

Logistics Service Providers and the Transport Geography of Global Supply Chains

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Abstract

Trade liberalization, advances in transportation and development of new telecommunication technologies has enabled industrial shippers to expand their supply chains on a global stage. But the globalization context has often forced companies involved in local as well as global competition to revise their production strategies. Thus, huge changes have been arising in production processes because the scale of production networks has changed considerably. Existing production networks have been extended geographically. Then today production systems are abounding with global strategies. These inter-organizational strategies asked serious questions of the logistics system and require more attention in order to control the supply chain. In fact, underestimating the management of supply chains increases the risk of undermining the global distribution network responsible for the physical movement of goods, information and finance. Transnational corporations tend either not to want to be responsible for managing the supply chain, or not to have the resources to carry out the logistics of traffic flows in space and time. These two factors have encouraged the emergence of logistics service providers. They are used to supporting industrial shippers in the development of logistics solutions to facilitate the mobility of traffic flow within the globalized freight system that underpins global production networks. A case study of the logistics service provider APL Logistics is presented as an example of mobilizing the concept of transport geography.

Introduction.

Economic liberalization of the global economic space has significantly increased the potential sales of corporations that have embraced the internationalization of their production process. Companies that now have the major share of customers are those who, like Dell, Zara or Wal-Mart, have organized their production networks so well that they have succeeded in transforming potential markets into real ones. In a short time, these companies have surpassed their competitors in their respective fields. For example, Dell beat former number one selling computer hardware company, Hewlett-Packard; Wal-Mart overcame Sears in the retail business and Zara surpassed Marks & Spencer in the fashion sector. These transnational corporations successes are from their global production, which the logistics flow circulate through integrated freight distribution networks. In many cases, they chose to focus on their core businesses. Therefore they have entrusted the management of their on going globalization supply chains processes to third party companies. In contrast, the core business of these specialist companies is the administration of the movement and physical flow of goods and the associated information through space and time. Known as logistics service providers (LSPs), the purpose of these third party companies is not simply to reduce the unique logistics costs engendered by the mobility flows. Rather, they are charged with constructing integrated global production networks that enable consumers to receive their goods at the right time, right place, as quickly as possible and at the right cost. This article is based on the concept of transport geography; on the one hand, it seeks to show the evolution of logistics and transport in the management of the physical flows of goods, associated information and finance in space and time. On the other, it highlights the role of support provided by the logistics service providers in the process of globalization of production networks. This will be illustrated by a case study showing the logistics service provider APL Logistics taking charge of the global production networks of a shipper.

1. Globalization and the emergence of global production networks.

For years, large companies have sought to control their entire production process. In other words, as well as mastering the process of production, they concern themselves with the extraction of raw materials to build the elements, and move on to look at the marketing and distribution of finished products. This strategy was so ingrained in organizations that to deal with requests from a foreign market, companies tended to establish a branch in the territory where the demand was identified. In the 1980s, this strategy paused and took a deep breath.

Companies then turned to alternative approaches that drew on procedures based on the network paradigm. Thus, the system that dominated “Fordist” industrial production for many years gradually faded to be replaced by the integrated model known as the “Toyotism”. It is a source of flexibility that ensures a very high standard of physical flows of goods within production systems, without losing one of the benefits of Fordism, namely standardization. This is the era of outsourcing and offshoring, companies relocate their operations, at first locally and then abroad. Sturgeon (2003) has called this practice “production contract”, but the movement has increased further and taken on another dimension. Indeed, subcontractors are no longer satisfied with just producing what the focal firms (in this case transnational organizations) order from their networks. In fact, subcontract manufacturers gradually take over the coordination of the organization’s activities such as component purchasing, inventory management, final assembly of products, logistics management, physical distribution of goods, etc. The deployment of such a strategy expands the range of services offered to multinational companies. At the same time, organizations experience a profound change in their business practices. The development of these network strategies has increased the internationalization of business activity. Corporations have developed businesses beyond the frontiers of their original territories. These new organizations operate in networks that are so dense that the terms “firms-networks” has been coined. Multinational companies that operate in these network structures are central players that keep the key management capabilities in their organizations. Their role in the network is so strategic that they are also called “hub firms” or “focal firms” because they are the ones who set the tone of the now globalized network.

We are thus witnessing the widespread fragmentation of production units across the world economic space and thereby, the growth of global production networks. Thus, unlike the multinational, the global firm is not characterized by high autonomy of local production systems and a discontinuity of the production process between the other members of the whole. This is the opposite in that the interaction between members of the production networks is so far advanced. Also, the functions of dispersed global firms are administered almost continuously across geographically space. The networks are then aggregated and globalization means a strong integration between members of the global production networks. According to Coe *et al.* (2004, p. 471), global production networks can be considered as “the nexus of globally organized, interconnected functions and operations by firm, and non-firm institutions-through goods and services which are produced and distributed.” This assertion undeniably has a network perspective. Indeed, it reflects “the fundamental structural and relational nature of how production, distribution, and consumption of goods and services are organized. From this perspective, networks are not new: although they have undoubtedly become far more complex organizationally, as well as far more

extensive geographically, production networks are a generic form of economic organism rather than a hybrid form existing somewhere in-between markets and hierarchies” (Yang and Coe, 2009, p. 34). From the perspective of global production networks (GPN), “production networks are inherently dynamic and are always in flux organizationally and geographically in response to both internal and external circumstances. While some networks are very stable, others are more transitory and while some are geographically extensive, others are more localized” (Yang and Coe, 2009, p. 34). According to Coe, Hess and Dicken (2008) and Yang and Coe (2009, p. 33), the approach of global production networks “seeks to provide an heuristic framework that is both time and space sensitive.” Moreover, there is recognition that GPN are social and cultural phenomena as much as economic. GPN configurations and characteristics are shaped by, and in turn shape, the geographically differentiated social, political, and cultural circumstances in which they exist, as well as the material transformations which lie at the heart of a particular GPN” (Yang and Coe, 2009, p. 33).

2. Logistics service providers and the management of flows through global production networks.

2.1. The challenges of coordinating logistics flows within global production networks: the birth of global supply chain management.

The circulation flow within global production networks represents a very high stake to the sustainability of the system. Its effectiveness makes the connection between the different members of the production network possible (Coe *et al.*, 2008). Distribution logistics is an essential function between buyers and sellers of the production system in which they are involved. Management of distribution logistics is not just the administration of physical flow of goods or financials, it also includes the management of information associated with that flow. Traffic flow management therefore includes that of financial and other information as well as goods that originate in one place and are consumed in another. The circulation process is central to business strategies engaged heavily in a globalization of their geographically disperse productive networks, which therefore lead to complexity in their organization. In addition, time based competition has also contributed to increasing importance of logistics management in maintaining the efficiency of those globalized production networks (Schoenberger, 2000; Stalk and Hout, 1990). In fact, the nature and effectiveness of the distribution system, the freight system or the supply chain, are a major source of competitiveness for global companies; in other words, their global production networks can contribute to their competitive advantage. In recent years, global production networks

depend on them to deliver physical flows of goods and meet the ever increasing demands of their clients. The atmosphere in global production networks prompts Min and Keebler (2001, p. 265) to argue that “time-and quality-based competition depends on eliminating waste in the form of time, effort, defective units and inventory in manufacturing-distribution systems ... requiring firms to practice such logistical strategies as just-in-time management, lean logistics, vendor-management, direct delivery and outsourcing of logistics services so they become more flexible and better able to satisfy customer requirements quickly.” Thus “logistics has been transformed into the more comprehensive mode of supply chain management” (Rodrigue and Hesse, 2007, p. 104).

2.2. Logistics service providers, distribution services and logistics.

In this context, flow management, through global production networks, has fostered the emergence of players capable of providing solutions as such as industrial transportation, logistics, global supply chain management and so on. Known as logistics service providers (Dornier *et al.*, 1998), they offer their expertise in managing logistics flow and supply chain networks across space to companies involved in the process of on going global strategy. They are particularly experienced in the global production network interface management, and may support some or all of the constraints inherent in interactions between players and spatially distributed sites. Some of the services offered by logistics service providers (LSPs) are intended to regulate relations between different places and times found inside global production networks. Assigning workflow management within global production networks to an LSP offers many advantages to transnational corporations that have chosen to “go global”. Through their long experience as integrators and monitors of the geography and functional logistics, LSPs are able to offer the effective, value added services and tailored logistics solutions needed by their customers’ global production networks (Byrne, 1993; Dillon, 1989; Richardson, 1993; Troyer and Cooper, 1995). They can mobilize resources and develop the processes needed to provide superior quality logistics services (Byrne, 1993; Richardson, 1990). Their knowledge of the supply chain has helped to build their skills to reduce logistics costs and improve the flexibility of value chains for which they provide mobility flows (Bhatnagar *et al.*, 1999; Lieb, 1992; Lieb and Randall, 1996). Moreover, the LSPs may also contribute to better synchronization of flows in global production networks by supporting the administration of the physical flows of goods, information and finance; they can also plan, direct and track real-time traffic flows in space and time. The LSPs is capable of assuming responsibility for a wide range of logistics and para-industrial operations within distribution or cargo systems that underlie the global production networks to ensure smooth flow inside the entire logistics system. The logistics hubs are places where a multitude of

logistics functions are performed, whose purpose is to speed and direct the circulation flow. Such warehouses are no longer merely storage facilities, rather they act as “switching points” that enable the routing of product through supply chain networks to achieve tactical and strategic effectiveness and or efficiency. The strategic role of gateways, logistics platforms, ports or dry ports and so on in supply chains is a concept scholars have called “supply chain terminalization” (Lambourdière and Savage, 2012; Rodrigue and Hesse, 2004). This includes logistics operations such as picking, packing, post-manufacturing, co-packing and so on, which are operated at a very high level of sophistication. These are “flow factories” whose main purpose is to ensure that logistics processes are streamlined, but where there is an opportunity to carry out high value added logistics activities without interrupting the flow.

The logistic platforms are no longer just content to administer the static or even dynamic management of physical flows of goods because global shippers expect much more. Everything implemented within these platforms is intended to streamline plants to create value through the mobility of logistics flows along the distribution system that underpins global production networks. Functions now moved into logistics platforms allow the flexibility of physical distribution systems that underlie global production networks. They are generally located upstream and downstream of the physical cargo distribution systems. The logistics platforms are places in which many producers invest in order to consolidate and deconsolidate flows to coordinate and synchronize them throughout global production networks (Goetz and Rodrigue, 1999; Rodrigue, 1999; Rodrigue and Hesse, 2004). The development of such logistics infrastructures allows LSPs to overcome the “viscosity” of space and discontinuities in global production, networks. The establishment of a spatial network of logistics platforms enables LSPs to accelerate the pace of delivery to points of consumption at competitive prices. In addition these logistics sites allow LSPs manage the “last mile” logistics effectively. The management of the logistics flows within these networks of platforms gives the LSPs the opportunity to achieve the optimal mobility of the logistics flows in the space and the time. The freight system can transfer flow from one mode of transport to another. Furthermore, advances in information technology and communication, such as the Internet and electronic data interchange (EDI), have greatly improved the reliability of transfers and the running speed of information flow between different actors and the geographic locations where they operate.

Thus, it is true that globalization of production systems has been accompanied by a rise in the strategic role of logistics service providers in international business processes (Lewis and Talalayevsky, 2000; Mahnke *et al.*, 2005; Maltz and Ellram, 2000; Sanders *et al.*, 2007; Yeung *et al.*, 2012). Therefore, logistics services have become very important in today's economy. Globalization, increased trade and deregulation of global transport are the main factors that have enabled LSPs, like leading manufacturers, to include a globalization

strategy in the range of services they offer (Lovelock and Bless, 1996). The services sector accounts for two-thirds of the wealth creation in the world. Like the production of goods, it has been hit by the decoupling of business processes in space and time. “Multinationalization” is therefore no longer only the concern of industrial shippers, it also relates to another actor in the supply chain, namely the logistics service provider, especially the global logistics service providers (Bhatnagar and Viswanathan, 2000). Multinational logistics services go beyond the simple extension of services such as land, air or maritime transportation; which are, by their very nature, international. They have taken over “internal” transport activities, thus helping those transport auxiliaries to acquire and develop logistics skills and competencies. The management of globalized industrial shippers’ logistics flow within the production environment has exploded on a worldwide scale so that significant technical and economic constraints are eased. Logistics service providers must be able to steer the entire distribution system that underpins integrated global supply chains with watch-like precision. Intelligence enables strategic logistics operators to determine the most effective arrangement of their tangible and intangible resources, giving them the ability to anticipate and meet any of the industrial shippers’ new logistical needs (Wong and Karia, 2010). LSPs also contribute to creating the demand for global logistics services by allowing industrialists to become aware of needs that, previously, they could neither identify nor formulate by themselves (Bhatnagar and Viswanathan, 2000). LSPs that operate in dynamic supply chains do not all offer the same logistics services. Indeed, logistics and supply chain management literature distinguishes between LSP’s based on the services that they offer to their costumers (Cui and Hertz, 2011). There are various logistics operators inside a supply chain. Intermediation logistics companies are actors who take over the management of freight movements, such as freight forwarders, consolidators and so on; their role is the management of the physical handling of freight (Bowersox *et al.*, 2010; Coyle *et al.*, 2000).

3. The concept of transport geography to explain the role of logistics service providers in global production networks.

3.1. Functional and geography integration and the global production networks efficiency

The concept of supply chain management helps to give another dimension and perspective to the space-time concept. Indeed, logistics activities such as distribution, which had not previously been introduced into the space-time analysis, are now part of this concept (Rodrigue and Hesse, 2004; Rodrigue *et al.*, 2009). The organization and synchronization in a spatio-temporal perspective of logistics flows operate through the nodes and network

strategies of logistics infrastructure. Managing the supply chain from the perspective of transport geography requires both geographical and functional integration of the supply chain. The objective of functional integration is to ensure a harmonious relationship between members interacting within the supply chain. Functional integration began in companies but now concerns corporate networks with highly globalized supply chains. There is interdependence in the extended supply chains, which is directly linked to strategies of “just-in-time” or “door to door” that provide mobility and agility for the physical flow of goods.

Thus, logistic links between members of the supply chain, and in some cases the collaborative strategy vector in supply / demand relationships between partners, ensures outstanding agility and resilience in the physical flow of goods, information and finance in a logistics system. The objective of geographic integration is to use the competitive advantages that each territory of the world economic space can offer. Indeed, companies today have a much easier access to resources and foreign markets where they can take full advantage of ample supplies of well-trained labour at competitive prices.

Exchanges of logistic flows between supply chain members in the origin to destination direction, and vice versa, are the source of the complementary space emerging in logistics systems being developed by supply chain players (Rodrigue, 2006).

3.2. Transport geography concept to understand LSPs role in global supply chains.

The goal of transport activity is then to try to conquer space using time. When the combined value of these two factors is positive, we say that space-time is converging. Unfortunately, a number of factors, such as congestion, can change the space-time relationship, thus invalidating calculations. The concept of space-time convergent was introduced for the first time by Janelle (1968) and expanded by Janelle and Gillespie (2004) to show the rapid transport advantage of the big cities versus small ones. Literature on globalization and particular on global production networks appear to be wary of the concept of space-time converging to explain, for example, the expansionist companies' strategies around the world. According to Sassen (1991), Smith and Timberlake (2002) and Taylor (2004), only telecommunications systems and integrated transport are able to explain the magnitude of the processes of contemporary globalization.

If global production networks have an eminently geographical dimension, then they can be analyzed in terms of flows, nodes and networks that are in fact elements of a supply chain (Rodrigue and Hesse, 2004; Rodrigue *et al.*, 2009). These three elements interact in time as well as in space. The concept of space-time has been studied successfully in transport geography (Rodrigue and Hesse, 2004). Thus it is possible to explain the organization of space according to a three-dimensional perspective. In a supply chain perspective, we consider that logistics flows act in a two-dimensional space but also a third dimension, that of

time. These two categories taken into account simultaneously are used to analyze the spatial practices that fit into the space and time. In other words, the concept of space-time can be measured by a number representing space that can be traded off against a number representing time.

3.3. Flows.

Spatial differentiation is a source of flow. We can therefore consider the stream as a flow, transfer, or movement from point A to point B of a number of people, goods, and data. The flow is routed through a network. The amount and the value of the plethora flow in motion inside global production networks are closely linked with the governance that one can find in the supply chains and the freight distribution systems. In other words, territories position inside a global commodity chains much would depend on the nature of the freights in circulation through the logistics systems. Concentration and infrastructure interconnection have effects on flows. Indeed, the more efficient, resilient and modern the network is, the more the supply chains actors' make use of administered, integrated logistics management. The globalization paradigm multiplies the number of streams that flow between globalized supply chain actors, and therefore additional spaces generated. Flows are not only a marker of spatial differentiation, the volume and flow dynamics have a direct impact on the construction of new competitive spaces or the annihilation of spaces whose competitiveness would be strongly challenged by competition. Physical flows of goods are not the only change in space and time. Mastering the movement of information flows in the new geography of production is a major issue for supply chain members who must ensure that the complementary space is not a source of supply malfunctions, in other words that global logistics strategies do not disrupt the mobility of information flow within the supply chain. For long time traffic information flows could not be conceived without the movement of property or people. The advent of new generations of information technology and telecommunications has fundamentally changed the situation, because information flows are now paperless. Moreover, they travel on the information superhighway capable of transporting large quantities of data of any kind, at high speeds regardless the position of the actors in the supply chain.

Velocity and instantaneous flows are a concern, as information must reach the decision taking areas of the extended supply chain very quickly. Also, the construction of a broadband network is a major challenge for supply chain actors who want real time monitoring of the evolution of the physical flow of goods trough space and time.

3.4. Nodes and locations

Management of mobility flows in space is based on nodes that join intertwining and interconnecting lines or traffic lanes. These can be ports, airports, warehouses, national or regional hubs, logistics hubs and so on. These nodes are places where members of the supply chain carry out logistics intervention on flows through the supply chains. For example, it is thanks to those nodes that logistics operators carry out operations such as transshipment or interconnection operations. The role of these logistics platforms is to make the mobility flows inside the distribution network smooth. Transnational corporations can count on LSPs who can assemble a collection of logistics functions in those places that they consider to be strategic for the mobility management of logistics flows in space and time. Therefore, warehouses are much more spacious than before and the paradigm of globalization has had profound effects on the location strategies of logistics nodes. In other words, the new geography of production has considerably changed the geography of freight. Indeed, the warehouses were traditionally located near centres of production. Now, the physical flows of goods are sent to gateways, logistic platforms, ports or airports capable of handling very large volumes of goods. These logistics nodes are often located close to dense roadways. This spatial strategy thus allows LSPs to ensure that agile logistics flows are available to global shippers and thereby enables them to have easy access to a number of regional markets. The development of logistical flow administration is generally performed in the nodes, which are scattered through space. Their location depends on the nature of the flow and mode of transport used, and is critical in terms of both strategic and tactical effectiveness. Therefore, the positioning problem has attracted the attention of Operations Research specialists and mathematical modellers who have developed sophisticated algorithms (Cornuejols *et al.*, 1991; Kouvelis *et al.*, 2004). Many of these have been used to develop depot location software by companies such as Paragon (<http://www.paragonrouting.com/>) or DiPS (<http://www.dips.co.uk/products/strategic.htm>). The more accurate the location of a node can be, the greater is a potential for successful connections and contact with other network nodes.

3.5. Networks

A transport and logistics system consists of networks that allow the circulation of logistics flows in space and time. The networks support the flow that has to reach customers located at the extremities of the supply chain. The networks are composed of roads, railway lines, communication lines, electrical conductors and so on. Networks are established to serve a space, which helps to determine the architecture of the entire infrastructure composed of links and nodes. The construction of a network is an operation that takes time, the builders

start with a minimal network and add nodes and links to cover the required geographic area when they have the financial capacity to do so. The addition of nodes and links does not rely on an haphazard approach, rather the development of an additional node should establish a low cost link with several others. When a node does not have a dense traffic volume, network builders can connect that low traffic node with a pre-existing node neighbour to enable a link with many others. The choice of connecting network nodes may compel the operators responsible for network administration to compromise. For example, a logistics operator may have to choose between making a connection to a node of the major logistics network that is far from the network hub or connecting to a node with fewer network connections but which is closer to the origin point of the flow. The morphology of the network is not homogeneous as the spatial structure of a distribution system follows the supply chain behind it. Contemporary logistics networks consist increasingly of very large centres whose primary function is to serve the strategic markets of transnational corporations. All such complex distribution systems are set up to make the corporations' supply chains more effective. Despite this, the flow of some physical goods through them may not be effective, which means that there are still some supply chains that need additional work to ensure efficient traffic flows.

Most supply chains actors have difficulty distinguishing between supply chains that are just "complicated" and those that are genuinely "complex". As a result of this, some distribution and logistics systems managers continue to treat global supply chains that are truly complex as though they were just "complicated". Practically speaking, the growth of complexity inside the supply chains space reflects their ambitious goals. For example, supply chains members want to satisfy their customers whilst at the same time the latter demand low prices as well as high quality goods and services. Those requirements appear to be in conflict and are therefore very difficult to meet. In and of itself, supply chains complexity is not a bad thing; but with increasing complexity, as well as new opportunities, come difficult challenges. Therefore, the way members attempt to respond to this increasing complex supply chain environment imposes serious problems in day-to-day supply chain management. Supply chains actors and particularly focal companies clearly need a better way to manage their supply chain complexity. Given those requirements, it is necessary to create an environment in which supply chains members can work with one another to build creative logistics solutions to the challenges of complex global production networks' distribution systems. There is also a need to construct networks with distribution centres in regional, national or international locations. Despite the different scales of their operations, the networks in question are still able to connect with the global distribution system. Logistics solutions now have to be "complex" rather than "complicated" to cope with the high complexity level of global production networks. Learning to live with complexity is far from easy and makes it

very hard for many supply chain members to go from managing a “complicated” supply chain to dealing with a “complex” one. This difficulty helps prevent a significant number of non-efficient supply chains from becoming efficient. In turn, this keeps some underlying global production networks throughout the world state of uncertainty despite shippers quest for logistics solutions suitable for a radical supply chain. LSPs are instrumental in helping supply chains members thrive in turbulent supply chains, and therefore have the capacity for both agility and absorption. Indeed, supply chains’ actors turn to LSPs to help manage such supply chains. Thus, the latter try to develop logistics solutions that could find-tune global shippers’ supply chains to meet “complex” requirements. In other words, as the old “one-size-fits-all” logistics solutions are no longer adequate for today’s “complex” global systems, LSPs develop custom-fit solutions for the benefit of supply chains players.

4. Case study: APL Logistics and global supply chains monitoring.

Shippers from automotive industry or retail distribution sector are likely to give over the management of their global flows to LSPs with an appropriate global logistics networks. APL Logistics is an example of such a company. It draws 32% of its revenue from industry and 29% from the retail sector. APL Logistics is also involved in other industry sectors as such consumer goods (21%), electronics (4%) and other products (14%), but they represent only a small proportion of its total income. APL Logistics can be regarded as a global company because it has a globalized freight distribution network developed through geographical and functional integration of his logistics systems. The Americas market represents 65% of the turnover of the company whilst Asia and the Middle East contribute 25% and Europe 10%. This global logistics provider is also engaged in a form of a joint venture strategy that has enabled it to penetrate China and operate successfully there. Two thirds of APL Logistics’ revenue comes from logistics contracts and a third from freight-forwarding activities.

4.1. The nature of the main logistics flows driven by APL Logistics: the workflow of the automotive industry.

Although the geography of production units has changed considerably in recent years, to date, big integrated manufactures are the exceptions. Vehicle production now takes place within a large network in which the assembly is carried out at the centre of network supplier’s plants and the suppliers are very close to that centre both geographically and organizationally. Internationalization of automobile production began firstly with exports of Japanese cars; secondly, Japanese manufacturers have made direct investments in a

number of territories such as those located in Europe and United States. The U.S. carmaker Ford started the internationalization of automobile production. Japanese manufacturers then paved the way for a global expansion of production capacity thus heralding the advent of globalization of automotive industry. The internationalization of the vehicles produced will now bring foreign competition to each national market. It is necessary to make a distinction between global production networks such as those of the electronics industry, mass consumption products, computers and those of the automotive industry. The demand for motor vehicles is far from homogeneous, resulting in a highly segmented market. Also, the production of cars is global and yet very fragmented. New production units exist that, whilst fully integrated into the automakers global production networks, are there to provide tailored products to support local sales. Manufacturers must now both cut costs and diversify their production whilst producing attractive cars able to meet high customer requirements and generate sales. Such constraints have an impact on the control of workflow within global production networks. APL Logistics has extensive experience in managing such workflows as a result of several years of looking after automotive manufacturers' multiple production networks. Constraints in production flow management in recent years have led to changes that have had repercussions of the management of their movement in space and time. To achieve economies of scale and meet consumer demands quickly, motor vehicle manufacturers have changed the principles of both car production and the related network flows. A number of production concepts were introduced to reduce stock levels in production networks. They can be grouped under the generic terms lean production, agile (flexible) or leagile manufacturing. This means that the product and components that circulate in the global production network must not exceed the needs of that network. Therefore, finding a balance between the upstream and downstream flows of the global production networks is a major challenge for automakers. By ensuring flow management using the lean production method, they can then adapt the productive resources very quickly. This manufacturing method enables a failing model to be replaced in a very short time by a brand new model and, possibly, without changing the assembly lines. The manufacturers set up this kind of production strategy to try to maintain continuous flexibility of the production network. In this context, the workflow must be controlled so that its mobility in space and time can be affected without having downtime.

Workflows within global automobile production networks are driven by the downstream network, that is to say customers because they trigger the vehicle construction. As a result of this downstream control, there should not be any workflow in the upstream production network that is not allocated to a customer's order. Workflows are generated only when there is a customer order. Such workflows in production networks can also be synchronous. The principle of synchronous flows is as follows: an OEM company's production network flows

consist of subsets of the components and sub-assemblies feeding the constructor's assembly line; the delivery of these materials must occur in the order that the vehicles are scheduled on the line. From the component provider's perspective, given the short notice of any change, they do not have the time to produce subsets starting from scratch. Also, suppliers apply the principle of postponement, which involves delaying the final assembling and configuration of intermediate products into modules. As module completion is done as "late as possible", it is an activity that requires a large amount of manpower. The automotive corporations engage in outsourcing practices, which means that this completion of the sub-assemblies needs to be carried out close to the vehicle assembly plant in order to allow delivery on time and thus maintain synchronous flows. The velocity that the logistics service provider APL Logistics provides to supporting flows is a key strategic issue for these clients and the operator must make every effort not to restrict the mobility of logistics flows in space and time. Further, they must ensure the rapid logistics flows in the form of product and information throughout their global production networks. APL Logistics relies on the terminal or gateway nodes to carry on logistics activities.

4.2. APL Logistics and the processing of logistics flows at terminals.

APL Logistics' terminals that handle logistical flows fulfil the functions of transport and logistics management on behalf of its customers. In other words, an integrated set of logistics functions is performed within these terminals in which the management of the physical flows of goods is dynamic rather than static. The transport activities performed by the provider inside the terminals are reserved for the treatment of logistics flows. Workflows make use of specialist satellite terminals that ensure transmodal options are available. This type of terminal is called a load centre. Such terminals are able to respond to any increasing need for transport units (such as the number of containers) in the logistics system. Satellite terminals are often located close to marine terminal infrastructure. Sometimes APL Logistics build these satellite infrastructures to deal with the rising cost of land in regions where their existing logistics terminals are located. These terminals are serviced by trucks working on rotation. Furthermore, in order to set up sustainable logistics solutions suit, for example, a green customer's sustainable development strategy, APL Logistics offers delivery by rail or river transport for goods that have to be moved over 200 km. The company also performs transfer operations within its satellite terminals although their function is primarily dedicated to road transport. The load centre, although one of the common services on offer to industrial shippers by APL Logistics, is not found within these terminals. This operation is achieved through dedicated intermodal rail or river transport terminals. One or more of these logistical nodes are usually available to a container port. This type of terminal facilitates the movement

of goods between ports and the production and consumption areas. The containers are then loaded, consolidate and routed along the corridors. The load centre has a strategic place in freight distribution, but centres with this transmodal transportation function are often underdeveloped in physical distribution systems. This is a logistics network node that is connected to the vast system of freight distribution. The transmodal centres are served by either modal or intermodal transportation systems enabling them to be a starting point for the product's onward journey. This transport infrastructure enables the routing of workflow into a country's hinterland. So, from this perspective the terminal is considered an intermediate node of the land distribution system. Transport operations that are performed there are often high value ones. Besides the transport functions, APL Logistics can supply a number of logistics management capabilities to their customers' global production networks. APL Logistics offers three principal activities. The first relates to consolidation / deconsolidation and transloading operations. This service consolidates or deconsolidates packages that are shipped in containers to move them onwards or return them. Generally, the purpose of this logistics strategy is to adapt the physical flow of goods to match the volume required by the physical distribution system. For example, APL Logistics can receive pallets by road to deconsolidate and consolidate and then reship new shrunk wrapped pallets by rail or barge. The operations of deconsolidation and consolidation are followed by others such as transloading because they often allow physical flows of goods to transfer from a standard international configuration to that of a local mode of transport.

Postponement operations are performed within the logistics terminals to convert industrial shippers' product configurations to suit manufacturing operational requirements at the latest possible stage in the supply chain. Various logistics operations such as these, known as post manufacturing, are supported by APL Logistics. The deliberate postponement of processing or final conversion allows shippers and manufacturers to reduce storage costs and risks within the workflow system significantly, whilst retaining flexibility and service levels. These logistics services were pioneered by electrical good manufactures such as Xerox, who used it, for example, in the final assembly, integration and configuration of multifunctional devices in their Venray (Netherlands) site prior to distribution throughout Europe. They are also heavily used by automotive and retail shippers' global production networks. APL Logistics' terminals are at the heart of its customers' logistics systems. Rapid implementation of activities such as receiving, storage / retrieval, order picking and shipping is usually obtained by implementing powerful management information and telecommunications tools within its logistics terminals. These tools commonly include Warehouse Management (WMS) and other operational systems linked to overarching enterprise management (ERP) systems to provide integrated functionality to synchronize and ultimately endeavour to optimize the logistics activities carried out in APL's logistics terminals. The success of this varies and

relates to the nature of the business, the level of investment and the number of “add-on” tools employed. The combined software capability enables APL Logistics to provide information on its website simultaneously mapping logistics flows. This traceability is mainly based on investments that APL Logistics has made in RFID technology. APL Logistics is not only looking for the optimization of these terminals. Rather, it is also very concerned about the degree of flexibility of logistical support and traffic flow organization within its terminals. Also, APL Logistics has invested in Warehouse Control System software that allows them to optimize and monitor the flow of automated warehouses whilst restoring flexibility by careful management of workflow.

4.3. APL Logistics' network infrastructure.

APL Logistics has a worldwide network that supports administrative management. This network includes 111 offices in 172 cities in 53 countries. APL Logistics has also developed a global logistics network to be able to manage a flow that is agile as well as being integrated in space and in time. That is, the logistics terminals mentioned earlier are integrated through their high synchronization. APL Logistics has 166 platforms within its global terminal network of which 158 are distribution centres, encompassing a total of 24.7 million square feet. APL Logistics sends the items to be processed to a central distribution centre from where they are routed to the appropriated geographic region. An APL served central distribution centre has been assigned in each region. The logistics network extends beyond integrating terminals to include customer sites and manufacturers' factories. Distribution centres have connections to customer plants.

The logistics network is the culmination of a strategy to expand the activities of APL Logistics in the world economic space. To breakthrough into other territories, APL Logistics usually used mergers and acquisitions but relied on joint ventures in territories where they thought the risk is too high to “go it alone” because of their limited territorial knowledge. Subsequently, APL logistics favoured a more cautious expansion & consolidation strategy. For example, in 2000, their horizontal integration strategy allowed them to significantly strengthen their global freight distribution system and then their global logistics network. During this time, APL Logistics completed the acquisition of another LSP, the GATX Company. Buying this company not only made a great contribution to the strength of APL Logistics' network distribution system but, because it started strongly, moved into profit in the same year. APL Logistics has a very strong presence in the South East Asian region, which includes the company headquarters, but 32% of terminals that make up its global logistics network are in North America. The entire North American warehousing consists of approximately 13.2 million square feet. One subsidiary with a shipping enterprise network

provides high connectivity for intermodal shipping, which allows the physical flow of goods from any node to another. APL Logistics has also invested to maintain a high level of connectivity inside its integrated global freight distribution. The dedicated air transport network, especially the Asia / Europe axis is less efficient than its sea transport or intermodal counterparts.

The network established by APL Logistics enables the movement of goods, information and financial flows. It is a nested network whose reliability is highly valued by industrial shippers. The logistics networks developed by APL Logistics take full account of production and consumption geography, which themselves determine the logistics geography, which in turn espouses the geography of transportation and freight distribution. APL Logistics has decided to strengthen its global logistics network in India to match the growing foreign investments in the sub-continent. This has led to central consolidation and outbound logistics dedicated to automotive vehicle components being opened and simultaneously integrated in APL Logistics global logistics network in India. APL Logistics is also actively engaged in the strategy of expanding its global logistics network in China. The Chinese logistics market has a dire shortage of people trained in logistics. The technologies available there to improve the flexibility of freight systems are somewhat dated and the physical distribution network is far from efficient. In a logistics context, APL Logistics has made additional investments in human resources, logistics information systems and infrastructures such as distribution centres. Recent use of the APL Logistics system by industrial shippers has been greater than previously as demonstrated by the increased turnover of the company of 66% between 2010 and 2011.

Synchronization of logistics terminals represents a significant challenge for APL Logistics. The global logistics provider seeks to achieve real-time coordination of all the terminals that make up their logistics network in order to achieve a global integrated freight system. The terminals are intermediate points between the origin and final destination of the goods. APL Logistics' efforts mean that it is possible to adjust the flow of goods through space and time. These terminals set up relay networks between shippers and their industrial customers. APL Logistics has therefore developed synchronization both upstream and downstream in the freight system. Its global logistics network objective is to provide its customers with the resource they want while keeping logistics costs at a very low level. The use of software designed by CAPS Logistics helps achieve these strategic objectives. This means having a good network structure that allows it to satisfy customers in terms of quantity, time of availability and so on, and at the same time managing to monitor and control the logistics costs.

Information systems and telecommunications contribute significantly to the integration process that APL Logistics have developed. They facilitate the efficient management of

logistics networks, freight distribution and supply chains in space and time. Moreover, this information strategy promotes “ubiquitous logistics” in the freight distribution system. Thanks to integrated logistics information systems, APL Logistics can then ensure traceability of physical flow of goods in space and time. In fact, it is the ubiquity provided by the IT network that promotes the integration of physical logistics networks consisting of a wide-ranging set of terminals. Ubiquitous networks dedicated to the logistics management of physical goods flow enable APL Logistics to follow the storage and the processing of logistical information linked to industrial shippers’ goods and entrusted to them in real time. Logistics systems’ applications using technologies such as RFID (radio frequency identification) combined with sensors, scanner and satellites can serve as permanent virtual connections between users and their goods throughout the range of those networks. Because of these networks and their technology APL Logistics can track, store and process information in real time and reroute goods through their logistics framework to suit any change in customer requirements whether in terms of time or location.

5. Conclusion

Over a period of years, industrial shippers have developed strategies that take account of the way the world has become flattened by globalization (Ref. BBC), technology logistics and then supply chain management. This is partly manifested by transnational companies trying to use transportation and telecommunications to breakthrough into new markets. Trade facilitation opportunities offered by globalization should operate without undermining the organization of any entity that attempts to profit from the internationalization of its business process. The network organization concept, both inside and outside company boundaries will promote the emergence of global production networks, which go beyond the borders of companies that constitute those production networks. This means that to achieve effective and efficient market coverage, the network’s focal firm may seek to integrate companies that are part of the production process but not of the same nationality into the network structure.

The myriad physical flows of goods, information and finance that circulate within the global production networks require seamless logistical coordination otherwise there is a risk of stopping the progression of logistics flows within those networks. Data accompanying the flow of goods could provide vital intelligence for the company, so the distribution or freight systems must enable all flows, both physical and information, to be effective. Therefore, geographical and functional integration of logistics is a major challenge for industrial shippers who do not always have the necessary logistical resources or skills to accomplish it. For this

reason, they may choose to entrust the management of flows of goods and data to third party companies known as logistics service providers.

By mobilizing the concept of transport geography, this paper has shown how a logistics service provider, in this case APL Logistics, manages to handle the logistics of flows in space and in the time. While economic geography literature recognizes the importance of global production networks, the related logistical issues are seldom discussed (Rodrigue, 2006). The paper tries to address this deficit and opens the issue of logistics in global production networks for further research.

This is important since the geography of production, physical distribution or consumption raises issues for which, governments, transnational corporations and logistics network developers do not provide satisfactory responses. Further, these players may no longer be able to afford the investments in human, material and financial resources to improve logistics systems or put efficient organizational solutions in place. Management science researchers have analyzed the contribution of LSP's in the global production networks extensively. The transport and economic geographers must also understand the dynamics of the players whose strategic logistics decisions have an impact on the competitiveness of production networks and therefore the competitiveness of any territory's regional development.

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