbents in the trucking industry are restructuring to offer integrated transportation solutions by including logistics and other transportation options in their corporate portfolio of asset-based transportation management services. These firms are now offering suites of “one call, one carrier” services, including TL, LTL, logistics, package express, and intermodal services. Third, some incumbents are leveraging existing freight movement skills to explore new

12. See, for example, Penrose (1959); Singh and Mitchell (1993); and Christensen and Rosenbloom (1995).
opportunities in related industries. These transitions are leading to substantial changes in industry structure through concurrent waves of consolidation, expansion, and entry.

Virtual Trucking: A New Organizational Form

The Internet has given rise to a new breed of firm, "the virtual trucking company." Such companies own no assets themselves; instead, they act as system integrators for asset-based companies. For example, FreightPro.com is an Internet venture started by a group of trucking executives backed by $3 million in venture capital. FreightPro.com uses the Internet to compete directly with asset-based transportation management service providers. The new firm contracts with independent carriers, warehouses, and drivers to provide LTL freight transportation while using web technology for services that range from rating shipments and scheduling pickups to tracking shipments and billing customers. The founders are veterans of the trucking industry and have extensive knowledge about the inefficiencies in the LTL environment—the new venture is attempting to exploit the inefficiency of the traditional LTL business model. These inefficiencies arise because most LTL freight consolidation takes place during the night, leaving the terminal facilities nearly empty the rest of the time, while most LTL warehouse operators are busy only during the day. FreightPro.com proposes to execute an efficient virtual trucking business by using existing public warehousing space to consolidate shipments, using the Internet and load-planning software to put together pickup and delivery and line-haul routes, and subcontracting the shipments and routes on a per shipment basis.

The Internet allows virtual truckers to communicate with shippers and subcontractors. In turn, the business proposition permits the firm to use embedded knowledge and current industry characteristics to advantage. "Assetless" logistics providers have been a part of the trucking environment for the past two decades—since the widespread availability of computing hardware and software. However, limitations on immediate and widespread communication prevented these firms from expanding beyond offering very limited services. The Internet provides the foundation for innovative integration of complex logistics algorithms with aggregation of fragmented information, thereby providing a more seamless transportation alternative.¹⁶

Virtual trucking is an example of alliances in the trucking industry. Like acquisition activity, such alliance activity stems from needs for access to capabilities and coordination of activities. At the same time, the needs for coordination often will involve such complicated interactions among the firms that alliances will provide only partial solutions. Instead, it is likely that there will be increased reliance on acquisitions of complementary firms in order to undertake the substantial changes that Internet-based business will require.

**Industry Consolidation and One-Stop Transportation Solutions**

Several trucking firms have developed portfolios of asset-based transportation management services through mergers and acquisitions. Examples include CNF Transportation, Caliber Systems, USFreightways, and CRST International. The operating units of CNF Transportation include a package express firm (Emery Worldwide), an LTL firm (Con-Way Transportation Services), and a logistics provider (Menlo Logistics). Similarly, the operating portfolio of Caliber Systems includes a package express firm (RPS), an LTL firm (Viking Freight), and a logistics provider (Caliber Logistics). Caliber, in turn, was acquired in late 1997 by Federal Express. USFreightways acquired Glen Moore Transport in 1998 in order to provide truckload services nationwide. USFreightways has expanded its primary business of providing regional LTL by acquiring a domestic and international freight forwarder, a reverse logistics firm, and a regional truckload carrier.

Notably, such acquisitions require substantial postacquisition change and integration of the businesses. For instance, UPS is now undertaking greater vertical integration of its activities to provide better coordination of the types of services that we described earlier. Similarly, CRST International has recently restructured itself into a single transportation services company by combining its six units into one operating unit. In the past, each unit served customers separately in their niche markets. Through the restructuring, CRST International combines CRST for TL, Malone Freight lines and the Three 1 truck line for flatbed services, CRST Logistics for logistics services, and an express LTL service. According to the president of CRST, John Smith, "It didn't take a genius to figure out it was better

approaching this as one team of professionals totally focused on the customer and making transportation as easy as possible for our customers.\textsuperscript{19}

Competitively, these organizations have to contend with the challenges posed in each of the segments in which the firms participate. Many of the firms began restructuring and consolidating when logistics software became widely available and increasing cross-border shipments necessitated shippers to require multiple services from their trucking vendors.\textsuperscript{20} As more firms present themselves as providing transportation management services, their formidable task is to achieve the close coordination that is required to capture the benefits of being a single entity.

Many or most of the acquisitions in the industry involve vertical combinations of firms. Vertical combinations involve mergers of transportation providers and firms that provide complementary services, such as logistics firms and freight forwarders, rather than horizontal combinations of direct competitors. The rationale for the complementary vertical combinations involves, first, gaining access to capabilities that the firms require to refine existing services and offer new services and, second, providing greater coordination of changing activities than the firms could achieve through arm’s-length negotiation between independent companies.\textsuperscript{21} Such vertical consolidation might be only a temporary stage in the industry but will provide critical coordination at this stage of learning about integrated opportunities.

\textbf{Exploring New Frontiers}

The Internet is leading to major changes in retailing and, in turn, presents an opportunity for the trucking industry. However, in order to exploit the growing potential of this environment, trucking firms have had to change their business practices in significant ways. These changes parallel our earlier discussion of asset-based transportation management.

Bekins Van Lines, a subsidiary of third-party logistics provider GeoLogistics, created a new firm called HomeDirect USA to focus exclusively on services for online retailing of home furnishings. The company combines the trucks of Bekins Van Lines and the trucks of 500 other LTL firms to deliver furniture from manufacturing sites to local markets. To

\textsuperscript{20} Nagarajan, Bander, and White (2000).
\textsuperscript{21} Capron and Mitchell (1998).
further customize its support for online retailers, HomeDirect offers a "white glove" service option in which the driver and a helper carry the furniture inside the home, place it in the desired location, and dispose of packaging debris. The extra service costs the customer about $215, which is 72 percent above normal shipping rates and adds significantly to the firm's profitability. According to Jim Greiger, vice president of strategic marketing and development for HomeDirect USA, "It is no longer just logistics, trucking, and warehouse. Customer service is now a core focus."22 In this model, the trucking firm, as the only live contact between the retailer and the customer, now takes the role of the retailer's company service representative.

Other trucking firms have chosen to expand beyond their traditional segments to exploit the geographic reach of the Internet. For example, Consolidated Freightways hopes to boost its customer base by moving beyond its traditional LTL services. The company has created a website, CFMovesyou.com, to provide household moving services. While moving household goods is significantly different from moving bulk freight and other LTL shipments, the Internet has provided an opportunity for Consolidated Freightways to leverage its nationwide assets and use its expertise in logistics and freight handling to diversify into a new business opportunity.

The cases described above are instances in which firms in the trucking industry are value innovators.23 These firms are addressing the opportunities provided by the transformation of the traditional trucking industry structure. Their actions address the exogenously created demands that arise from their shippers and consignees due to the impact of technological change. In addition, the changes that the trucking firms undertake are leading to further changes in their competitive environments by developing demands for new services.

Firm-Level Activities: Information from a Survey of the Trucking Industry

E-commerce is leading trucking firms to transform their internal information-based operations. First, firms are attempting to align their structure,
systems, and people with the new competitive environment. Second, firms have changed and improved internal processes by adopting information technology that emphasizes mobility and connectivity.

The data in this section are based on reviews of trucking company websites plus a mail survey concerning the use and impact of information technology in the trucking industry.24 We summarize results from 177 respondents to the survey, with information that applies to late 1999 and early 2000. The respondents represent a cross section of the trucking industry, including operators in the TL (40 percent), LTL (71 percent), logistics (20 percent), package express (9 percent), and private fleet (30 percent) segments. About 55 percent of the firms participate in two or more segments of the industry. About 65 percent of the firms operate 100 or fewer power units.

Organizational Change: Structure, Systems, and People

Trucking firms increasingly are adopting the Internet to accomplish their e-commerce initiatives and have transformed the business organizations to do so. Trucking firms are using the web for automating many of their exchanges with shippers and consignees, improving communications, acquiring new customers, and customizing services. Table 14-1, which we developed by reviewing the Internet sites of ten leading LTL carriers, provides a list of the ways in which firms use the web and an indication of the extent of use of these features by some prominent trucking firms. It is evident that the Internet offers the opportunity for trucking firms to improve processes, reduce paperwork, and reduce administrative overhead costs. At the same time, though, it is not yet clear whether the savings will be enough to offset the investment in new web-based technology and organizational change.

We summarize five areas of trucking changes: the competitive environment, Internet use, sources of Internet technology, organizational changes, and early impact of Internet activities. First, the firms report that the competitive environment has changed in terms of time demands from customers since 1996. More than a third of the firms (37 percent) reported that they had more time-sensitive deliveries in 1999 than in 1996, while

24. We conducted the survey with the sponsorship of the University of Michigan Trucking Industry Program (UMTIP). UMTIP receives generous support from the Sloan Foundation and from trucking industry corporations.
time-sensitivity rarely declined (9 percent). Indeed, about 55 percent of the respondents classified over half of their total dispatches as time-sensitive in 1999. Many customers now require fast, frequent deliveries.

Second, the survey suggests that the Internet had become a part of the trucking firms’ business by early 2000. Among the respondents, 75 percent report at least minimal Internet activity. At the same time, however, the impact is at its very early stages of both investment and customer activity. The firms on average devoted only about 12 percent of their investment in new technology on Internet-related projects. Internet sales activity is even lower; on average, the firms with Internet activity procured only about 5 percent of their shipments via the Internet in 1999. Thus although Internet applications are diffusing widely among trucking firms, they still account for only small parts of the firms’ business activities.

Third, the trucking firms most often developed the Internet applications internally (78 percent), sometimes in conjunction with consultants. Our conversations with trucking firm managers suggest that the nature of the trucking industry requires company-specific knowledge to develop effective applications, at least at this early stage of Internet diffusion. Such knowledge includes detailed information about customers, routes, services, and physical assets that would be difficult or impossible for independent software companies to develop as “off the shelf” applications.

Fourth, the firms report substantial organizational changes since 1996, particularly for firms with the greatest Internet activity. Listed here are the most significant.

—More cross-functional work: cross-functional work is more common at many firms (67 percent). Such cross-functional work helps integrate the activities of asset-based transportation management.

—Increased span of control for dispatchers: dispatchers and other managers at many firms (65 percent) have greater span of control than they did three years ago. This increased span of control both increases productivity and provides more direct coordination of the complex delivery schedules and activities of asset-based transportation management.

—Addition of line haul terminals: many of the firms (34 percent) increased the number of terminals they operate, although few firms (16 percent) reported significant increase in the length of haul. The increased number of terminals provides denser line-haul networks and allows the firms to provide quicker responses for time-sensitive deliveries.

—Increase in hiring of drivers and IT professionals: employment changes reflected the changes in time-sensitivity and the growth of Internet
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(These are placeholders for the actual content)
applications. Increased employment was most common for line-haul drivers (66 percent of the firms) and pickup and delivery drivers (64 percent of the firms) in LTL operations, consistent with the finding that firms increased the number of terminals they operate. The need for more fine-grained time-sensitive deliveries has led to greater need for people for these activities. The number of programmers and other information technology personnel most often stayed about the same from 1996 to 1999 (53 percent of the firms), although a substantial minority of firms (39 percent) reported increased IT staff. Moreover, firms that invested in Internet technology were almost twice as likely (36 percent versus 20 percent) to hire more programmers and systems personnel than firms that did not invest in Internet technology. Clearly, firms often need to invest in new information technology personnel in order to develop Internet applications.

—Organizational rationalization: organizational change was common for firms offering Internet services. Many respondents added new departments (48 percent) or eliminated old departments (63 percent). Firms using Internet applications were the most likely to add or eliminate departments. These trends suggest that organizational rationalization helps firms avoid a mismatch between the new services that they offer and their old organizational structures.

—Increased alliance and acquisition activity: alliance and acquisition activity was common. Many firms created new alliances (51 percent), while a sizable minority acquired other businesses (28 percent). These interfirm changes are part of the process of offering integrated transportation management services, whether as "virtual" systems through alliances or integrated systems within single companies. In addition, many firms have ended old alliances (25 percent) or divested parts of their businesses (22 percent). Firms with Internet applications were slightly more likely to create new alliances or acquire new businesses. As in the case of departmental rationalization, interfirm rationalization activities are part of the process of changing the mix of services at the firms.

Fifth, although it is still far too early to assess the full impact of the Internet, several initial observations about how the Internet may influence business changes are notable.

—Overall, many firms (50 percent) reported that the Internet helped them manage change.

—Firms using the Internet found that it had a substantial impact on exploitation opportunities building directly on existing activities. Existing
activities that commonly benefited include improving internal process quality (56 percent) and process time (43 percent); improving external relationships with shippers (52 percent), consignees (45 percent), and third parties (49 percent); improving service speed (42 percent), timeliness (32 percent), and dependability (34 percent); reducing costs (33 percent); improving dedicated services (32 percent); and analyzing customers (33 percent). By contrast, the Internet had little impact on shipment length or size (5 percent to 12 percent).

—At the same time, the Internet also contributed to exploration opportunities, including adding new customers (58 percent), new services (38 percent), and new markets (34 percent).

—The comparative results show that exploitation and exploration are complementary activities rather than substitutes for each other. Firms that reported higher mean exploration usage of the Internet also tended to report higher mean exploitation activities. That is, firms rarely sought exploration opportunities without also attempting to exploit existing skills in more depth. This joint emphasis reflects the competitiveness of the industry, which leaves little room for future-focused strategies that do not also pay close heed to improving current operations.

The results serve as an indication of firm-specific actions in response to the emergence of the Internet environment in the trucking industry. They consistently show that competitive conditions are changing and that many firms are seeking both exploitation and exploration opportunities in the turbulent world of e-commerce.

Adoption of Web-Based EDI and Mobile Communication

Many shippers are insisting that carriers provide visibility for the freight from the buy button on a retailer's website to the customer's door. Trucking companies have responded to this challenge in several ways, including mobile communications, Internet-based EDI, and information-based service quantification.

Mobile communications products connect trucks with the office, thereby providing substantial transparency throughout the system. Schneider, the nation's largest truckload company, was a pioneer in the use of Qualcomm's mobile satellite systems that combine vehicle location with fleet management. The process improvements enabled by the information provided by the system and the extent to which shippers value carriers with
"connected" fleets have prompted widespread adoption of three types of mobile communication systems: (1) cellular communications; (2) specialized mobile radio; and (3) satellite systems. Results from our survey on information technology use in trucking show that these three types of mobile communications systems are now very common among trucking firms. We find that almost two-thirds of the respondents (61 percent) had adopted at least one, and about a quarter (23 percent) more than one kind of mobile communication system.

Products that use the Internet as the communications vehicle for EDI transactions have dramatically decreased costs. Traditionally, EDI services such as load tendering, status reporting, and invoicing cost thousands and tens of thousands of dollars to set up and run, while also requiring substantial ongoing effort to maintain interfirm system compatibility. These costs and difficulties inhibited adoption of EDI systems by small carriers; in turn, the limited adoption hurt the capability of small carriers to work with large shippers that mandated EDI transactions. Now some shippers are using systems that allow EDI transactions over an extranet, which is a secured Internet location that reduces set-up costs. Still in its nascent phase, web-based EDI systems require manual entry and have not yet been widely adopted. However, the potential low cost and standardized accessibility of EDI over the Internet levels the playing field for carriers that had been excluded from many freight opportunities earlier.

The higher demand for logistics, vehicle and freight tracking, and other information increases the amount of information the trucking firm must process. The data can be used to quantify the quality of service the carrier offers. Details concerning on-time delivery, service records during surge periods, and low damage records provide competitive advantage.

As we noted, the survey suggests that companies that invest in Internet development value the easy acquisition and exchange of information with their shippers, consignees, and third parties. Moreover, Internet applications may diffuse more widely than traditional dedicated EDI systems have done. Fewer than half of the firms in the survey (44 percent) report using traditional EDI systems, while, as we noted earlier, about 75 percent of the firms offer Internet services. Moreover, about two-thirds (65 percent) of the firms that do not use traditional EDI have introduced Internet services. Early indications, therefore, suggest that Internet applications may prove more widely accepted than traditional EDI systems, which are often dedicated to particular customers.
Conclusion

Rich Hardt, director of systems development at Yellow Corporation, said as he announced that Yellow had signed on to be the transportation provider for eChemicals, "One Internet year is seven business years and twenty transportation years." Trucking firms are having to adapt to the "Free, Perfect, Now" e-commerce environment or go out of business.

Many firms in the industry have adapted by making major changes in business practices involving both exploitation of existing skills and exploration of opportunities that require new capabilities. Trucking firms are participating in the new economy by expanding existing resources, adopting new technologies to enable Internet-based communication with their customers, and improving processes to promote service and efficiency. The freer flow of information, the connectivity, and the opportunity to aggregate dispersed information have spawned new web-enabled businesses, and these new entrants are challenging many traditional assumptions and business practices. At the same time, trucking industry incumbents are using alliances and acquisitions to redefine themselves as asset-based transportation management companies. In this process, the industry incumbents have had to modify their existing organizational structures, systems, and people to execute the e-commerce strategies. The industry is facing its greatest challenge since deregulation two decades ago.

The actions of the trucking firms will affect far more than the performance of the trucking services industry alone. The response of trucking firms to Internet-based opportunities and challenges will have major influences on the economy as a whole. The future of e-commerce depends on how physical goods are transported within the constraints of time, cost, and quality. As a result, the response of established and new trucking firms will play a significant role in determining the extent to which the full potential of e-commerce will be fulfilled in the economy.

References


