LOGISTICS - International Encyclopedia of Human Geography (1025)

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Glossary

Commodity chain (supply chain): A functionally integrated network of production, trade and service activities that covers all the stages in a supply chain, from the transformation of raw materials, through intermediate manufacturing stages, to the market. The chain is conceptualized as a series of nodes, linked by various types of transactions, such as sales and intrafirm transfers.

Distribution centres: Facility or a group of facilities that perform consolidation, warehousing, packaging, decomposition and other functions linked with handling freight. Their main purpose is to provide value-added services to freight and they are a fundamental component of freight distribution.

Electronic data interchange (EDI): Communication mode for inter- and intra-firm data exchange in the freight forwarding and logistics business.

Gateways: A location offering accessibility to a large system of circulation of freight, passengers and/or information. Gateways reap advantage of a favorable physical location such as highway junctions, confluence of rivers, seaboards, and have been the object of a significant accumulation of transport infrastructures such as terminals and their links.

Hubs: Central point for the collection, sorting, transshipment and distribution of goods and passengers for a particular area. This concept comes from a term used in air transport for passengers as well as freight. It describes collection and distribution through a single point ("Hub and Spoke" concept).

Intermodal transportation: The movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in changing modes. Enables cargo to be consolidated into large units (e.g. containers) in order to have efficient cargo transfer between ships, barges, railcars, or truck chassis.

Platform/modular manufacturing: Strategy in which a multinational corporation retains its core competencies, namely its research and development, retailing, marketing and distribution, while subcontracting much of the manufacturing to the lowest bidders.

Radio Frequency Identification Device (RFID): Technology that uses small devices attached to objects that transmit data to a receiver. An alternative to bar coding used for identification and tracking purposes, notably for items shipped in units (boxes, containers, etc.), but can also be attached to an individual item. Main technical advantages include data storage capacity, read/write capability, and no line-of-sight requirements during scanning.

Supply Chain Management (SCM): The management of the whole commodity/supply chain, from suppliers, manufacturers, retailers and the final customers. To achieve higher productivity and better returns, SCM tries to reduce inventory, increase transaction speeds, and satisfy the needs of the customers in terms of cost, quantity, quality and delivery as much as possible.

Keywords
Logistics, freight distribution, materials management, supply chain management, freight transportation, distribution centres, logistics networks, geography of distribution.

This section is dedicated to the analysis and assessment of different dimensions in the system of logistics and material flows, to identify their outcome on physical distribution and freight transport, and to determine their particular geographical significance. Logistics comprises materials management and physical distribution within and among firms. Once, it mainly consisted of transport and warehousing activities. More recently, logistics developed as a response to the rising complexity (e.g. division of labour) and increasing scale (globalisation) of economic activity. It now includes a wide array of activities such as order processing, production planning, scheduling, and even some manufacturing tasks such as packaging and labeling. Technological change, particularly new information and communication technologies, allowed for a comprehensive analysis, management and control of information and goods flows. Major characteristics of modern logistics are the functional integration of supply, manufacturing, distribution and recycling of materials in the concept of supply chain management, also the establishment of large scale logistics networks. Both have substantially changed the way goods merchandise is being processed, in terms of magnitude, frequency or location. Logistics networks consist of flows and nodes, thus representing the geographical manifestation of the system. Whereas the overall volume of freight transport has increased for decades, particularly for the road and air modes, freight distribution is also subject to dynamic changes, in terms of technology, size and location.

Logistics

Logistics involves a wide set of activities dedicated to the transformation and circulation of goods, from raw materials, manufacturing to final market distribution as well as the related information flows. Such activities are divided into two major functions which are materials management, with an emphasis on organization, and physical distribution, including transportation. By definition, materials management considers all the activities related in the manufacturing of commodities in all their stages of production along a supply or commodity chain. It includes production and marketing activities such as production planning, demand forecasting, purchasing and inventory management. Physical distribution includes the broad range of activities involved in the movement of goods from points of production to final points of sale

and consumption. Logistics has to provide for seamless between the different components of a increasingly fragmented creation of added value.

In the context of globalization, logistics includes the set of operations required for goods to be made available on markets or to specific destinations, which mainly include transportation, stock management and order processing (Figure 1). Logistics is a multidimensional activity where added value is provided through the use of production, location, time and control of elements of the supply chain. It reconciles production and consumption and its efficient use insures a close match between the needs of the customers and the capacity of the suppliers to provide them. Other terms have been used in close association with logistics, including supply chains and commodity chains, aiming at analyzing the set of interrelated activities needed for the manufacturing and marketing of certain products. Regarding logistical expenditures, which include transportation, warehousing, inventory carrying, order processing and administration, they represent about 10-15 per cent of the total world Gross Domestic Product (GDP). The most significant cost concerns transportation (39 per cent), followed by warehousing (27 per cent) and then inventory carrying (24 per cent); they jointly account for 90 per cent of all logistics costs. It is quite clear that considering those costs there are substantial interests for transport companies and manufacturers to improve their freight distribution.

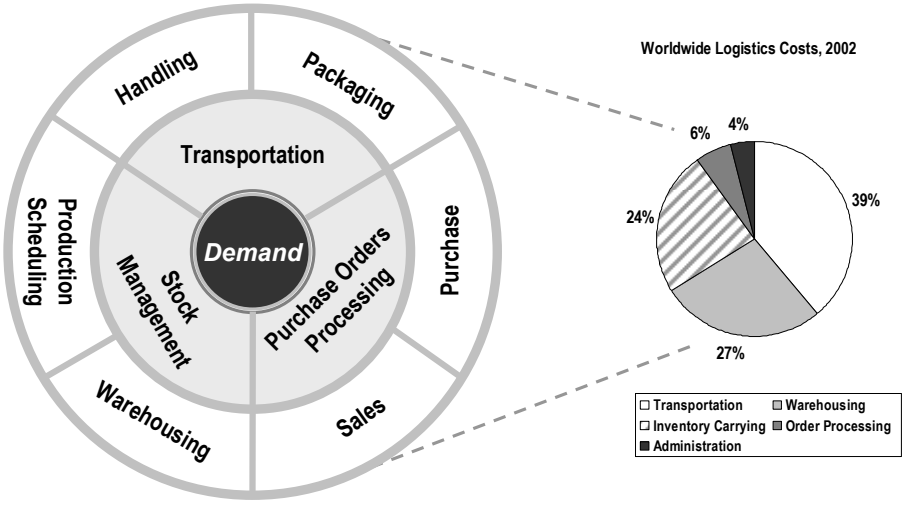

Figure 1 Logistics Operations and Global Logistics Costs

On the basis of new information and communication technologies, distribution systems have become increasingly driven by demand instead of by supply, implying a shift in the relative importance of specific logistical functions, mainly inventory, transport and information systems (Figure 2). In a conventional situation, a supply driven distribution system is mainly based on the function of inventory. Production, often taking place in large batches, is simply "pushed" down the supply chain with the hope that what is being produced will be consumed. Since elements of the supply chain are loosely integrated, parts and/or products must be stored to accommodate the chronology of the demand. In contrast, contemporary distribution systems are becoming increasingly demand driven (upstream). Under such circumstances, minimal inventories are maintained and most of it is circulating, thus the increasing importance of the transport component in distribution. The operational management of such as system relies heavily on information systems to insure that parts and/or products are delivered where and when they are required (on demand).

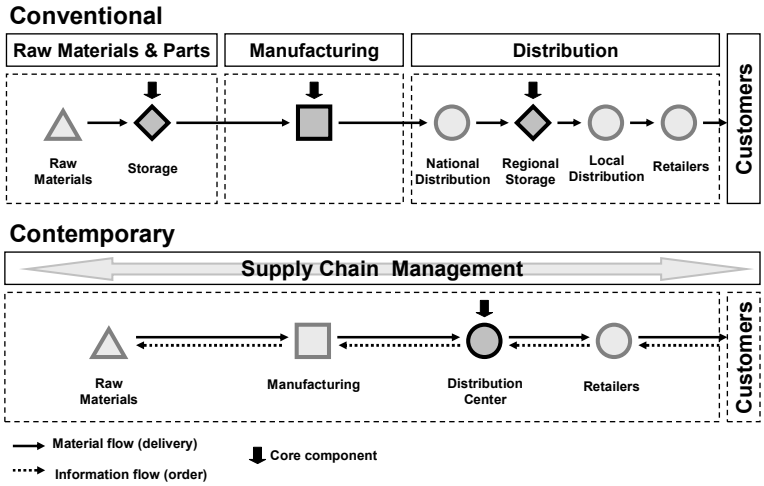

Figure 2 Conventional and Contemporary Arrangement of Goods Flow

The Dimensions of Logistics

Organizational Perspective

Integrated supply-chain management has developed in response to new modes of production, in the context of globalization, and with respect to a highly competitive market environment. The focus of supply chain management is shifting from maintaining inventories aimed at approximately satisfying a demand towards a comprehensive data collection system insuring that supply matches more closely with demand. This is mainly to be achieved through on-demand distribution. Thus, physical flows also involve a significant amount of information flows. This trend was accelerated by the use of logistics, namely a better integration between transport modes and inventory control.

One of the main rationales for eliminating inventories is the need for cost reduction at all levels of corporate activity. Also essential is achieving a high market presence in terms of timely delivery, particularly since inventories no longer buffer against supply problems, disruptions in the transport chain etc. In order to fulfill these requirements, specialized coordinators and integrators (third- and fourth-party logistics providers) have emerged, focusing on improving parts of the supply chain or providing their coordination and control. While push logistics involves a limited level of integration between suppliers, manufacturers and distributors, a pull logistics system tries to achieve a higher level of efficiency through integration. Freight flows between components of the supply chain tend to be more frequent and in smaller batches. In addition, the sharing of demand dependant data helps better synchronize supply with demand. Reverse logistics also tends to be better integrated in the system to achieve a higher level of customer service as well as to promote environmental strategies such as recycling.

The conventional forward channel in freight distribution is well understood with raw materials, parts and finished goods flowing from suppliers to producers, distributors and, finally, to consumers. There is also a reverse channel where waste, packages, and defective/obsolete products are “climbing back” the supply chain (Figure 3). In some cases (such as a defective product), distributors will take back the merchandises, but in many others, a specialized segment of the distribution industry aims at collecting and then recycling goods and parts. Thus, reverse logistics (or reverse distribution) is concerned about the movements of previously shipped goods from customers back to manufacturers or distribution centers due to repairs, recycling or returns.

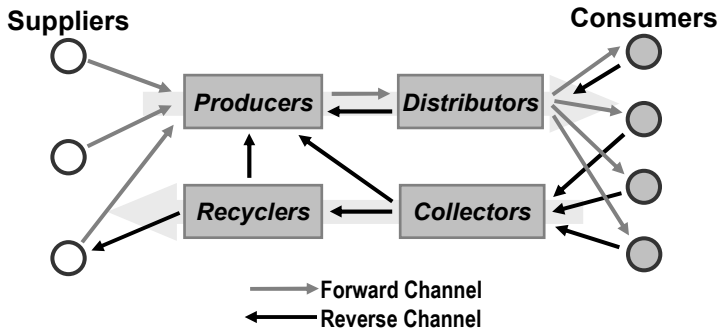

Figure 3 Forward and Reverse Distribution

Major changes in the manufacturing systems have led to the emergence of "platform corporations" that bundle a core of research and development, finance, marketing and distribution activities while removing (outsourcing) the manufacturing component, or never had manufacturing in the first place. They have done so by focusing on the activities that provide the most added-value and subcontracted the manufacturing of the products they design. Their core activities include research and development, finance, marketing, retail and distribution. Many of them own globally recognized brand names and are actively involved in the development of new products. Their net worth is thus more a function of their brand names and capacity at innovation than from some tangible production assets. They outsource as much of the low margin work as possible and are flexible in their choice of suppliers. Thus, the term platform is used to characterize a mobile core establishing temporary relationships with manufacturers.

Platform corporations particularly thrive in the context of free trade the mobility of factors of production is facilitated so that products can be produced wherever costs are the lowest and exported back to major markets. Telecommunications have also allowed corporations to decentralize their process while maintaining a level of control over their supply chain and informing their suppliers about changes in the demand. Since platform corporations provide the specification of the products / parts they require, there are a potentially high number of manufacturers that can bid to become suppliers. This works to the advantage of platform corporations by keeping costs low and it even create a situation of recurrent overcapacity. Dell, IKEA and Wal-Mart are examples of such corporations that outsource the low margin manufacturing activities to low cost locations and establish effective networks of supply and production. Corporations are thus becoming "logistical entities" since they manage a complex structure of production, distribution and retailing.

Technology

Modern distribution systems require a high level of control of their flows. Although this control is at start an organizational and managerial issue, its application requires a set of technical tools and expertise. If technology can be defined by the level of control over matter, technology applied to logistics can be defined as the level of control of its flows, let them be physical and information related. An important technological change relates to intermodal transportation, particularly containerization, which has been shaping the logistics system in a fundamental way. Logistics and integrated transport systems are reciprocal endeavors. More recently, the application of new Information and Communication Technologies (ICT) for improving the overall management of flows, particularly their load units, has received attention. Thus, the physical as well as the ICT parts of technological change are being underlined. The ICT component is particularly relevant as it helps strengthen the level of control distributors have over the supply chain. The technological dimension of logistics can thus be considered from five perspectives:

- Transportation modes. Have been the object of very limited technological changes in recent decades. In some cases, modes have adapted to handle containerized operations such as road and rail (e.g. doublestacking). It is maritime shipping that has experienced the most significant technological change, which required the construction of an entirely new class of ships and the application of economies of scale to maritime container shipping. In the context of these changes, a global network of maritime shipping servicing large gateways has emerged.
- Transportation terminals. The technological changes have very significant with the construction of new terminal facilities operating on a high turnover basis. Better handling equipment lead to improvements in the velocity of freight at the terminals, which are among the most significant technological changes brought by logistics in materials movements.
- Distribution centers (DCs). Technological changes impacted over the location, design and operation of distribution centers; the facilities handling the requirements of modern distribution. From a locational standpoint, DCs mainly rely on trucking, implying a preference for suburban locations with road accessibility. They have become one storey facilities designed for higher throughput and less warehousing with specialized loading and unloading bays and sorting equipment.
- Load units. Since logistics involves improving the efficiency of flows, load units have become particularly important. They are the basic physical management unit in freight distribution and take the form of pallets, swap bodies, semi-trailers and containers. Containers are the privileged load unit for long distance trade, but the growing complexity of logistics required a more specific level of load management. The use of bar codes and increasingly of RFID (Radio Frequency Identification Device) enables a high level of control of the load units in circulation.
- E-commerce. Consider the vast array of information processing changes brought by logistics. The commodity chain is linked with physical flows as well as with information flows, notably through Electronic Data Interchange. Producers, distributors and consumers are embedded in a web of reciprocal transactions. These transactions mostly take place virtually and their outcomes are physical flows. E-commerce offers numerous advantages for the whole commodity chain, from consumers being exposed to better product information to manufacturers and distributors being able to adapt quickly to changes in the demand.

For logistics, ICT is particularly a time and embeddedness issue. Because of ICT, freight distribution is within a paradigm shift between inventory-based logistics to replenishment-based logistics (Figure 4). The reliance is shifting from maintaining inventories aimed at approximately satisfy the demand to a comprehensive data collection system insuring, mainly through on-demand transport, that supply matches with demand. This trend is accelerated by logistics, namely a better integration between the movement of goods on one hand and inventory control on the other hand. While a push logistics system involves a limited level of integration between suppliers, manufacturers and distributors, a pull logistics system tries to achieve a higher level of efficiency through integration of flows (i.e. information). Freight flows between components of the supply chain tend to be more frequent and in smaller batches. In addition, the sharing of demand dependant data (such as sales) helps better synchronize supply with demand. Reverse logistics also tends to be better integrated in the system to achieve a higher level of customer service as well as to promote environmental strategies such as recycling. In several cases, third-party logistics providers (3PL) are contracting the supply chain management of some segments of the commodity chains.

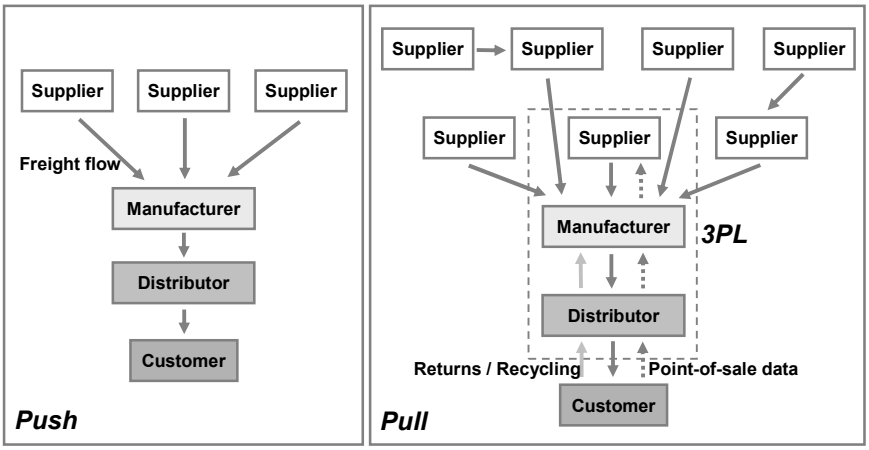

Figure 4 Push and Pull Logistical Systems

Institutions and regulation

In conventional logistics, materials management and physical distribution have been operated by manufacturers or retailers. The transport industries were constrained to a certain portion of the market, due to strong regulations pertaining to market access, multimodal ownership and freight rates. As a consequence of deregulation, the market share of specialized service providers has increased tremendously through modal and intermodal penetration. According to recent organizational change in supply chain management, specialized subsidiaries like third- and fourth-party logistics providers (3PL and 4PL) have been taking over large portions of materials management from shippers in industry and retail (Figure 5). A 3PL is an asset based company that offers logistics and supply chain management services to its customers. It commonly owns and manages distribution centers and transport modes. A 4PL integrates the resources of producers, retailers and third-party logistics providers in view to build a system-wide improvement in supply chain management. They are non-asset based meaning that they mainly provide organizational expertise.

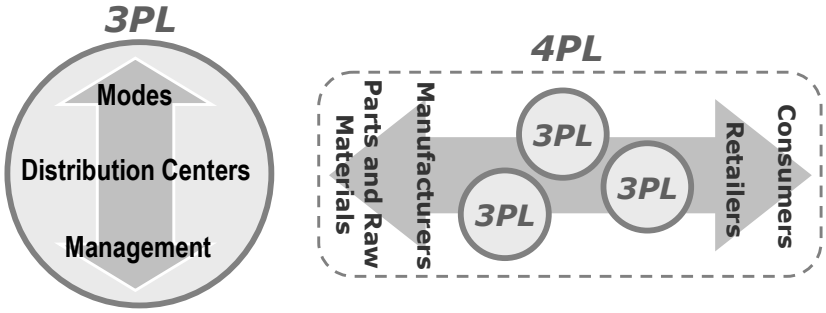

Figure 5 Third and Fourth Party Logistics Providers

Major changes have occurred in the global transportation regulatory framework, particularly in North America and in Europe through deregulation and privatization. Whereas transport services have traditionally been considered part of the national transport infrastructure and thus been subject to strong regulation, most transport and logistics submarkets have been opened to competition since the 1980s. Formerly public or state-owned companies like the Deutsche Post World Net now belong to the largest logistics corporations worldwide. As a consequence of deregulation, freight rates have decreased, productivity improved and markets became integrated at a transnational level (e.g. NAFTA, European Community). In most cases, deregulation also permitted cabotage, foreign market entry or multi-modal ownership and thus improved the degree of integration of supply chains. Also, freight transport increased

in response to lower freight rates and transnational integration based on diminishing barriers (customs, concessions). More recently, the globalization of supply chains is further increasing, with multinational corporations offering worldwide services in logistics, terminal operations, etc. In particular, the specialization and globalization of port terminal operators is becoming highly important to understand spatial dynamics in the networks of global flows. Thus, both fragmentation and integration of supply chains can be observed. Also, as a general trend, the formerly strong link between corporate activity (e.g. terminal operations) and locations (e.g. main ports) is unraveling.

Regardless of the important role market deregulation has played in transport over the last decades, public policy remains a major factor of influence for the framework of distribution and thus on the freight traffic performance. This is due to the still vital role of nation states in providing and maintaining transport infrastructure, also to jurisdiction issues, particularly the enforcement of load and vehicle inspections, labor regulations, or vehicle noise and air emission standards. The main rationale used by public agencies to justify their involvement is increasingly related to the environmental sustainability of transport. Improved logistics is commonly perceived as a strategy to achieve this goal. At the local and regional levels, zoning policies and building permits regulate the locational constraints and opportunities of the logistical firms. Yet the modern corporation appears to be quite powerful in selecting or even creating the locational environment that is needed. This usually exerts high pressure on local communities to offer appropriate conditions and to compete for corporate investments.

Territory and infrastructures

The territorial development of the conventional logistics system was mainly determined by transport infrastructure and the physical conditions under which it could be established and operated. In contrast, the spatial performance of modern logistics is an outcome of network building and network design. Logistical networks are the major precondition for market coverage, spatial reach and scale of distribution. They are increasingly hierarchical and configured at large scale, shifting from the local or regional level to national or even trans-national reach. The flow of goods depends on this particular characteristic, as does the locational system, according to the demand for cost reduction and economies of scale. Thus, the extent of goods flow and the number of distribution levels and places are inversely correlated: The more centralized the logistics network, the higher the amount of vehicle miles required to operate the system.

As a consequence of this trend towards hierarchy, distribution functions tend to be centralized, with distribution areas being extended. Thus, new logistics networks support the shift towards larger distribution centers, often serving significant trans-national catchments. However, this does not mean the demise of national or regional distribution centers, with some goods still requiring a three-tier distribution system, with regional, national and international distribution centres. Besides the shift from multi-level structure towards a more large scale network structure, logistics networks have also been changing from direct to hub-and-spoke-relations, with central hubs being interconnected and serving subordinated nodes (Figure 7).

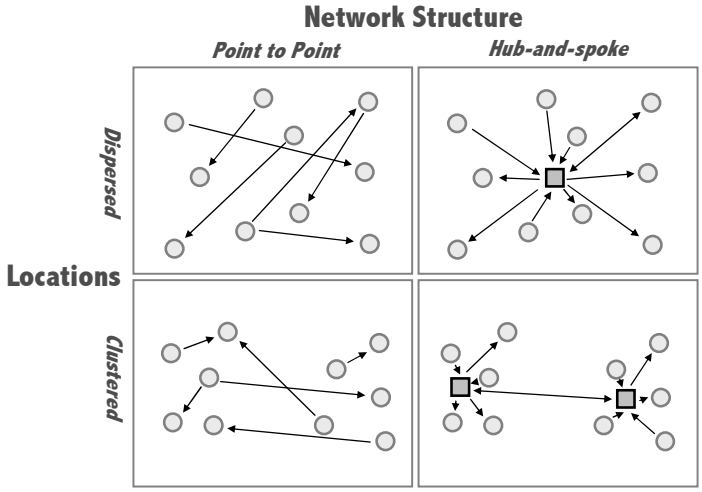

Figure 6 Logistics Networks

Concomitantly, facilities for logistics operations are much larger in size than before, the locations being selected with particular respect to long-distance accessibility. Traditionally, freight distribution settled close to the places of production, such as in the manufacturing belt at the North American east coast and in the Midwest, or in the old industrialized regions of England and continental Europe. Today, particularly large-scale goods flows are directed through major gateways and hubs, mainly large ports and major airports, and at highway intersections with access to an extended market area. The changing geography of manufacturing and industrial production has been accompanied by a changing geography of freight distribution. This is notably the case in Pacific Asia, where industrialization and integration to global trade have triggered the emergence of large-scale high-throughput nodes such as Hong Kong, Singapore, Shanghai, Busan and Kaohsiung, now representing the largest container ports in the world. In the case of North America, those hubs or gateways are strategically located at the East and West Coasts, such as the Ports of the San Pedro Bay in Los Angeles, the Port of Seattle/Tacoma, and the Port of New York/New Jersey.

The expansion of such places is primarily due to the growth of trade and transport in general, supported by economic growth and the expansion of market areas due to globalization. Yet the strategy of concentrating freight at hub locations is also becoming restricted, due to density, land constraints, and congested traffic arterials. Such limits to expansion and the scarce hinterland connections of major hubs are considered the most important obstacle for further developing major hub locations. Consequently, inland hubs are becoming more and more important, where primarily road and air freight is consolidated. These new DC areas are mainly affiliated with the interstate network and air cargo facilities. Warehousing, trucking, freight forwarding and air cargo activities are major indicators and drivers of this new distribution economy. One of such new inland hubs is emerging in North America along the Ohio River Valley, stretching across a corridor from Ohio and Indiana to Tennessee. Respective European developments favor strategic places in Southeast England, the Benelux countries, Germany and eastern France. The Netherlands has emerged as the most favored location for European logistics, due to excellent accessibility, advanced terminal and transport infrastructure, critical mass of logistics functions and attractive operating conditions (vis-à-vis its neighbours). Schiphol Airport and the Port of Rotterdam are among the most important hubs for international freight flows in Europe.

Since many parts of the supply chain are now globally integrated, distribution centers tend to be the link between global sourcing and regional distribution. Thus the DC has become an interface between the geographies of manufacturing and retailing, consequently handling the

distribution scale and scope. Innovations such as containerization and particularly developments in information technologies have integrated all components of the chain. In response, major players in the distribution business (e.g. container shipping lines, freight forwarders, warehousing firms, terminal operators) are trying to control as many parts of the logistics chain as possible. Challenged by vertical and horizontal linkages, by mergers, takeovers and strategic alliances, they need to stay competitive by increasing throughput and providing services at the lowest rates. As a result, the activity space of mainports is becoming relocated to low cost locations reaching far beyond traditional terminal sites and connecting more distant places of their hinterlands.

Outlook

The enduring growth in the movements of goods and innovations in the associated networks of logistics and freight distribution represent a dynamic part of economic globalization. These issues have however been underrepresented in regional science and geographical studies. Freight transportation appears to have been dominantly the focus of geographers dealing with maritime, port and rail transport issues. More recent developments in intermodal transportation, logistics networks, international trade and the emergence of e-commerce have substantially transformed the freight transport sector. The same applies for changes in the institutional regimes and in corporate competition. These changes triggered a renewed interest from Economists, Social Scientists and Geographers, placing the issue of freight distribution as a central concern of human geography, much beyond the traditional focus of transport geography. As technological change and globalization are moving forward, flows, circuits and the associated spaces will receive further attention, since they are essential for the global network economy.

Further reading

Brewer, A., Hensher, D., Button, K. (2001) *Handbook of Logistics and Supply-Chain Management*. London: Pergamon.

Dicken, P., Kelly, P., Olds, K. and H. Yeung (2001) Chains and networks, territories and scale: towards a relational framework of analyzing the global economy, *Global Networks* Vol. 1, No. 2, pp. 89-112.

Hesse, M. and J.-P. Rodrigue (2004) The Transport Geography of Logistics and Freight Distribution, *Journal of Transport Geography*, Vol. 12, No. 3, pp. 171-184.

Leinbach, T., Capineri, C. (2006) Freight Transport, Seamlessness, and Competitive Advantage in the Global Economy, *European Journal of Transport and Infrastructure Research*, Vol. 6, No. 1, 23-38.

Notteboom, T. and J.-P. Rodrigue (2005) Port Regionalization: Towards a New Phase in Port Development, *Maritime Policy and Management*, Vol. 32, No. 3, pp. 297-313.

Sturgeon, T. (2002) Modular production networks: a new American model of industrial organization. *Industrial and Corporate Change* Vol. 11, No. 3, pp. 451-496.

Slack, B. (1998): Intermodal Transportation. In: B. Hoyle and R. Knowles (eds.): *Modern Transport Geography*. 2nd Ed. 263-289. London: Wiley.

Slack, B. and A. Frémont (2005) Transformation of Port Terminal Operations: From the Local to the Global. *Transport Reviews* Vol. 25, No 1, pp. 117-130.

Visser, E.-J. and Jan G. Lambooy (2004) A dynamic transaction cost perspective on fourth party logistic service development. *Geographische Zeitschrift* Vol. 92, No. 1/2, pp. 5-20.

Recommended websites

Council of Supply Chain Management Professionals, http://cscmp.org/

Logistics Management, http://www.logisticsmgmt.com/

The Geography of Transport Systems, http://people.hofstra.edu/geotrans/