

Freight Transportation Planning and Logistics

AMELIA REGAN, *University of California, Irvine*

JOSE HOLGUIN-VERAS, *City College of New York*

GARLAND CHOW, *University of British Columbia*

MILES H. SONSTEGAARD, *University of Arkansas*

A well-functioning freight transportation system is an essential element in any successful economy. However, at the beginning of the new millennium, the prediction is that the demand for goods movement will outstrip the rate of improvements to the physical infrastructure. Marked growth in time-sensitive freight markets will tax demands on a system that already is operating near capacity in some areas.

Key issues and challenges that will affect freight planning and logistics in the future include the following:

- The demands for freight transportation and logistics services, and the ability of the physical and information infrastructure to meet these demands;
- The role of road pricing in urban freight transportation;
- The impact of information technology on goods movement; and
- New developments in logistics management.

SUPPLY, DEMAND, AND PRICING

In the new millennium, the freight transportation system will face challenges that will require the development of new paradigms of operations and planning. This situation will result from a combination of factors.

First, domestic and international freight demand will continue to grow. Domestically, the consumption of goods will increase as new segments of the population enjoy more effective income. Internationally, the incorporation of the former socialist republics into the world trade system and the expansion of economic activities in developing countries will significantly augment the flow of goods and merchandise. Concurrently, pressure for enhanced economic competitiveness—a consequence of the economic unification of Europe and the resurgence of the Asian economies—will increase.

New freight-transport systems must be responsive to user needs and expectations. The trends in service differentiation that have characterized the late 1990s will shape the freight systems in the next century. Consumers will demand more control of the nature of the service they receive. This trend will be accentuated by the availability of information systems and technologies that enable users to specify the kinds of service they require and to integrate their operations effectively with the freight transportation system.

In addition, freight planners will have to deal with significant constraints. Additional infrastructure will be increasingly difficult to obtain and possibly undesirable in some

communities; therefore, more efficient use of existing infrastructure and careful development of new capacity will become increasingly important. Examples of this trend include the implementation of intelligent transportation systems (ITSs) to manage traffic flow, the development of the Alameda Corridor in California, and assessments under way in the New York–New Jersey area for developing exclusive truck routes linking intermodal facilities, new maritime terminals, and a new rail freight tunnel.

ROAD PRICING

Differential road pricing—that is, using different toll rates for different classes of vehicles at different times of the day to manage traffic and reduce congestion—is being assessed in some metropolitan areas, and its role is likely to increase. However, the demand-driven nature of freight movement today—customers can specify the precise time when freight is to be delivered—may make congestion pricing for freight less effective. Any implementation of road pricing must consider the impact on certain industry and commodity clusters. Some businesses must receive their goods during peak periods for reasons that include production schedules, community curfews, security, and labor considerations.

Finding appropriate solutions to these challenges will require new paradigms for cooperation between private industry and government. These new paradigms should revolve around three issues:

1. Using public funds to finance freight infrastructure projects that would benefit private industry,
2. Incorporating private industry input into the planning process, and
3. Streamlining of the environmental approval process and the resolution of disputes between regulatory agencies and the freight industry.

Freight issues must be elevated to a level commensurate with their importance in the transportation planning process. From an institutional standpoint, one of the major challenges will be to implement a planning process for freight transportation that is both responsive to and flexible enough to accommodate the needs and expectations of the different stakeholders. This goal must be accomplished while transforming the planning agencies into truly multimodal agencies. Public awareness of the importance of freight movement also must be improved. It should not take a crisis—for example, a strike by a major freight provider, threatened terminal closures, or freight traffic diversions that result from delays in port dredging—to make the public recognize the value of reliable freight service.

The planning process also will require the development of new modeling paradigms for freight demand. Regrettably, not enough progress has been made toward improving the state-of-the-practice for estimating freight demand. The lack of appropriate models, the inherent difficulty of obtaining reliable data on freight movements, and the lack of substantial research initiatives in this area—and the funds for them—pose significant obstacles to the proper and expedient incorporation of freight issues into transportation planning.

INFORMATION TECHNOLOGY

The impact of information technology on the freight transportation system has been significant and likely will increase sharply. The steadily declining prices of new technology, coupled with an increased awareness among freight operators of the technology's potential benefits, will encourage the freight industry to increase its use of information technology. The industry already has implemented cutting-edge technologies to improve customer service and to reduce expenditures.

Information technology also will have varying effects on the different modes of transportation. Carriers in all modes increasingly will rely on continuous updates on the location and status of the vehicles and containers in their system. Additional growth in the intermodal freight market requires an increase in information sharing across companies. The productivity of integrated freight transportation providers such as Federal Express and United Parcel Service will improve with increased use of information technology. Nonintegrated intermodal users may achieve even greater gains as electronic waybills replace the paper trail that follows freight movements and as shipper service and status requests take place via electronic data interchange. Electronic commerce (e-commerce) probably will bring about changes in both the configuration and profitability of a portion of the freight sector. It also might lead to reductions in average shipment size, corresponding increases in shipment frequency, and an emphasis on time-definite delivery.

Recent technological advances include but are not limited to electronic data interchange (EDI) technologies, automatic vehicle and container identification systems, location and navigational systems, mobile communication technologies, mobile computers, database management and value-added data manipulation systems (e.g., data mining), container status information systems, and advanced traffic information and management systems. The result of these developments is that freight transport is moving toward operational integration, both within and between companies. Information technology will make nonintegrated transport providers more competitive with integrated ones. Appropriate sharing and integration of information will substitute for full-scale control.

The information revolution is responsible for changes that originate both inside and outside the freight transportation system. Information technology available to manufacturing and retail firms affects their distribution strategy in many ways. Just-in-time manufacturing and distribution systems rely on a continuous and reliable stream of information on the current and near-term status of every link in the supply chain. Manufacturers and distributors leverage information to reduce their inventories significantly and to shift inventories from warehouses and distribution centers to rolling stock in the transportation network. This shift increases the burden of responsibility on the carriers as well as the need for shippers and carriers to cooperate. Information sharing by shippers and consignees will reduce inventory further, if the providers of freight transportation are integrated into the information stream.

LOGISTICS

Logistics is concerned with the efficient flow of raw materials, of work in process inventory, and of finished goods from supplier to customer. In addition to transportation, logistics entails inventory control, warehousing, materials handling, order processing, and related information activities involved in the flow of products. How these activities are managed and organized determines the quantity and quality of transportation demanded and

the nature of the commercial relationships between shippers and transportation service providers.

The globalization of business has increased the need for global supply chains that are longer, more complex, and inherently costlier. Businesses will seek logistics service suppliers who can meet their global logistics needs. This development will spur the growth of global third-party logistics (3PL) providers who provide a full portfolio of logistics services, including transportation. It also will encourage the development of modern and efficient transport infrastructures to minimize the cost of transport operations on major trade routes. These infrastructures include right of way, intermodal facilities, and communications links for all modes.

The need to reduce inventory investment by reducing cycle time has led away from these *push* systems, which are driven by the supply of materials and goods, to *pull* systems, in which actual demand for goods triggers product flow. Just-in-time and quick-response are some of the names given to these logistics systems. Production or ordering is postponed until products are sold or consumed. The product is produced and transported in smaller quantities. Because the product demand is known with great accuracy, products bypass the traditional storage and holding processes in warehouses and distribution centers. Instead, they are delivered directly to customers or are mixed with other freight for immediate delivery in cross-dock facilities.

Pull processes require fast, frequent, and reliable transportation systems with shipment visibility. This requirement has fueled the growth of time-sensitive transport alternatives such as air freight and priority ground transport. Full-load transport is not inappropriate for the frequent delivery of small quantities of a particular product, because full loads can comprise multiple products from multiple sources. At the same time, direct delivery of small, individual shipments via parcel carriers to consumers is becoming the rule rather than the exception, as speed is built into the logistics system rather than being reserved for emergencies. Transport suppliers must be able to provide shipment visibility by adopting mobile communication, e-commerce, vehicle status, and other technologies.

Outsourcing noncore activities previously involved a single logistics service, such as transportation. Today, 3PL providers offer an array of bundled logistics services, including strategic planning and control of the logistics process. The attractiveness of outsourcing is evidenced by the rapid growth of the 3PL industry from \$10 billion in gross revenue in 1992 to \$40 billion in 1998, and annual growth forecast between 15 and 20 percent through 2003 (1). Some of the leading suppliers are subsidiaries of transportation companies, and most large transportation companies offer comprehensive logistics services through subsidiaries or affiliates.

Shippers traditionally purchased transportation from asset-based carriers that could provide service at less cost because of economies of scale, utilization, and specialization. However, non-asset-based logistics suppliers are increasingly important as information technology plays an ever-greater role in supply chain integration and as operations research models become more sophisticated. Increasingly, economies of scope, or the benefits arising from being able to manage and integrate complementary logistics services, have become the source of reduced cost or improved service and therefore are prime criteria for choosing a logistics service provider.

Traditional transport firms face the dilemma of expanding their capabilities and becoming 3PLs or becoming suppliers to 3PL providers that represent the end customer.

The competitive boundaries between transport companies and 3PL providers are blurred because both are competitors and partners in meeting the demand for transportation and logistics services. Similarly, regional or domestic providers must decide how to provide the seamless, one-stop service demanded by global customers. Direct expansion was considered the most effective means to achieve broader coverage in the past, but alliances and partnerships rapidly are becoming an effective alternative for extending logistics services and geographic areas.

Partnerships between firms and logistics suppliers are growing and taking on more importance with the outsourcing trend. The traditional transaction-based relationship will continue, but more companies will seek the benefits of coordination and collaboration through partnerships. Successful alliances often involve concentrating business to fewer suppliers to leverage the customer's buying power and make the process economical.

The ability to build partnerships will be a critical advantage for a transportation company or 3PL. Partnerships with customers and suppliers will be important, but so will alliances with other transportation and logistics suppliers. These alliances provide the strategic advantages of multiple partners to meet the demand for one-stop, seamless, global, and comprehensive logistics services. Although the adoption of interfirm communications technology will be important in implementing partnerships, the ability to build and sustain relationships with other firms will be the key to success.

CONCLUSION

Freight movement uses local, regional, national, and international systems. Cooperation between private and public sectors—requiring changes in both—will be needed to ensure a transportation system that meets the freight needs of businesses and consumers. Because customers will require one-stop shopping, freight movement increasingly will be intermodal and multimodal. This trend will accelerate cooperation and coordination between modes and transportation companies. Successful freight transportation providers will offer an increasingly wide array of logistics services or they will partner with well-equipped logistics management firms. In short, the roles are changing for freight transport users, transport providers, and policy makers interested in ensuring the swift and efficient movement of goods, which is vital to the strength of our economy and the prosperity of our communities. Although increased coordination and involvement has started in some regions, a greater effort is needed to achieve a shared vision for freight movement.

ACKNOWLEDGMENTS

The authors thank Isaac Shafran, chair of the TRB Committee on Freight Transportation Planning and Logistics, for contributions to this paper. Committee members Amelia Regan, Jose Holguin-Veras, and Anne Strauss-Wieder edited an early draft of this paper.

REFERENCES

1. Delaney, R. *A Look Back in Anger at Logistics Productivity*. 10th Annual "State of Logistics Report," Cass Information Systems and ProLogis, Saint Louis, Mo., 1999. <http://www.clm1.org>.