

Globalization and the Synchronization of Transport Terminals

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Abstract

Globalization underlines higher levels of integration between different production and distribution systems. It is commonly acknowledged that this process leans on improvements of transport modes and infrastructure, resulting in a space / time collapse. However, it is argued in this paper that the synchronization of transport terminals is the main paradigm shift of the current space / time collapse. Terminals are where transport efficiency is mainly achieved. Empirical evidence is drawn from the strategies of freight and air transport companies.

Keywords: Globalization, Transport terminals, Synchronization.

Context: A Space / Time Collapse?

It is well acknowledged that globalization has been supported by improvements in transport technology and massive investments in transport infrastructures. The result has been a space / time collapse of global proportions, which has shrunk the transactional space and enabled extended exploitation of the comparative advantages of space in terms of resources, capital and labor. However, we argue that the consideration of a space / time collapse is now diverging from its evolution since the industrial revolution and is taking a new and different dimension: a paradigm shift in transport geography.

An overview of the current technology used for mass transportation, outside the rail sector, does not foresee any significant improvements for modal speeds. In other words, movements of freight and passengers are not occurring much faster, but they are becoming more efficient and cost effective. For instance, transporting a passenger over the North Atlantic roughly takes the same amount of time as it did 25 years ago when the firsts Boeing 747 were introduced¹. Furthermore, moving maritime freight over the North Atlantic has not significantly improved in speed over the last 50 years². Meanwhile, the economy has shifted towards globalization with a growth of trade commonly faster than the growth of

¹ Commercial supersonic planes, such as the Concorde, have been found economically and environmentally unsound.

² A new fast containership ship service will be introduced in 2001 between Philadelphia and Sherbourg. They will provide door-to-door services anywhere between the Eastern United States and Western Europe within 6 to 7 days. Little is known so far about the space-time collapse this speed improvement will provide.

production that cannot be linked to modal speed improvements. Consequently, how could we define the current space / time collapse behind globalization?

A preliminary answer to this question refers to the concept of *economies of scale* that have been applied to transportation. Indeed, the ability to transport increasing amounts of freight and passengers at lower costs has improved considerably the capacity and efficiency of transport systems. However, this does not necessarily imply that the transported units will move faster from their origins to their destinations, but simply in larger quantities. We have also reached the point where pursuing economies of scale would decrease the efficiency of transport systems because shipments would be significantly delayed, although having low transport costs.

Another answer would be that *transport infrastructures have expanded considerably* to service areas that were not serviced before or were insufficiently serviced. A drawback to this assertion is that although the expansion of transport infrastructures enabled the expansion distribution systems, it also expanded the number of tons-km or passengers-km considerably. Transportation in urban areas provides a relevant example. Any town planner or urban geographer would agree that expanding urban transport infrastructures will often do little in solving or improving congestion in this transportation system. Moreover, several cities have reached a point where any expansion of transport infrastructure will not lead to a space / time collapse, but to a space / time expansion due to congestion.

Also, a *substitution of transportation by telecommunications* has enabled several economic activities to bypass the spatial constraint in a very significant manner. Electronic mail is an example, in which transmission information does not have a physical form (outside electrons or photons) once the supporting infrastructure is established. There is obviously a limit to this substitution, but several corporations are trying to use the advantages of telecommuting as much as possible because of the important savings involved. It looks like that the diffusion of telecommunications has increased transportation requirements.

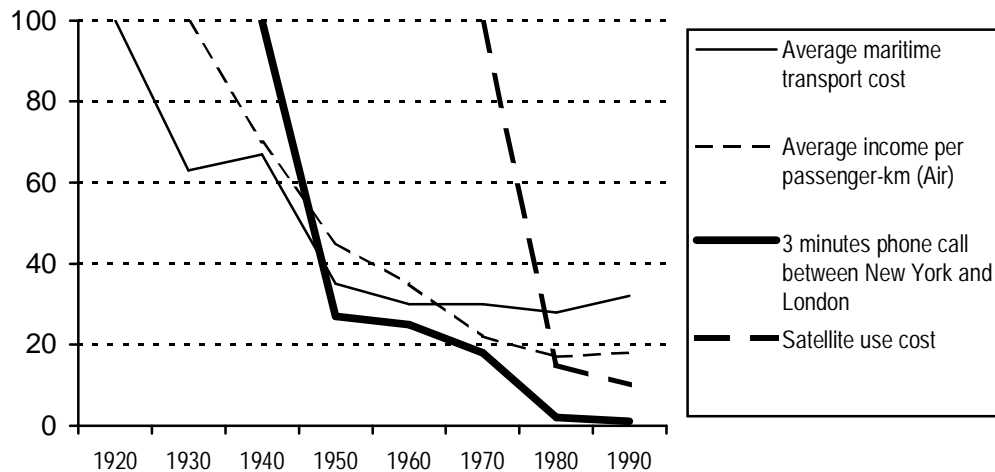


Figure 1 Transport and Communication Costs Indexes, 1920-1990³

Figure 1 provides some empirical evidence of the dimensions of the space / collapse discussed so far. However, maritime and air transport costs have achieved a phase of stability while significant improvements are still occurring in the telecommunication sector. Deregulation, which is affecting several transport sectors, has increased modal and intermodal competition and reduced costs. The main outcome was rationalization, changes in the frequency of services and changes in the terminals used.

The answers provided so far are relevant but inadequate to understand the full extent of the current space / time collapse. Evidence suggests that contemporary improvements of transport systems are mostly undertaken at terminals, notably through their synchronization. Indeed, it is suggested that the ongoing space / time collapse is mainly the result of the synchronization of transport terminals and the integration of transport systems through terminals. The emphasis has shifted from modes to terminals and it is worth investigating this dimension of transport geography. This paper is thus an attempt to establish a conceptual consideration behind transport terminals and their convergence with contemporary economic and spatial changes.

The Concept of Synchronization and Transport Terminals

Changes in the Transport Environment

Economies of scale applied to transport modes and the expansion of transport infrastructure have increased the need for the synchronization of movements between transport terminals, and thus the synchronization of transport terminals themselves. This is the latest stage in a long process of transport system development. Until recently infrastructure, modes and technology were developing altogether, although at different pace. The results were a spatial

³ Source: The Economist.

expansion coupled with a space / time collapse, but several disjointed transport systems. However, in a contemporary context, two major changes are occurring.

The first major change behind the synchronization of transport terminals lies in the *modes* themselves, more specifically over modal competition. The competition between modes was typical of segmented and unintegrated transport systems. In such an environment, each mode maximized its own advantages in terms of cost, service and reliability. The lack of integration between the modes has been accentuated by public policy that has frequently prevented companies from owning firms in other modes (as in the United States before deregulation), or has placed a mode under direct state monopoly control (as in Europe). This environment is being modified considerably with deregulation and privatization. Consequences have been increased integration between modes, and this through terminals.

The second change in the transport environment is linked with mutations of the *production systems* it services⁴. The current “post-fordist” environment is characterized by just-in-time (JIT) and tense fluxes, which are becoming the norm in several production and distribution systems.

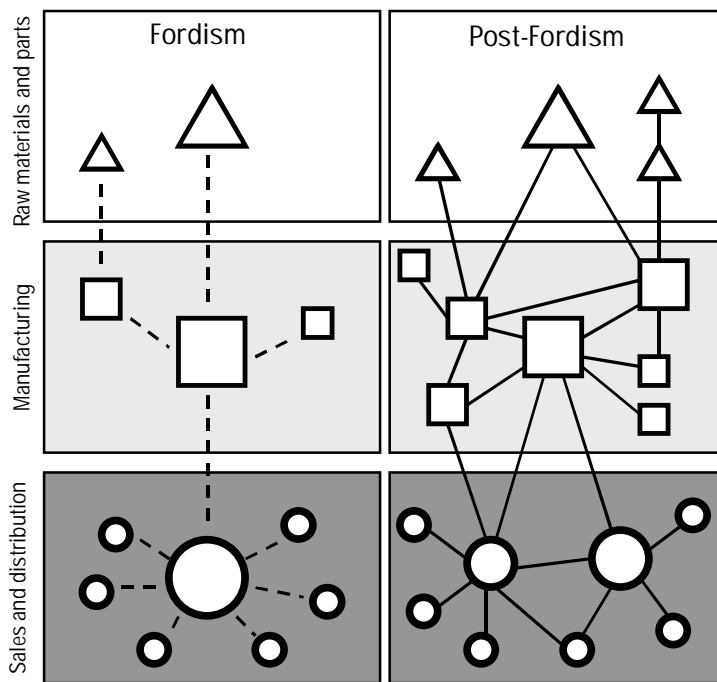


Figure 2 Fluxes in a Fordist and a Post-Fordist Production System

In a fordist production system (Figure 2), the integration of the industrial system is often discontinuous and subject to delays in the transport chain. Links between different functions generally imply an accumulation of stocks (raw materials,

⁴ Transportation is after all a derived demand.

parts and manufactured goods) before their usage (processing, manufacturing and distribution). The high output of an assembly line requires warehousing of all required parts in the vicinity. This cannot occur without a stable and constant demand, which is assumed to absorb a supply-oriented production. The transport function in such an environment is massively applying economies of scale with accumulation and delays at break and bulk points.

In a post-fordist environment, JIT and tense fluxes tend to reduce warehousing and increase the integration between elements of the production system in a complex network of relationships. This system is more linked to the demand, and each of its elements adapt to constant fluctuations of origins and destinations. In this environment, the transport function is closely integrated to production and distribution and is the main element minimizing delays and warehousing. Consequently, there is paradigm shift in transport systems putting more emphasis on the terminal not necessarily in terms of their infrastructures, but for what logistics can do to the spatial organization of traffic.

Synchronizing Transport Terminals

Different transport terminals and thus different transport modes have different synchronization strategies. While air terminals are dealing with important movements of passengers and a strong growth of air cargo, maritime terminals face integration with inland transport systems. Achieving synchronization between transport terminals, regardless of the mode, involves the following considerations:

- *Geographical considerations.* Synchronization is done upstream and downstream of the transportation chain. Traffic arriving at a transport terminal is generally bound to another transport terminal. Traffic by its origins and destinations must be known throughout the transport chain in order for one terminal to anticipate incoming and outgoing traffic. Of particular relevance is the issue of synchronizing different geographical scales of traffic. These involve considerations such as local collect, shipment / transshipment at regional hubs and deliveries to international flows between major hubs.
- *Operational considerations.* Synchronization minimizes warehousing / delay functions by spreading the intermodal transfer demand over a period of time. A transportation terminal handling time-distributed traffic could have the same capacity as a much larger terminal handling undistributed traffic. The lack of anticipation automatically results in delays and accumulation. In such an environment, warehousing takes a less important part in the activities of transport terminals. Also, a fundamental condition of synchronization implies the level of control over the transport activities involved, which requires an information exchange process and intense scheduling part of logistical integration. Telecommunications and information systems obviously support such an undertaking, but the main factor promoting the exchange of information is the willingness of transport companies to share this information. Strategic alliances, notably among maritime and air companies, have enabled these carriers to share their modes, terminals and distribution

networks and consequently to improve the synchronization of their respective transport systems by a higher level of control.

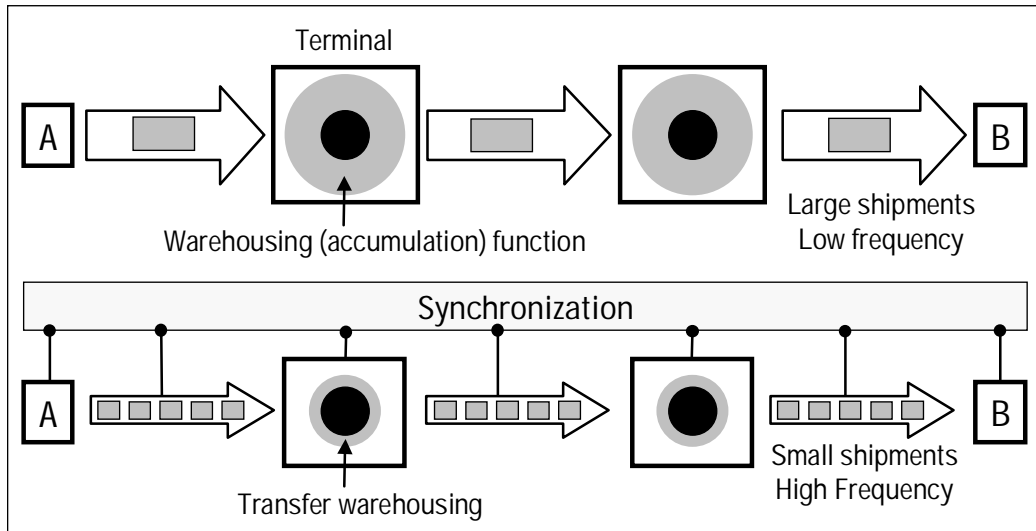


Figure 3 Effects of Synchronization on a Transport Chain

Synchronization is occurring at the expense of economies of scale in shipping, which may look counterproductive (Figure 3). However, two advantages are overcoming the costs incurred. First, warehousing costs are decreased, since this function is often reduced to a transfer warehousing of a few hours up to a few days. Second, flexibility enables more terminals to be serviced at a higher frequency, in accordance with JIT strategies. The result is an overall increase of the rapidity of shipments in the transport system without improvements in modal speed. Furthermore, space requirements of the terminal, for the same level of activity, are likely to drop, although intermodal facilities tend to consume more space. This strategy obviously fits the requirements of contemporary production systems.

An Analogy and Its Lessons

What is to gain from synchronization and in what context synchronization is relevant? This can be demonstrated by a simple analogy using the example of the road transport system of a city. These types of problems have been thoroughly investigated by traffic engineers. On network A (Figure 4), there are no specific attempts to regulate traffic at intersections. This is a typical unconstrained free-flow network. On network B, synchronization involves traffic lights at intersections giving time slots regulating the volume and the direction of traffic. Traffic can thus be better controlled by anticipating events such as flows would be inward in the morning and outward in the afternoon and adjusting synchronization accordingly.

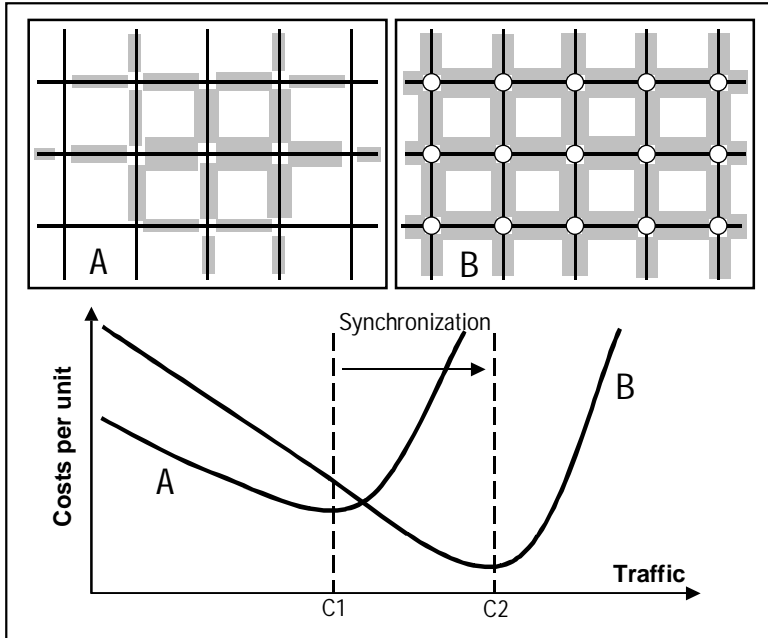


Figure 4 Transport costs per unit for networks A and B

The efficiency in terms of costs per unit of both networks varies according to the amount of traffic. Network A (unsynchronized) reaches optimal capacity, $C1$, much faster than network B (synchronized), which has an optimal capacity $C2$. However, when traffic is low an unsynchronized, network A is more efficient because of the limited constraints it imposes. When traffic reaches a certain level, a synchronized network becomes advantageous, and the benefits increase as traffic grows further.

- *Lesson 1.* If the physical capacity of a transport infrastructure is kept constant, the only way to improve the capacity and the efficiency of a network is through traffic synchronization.
- *Lesson 2.* Synchronization is more efficient when applied over saturated and complex transport systems. For a terminal having low traffic, synchronization may not be profitable due to costs such as having infrastructures operated over a longer time period with a limited amount of traffic.

Case Studies: Comair and UPS

This section illustrates how two transport companies are relying on synchronization to increase the efficiency of their transport systems. The first example deals with passengers while the second deals with freight, mainly parcels.

Comair: Synchronization of a Regional Air Transport System

Air transportation in the United States is the most complex and heavily used system in the world. Although the capacity of air corridors is almost limitless, the capacity of terminals is obviously not. The last 20 years have seen a

reorganization of air transport networks around major hubs, most of them selected by airline companies. Comair, a regional carrier mainly servicing the eastern part of the United States, was founded in 1977 in Cincinnati, Ohio. It transports more than 3.5 million passengers annually, schedules 675 flights per day, and is an eloquent example of an airline company created during deregulation⁵. In 1981, the company started important growth strategies involving the purchase of new aircraft, the re-organization of its services and an alliance with a major air carrier.

The purchase of high performance and medium-sized aircraft (such as the Canadair Regional Jet) is a strategy used to increase the market share. Comair's fleet included 92 aircraft, which carry between 30 and 50 passengers. In addition to providing cost savings over larger commercial planes, smaller planes permit the frequency of services to be increased. This is a very efficient strategy for destinations located less than 1,000 km apart and generating a lower number of passengers per day. Comair has consequently adapted its mode to fit a synchronization of its network. Small shipments of passengers with a high frequency of service, as compared with the lower frequency that larger planes would offer, are the norm.

In 1981, Comair began an association with Delta Airlines by integrating their reservation systems, allowing the two airline companies to synchronize their connections and thus reduce their respective connecting times. Delta owns about 20% of Comair's stock. Comair gained access to Delta registration counters and thereby enhanced the quality of its service. Both airlines have established strong hub-and-spoke networks, which are operating at different geographical scales.

⁵ Data from Comair web site: www.fly-comair.com.



Figure 5 Comair's Network, 1997

Figure 5 illustrates the two main hubs of Comair; Cincinnati and Orlando. They represent connecting points to Delta's national and international networks. Comair thus ensures a maximal territorial cover, since 68 airports service the most developed region of the United States. Main urban centers are often serviced by smaller and less congested airports such as Midway for Chicago, Manchester for Boston and White Plains for New York. For this goal, the hub-and-spoke structure offers some incontestable advantages. For instance, a city of average size (about 150,000 inhabitants) rarely generates enough passengers to justify air transportation towards several destinations. On the other hand, with the hub-and-spoke structure and synchronization, it is possible to consolidate all the passengers generated by a city toward the hub, where they can reach their respective destinations by consolidating with passengers coming from other origins, but bound to the same destination.

The strategy of Comair clearly depends on synchronization enabling a better use of resources in an highly competitive environment. This synchronization occurs at two geographical levels, one – regional – being directly controlled by Comair and the other – national / international – in which Comair can anticipate traffic through information sharing with Delta. Cincinnati and Orlando hubs are the main terminals used for this purpose.

UPS: Synchronizing a Freight Distribution System

United Parcel Service (UPS) is an enterprise specializing in the collection and the routing of parcels throughout the world. Its service area covers 200 nations and handles 3.1 billion parcels per year, of which 1.6 billion by air transport; around 1.2 million per day. Its infrastructure includes 2,400 distribution centers, 147,000 vehicles and 500 airplanes going to more than 600 airports. Besides, UPS makes call to about 300 planes on a contractual basis according to variations in demand⁶.

UPS was founded in 1907, in Seattle, to supply private messenger and delivery services. The company started as an enterprise specializing in the routing of parcels from department stores. One of the main factors explaining the success of the enterprise is the early adoption of a logistic based on the consolidation of freight. It implies the combining of packages addressed to a certain neighborhood onto one delivery vehicle to optimize the transport costs.

Important commercial changes after the Second World War forced UPS to focus on different arrays of services, since customers increasingly used their cars, which did not require a delivery service. It became a common carrier with the right to deliver parcels between private and commercial addresses in the United States and was able to service the whole country. The major phase of growth however came from the deregulation of air transportation. In 1988 UPS was able to operate its own airline and began an accelerated phase of synchronizing its distribution activities occurring at different geographical scales. The result was the development of a distribution network involving a number of steps (Figure 6).

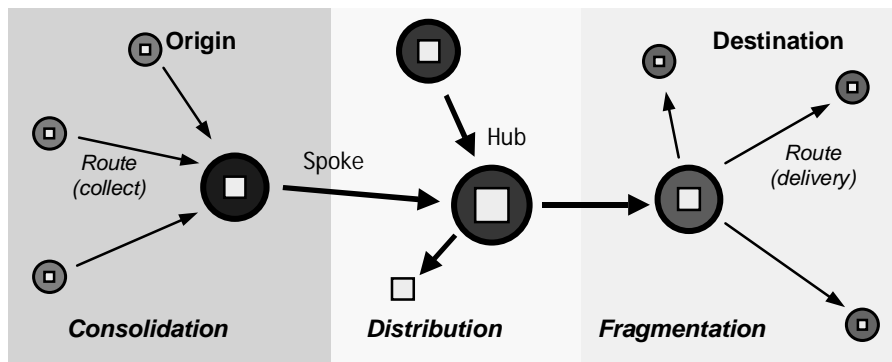


Figure 6 UPS Distribution Strategy

The first step is the pickup; specific routes are assigned and regular stops are planned according to tight schedule. This operation is obviously local in scale. Freight will inevitably be sent to the hub for consolidation. All the smaller local operating centers have to take their freight to the nearest hub, thus a shift of the geographical scale. There are only 6 hubs in the world, each linked to a vast hinterland that can be serviced within a few hours. At the hub, freight is unloaded and sorted according to the geographical location where it is bound to. Consequently, all the parcels are divided to be loaded in the courier leading to the

⁶ Data from the UPS web site: www.ups.com.

right destination. Deliveries are either made on the ground by cars and trucks (ubiquitous brown).

The examples of Comair and UPS show transport companies adapting their systems in a competitive environment. The outcome involves more efficient passenger or freight distribution systems, not because passengers or freight are moving faster or more directly, but because delays at terminals are minimized.

Synchronization of Transport Terminals: Assessment and Prospects

In this paper, a divergence of the process of space / time collapse commonly linked to globalization processes was discussed. This divergence involves synchronization in an environment where limited improvements in the speed of transportation modes are achieved while acknowledging economies of scale, expansion of infrastructure and some level of substitution. The bulk of synchronization can only be achieved at the terminal because it is almost the only place where time-savings can be undertaken. The transport terminal is consequently the key feature in the contemporary improvement of transport systems.

There are different interdependent levels of synchronization of transport terminals, ranging from local to international transport systems. Previously, these systems were independently synchronized but the current developments and expansion of intermodal transportation rely on the synchronization of different geographical scales, as the Comair and the UPS examples demonstrated. With deregulation, both corporations have increased the efficiency of their terminals.

It is also important to acknowledge that there is conceptually a limit to synchronization. This involves a consideration of the amounts of energy and efforts spent in view of returns. A complex transport system simply cannot be thoroughly optimized. At some level, it may even promote instability and thus be counter-productive.

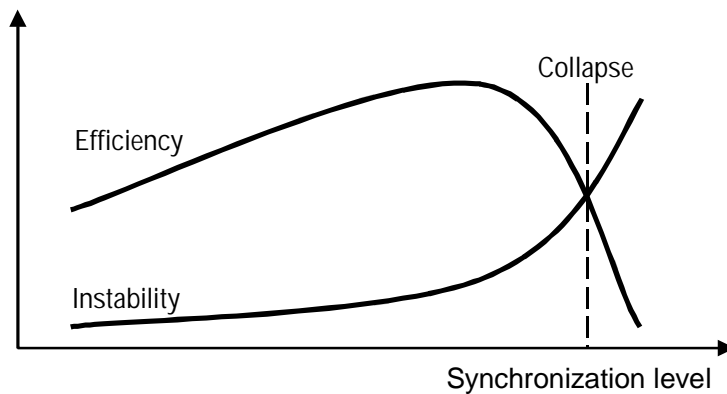


Figure 7 Synchronization and instability

As the synchronization level increases (Figure 7), so does the instability of the transport system. For instance, if an element of a transportation chain is delayed in a tightly synchronized environment, the whole chain will be affected. It is now common that a strike in a plant part of a tense fluxes system will result within a few days in the shutting down of several plants upstream and downstream of the production unit. It is logical to infer that delays at a terminal, whatever their causes, would have impacts on linked terminals⁷.

Variations in the space / time collapse process are observed depending on the mode considered. Improvements in rail technology, such as high-speed rail systems, are likely to produce a standard space / time collapse enhanced by synchronization with other modes. However, the case of high-speed rail systems also tends to demonstrate reorganization along terminals.

Overall, significant improvements are still to be derived from synchronization in a “new” geography of transport terminals. Several issues remain to be addressed, such as the extent of synchronization between terminals, spatial changes involved in distribution systems, and the different externalities involved. Even if it was argued that terminals are the main paradigm behind the current space / time collapse, they are still entities that transport companies can choose or bypass.

⁷ I personally witnessed an instance of this event in early January 1999 while trying to get from Calgary to Montreal. Due to a snowstorm, the Toronto hub of Air Canada collapsed and several flights were cancelled. The impacts were felt all over the system, even on flights that did not involve Toronto. Toronto (Pearson) handles between 50 and 60 % of all Air Canada’s daily flights and the company accounts for 45% of the 26 million passengers handled by that terminal. Developing a hub increase airline efficiency but may be subject to large problems when the hub collapse.