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North American Intermodal Transportation:

Infrastructure, Capital and Financing Issues




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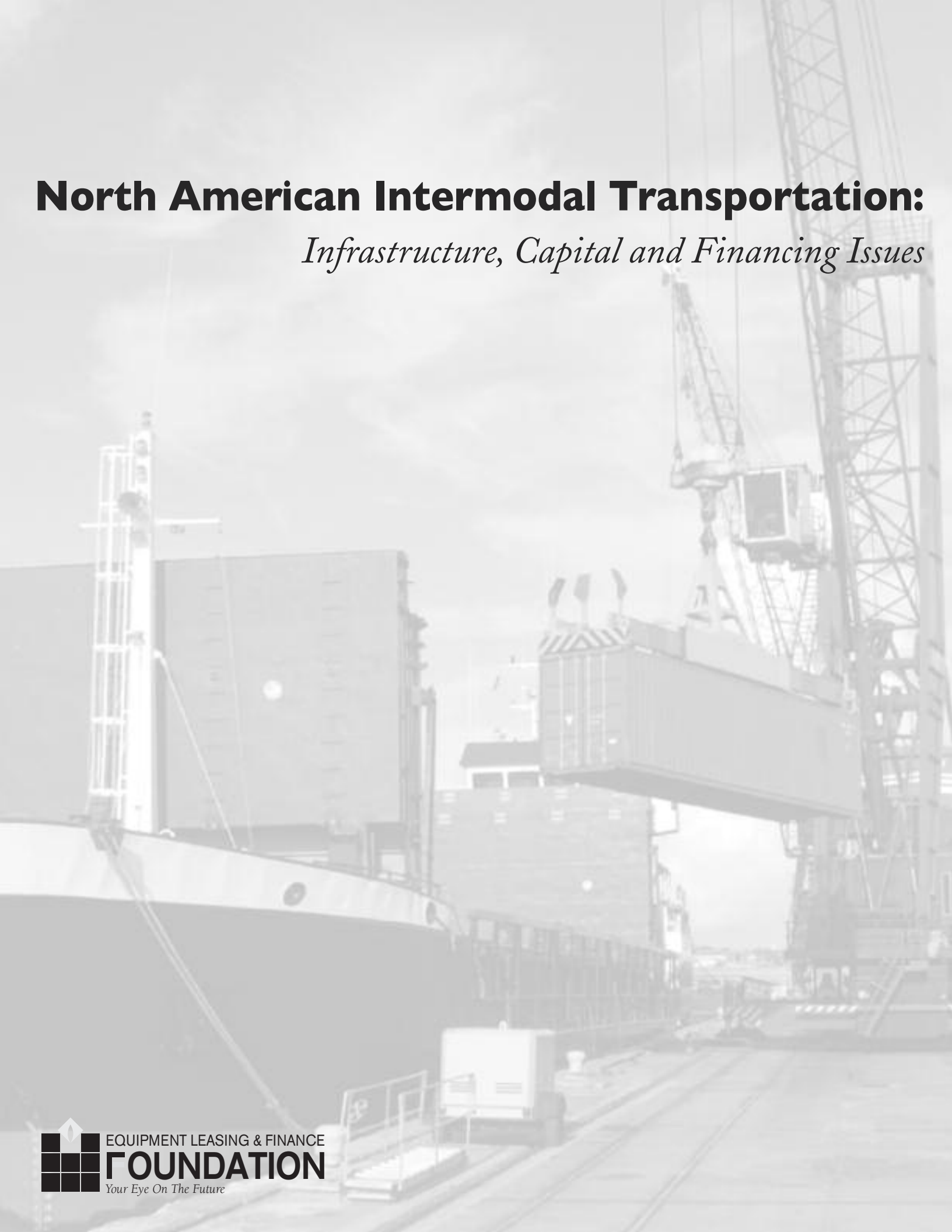

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Executive Summary

More than 25 years of fast growth in international trade has left the North American freight transport system with serious capacity challenges. The growth of containerized traffic took place at a rate faster than global trade, which was itself growing faster than the gross global economic output. As an outcome, many intermodal terminals such as ports and rail facilities are running close to, if not above, design capacity. Although containerization has been a significant factor in the improvement of the efficiency of transport systems, maritime and inland alike, the current context underlines serious limits in existing practices. Logistics has placed intense pressures to manage containerized freight distribution in a more time dependent manner, placing additional challenges for intermodal terminal operators. A new wave of investments in intermodal transportation is currently underway, but yet the inherent fluctuations in market conditions and the private character of the industry make such endeavors quite prone to risks and uncertainties. For instance, the economic slowdown and volatility in energy prices have been relatively unexpected and have substantial consequences on global commodity chains and intermodal transportation. Thus, outside existing terminals that have a long standing history of generating traffic, private capital is reluctant to commit investments. Yet, intermodal transportation as a system also requires investments in new locations along the supply chain to improve its overall throughput and efficiency, namely through satellite terminals and freight distribution clusters. These new terminals and the additional capacity will also require the financing of intermodal equipment servicing their operations. The purpose of this report is to assess the financing models related to the next generation of intermodal terminals equipment. A particular emphasis is placed on the feasibility of public / private partnerships.

Intermodal Transportation in North America

The Intermodal Freight Transport System

The major freight markets concern bulk and intermodal transportation with the intermodal segment being the most flexible. Intermodal transport terminals are an essential part of global, national and regional trade, all of which has seen a substantial increase in the amount of freight traffic being carried. In addition to being locations where freight is consolidated or deconsolidated, terminals are points of transfers between different systems of circulation. For instance, international trade commonly relies on the efficient interface between maritime and inland freight transport systems. In addition to being a piece of real estate, terminals require substantial infrastructures taking the form of fixed assets (piers, rail tracks, warehouses, paved surfaces, road and rail access, etc) and equipment (cranes, holsters, containers, chassis, etc.), both of which are capital intensive. Unlike bulk terminals, intermodal equipment has a better relocation potential, although balance can be difficult as trade flows fluctuate (often with currency fluctuations) but rarely coincide. There are also different types of intermodal traffic with different weights and other characteristics. However, the equipment itself, within limits, has interoperability characteristics since the efficiency of intermodal transportation resides on globally followed standards.

Freight distribution is a physical activity where the transportation component is of prime importance. Paradoxically, because of its efficiency, freight transportation is almost invisible to the end consumer as the outcome (retailing) is seen, but not the process (distribution). Such a perspective often permeates public policy where the importance of freight transportation is often understated. Still, the global economy is based on the backbone of freight distribution, which in turn relies on networks established to support its flows and on gateways that are regulating them. Networks, particularly those concerning maritime shipping and air transportation, are flexible entities that change with the ebb and flows of commerce while gateways are locations fixed within their own regional geography.

Deregulation of the Intermodal Transport Sector

The North American transport sector has traditionally been heavily regulated since it was perceived as of national economic importance. There has been a significant shift in public policy concerning the funding, oversight and management of transportation infrastructure. The need to reform the industry was made necessary because of its imminent collapse. For instance, by 1960 one third of the American rail industry was bankrupt or close to failure as service levels and fare structure were regulated by the Interstate Commerce Commission and could not be changed without approval. The key question was freeing entry levels into specific transport sectors, since in many regulated industries, the regulators restricted entry. There was a growing acceptance for a solution based on a relaxation of regulatory control which resulted in a series of laws and reforms through the 1980s and 1990s (see Table 1).

Table 1 Major Deregulation Legislations of Intermodal Transportation in North America

Year	Country	Legislation
1976	USA	Railroad Revitalization and Regulatory Reform Act
1980	USA	Staggers Act; Motor Carrier Act
1984	USA	Ocean Shipping Act
1987	Canada	National Transportation Act; Shipping Conference Exemption Act; Motor Vehicle Transport Act
1991	USA	Intermodal Surface Transportation Efficiency Act
1995	USA	Interstate Commerce Commission Termination Act
1996	Canada	Canada Transportation Act
1998	USA	Ocean Shipping Reform Act
2001	Canada	Canada Shipping Act

The first round of policy change was the Railroad Revitalization and Regulatory Reform Act of 1976 which eased regulations on rates, line abandonment, and mergers. Four years later, when the political tide of deregulation was in full motion, Congress followed up with the Staggers Rail Act of 1980. The most important features of the Staggers Act were the granting of greater pricing freedom, streamlining merger timetables, expediting the line abandonment process, allowing multi-modal ownership, and permitting confidential contracts with shippers. The railroads immediately divested themselves of their unprofitable passenger business, and began to concentrate on their core freight activity, the business which was most profitable and least subject to competition from other modes was bulk freight. Railroads began abandoning tracks, with over 100,000 miles being abandoned between 1975 and 2000. Because there was a relaxation in controls over entry and exit, the post deregulation period has been marked by a significant development in mergers and acquisitions. From 56 Class I railroads in 1975 the number has been reduced to 7 in 2005 (two of which are Canadian). Two key examples of privatization of major freight rail assets involve the selling of the federally owned Conrail to NS and CSX in 1987 and the privatization of CN (Canadian National) in 1995. This has helped the industry achieve scale economies and boosted their economic performance. Finally, the restric-

tions on intermodal ownership and operation have led to a revitalization of the general freight business. For the first time, intermodal traffic accounted for the majority of rail revenues in 2003 (Slack, 2008).

The maritime segment also saw a significant deregulation beginning with the Ocean Shipping Act of 1984 which granted an easier access to American ports to foreign maritime shipping lines. The Ocean Shipping Reform Act of 1998 expended on this deregulation by providing shippers and ocean carriers greater choice and flexibility in entering into contractual relationships with shippers for ocean transportation and intermodal services (Valenga, 2000). From a regulatory standpoint, there is a clear emergence of an intermodal perspective underlined by the Intermodal Surface Transportation Efficiency Act of 1991 which identified strategic long distance corridors and placed freight planning within the agenda of regional planning agencies. The early 21st century leaves the North American intermodal market firmly in private hands and with growing sign of integration between modes as well as between global, national and regional freight distribution systems.

North America and the Global Economy

Historically, the setting of national rail and highway systems has permitted the emergence of a North American freight distribution market. Yet, this scale is being expanded further by the North American Free Trade Agreement (NAFTA) as well as the by the globalization of production. Jointly, they have created an environment where the transport sector is coping to adapt to higher volumes, particularly at major gateways, as well as more stringent requirements in terms of frequency and reliability. Globalization is certainly a dimension that has been discussed in length and from many different perspectives (sources). Among the most common factors identified are related to the exploitation of comparative advantages, mainly in terms of labor, information and telecommunication technologies, foreign direct investments and technology transfers. All these have helped create a clustered and spatially diffused global economy, particularly in terms of production and consumption. A very powerful and widely acknowledged trend in recent years has been the rapid industrialization of Pacific Asia, particularly China, and the enduring growth in the consumption of foreign goods in North America and Europe. Global trade is thus steadily growing despite the increase in the average distance of the involved trade relations. Parallel to this growth, the need to reconcile spatially diverse demands for raw materials, parts and finished goods has placed additional pressures on the function of freight distribution and logistics.

Yet, the conditions behind globalization that were supported by the setting of long distance intermodal transportation chains have significantly changed in recent years. The current macroeconomic context is uncertain, volatile and prone to risks. It must be acknowledged that the surge of American imports was based on a debt driven process supported by a massive wave of asset inflation, namely in real estate, enabling many consumers to borrow against the paper value of their equity. As long as this process was taking place international trade and transpacific container flows were growing, placing pressures on the North American intermodal transport system to cope. From 2006, as the real estate bubble started to deflate, intermodal traffic leveled off. By late 2007, the global financial system began a phase of deflation with massive defaults and downward revisions of asset prices. This, in conjunction with an ongoing debasement of the US dollar led to a notable drop in port and rail traffic, but an increase in exports. Oil prices have also surged, making long distance trade more costly and forcing many suppliers to reconsider their strategy that have over the last two decades depended in low input costs, particularly from China.

The "China Effect"

The emergence of China in the global manufacturing market had profound impacts in terms of the volume and pricing of a wide variety of goods. Several factors must be considered in the rapid and massive emergence of China. From an internal market perspective, China is going through its peak years of demographic growth with a stabilization of its population expected to reach 1.5 billion by 2040. Thus, about 10 million new workers are entering the labor market each year, placing intense pressures on financial, economic and industrial policies to accommodate this growth. From an historical perspective, China is eager to reclaim its former status as the world's dominant economic power, a role it held until the 18th century. All these factors provide a strong impetus, either implicit or explicit to undertake strategies, many potentially macro-economically unsound, aimed at accelerating economic growth and the modernization of China.

This strategy turned out to be highly successful in turning China into a major manufacturing center and exporter, particularly along its coast where the major container port facilities are located. China also applied an export-oriented currency debasement strategy particularly because the Yuan was kept devaluated compared with other currencies; it "lost" almost 50% of its value in comparison with the USD between 1993 and 2003. During that period, China mostly focused on the lower range of the added-value manufacturing process in addition to have low labor costs. Still, this strategy is now undermined by a surge in com-

modity prices, namely energy, creating inflationary pressures on Chinese production costs. These pressures have incited China to reevaluate its currency, making its exports less competitive.

The usage of China as a privileged location in the global manufacturing system has thus been linked with low input costs (mainly labor) as well as low long distance transport costs brought by containerization. When oil prices where low (in the $30 per barrel range), the longer distances of shipping freight from China were positively compensated by lower input costs. This explains why integration processes in North America, namely the use of Mexico as a low cost manufacturing base, were mainly by-passed in the last decade. However, from 2005 the price of surged which eroded the comparative advantages of China in freight intensive goods (such as steel and other ponderous goods). The Mexican economy may be positively impacted by such a trend which will put a greater emphasis on NAFTA as a comparative advantage structure. Changes in the structure and direction of freight flows in North America are to be expected.

The Intermodal Transport Agenda

Issues related to the capacity and reliability of the North American freight transport system are increasingly getting the attention of public officials since long term economic prospects are at stake and linked national welfare. From a public policy perspective, the main agenda for intermodal transportation in the United States specifically covers (Barrett, 2007):

- **Intermodal integration.** In spite of 25 years of deregulation of the transport industry, an intermodal perspective on freight distribution is still limited. Most transport operators are dominantly focused on their segments of the system, so it is often challenging to have them realize that investments and improvements on other segments tend to have positive impacts not only on that segment, but system-wide. New investments will thus need to focus on the crucial links between transport systems and are likely to involve different modal stakeholders. There is an increasing willingness for investors to fund infrastructure down (or up) the transport chain, particularly if it is directly related to the productivity of terminal they have a stake in. The emergence of global transport firms, such as maritime shipping companies and port operators is a strong factor imposing intermodal integration, particularly between maritime and inland freight transport systems.

- **Technological improvements.** The current intermodal technology is mature and most terminals have been operating for decades with now standard equipment and management practices (Notteboom and Rodrigue, 2008). To meet potential growth in traffic and more stringent supply chain management requirements, terminals will have to significantly improve their productivity, mainly by handling containerized freight in a manner that will improve its velocity. With more technologically advanced equipment the same terminal could double its design capacity with a higher throughput. Thus, the current capacity constraints at terminals are more than simply an infrastructure issue, but would also imply a shift in the type of infrastructure as well as their operational context. This will involve an appropriate balance of infrastructure and technology as well as an appropriate level of investment. It goes beyond a capital intensive perspective (hard assets) to include knowledge-based issues (soft assets) linked to logistics and supply chain management.

- **Security.** Due to the current geopolitical context, security issues are high on the agenda and are likely to remain as such. However, a variety of additional security measures are imposing several constraints on freight movements, which can cause unforeseen delays. For instance, less than 5% of all containers entering the United States are inspected. Investments in new intermodal terminal equipment, particularly those directly linked with international trade, must consider the impacts of security regulations on their design and operation.

Transport Terminals and Equipment

Nature and Function of Intermodal Terminals

Intermodal freight handling requires specific loading and unloading equipment. In addition to the facilities required to accommodate ships, trucks and trains (berths, loading bays and freight yards respectively) a very wide range of handling gear is required to handle containers between modes. There are three major types of intermodal terminals each having their own locational and equipment requirements (Figure 1):

- **Port terminals.** They are the most substantial intermodal terminals in terms of traffic, space consumption and capital requirement. A container sea terminal provides an interface between the maritime and inland

systems of circulation. The growth of long distance maritime container shipping has also favored the emergence of offshore hub terminals, even if many do not have an "offshore" location. Their purpose is mainly to transship containers from one shipping network to the other and they essentially have little, if any, hinterland connections. The terminal is used as a buffer while containers wait to be loaded on another ship. The containerization of inland river systems, particularly in Europe, has led to the development of an array of barge terminals linked with major deep sea terminals with scheduled barge services. At the maritime container terminal, barges can either use regular docking areas or have their own terminal facilities if congestion is an issue. Although in the North American context, intermodal barge transportation and short sea shipping are very small markets, they are likely to see in the coming years a substantial development in infrastructure and equipment, mainly because of energy and environmental issues.

- **Rail terminals.** At the start of the inland intermodal chain, rail terminals are linked with port terminals. The fundamental difference between an on-dock and a near-dock rail facility is not necessarily the distance, but terminal clearance. While for an on-dock rail terminal containers can be moved directly from the dock (or the storage areas) to a railcar using the terminal's own equipment, accessing a near-dock facility requires clearing the terminal's gate (delays), using the local road system (congestion) and clearing the gate of the near-dock rail terminal (delays). Near-dock facilities tend to have more space available however and can thus play a significant role in the maritime / rail interface, particularly if they are combined with transloading activities. The satellite terminal, the load center and the interline (transmodal) terminal all qualify as a form of inland port. For the satellite terminal, it is mainly a facility located at a peripheral and less congested site that often performs activities that have become too expensive or space consuming for the maritime terminal. Rail satellite terminals can be linked to maritime terminals through rail shuttle or truck drayage (more common) services. A load center is a standard intermodal rail terminal servicing a regional market area. If combined with a variety of logistical activities, namely freight distribution centers, it can take the form of a freight distribution cluster. The surge of inland long distance containerized rail traffic also require transmodal (rail to rail) operations as freight is moved from one rail network to the other. This can be done by switch carriers or trucking containers from one terminal to the other. Eventually, dedicated rail-to-rail terminals are likely to emerge.

- **Distribution centers.** They represent a distinct category of intermodal terminals performing an array of value added functions to the freight, with transmodal operations dominantly supported by trucking. Distribution centers can perform three major types of function. A transloading facility mainly transfers the contents of maritime containers into domestic containers (or vice-versa). It is common in North America to have three 40 foot maritime containers to be transferred into two 53 foot domestic containers. Sometimes, shipments are palletized as part of the transloading process since many containers are floor loaded. Cross-docking is another significant function that commonly takes place in the last segment of the retail supply chain. With very limited storage, the contents of inbound loads are sorted and transloaded to their final destinations. Warehousing is a standard function still performed by a majority of distribution centers that act as buffers and points of consolidation or deconsolidation within supply chains.

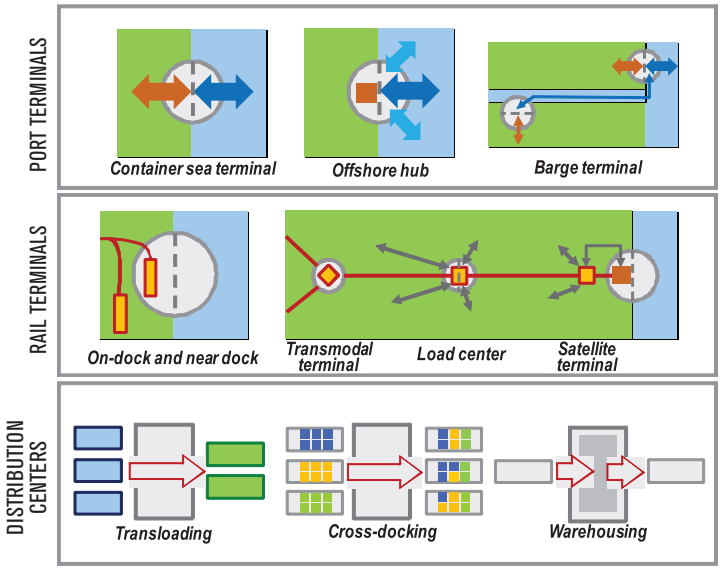

Figure 1- Types of Intermodal Terminals

A feature of most intermodal freight activity is the need for storage. Assembling the individual bundles of goods may be time-consuming and thus some storage may be required. This produces the need for terminals to be equipped with specialized infrastructures such as refrigerated warehouses, or simply space to stockpile containers. Containerization, because of its large volumes, has forced a significant modal and temporal separation at terminals as

well as a variety of transloading activities in the vicinity of terminals.

Terminals are important activity systems which fall into two categories, core and ancillary (Table 2). While core characteristics refer to what a terminal needs to operate, such as infrastructure and equipment, ancillary characteristics tend to be more value added. They also play an important role in the differentiation of terminals since they shape their functional and operational characteristics. Core characteristics are replicable as they imply capital investments in relatively standard technologies, infrastructure and equipment. Ancillary characteristics are more linked with a policy framework as well as the regional economy, local initiatives and clustering effects.

Table 2 Main Characteristics of Intermodal Transport Terminals

Core (Operations)	Infrastructure	Modal access (dock, siding, road), unloading areas
	Equipment	Intermodal lifting equipment, storing equipment
	Storage	Yard for empty and loaded containers
	Management	Administration, maintenance, access (gates), information systems
Ancillary (Added Value)	Trade facilitation	Free trade zone, logistical services
	Distribution centers	Transloading, cross-docking, warehousing, light manufacturing, temperature controlled facilities (cold chain)
	Storage depot	Container depot, bulk storage
	Container services	Washing, preparation, repair, worthiness certification

Ports

The last decade was characterized by a cycle where containerized trade surged, particularly along Pacific Asia – North America trade routes. From 1996 to 2007, North American container volume essentially doubled to reach 52.6 million twenty-foot equivalent Units (TEUs) (Figure 2). The issue not only concerns the growth in volume, but also the growth in the imbalances of the transpacific container flows, which accounted for 9.3 million TEUs in 2006.Transatlantic trade shows a similar, albeit less extensive imbalances with imports to the U.S. growing 6.1% annually for the same period and exports to Europe growing at a much lower rate, 3.5% annually. It remains to be seen to what extent past growth trends will endure in the future since containerization has achieved prevalence within the majority of supply chains. It is expected that container traffic growth has peaked and will likely decline until macroeconomic conditions, namely those linked with trade imbalances, are corrected.

The North American port system tends to be characterized by major port clusters where several large port terminal complexes are in proximity (Figure 3). While some are competing directly with one another, there is also an existing complementarity if they offer access to specific hinterlands through high capacity rail corridors. Significant

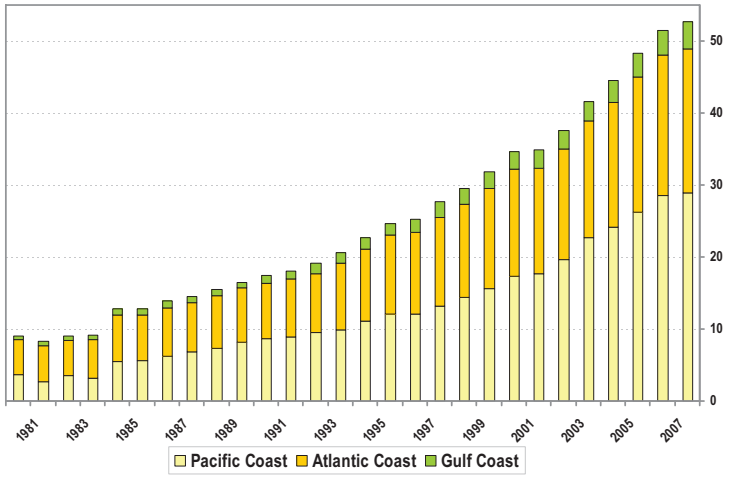

Figure 2 Container Volume Handled by Main North American Maritime Range, 1981-2007

growth of containerized traffic has placed intense pressures on port facilities and the rail and road access, particularly in major metropolitan areas. Many contemporary port terminal developments in North America must offer better connection with the hinterland such as with the setting of on-dock (or near dock) rail facilities and inland terminals (load centers).

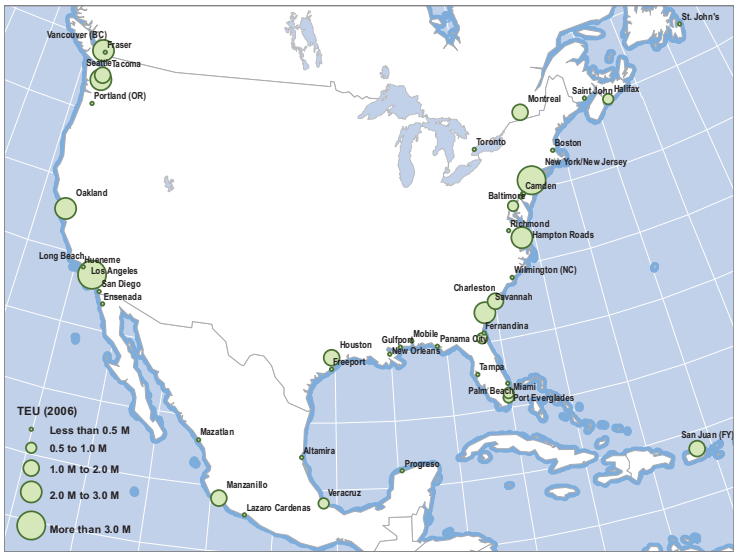

Figure 3 Traffic at major North American Ports, 2006

Along with established gateways, such as New York and Los Angeles / Long Beach, the recent years has seen attempts to establish new container ports that would act as alternatives. Two notable attempts are the Port of Prince Rupert in North British Columbia (not shown on map 3) and Lazaro Cardenas in Mexico. The Port of Prince Rupert came online in 2007 has a current design capacity of 500,000 TEUs and offers a shorter alternative for transpacific trade through its direct rail connection to Chicago in

less than 100 hours. For Lazero Cardenas, operated by the global terminal operator Hutchinson Port Holdings, its capacity has recently been upgraded to 500,000 TEUs and it is expected that 2 million TEUs could eventually be handled by the port (Randolph, 2008).

However, there is growing evidence that the boom in container volume handled at North American ports is coming to an end, or at least reaching slower growth rates. While traffic growth figures vary substantially by port and their maritime ranges, a stabilization and even a downward trend is emerging. This trend is dominantly linked with the slowdown of the American economy as it enters a recessionary stage linked to large amounts of accumulated debt and higher energy prices. The Port of Los Angeles is an excellent example of a port terminal complex that rode the growth of transpacific trade and its associated containerized volumes. Since 1995, its traffic has more than tripled to reach 8.4 million TEUs in 2007. Yet, traffic trends for the port are shifting (Figure 4).

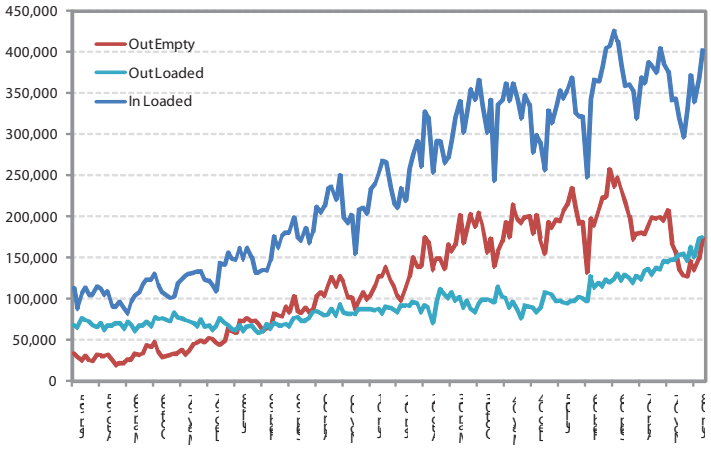

Figure 4 Monthly Container Traffic Handled by the Port of Los Angeles, 1995-2008

Since 2006, a downward trend is emerging for containerized imports, while loaded container exports have increased by about 50% on a monthly basis, surpassing for the first time in about 10 years exports of empties. The drop of empties is correlated with the drop of imports. The surge of exports is linked with the debasement of the US dollar making American manufactured goods and commodities more attractive on global markets. Another emerging pattern concerns a disconnect that began in 2008 for the export of empties. While some empties have been filled for the backhaul through Los Angeles, it also appears that they are being repositioned elsewhere in North America instead of being exported through Los Angeles. Still, the domestic market share and exports are not yet large enough to compensate for the import collapse. The Port of Long Beach, which is adjacent to the Port of Los Angeles, shows a closely similar traffic structure.

Rail Corridors and Terminals

Rail is of primordial importance to support long distance trade corridors in North America. It accounts for close to 40% of all the ton-miles transported in the United States, while in Europe this share is only 8%. Rail freight in the United States has experienced a remarkable growth since deregulation in the 1980s (Staggers Act) with a 77% increase in tons-km between 1985 and 2003. The North American rail transport system shows a high level of geographical specialization with large rail carriers servicing large regional markets (Figure 6). Rail companies have their own facilities and customers and thus have their own markets along the segments they control. Each rail system is the outcome of substantial capital investments occurring over several decades with the accumulation of impressive infrastructure and equipment assets. However, such a characteristic created issues about continuity within the American rail network. Mergers have improved this continuity but a limit has been reached in the network size of most rail operators (Figure 7). Attempts have been made to synchronize the interactions between rail operators for long distance trade with the setting of intermodal unit trains. Often bilateral, trilateral or even quadrilateral arrangements are made between rail carriers and shipping companies to improve the intermodal interface at the major gateways or at points of interlining between major networks. Chicago is the largest interlining center in North America, handling around 10 million TEUs per year. Its location is at the junction of the Eastern, Western and Canadian rail systems (figure 5).

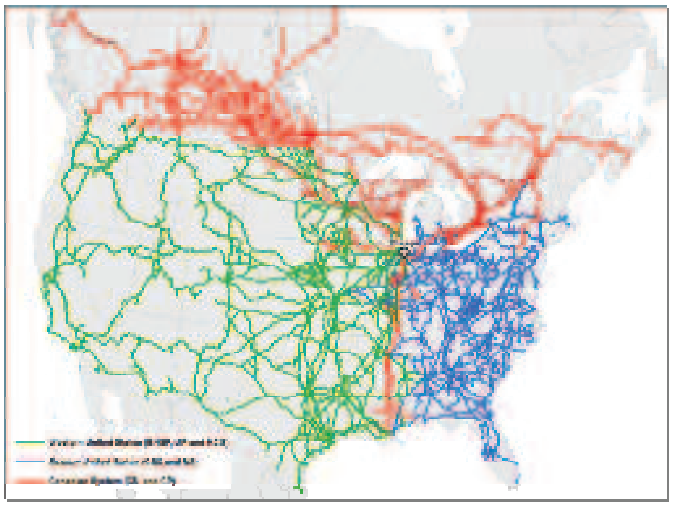

Figure 5 The North American Rail System

The main growth factors for rail activity in recent years have been linked with a growth in international containerized trade, particularly across the Pacific, a growth in the quantity of utility coal moving out of the Powder River

basin and a growth of the Canadian and Mexican transborder trade. Intermodal and coal represent the two most important sources of income for most rail operators.

The emergence of landbridges is a good example of the setting of an intermodal freight distribution system relying on long distance rail freight corridors. A landbridge has many definitions but can be summarized by a long distance rail corridor servicing at least one major port gateway. The main North American landbridge is linking two major gateway systems; Southern California and New York/New Jersey via Chicago. This represents the most efficient Landbridge in the world, which considerably reduces distances between the East and the West coasts. Thus, the North American landbridge is mainly the outcome of growing transpacific trade and has undergone the containerized revolution; container traffic represented approximately 80% of all rail intermodal moves. Landbridges are particularly the outcome of cooperation between rail operators eager to get lucrative long distance traffic and maritime shippers eager to reduce shipping time and costs, particularly from Asia. The two largest North American railroads, UP and BNSF, derive a sizable share of their operating revenue from long distance intermodal movements (landbridge) originating from the Pacific Coast (Figure 5).

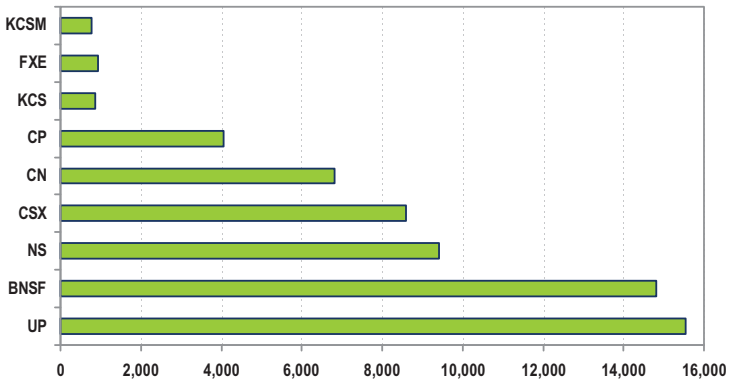

Figure 6 Operating Revenue of Major North American Railroads, 2006 (million U.S. dollars)

Long distance intermodal rail corridors are also planned in Mexico. Kansas City Southern de Mexico (KCSM, a subdiary of Kansas City Southern) is building an $80 million intermodal terminal next to the port of Lazero Cardenas. KCSM plans to establish a new International Intermodal Corridor stretching 1,300 miles across Mexico to the border crossing at Laredo, Texas. At Laredo, the Kansas City Southern system that connects to major American rail hubs, namely Chicago and Kansas City, takes over (Randolph, 2008).

However, due to road congestion, infrastructure capacity issues and a surge in fuel price the advantages of the landbridge are being challenged, particularly for long distance trade. For instance, shipping a forty foot container from New York to Korea cost about $3,000 if the all-water maritime route through the Suez Canal is used and $9,000 if shipped by rail to a West Coast port and then across the Pacific. Thus, this form of rail intermodalism appears to have reached a phase of maturity. Still, the market segment of domestic (North American) rail intermodalism is expected to grow substantially as the only available alternative to long distance trucking. This will lean on the setting of a variety of inland terminals acting as load centers for the respective market areas.

The United States has about 2,270 intermodal rail facilities able to move freight from rail to trucks (Figure 7). Although this appears to be a large number, only about 20% of these facilities handle a significant intermodal volume. The rest are local facilities fulfilling specific industrial, resources or manufacturing needs.

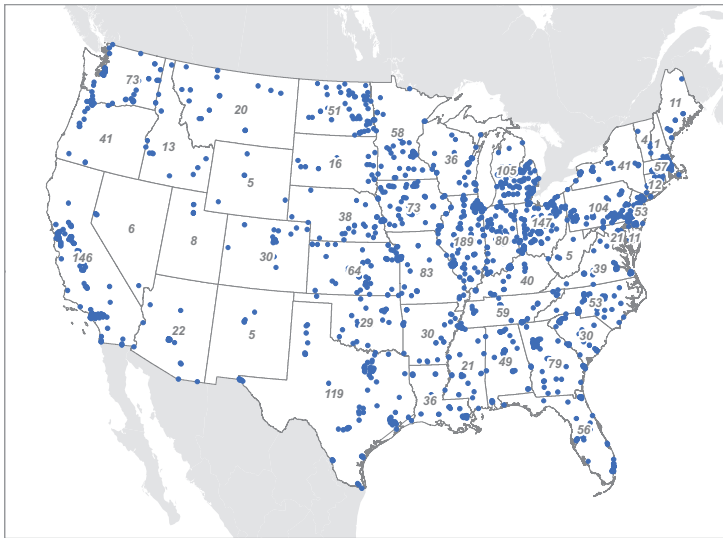

Figure 7 American Intermodal Rail Terminals (number per state)

At this point, very few available datasets provide information about the volume handled by rail terminals since most are operated by private interests. Still, the pattern of existing locations is a good indication of the demand of the intermodal industry. Most terminals are clustered around major maritime gateways (Los Angeles, New York), intermediary locations (Chicago, Kansas City) and major manufacturing and resource extraction areas (Indiana, Iowa).

Intermodal Infrastructure Development Needs

Capacity Issues

ownership structure of rail transport systems in North America involves substantial maintenance costs carried by private operators over the infrastructures, the terminals and the equipment. The rail industry has one of the high-

est capital expenditure as a share of revenue ratio, in the range of 18%. Typically, the two most important operating costs are transportation, which includes labor and fuel, (51%) and equipment (21%). The surge in traffic in recent years, particularly imports, has resulted in congestion in various segments of the North American transportation system (Figure 8). For instance, between 1999 and 2007 the number of containers handled by the intermodal rail system increased by 72% to reach 11.9 million units. While importers have benefited, North American manufacturers are impacted by greater rail and roadway congestion, which has made it more expensive to service domestic markets and to reach export markets. Constraints on growth in the trucking industry, including a shortage of drivers, highway congestion, high insurance rates, and increasing fuel and labor costs, have helped intermodal rail operations capture a significant fraction of international freight, yet so far only a small fraction of the domestic market.

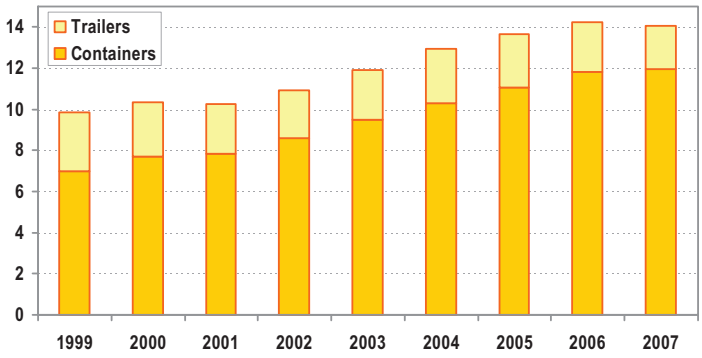

Figure 8 American Intermodal Rail Traffic, 1999-2007

Although the domestic long distance market is enormous and growing, the costs associated with intermodal transfers, both containers and trailers on flat cars, are a major factor accounting for the small share of the domestic freight market for intermodal rail. As long as capital and capacity remains limited, domestic traffic will be undermined by the more profitable long distance international traffic. Intermodal rail service continues to grow, but to attract more roadway traffic it will require additional capacity and equipment that reduces the operating costs at the ports, inland terminals, and the drayage operations serving both facilities. By improving connectivity between the modes, intermodal has the potential to dramatically improve the performance of supply chain and significantly reduce the volume of truckload freight creating highway congestion and consuming large quantities of fuel (Zumerchik, Rodrigue and Lanigan, 2008). This performance can be assessed in many ways. In terms of energy performance, rail has an obvious net advantage over road, particularly over longer distances. With unit trains, economies of scale can be readily been achieved while road accounts for no such advantage. Each additional container being carried by road involves the same marginal price increase.

Delays and disruptions are increasingly costly for supply chains maintaining relatively low inventory levels, particularly if they involve global freight distribution systems. For instance, the 2002 strike at West Coast ports (particularly Los Angeles / Long Beach) tallied economic costs of about $1 billion per day. Delays imposed by ports terminals are excessively expensive for maritime shipping companies; a 8,000 TEU containership has operating costs of about $50,000 to $60,000 per day and must constantly be in circulation to amortize its capital costs. Higher levels of circulation are linked with higher turnover levels of revenue generating cargo. In 2007, freight rates surged to much higher levels, such as $100,000 per day, but it went down to the range of $75,000 during 2008. Overall, it is estimated that congestion in the United States cost about $70 billion per year for freight. In view of these challenges it is acknowledged that new financing models are required as neither the government nor the private sector appear fully equipped to address the issue.

The nature and extent of these investments is very difficult to assess. For instance, investment needs for maritime transportation have been labeled as “unknown”, particularly within the 2005-2020 planning framework (Nelson, 2007). For other modes, such as air, road and rail, the Federal Department of Transportation was able provide figures that are judged to be fairly accurate. Yet, no such assessment exists for the maritime sector, namely for ports that are the major gateways for international trade. This is mainly related to the fact that the maritime industry is private and that port terminals are dominantly managed by private operators. These actors have their own investment strategies and sources of capital, which in the recent past did not require much government funding, except for the issue of dredging. All this represents a unique opportunity for North America to develop an efficient intermodal freight system with significant energy, environmental and competitive advantages.

Advances in Terminal Design and Operation

A highly desirable market potential for intermodal would be to achieve a similar cost structure to rail carload service while providing the service level of truckload freight. This cannot be done without substantial improvement in intermodal terminal design and operations. By reducing the number of times a container is handled, the number of operations involved in the transfer, the distance over which a container is handled, and the labor, equipment and time needed for a transfer, efficiency and pro-

ductivity improvements (better asset utilization) can be achieved. Equally important is vessel and train turnaround times, and the drayage cost reductions achieved by shortening the wait time from shippers and consignees, particularly at port terminals, as well as an elimination of deadhead, empty loads and bobtail trips. Great strides have been made in port capacity, spurring additional demands and higher requirement in the timing of inland containerized shipping. A commensurate level of public and private investment needs to be made in inland intermodal transportation. Without improvements in to increase capacity and improve speed, reliability, and the costs associated with intermodal and transmodal transfers (rail to rail), goods movement will remain dominantly serviced by trucking over increasingly congested highways and taxed by higher energy prices. For instance, a number of East Coast distribution centers have relocated further inland in Pennsylvania and Upstate New York to minimize roadway congestion disruption, and to avoid transmodal interchange between Western and Eastern railroads: containers are trucked from Chicago instead of being railed.

Even after more than two decades of intermodal developments, there is a glaring need for a closer integration between maritime and inland rail transportation. The improvement of terminal operations is an ongoing process covering three key dimensions:

- **Intermodal and interline efficiency.** This can be achieved in many ways but the most fundamental aspect involves better performing equipment. For instance, many crane manufacturers are constantly striving to develop equipment that performs faster, with fewer breakdowns and abiding to environmental regulations (electric powered as opposed to diesel powered). Additionally, this requires other intermodal equipment for the storage yard.
- **Rail access.** While older generations of intermodal yards (or those with small volume) worked on a one-to-one basis (one trackside space available for loading or unloading for each car), new intermodal yards tend to operate on a two-to-one basis (one trackside space for loading and one trackside space for unloading). This leads to more space for operations but also requires a more land for terminal operations. Sites in central areas are ill-suited for these additional space requirements.
- **Terminal accessibility.** The key problem in terminal operations is often not related to the performance of the intermodal equipment per se, but with the truck / rail interface. As the volume handled by a terminal gets larger, highway connectors become increasingly congested. Additionally, gate access to the terminal becomes a major bottleneck as each truck must be processed to insure that the right documentation is presented. Information technology will be fundamental to better manage drop-off and pick up as well as the management of stacking areas.

Two recent terminal projects are particularly revealing for current considerations in design and operation. They are at the opposite ends of the Heartland Corridor; a rail corridor project undertaken by Norfolk Southern (NS) expected to be completed in 2010. The corridor will reduce the distance of container train trips between the East Coast and the Midwest. The Heartland Corridor will initially connect the new port terminal facilities of Maersk in Portsmouth, Virginia, with rail lines through West Virginia and end in Columbus, Ohio. At this point the corridor will link up with western rail networks or with the double-stack rail corridor to Chicago. Currently, double-stack trains heading towards the Port of Virginia must go through Harrisburg, Pennsylvania because of insufficient tunnel clearance. Through an increase of the clearance of 28 tunnels at a cost of about $266 million, the Heartland Corridor project will bypass this loop, cutting 233 miles and 36 hours off the present route from Virginia to the Midwest.

At the Port of Hampton Roads, Virginia, the new APM container port terminal is entirely private and one of the most automated intermodal facilities in North America. It opened in 2007 with a capacity of 1 million TEUs and it is expected that 25% of the volume will be handled by rail with a potential of up to 40%. The terminal is equipped with six super post-Panamax electric portainers with a stockage area serviced by 30 semi-automated rail mounted gantry yard cranes. The terminal is linked with the NS rail network with six on-dock rail spurs able to move containers directly to long distance double-stack unit trains.

On the other side of the Heartland corridor in Columbus, Ohio, the Rickenbacker Intermodal Terminal, a $68 million facility, was opened in 2008. The initial phase of the intermodal terminal occupies about 175 acres and has the capacity to handle more than 250,000 containers (COFC) and trailers (TOFC) annually. The setting of new inland rail terminals is commonly taking place in conjunction with the setting of logistics parks. In this case, the Rickenbacker Global Logistics Park has been planned with the expectation of becoming a load center and capturing added value freight distribution activities.

Terminals and Equipment Needs

The development of containerization and mechanized intermodal equipment in the 1960s was the starting point in the emergence of a more efficient intermodal rail system, particularly in the 1980s when double-stacking rail

cars entered in service. Although the earliest - unsuccessful - attempt at double stacking was made in 1977 by Southern Pacific Railroad, the first double stack unit train started in 1984 between Los Angeles and South Kearny, NJ, under the initiative of APL (American President Lines). This created strong pressures in the design and implementation of efficient intermodal cranes as growing quantities of containers were handled by rail terminals.

A recent comprehensive study of rail infrastructure investment needs underlined that to meet expected freight demand and level of service by 2035, about 148 billion 2007 dollars of new investments would be required (Cambridge Systematics, 2007). About 87% these funds would go to line haul expansion and the construction, repair and maintenance of bridges and tunnels. About 6% would go to rail facility expansion, including the expansion of carload terminals, intermodal yards, and international gateway facilities. Each time a new terminal is built or expanded, it represents an additional demand for intermodal equipment including loading and unloading equipment, containers and chassis, and office and security equipment (Table 3).

Table 3 Equipment Requirements at Intermodal Terminals

Loading / Unloading equipment	Cranes (portainers), overhead cranes (stacking), straddle carriers and lifts. (Nature and mix depend on the type of terminal)
Containers	ISO containers (20, 40, 45, 48 and 53 foot), Domestic containers (53 foot), washing and repair equipment.
Drayage	Container chassis. Holsters and Trucks.
Office and security equipment	Standard office IT equipment. Security equipment.
Construction and maintenance	Standard heavy construction equipment and materials.

Containers are particularly prone to be leased since about 40% of the global fleet is owned by leasing companies. Leasing arrangements come in three major categories (Theofanis and Boile, 2008):

- **Master leases.** They are also called full service leases or container pool management plans and involve a complex and comprehensive leasing arrangement where the leasing company assumes full management. This entails a set of conditions regarding the availability of containers and an accounting system including debits and credits between contracting parties depending on the condition of equipment at the time of interchange. The leasing company is responsible for the full management of the container fleet (repositioning, maintenance and repair) and for repositioning following off hire and contract termination.
- **Long term leases.** Also called dry leases and are commonly associated with the extended use of the leased container by an ocean carrier. This lease normally follows the purchase of new containers by the leasing company and they do not involve any management service by the lessor. The goal of leasing company seeks is to amortize its investment over the lease period which covers about half of the useful life of a container.
- **Short term leases.** Also called spot market leases since the lease price is strongly influenced by current market conditions pertaining to the volatility of supply and demand. Such arrangements commonly take place when there is a temporary surge in the demand, either cyclical or unforeseen. Because of its volatility leasing companies try to avoid having a large share of their equipment on the spot market because of the risk of having idle containers, but realize that such a condition is unavoidable. Still, with careful planning, containers can be positioned to take advantage of local or regional surges in demand.

The recent trend has involved a shift from master leases to long term leases, particularly because of acute imbalances in containerized trade flows, such as between Pacific Asia and North America, which required the long distance repositioning of empty containers. Under a master lease agreement, these repositioning costs had to be covered by the lessor. A substantial growth potential resides in 53 foot containers used for domestic distribution or through transloading requirements.

Intermodal Equipment Pools

A prominent tendency in the intermodal industry has been the setting of various equipment pools. Equipment is usually made available for leasing by freight market, namely around a major port or rail terminal, a logical strategy since drayage markets are highly regionalized. Still, there are also national equipment pools, namely TTX which is wholly owned by the major rail carriers. It leases rail cars primarily but not exclusively used in intermodal and automobile transportation. It owns the flat cars and rail carriers own or lease the "racks" that fit on top and hold the motor vehicles. TTX has been a successful business model, turning a steady profit while serving the variety of equipment needs of the rail sector. Rails carriers lease an increasing amount of their non intermodal car fleet through finance companies such as GE Equipment Services and CIT Rail. Rail carriers also work through other third parties (e.g. GATX, Union Tank) for their chemical car fleets.

Pools are also slowly being extended to other elements of intermodal transportation, notably container chassis and container leasing. Usually each steamship line has its own chassis, which means duplication of equipment and congestion of available terminal space. For instance, the private equity firm Fenway used its Roadlink company (one

of the largest intermodal drayage company in North America) to pursue a rollup strategy by buying a set of small companies in a market that until recently has been heavily segmented. The expectation is a better level of usage of existing equipment. On the West Coast new regulations designed to bring cleaner trucks in to the ports of the San Pedro bay (LA / Long Beach) have brought large players like Schneider into the former owner operator market of port drayage. Fortress, a noted private equity player (owner of air and ship assets and RailAmerica/FEC Railway) bought Interpool to try to bring some consolidation to the container leasing market. The financial and economic crisis that began in 2008 has slowed down consolidation and pooling plans, but they remain a long term trend in the intermodal industry.

Transloading

Transloading involves the transfer from one load unit to another, which can be a complex task if the load units are significantly different. There are several causes that may favor container transloading, which tends to take place in the vicinity of port terminals or inland (satellite) terminals (Table 4).

Table 4 Causes for Transloading Containers

Cause	Outcome
Weight compliance	Transferring the contents of heavy containers into loads meeting national or regional road weight limits.
Palletizing	Placing loose (floor loaded) containerized cargo unto pallets. Adapting to local load units (e.g. europallet).
Demurrage	Handing back containers to owner (maritime shipping or leasing company) by transferring its contents into another load unit (e.g. domestic container).
Consolidation	Transferring the contents of smaller containers into larger containers (e.g. three maritime 40 foot containers into two 53 foot domestic containers). Cost savings (number of lifts).
Equipment availability	Making maritime containers available for exports and domestic containers available for imports. Trade facilitation.
Supply chain management	Terminal and transloading facility as a buffer. Delay decision to route freight to better fulfill regional demands.

- **Weight compliance.** Simply involves shifting the contents of heavy containers into lighter loads such as domestic containers or twenty footers. This is particularly the case for the containerized movement of commodities.
- **Palletizing.** Very common for the shipment of consumption goods. To gain shipment space in imbalanced container flows many containers are "floor loaded" and once arriving near consumption markets, the shipments are broken down and assembled into manageable pallets. This also gives the opportunity to adapt to local load units that involve different sizes, such as the difference between North American and European pallets. Doing such a task at the point of origin would be logistically complex.
- **Demurrage.** Containers are commonly rented for a specific time period and/or the leasing contract specifies that the maritime container cannot leave the vicinity of the port (or cannot spend more than a specific amount of time inland). Transloading is thus performed to insure that the leased container is handed back to the maritime shipping or the leasing company without additional charge..
- **Consolidation.** In many cases where this is a significant market for domestic containers and that the domestic load unit is larger than the maritime load unit, a consolidation of the shipments is often performed. For instance, in North America the largest domestic load unit is 53 foot, which represents the maximal legal size of a truck load on the highway. Thus, in distribution centers in the vicinity of several major ports the contents of three maritime containers are transferred into three domestic containers. This enables cost savings as shipment costs, including terminal costs, are established in terms of loads. A domestic rail terminals charges by the number of lifts, which means the costs are the same to handle a 40 foot or a 53 foot container.
- **Equipment availability.** This often takes place in conjunction with demurrage. Transloading enables a more efficient use of both container assets (international and domestic) and can facilitate international trade by freeing transport capacity. For instance, moving maritime containers over long distances in the North American transport system can be considered a suboptimal usage of transport equipment. Conversely, the global maritime shipping industry is mainly designed to handle 40 foot containers.
- **Supply chain management**. A transloading facility can act as a buffer within a supply chain, enabling shippers some room to synchronize the delivery of goods with the real time needs of their customers. This is particularly the case for long distance trade where a shipment can be in transit for several weeks while the demand conditions at the destination may have changed. Transloading thus offers an opportunity to delay the decision about routing freight to the final destination by using the facility as an opportunity to do last minute adjustments in terms of which shipments should go to which markets.

Transloading accounts for a substantial activity at major port terminals. For instance, more than 25% of all the containerized traffic handled by the ports of Los Angeles and Long Beach is transloaded into domestic containers. In many cases transloading requires specialized equipment and a facility where it can be performed.

Freight Distribution Centers and Distribution Clusters

Technological changes impacted over the location, design and operation of distribution centers; the facilities handling the requirements of modern distribution. From a locational standpoint, distribution centers mainly rely on trucking, implying a preference for suburban locations with good road accessibility supporting a constant traffic. They service regional markets with a 48 hours service window on average, implying that replenishment orders from their customers are met within that time period. They have become one storey facilities designed more for throughput than for warehousing with specialized loading and unloading bays and sorting equipment. Cross-docking distribution centers represent one of the foremost expressions of a facility that handles freight in a time sensitive manner. Another tendency has been the setting of freight distribution clusters where an array of distribution activities agglomerate to take advantage of shared infrastructures and accessibility. This tends to expand the added-value performed by logistics.

Table 5 Characteristics of Large-scale Distribution Centers

Size	Larger	More throughput and less warehousing.
Facility	One story; Separate loading and unloading bays	Sorting efficiency; Potential for cross-docking.
Land	Large lot	Parking space for trucks (often not necessary due to high throughput); Space for expansion.
Accessibility	Proximity to highways	Constant movements (pick-up and deliveries) in small batches (often LTL); Access to corridors and markets.
Market	Regional / National	Less than 48 hours service window.
IT	Integration	Sort parcels; Control movements from receiving docks to shipping dock; Management systems controlling transactions.

The setting of large distribution centers, often part of distribution clusters, has been a dominant trend, particularly among major retailers such as Wal-Mart, Target and Home Depot, which have set the standard in terms of inventory management of their supply chains. These intermodal facilities require a large array of equipment which can vary based on the freight they handle (Table 6). A distribution center involved in food and produce distribution will obviously have different equipment needs than a distribution center supplying retail stores.

Table 6 Equipment Required by a Distribution Center

Storage	Racks, bins
Sorting	Conveyors, lifts
Palletizing	De-palletizing and re-palletizing, wrapping
Temperature control	(For cold chain activities) Temperature monitoring devices, refrigeration equipment
Information technologies	Computer, network and telecommunication systems, scanning equipment

Large distribution centers tend to develop on the principle of internal economies of agglomeration (within the distribution center). Freight distribution clusters (FDC; also known as logistics parks) expand these advantages through external economies of agglomeration implying that the concentration of distribution centers within the cluster, even if they concern different supply chains, has the potential to reduce an array of costs. The construction of new rail terminal facilities is particularly prone to see the development of logistics parks, particularly because of the following:

- **Land.** The site of the new rail terminal commonly involves a suburban location where the availability of land (greenfield) is much less an issue than for conventional terminals located in built up areas. There are thus a variety of sites available in proximity for space consuming logistical activities. If the development of a logistical park is planned in conjunction with the development of the rail terminal, then a land reserve can be readily set aside.
- **New infrastructure.** A new rail terminal is equipped with the latest and highest performing equipment. Nearby logistical activities are thus able to benefit from superior transport services. Additionally, the setting of new rail infrastructure and the expectation of the location of new activities often creates an incentive for regional authorities to provide additional infrastructures, namely roads. Consequently, logistics activities have the double benefit of having access to high quality road and intermodal infrastructures.
- **Traffic expectations.** A new rail terminal represents a substantial capital investment committed when there are high expectations that it will handle the traffic level it was designed for. Since this traffic volume is new, logistical links can be created to form new supply chains and new added value activities.

Financing Models

Private Participation in Transport Infrastructure

Transportation infrastructure, like several infrastructure classes, has a significant level of public involvement ranging from direct ownership and management to a regulatory framework that defines operational standards. This is notably the outcome of a tradition where transportation, particularly roads, was seen as a public good not to be subject to market forces and be free of access. A similar trend applied to port and airport infrastructures that were placed under the management of public authorities. Although rail freight has essentially been a private endeavor in the United States, it was significantly regulated by the Interstate Commerce Commission in terms of fares and level of

service. Rail terminals were managed by private rail operators while the warehousing / distribution industry is almost completely private. Like many civil engineering sectors, the private sector can be involved in transportation **project delivery**, which can include design and construction, **project management** such as maintenance and operations and **project financing**, namely raising capital.

The trend towards private involvement in the transportation sector has been an enduring one, which initially started with the privatization (or deregulation) in the 1980s of existing transportation firms. New relationships started to be established with financial institutions since public funding and subsidies were substantially reduced and new competitors entered the market. Then, many transportation firms were able to expand through mergers and acquisitions into new networks and markets. Some, particularly in the maritime and terminal operation sectors, became large multinational enterprises controlling substantial assets and revenues. As the freight transport sector became increasingly efficient and profitable it received the attention of large equity firms in search of returns on capital investment. The acquisition costs of intermodal terminals, particularly port facilities, has substantially increased in recent years as large equity firms are competing to acquire facilities with secure traffic (low risks). A new wave of mergers and acquisitions is taking place at the global and national levels as equity firms see terminals as an asset class that has an **intrinsic value** (real estate), an **operational value** (rent, income) as well as providing a form of **diversification and stability:**

- **Asset.** Globalization and the growth of international trade have made many terminal assets more valuable since they are key elements in establishing and maintaining global supply chains. Terminals occupy premium locations conferring accessibility to either maritime, rail or road transport systems. These locations, such as waterfronts, are rare and cannot easily (if at all) be substituted for other locations. Traffic growth is commonly linked with valuation growth of a transport infrastructure since the same amount of land generates a higher income. Thus, terminals and some transport infrastructure are seen as fairly liquid assets with an anticipation that they will gain in value.
- **Source of income.** In addition to being an asset, intermodal terminals also guarantee a source of income linked with the traffic volume they handle. They have a constant revenue stream with a fairly limited seasonality (unlike many bulk terminals), which make terminals particularly attractive in light of substantial traffic growth that most terminal facilities have experienced. Traffic growth expectations result in income growth expectations.
- **Diversification.** Intermodal terminals offer a form of functional and geographical asset diversification for a holding company and help lower risks. Terminals represent an asset class on their own. They also offer a potential of geographical diversification as holding terminals at different locations help mitigate risks linked with a specific regional or national market. Financial problems related to the residential real estate sector are likely to incite many holding companies to diversify their assets, even outside the United States.

Causes and Forms of Public Divestiture

Facing the growing inability of governments to manage and fund transport infrastructure, the last decades have seen deregulation and more active private participation. Many factors have placed pressures on public officials to consider the privatization of transport infrastructure, including terminals:

- **Fiscal problems.** Thelevel of government expenses in a variety of social welfare practices is a growing burden on public finances, leaving limited options but divestiture. Current fiscal trends clearly underline that all levels of governments have limited if any margin and that accumulated deficits have led to unsustainable debt levels. Since transport infrastructures are assets of substantial value, they are commonly a target for privatization. This is also known as "monetization" where a government seeks a large lump sum by selling or leasing an infrastructure for budgetary relief.
- **High operating costs.** Mainly due to managerial and labor costs issues, the operating costs of public transport infrastructure, including maintenance, tend to be higher than their private counterparts. Private interests tend to have a better control of technical and financial risks, are able to meet construction and operational guidelines as well as providing a higher quality of services to users. Operating deficits thus must be covered by public funds, namely through cross-subsidies. Otherwise, users are paying a higher cost than a privately managed system. High operating costs are thus a significant incentive to privatize.
- **Cross-subsidies.** Several transport infrastructures are subsidized by revenues from other streams since their operating costs cannot be compensated by existing revenue. For instance, public transport systems are subsidized in part by revenues coming from fuel taxes or tolls. Privatization can thus be a strategy to end cross-subsidizing by tapping private capital markets instead of relying on public debt. The subsidies can either be reallocated to fund other projects (or pay existing debt) or removed altogether, thus reducing taxation levels.

- **Equalization.** Since public investments are often a political process facing pressures from different constituents to receive their "fair share", many investments come with "strings attached" in terms of budget allocation. Earmarks are a common equalization issue creating serious funding impediments. An infrastructure investment in one region must often be compensated with a comparable investment in another region or project, even if this investment may not be necessary. This tends to significantly increase the general cost of public infrastructure investments, particularly if equalization creates non-revenue generating projects. Thus, privatization removes the equalization process for capital allocation as private enterprises are less bound to such a forced redistribution.

One of the core goals of privatization concerns the derived efficiency gains compared to the transaction costs of the process (Gomez-Ibanez, 2008). Efficiency gains involve a higher output level with the same or fewer input units, implying a more productive use of the infrastructure. Transaction costs are the costs related to the exchange (from public to private ownership) and could involve various buyouts, such as compensations for existing public workers. For public infrastructure, they tend to be very high and involve delays due to the regulatory changes of the transaction.

Privatization and Financing Models

Once privatization is considered, an important issue concerns which form it will take. There are several options ranging from a complete sale of the infrastructure to a management contract where the public sector retains ownership and a share of the revenues. Three forms of privatization are particularly dominant:

- **Sale or concession agreement (lease) of existing facilities.** Divestiture is part of a political agenda which began with deregulation. As discussed before, budget relief is sought because of mismanagement; the public sector is essentially forced to sell or lease some of its infrastructures. For a sale, the infrastructure is transferred on a freehold basis with the requirement that it will be used for its initial purpose (unless another agreement was negotiated). For a concession agreement, it commonly takes the form of a long term lease with the requirement that the concessionaire maintains, upgrades and builds infrastructure and equipment.
- **Concessions for new projects.** Tap new sources of capital outside conventional public funding. It can take place in the context of fiscal restraints or as a way to experiment with a more limited form of privatization since existing assets remain untouched. It also confers the advantage of getting the latest technical and managerial expertise for the infrastructure project.
- **Management contract.** While ownership remains public, management is given to a private operator, commonly through a bidding process. This strategy has been particularly popular in the terminal operation business as many rail and maritime terminals are managed by private operators who do not own the facilities but have long term leases. The outcome commonly involves efficiency improvements.

Concessions are a simple and fair strategy involving a bidding process, which underlines the importance to have it take place in a transparent and open way. This is particularly relevant in the current context as retirement funds, sovereign wealth funds, investment banks and other financial institutions are increasingly involved in the funding of transportation infrastructure. A lack of transparency can be perceived negatively by the general public and can transform a simple transaction into a complex political process. Since many concessions are set over long time periods (50-75 years), they bring the issue of changing market conditions that may force a renegotiation of the contract. It is next to impossible to foresee long term market changes and traffic levels, so a provision for renegotiation should be provided. Again, this renegotiation can be subject to controversy and public debate, particularly if performed in an un-transparent manner.

Due to their nature and function, several other forms of privatization can be established for intermodal freight terminals (Table 7). Considering that intermodal terminals have an intensive use of equipment, leasing agreements are an important dimension of privatization and of the strategies of existing private infrastructure operators.

Table 7 Forms of Intermodal Terminal Privatization

Type	Nature
Sale	Terminal is transferred on a freehold basis but with the requirement that it will be used only to provide terminal services.
Concession Agreement	Long-term lease of terminal land and facilities and the requirement that the concessionaire undertakes specified capital investments to build, expand, or maintain the cargo-handling facilities, equipment, and infrastructure.
Capital lease	Similar to a concession except that the private sector is not explicitly required to invest in the facilities and equipment other than for normal maintenance and replacement over the life of the agreement.
Management contract	Private sector assumes responsibility for the allocation of terminal labor and equipment and provides services to the terminal users in the name of the public owner. The public sector retains control over all the assets.
Service contract	The private sector performs specific terminal activities. The arrangement differs from a management contract in that the private sector provides the management, labor, and equipment required to accomplish these activities.
Equipment lease	Can be in various forms involving leaseback arrangements or supplier credits. These agreements are used to amortize the costs to the terminal for new equipment and to ensure a reliable supply of spare parts and, often, a guaranteed level of service/reliability from this equipment.

Limitations of Private Capital

Although a level of privatization is commonly perceived as a desirable outcome for the efficient use and operation of transportation infrastructures, privatization comes with limitations. In some instances privatization can be unsuccessful. The main reasons are linked with the private contractor unable to honor the commitments (which is rare) or the new cost structure is perceived to be unfair by users since the privatized infrastructure now offers market pricing (more common). If customers are used to low and subsidized costs they will not well respond to market prices, particularly if they are not introduced in an incremental manner. Although private initiatives commonly result in efficiency gains, private capital involves many limitations concerning capital costs and the issue of domestic versus foreign capital:

- **Capital costs.** Nominal costs for private capital are often higher than for public debt, since the later is guaranteed by the full faith in the credit of the state. This can create a moral hazard as the capital costs and their risks are transferred to the public in terms of guarantees to cover operating costs (cross-subsidy) or bail-outs in case of default. This process is very common in a variety of public enterprises which in spite of acute losses operate on the assumption that their financial shortfalls will be covered by the state. Thus, depending on the size and capitalization of a transport operator, capital costs can be higher than for a public counterpart.
- **Domestic vs. foreign finance.** Local private capital markets can be very limited, particularly in developing countries. Transportation assets are also so substantial that they are only accessible to the largest equity firms. Modern transportation infrastructure projects are easily beyond the range of local and regional governments. Finance can thus be tapped from foreign markets. Even in the United States, terminal assets are mainly accessible only to a few large equity firms, many of which are foreign owned. This can be controversial as the case of Dubai Ports World purchasing the port terminal assets of P&O in 2006 demonstrated. Because of political pressures DPW was forced to sell the American port assets of the transaction to the AIG holding company. Fluctuations in exchange rates can also be a significant risk factor, but if a currency is undervalued (debased), investments can pour in to take advantage of the discount to capture valuable and revenue generating assets. This appears to be the strategy of several Sovereign Wealth Funds concerning the United States.

Challenges to Existing Funding Practices in Freight Terminals

Freight transportation, particularly in North America, is already dominantly private. Still, private capital investments are increasingly difficult to secure for transport terminals, mainly for the following reasons:

- **Risks.** Private equity firms are increasingly concerned by the level of risk related to funding intermodal infrastructures and equipment. They are aware that past growth does not guarantee future results, particularly in the current economic context where substantial trade imbalances have emerged and where debt derived consumption has reached a limit. Traffic projections are likely to be on the over-estimation side. The main factor becomes reconciling traffic expectations, resulting in terminal capacity investments and equipment purchase, with real traffic once the terminal is operating. Any significant differences will be linked with substantial financial losses. The true extent of risk factors can only be known afterwards, but can have profound impacts in assessing future investment allocations.
- **Design phase.** The construction and upgrade of intermodal terminals are commonly delayed for several reasons, particularly through compliance to a variety of municipal, state and federal regulations. For a project involving a level of Federal funding, on average four years of delays may be inputted simply because of a variety of regulatory procedures. More recently, environmental and local impacts considerations have become an increasing burden which can account for up to 20 or 30% of terminal development costs. An increase in marginal costs has also been noted, as the more extended the design phase, the higher the final costs tend to be. Since transport terminals are among the infrastructures that are the most time consuming to design and build, private firms consider new terminals as high risk projects and will only commit when they have confidence about expected traffic levels. Delays in the design and construction phase also involve delays in the purchase of intermodal equipment servicing the terminal.
- **Low returns**. Delays in the design phase and higher operational costs than expected can lead to low, if not negative returns. Due to the growing involvement of private equity firms and the limited number of terminals, there has been an "over bidding" to acquire terminal assets with the expectation of significant future traffic growth. The price / earnings (PE) ratio of recent terminal acquisitions has increased to around 20, while the range of 10 to 15 has historically been the average value. Still, PE ratios must be interpreted cautiously as earnings are past earnings and may change in the fu-

ture because of changes in the traffic, competition from existing or new terminals as well as higher operating costs. Consequently, lower returns can be expected if terminals are seen from a more conservative financial evaluation perspective.

Private / Public Partnerships

Public / private partnerships (PPP) are contractual agreements between a public agency (federal, state or municipal) and a private sector entity that allow for the design, building, operation or financing of transport infrastructure (FHWA, 2007). They thus confer a wide range of options in terms of capital allocation and respective levels of participation. They can simply cover the standard design / build contracting process common in many road projects or involve innovative approaches where a private operator takes charge of the construction and management of a transport infrastructure over a long term concession. PPP take place in situations where stakeholders alone cannot clearly evaluate the respective advantages of the investment. The public sector thus helps leveraging the position of the private sector, which commonly results in a better allocation of resources than if they would have done so independently. While the public perception tends to relate PPP to toll roads, the reality places these initiatives in every segment of the transportation industry from modes to terminals.

PPP take a particular dimension in the freight sector as freight transportation is much the realm of the private sector with public interests mainly covering the regulatory framework. The most significant infrastructure assets are related to freight transport terminals, particularly ports and rail, a reason why they are dominantly owned or operated by private interests, which makes public involvement problematic. There is thus a conventional approach to PPP which is gradually been supplemented by an emerging framework where private entities are taking a higher level of responsibility (Figure 9).

The main forms of PPP include:

- **Design-Bid-Build.** In the first stage, a contract is awarded to an engineering design firm to set a clear guideline in terms of the potential costs, materials and equipment required to complete a public works project. Then private contractors are invited to bid on the proposed specifications, which are reviewed by the public entity. The bid winning contractor then undertakes the construction phase and once completed, management and maintenance will be performed by the public sector. All steps are financed by the public sector.

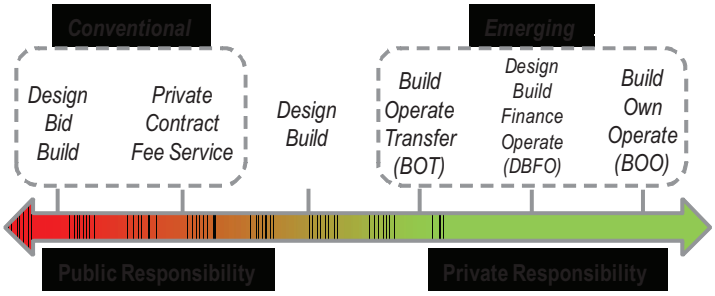

Figure 9 - Public / Private Partnership Options[1]

- **Private Contract Fee Services.** A common contract structure where the public sector transfers the responsibility of specific services, such as operation and maintenance of public infrastructures, to the private sector. There exists a variety of private firms that have specialized in providing services to transport infrastructure, particularly in terms of maintenance, repairs and upgrades.
- **Design-Build.** Similar to the design-bid-build partnership with the exception that they are combined into a single contract. As usual, the public sector owns the infrastructure as well as bearing the responsibility for its financing, operating and maintenance.
- **Build-Operate-Transfer.** While the public sector is responsible for the financing of the infrastructure, a private entity provides for construction and operation. It is also known as a "turnkey" PPP since after a specified amount of time, the public sector takes over the infrastructure. It can be decided to extend the operation contract to the same operator or have it up for bid.
- **Design-Build-Finance-Operate.** The responsibilities for designing, building, financing, and operating the infrastructure fall in the hands of the private sector, but ownership remains public. There is however some flexibility in the PPP as the respective shares of the financing could come from a pool of public and private interests. The flexibility also takes form in terms of the nature of the financing, which can be capital or in kind. The expectation is that the contracted debt used to finance transport infrastructure will be recovered by future revenues, which implies that user fees will be applied and that debt (such as bonds) is leveraged by future revenues.
- **Build-Own-Operate.** The design, development, financing, building, operation and maintenance of an infrastructure fall completely under the responsibility of the private sector and this for the duration of the concession, which is dominantly long term. Public sector involvement is limited to the general regulatory framework and assuring compliance to the terms of the contract.

[1]Source: adapted from US Department of Transportation, Federal Highway Administration (2007) Financing Freight Improvements, Publication #FHWA-HOP-06-108, http://ops.fhwa.dot.gov/freight/publications/freightfinancing/index.htm.

Conclusion: Options and Recommendations

The current context in intermodal transportation in North America is prone with risks and opportunities. While an expected slowdown in traffic would be indicative that the equipment leasing market for this sector could be stabilizing, or even shrinking, structural changes in the intermodal industry are offering several opportunities. One of the most influencing factors concerns higher energy prices that will incite a restructuring of North American freight distribution systems. Terminals and distribution centers will play a key role in this shift as shippers, operators and the public sector renew interests in intermodal transportation to cope with inefficiencies in freight distribution. Already the rise in all-water services connecting East Coast ports through the Panama and Suez canals (instead of using the West Coast and the rail landbridge) is an indication that maritime shippers are reconfiguring their services to face growing inland intermodal transportation costs. Time and performance requirements in modern freight distribution are also likely to make intermodal transportation a focus in the accumulation of scarce capital investments. It is thus expected that investments in intermodal transport terminals and equipment will endure. The leasing of intermodal equipment will be an approach favored by many terminal and freight distribution center operators. For new terminal and distribution center facilities it will minimize risk while the market potential is being developed. For established facilities, leasing equipment will represent a strategy to acquire more performing, but capital intensive equipment. In light of the changing economic and financial context in which intermodal transportation evolves in North America, the following recommendations can be underlined:

- **Advanced intermodal equipment.** There is a trend in existing and particularly in new terminals towards the implementation of advanced intermodal equipment, namely cranes, that is more reliable and energy efficient. While this equipment tends to be more capital intensive, productivity gains more than compensate. Terminal operators are thus more likely to lease this equipment as a risk mitigation strategy.

- **Domestic rail traffic.** The domestic intermodal rail market is expected to rise. While the main driver of intermodal transportation in North America was international trade and long distance inland movements, the restructuring of supply chains due to energy prices will favor more North American sourcing and shortening lengths of haul. Intermodal terminal development and the corresponding equipment demand are thus likely to shift more to inland load centers.
- **Freight distribution clusters.** The ongoing agglomeration of distribution centers into major clusters will offer ongoing opportunities to lease equipment. Due to the flexible and fluctuating nature of freight distribution, distribution centers are prone to lease equipment. Since these activities tend to be clustered, the leasing market can develop regional niches servicing these markets once they reach a certain size. As each distribution center tends to be part of a different supply chain linked with different sectors of activity (e.g. apparel, auto parts, furniture, food, etc.) they require a wide range of equipment. A growing number of initiatives involve the development of logistics parks, often in conjunction with the setting or expansion of an intermodal rail terminal. Again, this represents opportunities for leasing equipment both to intermodal and freight distribution activities within a region.
- **Greater involvement of global private operators.** At the global level, large private terminal operators and logistics service providers have emerged. While some are independent private entities, others are subsidiaries of sovereign wealth funds. The ongoing process is to insure a higher level of control on global supply chains since it is linked with better levels of service and the capture of added value along the transport chain. Many are now moving in inland transport operations and become increasingly involved in leasing intermodal equipment.
- **Environmental compliance.** The imposition of environmental regulations and standards on the transportation sector will endure. This will likely benefit intermodal rail which is comparatively more environmentally friendly than road. Yet, the growth of intermodal rail traffic will bring closer attention from an environmental standpoint and possibly additional regulations. These regulations will impose more stringent conditions for the related intermodal equipment, which will extend to the leasing industry.
- **Security and safety equipment.** Security and safety concerns are likely to endure with terminals the key facilities where security related activities will be performed. These activities involve the security of the intermodal facilities and the security of the containerized freight. The growth of intermodal transportation will thus be linked with the use of additional security equipment, particularly when international supply chains are concerned.

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Dr. Jean-Paul Rodrigue, Associate Professor, Dept. of Global Studies & Geography, Hofstra University, Hempstead, NY, USA. Email: Jean-paul.Rodrigue@hofstra.edu Jean-Paul Rodrigue is an internationally known academic focusing on transportation, freight distribution and trade issues, particularly in North America and Pacific Asia. He has published extensively on the topics of logistics, global production networks, transport gateways and corridors, economic integration, international trade and regional development. He is also on the international editorial board of the Journal of Transport Geography, the Journal of Transport and Land Use and acts as the Van Horne Researcher in Transportation and Logistics.

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