

Logistics and National Security

Jean-Paul Rodrigue

Dept. of Economics & Geography
Hofstra University
Hempstead, New York
11549 USA

Brian Slack

Dept. of Geography
Concordia University
Montréal, Québec
Canada, H3G 1M8

Published in S.K. Majumdar et al. (eds) (2002) Science, Technology, and National Security, Easton, PA: Pennsylvania Academy of Science, pp. 214-225. ISBN 0-945809-18-2.

Definition, Origins and Development

Logistics mainly involves the management of physical distribution systems. The first significant applications of logistics were developed in the military sector. Modern military operations require constant mobility and consume large amounts of supplies. Although military logistics first developed in the Nineteenth Century (O'Sullivan and Miller, 1983), it was in World War II that logistics theory and practice became sophisticated. As a conflict that was truly global and carried out with an unprecedented deployment of personnel, equipment and supplies, logistics played a central role in ensuring success for the Allies.

A comparable scale and scope of physical distribution within the civilian sector was only achieved later. Starting in the 1970s, economic activities, notably within multinational corporations, became increasingly globalized (Dicken, 1998). This required higher organizational levels of physical distribution systems, which in turn favored the development of the civilian logistical science. Both are now fairly different in their organizational structures. One of the main differences between military and civilian logistical science is that for the former the supply chain is forward-oriented while for the latter it is backward-oriented. While military logistics mainly aim to supply a mobile demand (military units) from relatively static supply sources, civilian logistics mainly attempt to supply a rather static demand with shifting supply sources, notably by fragmenting the elements of the supply chain, such as production.

Such a process has increased the amount of freight and passengers crossing international boundaries. On average, international trade has grown annually by 5% between 1990 and 1999 to reach 5.4 trillion dollars, of which the United States accounted for 12.4% (WTO, 2000). This trend has also been strengthened by trade agreements such as NAFTA (North American Free Trade Agreement) and reductions in tariffs promoted by the World Trade Organization. The transport industry has responded to this growth with massive investments in infrastructure and facilities that have expanded the capacity and efficiency of transportation systems, both domestic and international.

Added flows and capacities have in turn created increased demands on the management of physical distribution systems, which includes activities such as transportation, transshipment, warehousing, insurance and retailing. These are all of strategic importance to national economies, particularly the United States. With the increasing reliance on distribution systems, any failure of transportation, due to intentional or non-intentional causes, can have very disruptive consequences, and can compromise national security. According to the US Department of Transportation (2000), four major categories of national security issues are related to transportation:

- **Transportation supply.** Ensuring that transportation modes, routes, terminals and information systems are able to satisfy national security needs such as troop deployment and relief, within the United States and abroad.
- **Transportation readiness.** Maintaining the readiness of transportation to face time-sensitive national security needs.
- **Transportation vulnerability.** Reducing the vulnerability of the transportation modes, terminals and users to intentional harm or disruption.
- **Illegal use of transportation.** Reducing the flow of illegal drugs and illegal immigration to the United States.

Logistics is playing an important role in these four categories, notably over their organization and management. While military logistics has always been closely related to national security issues, today security concerns extend far beyond conventional military perspectives, for which the science was initially developed. This chapter will discuss the implications of both military and civilian physical distribution systems on national security.

Military Applications of Logistics

Impair mobility, and the ability of armed forces to react and counteract is undermined. As the nature of threats to national security have shifted from traditional great power conflicts, to more fragmented sources, such as civil wars, natural disasters, and terrorism, logistics requirements have changed accordingly. In the cold war era, the challenge for the USA was to face a single powerful adversary, the USSR and its allies, in well-identified and rather small potential theaters of conflict. In such a context, forces and equipment could be positioned well in advance, because each protagonist's actions were reasonably predictable. The logistical support system for such a strategy was efficient, but not necessarily flexible.

The emphasis today leans more on the rapid deployment of troops and materiel to face local incidents with little preparation time. In fact, the deployment of forces must be done within days to be effective, and inevitably air transportation is the only effective means to achieve such a goal. The Kosovo Crisis of 1999 underlined the difficulty of taking an intervention force to a region to end the crisis and enforce UN resolutions. While the air attack was under way, ground forces had tremendous difficulties reaching the theatre since the closest airport, Tirana (Albania), was incapable of supporting the required logistical demands. It was already under heavy stress from the humanitarian relief coming through, as more than half a million Kosovar refugees had fled to Albania. Part of the deficiency of the campaign, therefore, was the difficulty in providing ground support for the air campaign, leaving Yugoslavian military and Para-military forces free to undertake ethnic cleansing for several weeks, while UN troops were being assembled.

Since this setback, the US army has undertaken the logistical challenge of being able to deploy a combat ready brigade anywhere in the world within four days and three brigades within five days.

However, this brigade is likely to be lightly armed because of the physical distribution delays ferrying heavy equipment would create. Most modern tanks weight around 70 tons and require massive logistical support, namely fuel, likely to collapse if rapid deployment of large numbers of armored vehicles is required. The US Air Force Air Mobility Command, the most likely provider of logistical support for this requirement, had in 2001 two types of aircraft capable of ferrying Abraham M1 battle tanks; the C-5 (Galaxy), that can hold 2 tanks and the C-17 (Globemaster) capable of hauling a single tank. About 126 C-5 and 50 C-17 were in service by 2001, and there will be an additional 120 C-17 planes by 2005. With an increased reliance on reserve forces, the logistical requirements of deploying troops is getting more complex and more problematic, especially with airlift.

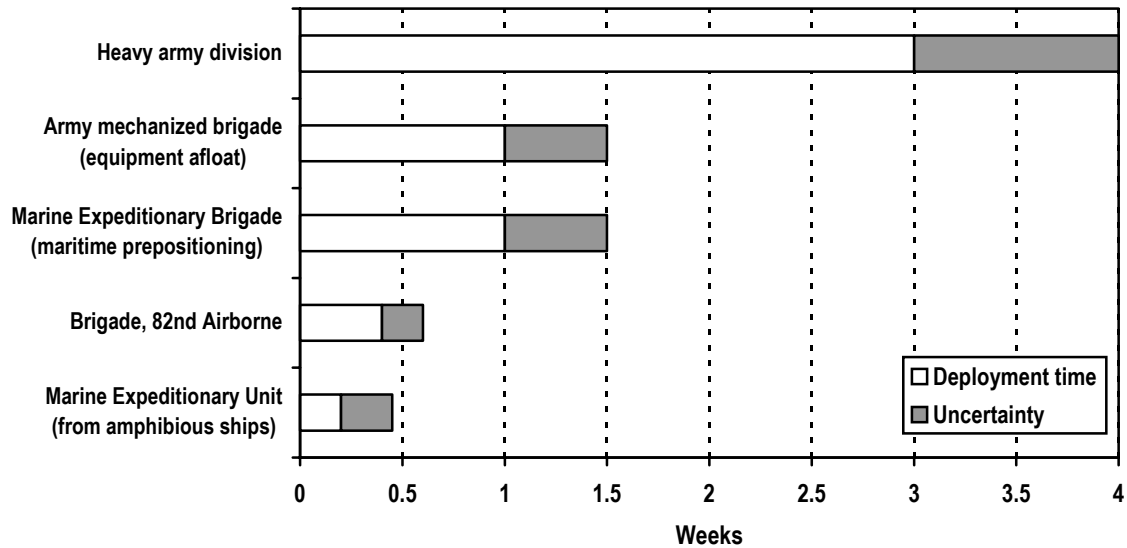


Figure 1: Deployment Times for Ground-Force Units, 2000. Source: Gritton, E.C. P.K. Davis, R. Steeb, and J. Matsumura (2000) *Ground Forces for a Rapidly Employable Joint Task Force: First-Week Capabilities for Short-Warning Conflicts*, RAND, MR-1152-OSD/A, p. 13.

The United States armed forces have limited capabilities for fast deployment times, essential to face emerging national security threats where the use of military force would be required (Figure 1). Assuming reasonable proximity and warning, it is possible to deploy a Marine Expeditionary Unit (MEU), of regimental size, in about 2 to 4 days. It is also possible to airlift a brigade of the 82nd Airborne Division in about 4 days, but this force would have limited capabilities against a mechanized threat. Any other units of the size of a brigade would require at least a week to deploy, and this assumes that the equipment is already afloat. Comparatively, a standard US Army heavy division would take at least 3 weeks to be deployed in a theatre of operation (Gritton et al, 2000).

Since the end of the Cold War, the US has closed down or been forced to relinquish many of its overseas bases which makes supply chains longer as equipment and personnel have further to travel. This also brings some issues since future conflicts are more likely to occur in the Pacific Asia region, which involve large distances. One former US military base in the Philippines, Subic Bay, has become a major logistical, industrial and commercial (Subic Bay Freeport) center since it was closed in 1992. Because of its central location, it now acts as a major hub for Federal Express in Asia.

In light of these observations, it becomes quite clear that future military logistics will need fast and efficient airlift capabilities and continued flexible maritime support. The latter is problematic. The United States military has depended upon civilian ships to haul much of its materiel to foreign bases and overseas theatres of conflict, such as the Persian Gulf. In the past this has been made possible by the subsidy support offered through the Jones Act to US-flagged vessels. The Act enables these merchant ships to be used in normal times to transport Department of Defense supplies and materiel under commercial contracts, but in times of war these vessels can be commandeered for military service. The Jones Act itself is being questioned by a variety of powerful commercial interests, who see the exclusion of foreign ships from coastal shipping as uncompetitive and inefficient. At the same time, the US-flagged fleet is being threatened by foreign takeovers. Thus, in the last five years every major US container shipping line has been taken over by foreign interests. SeaLand has been bought by the Danish firm Maersk, American President Line has been taken over by the Singaporean NOL, and Lykes has been absorbed by the Canadian CP Ships. Under a legal loophole, many of the ships are still registered under the US flag, but the ownership is foreign. Since all these major logistical suppliers were member of the Voluntary Intermodal Sealift Agreement (VISA)¹ as of 1999, this change of ownership to foreign interest raises issues of national security.

Civilian and Domestic Issues of Logistics

Although logistics might appear to be a military issue when national security is concerned, civilian and domestic factors are also significant. The nature of the threats differs, however. Acknowledged civilian threats include: oil dependency, intentional harm to transport systems, including infrastructures, freight and passengers, the issue of illegal movements of drugs and illegal immigration (USDOT-BTS, 2000) and humanitarian aid in situation of emergencies (World Food Programme, 1999).

Oil Dependency

Physical distribution systems that rely upon high levels of mobility provided mainly by the internal combustion engine, present a security challenge under specific conditions. For instance, the heavy dependence of the transport sector on petroleum as a source of energy, from the automobile to the airline industries, has been a determinant factor shaping foreign policy over the last 25 years. Serious national security issues have been linked with oil supply emergencies such as the OPEC oil embargo of 1973, the Iranian Revolution of 1979 and the Gulf War of 1991. The economy depends upon cheap energy, but with a growing imbalance between petroleum imports and national production, the physical distribution system of petroleum is of increasing national security interest. The pursuit of such interests has led to a number of inconsistencies in terms of foreign policy, involving issues such as human rights, sanctions and aid.

¹ VISA is a preparedness program that aims to provide civilian ships to the Department of Defense in case of war or emergencies.

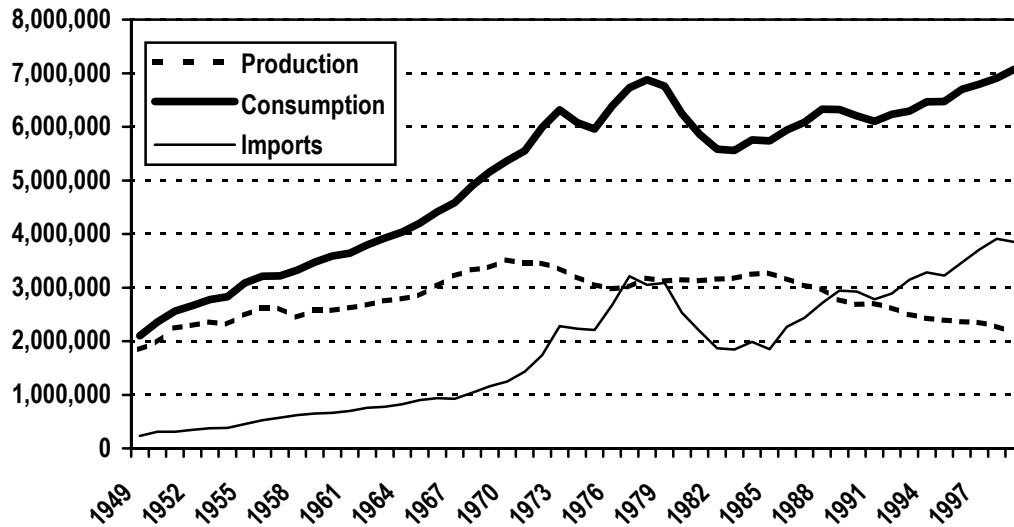


Figure 2: Petroleum Production, Consumption and Imports, United States, 1949-1999 (in million of barrels). Source: US Energy Information Agency, International Energy Annual Report 2000.

Figure 2 illustrates that the consumption of petroleum in the United States has grown, while domestic production has been largely stable, with a decline perceptible during the 1990s. This in turn has led to a growing dependence on foreign supplies to satisfy the ever-increasing demand for fuel that cannot be supplied from domestic sources. Indeed, since 1990 petroleum imports have surpassed domestic production. The transport sector itself accounts for more than 65% of the oil demand, which itself creates another dimension related to modal dependency. Road transportation consumes 80% of the energy from the transport sector in the United States, air transportation being the second with 8% (BTS, 1999). The logistics industry depends heavily on those transport modes.

Intentional harm to transport systems

The proliferation of terminals, for all modes, increases the difficulty of insuring the safety of logistical operations, both domestic and foreign. As the logistic industry becomes increasingly globalized, new vulnerabilities are exposed and new threats encountered.

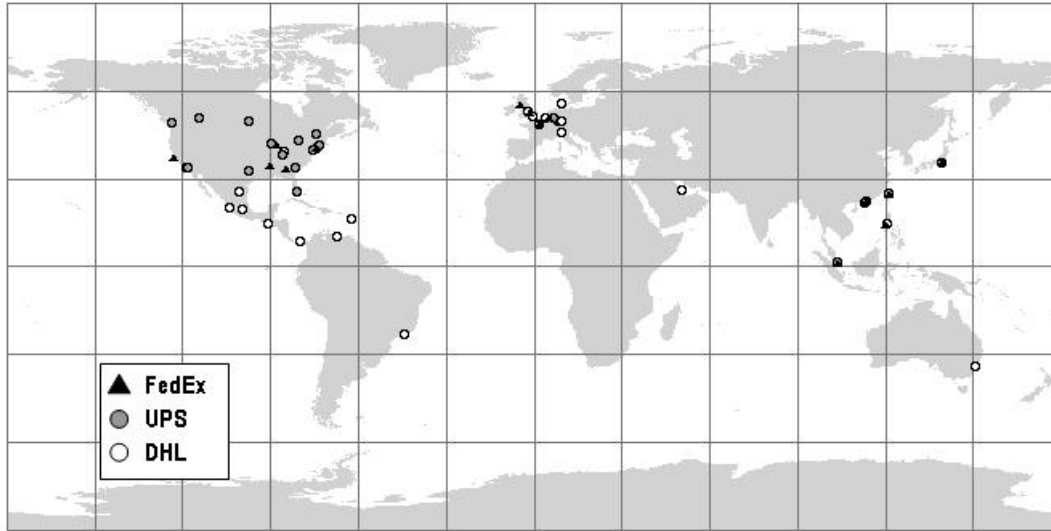


Figure 3: Major Air Hubs of DHL, FedEx and UPS, 2000. Source: Respective Web sites.

Figure 3 represents the major air hubs of three dominant American parcels distributors, DHL, FedEx (Federal Express) and UPS (United Parcel Services). These corporations are at the forefront of logistical development through the management and expansion of an international freight distribution system that jointly handles about 28 million parcels per day. A powerful recent trend has been for corporations, large and small alike and in every sector of the economy, to subcontract their logistical activities. Since in a globalized economy, the management of freight distribution systems is getting increasingly complex, subcontracting these operations to specialized operators has been a cost-effective solution for corporations facing distribution bottlenecks. As a result, civilian freight distribution systems are becoming more concentrated and efficient, but also more vulnerable.

The concentration of civilian logistics mainly relies on hub-and-spoke structures, whose logistical hubs are the heart of physical distribution systems. This network restructuring has been adopted by the whole air transport industry and has been linked with increased efficiency, but also increasing vulnerability. For instance, the main hub of UPS is located in Louisville, Kentucky and has the capacity to handle more than 5 million parcels per day. This gigantic air-freight sorting and warehousing center receives on average 100 flights per day and employs more than 18,000 people. If for any reason the Louisville hub was compromised, the whole UPS logistical system would also be jeopardized, with significant delays in deliveries. It is worth mentioning that those carriers have a very high visibility at the global level since they are represented in almost every country and have their own air companies. UPS Airline, the 11th largest in the world, alone operates more than 238 aircrafts and serves more than 450 airports around the world, as well as 475 airports in the United States. The very strategic importance of the civilian logistics industry makes it a target for any group or interest seeking to weaken the United States and the global economy. Because the industry relies heavily on civilian airports, they may be seen as being particularly vulnerable.

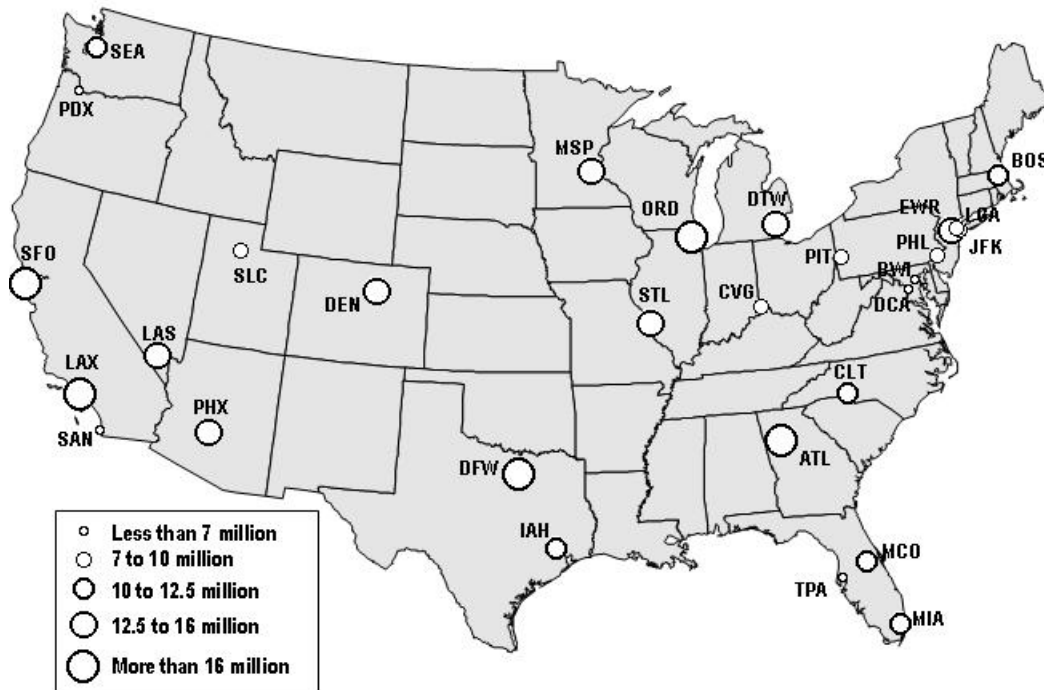


Figure 4: Passenger Traffic at the Largest American Airports, 1998. Source: Compiled from US Bureau of Transport Statistics (2001), The National Transportation Atlas Data.

The number of airports of civilian access in the United States is very large (Figure 4). In 2000, the Bureau of Transport Statistics censused more than 5,200 airport facilities, as well as more than 900 heliports. Obviously, only a limited number of these facilities are equipped to handle large-scale air transport operations, so there are roughly 420 commercial airports in the United States. Because of changes brought by contemporary logistical requirements of airlines, air traffic is focused on a limited number of hubs that are handling the bulk of the traffic. There were only 30 airports handling more than 5 million passengers in the United States in 1998. They jointly accounted for more than 68% (384 million) of all enplaned passengers (about 564 million in total²). Indeed, the 15 largest airports accounted for more than 45% of all the air traffic in the United States. In such a centralized system a wide range of disruptions are possible. A problem at one major hub can have consequences for the whole system. The last few years there have been growing concerns about increasing flight delays at major airports. The effects are evident when bad weather occurs, but delays and disruptions are being brought about by other factors, most of which are related to limited capacity and congestion. The practice of hubbing is a major contributor to these problems (Graham, 1995). Further, the concentration of the airline industry itself where each carrier has dominance on selected hubs can be perceived as a factor promoting vulnerability.

² This means that on average every American makes a little over 2 air travels per year

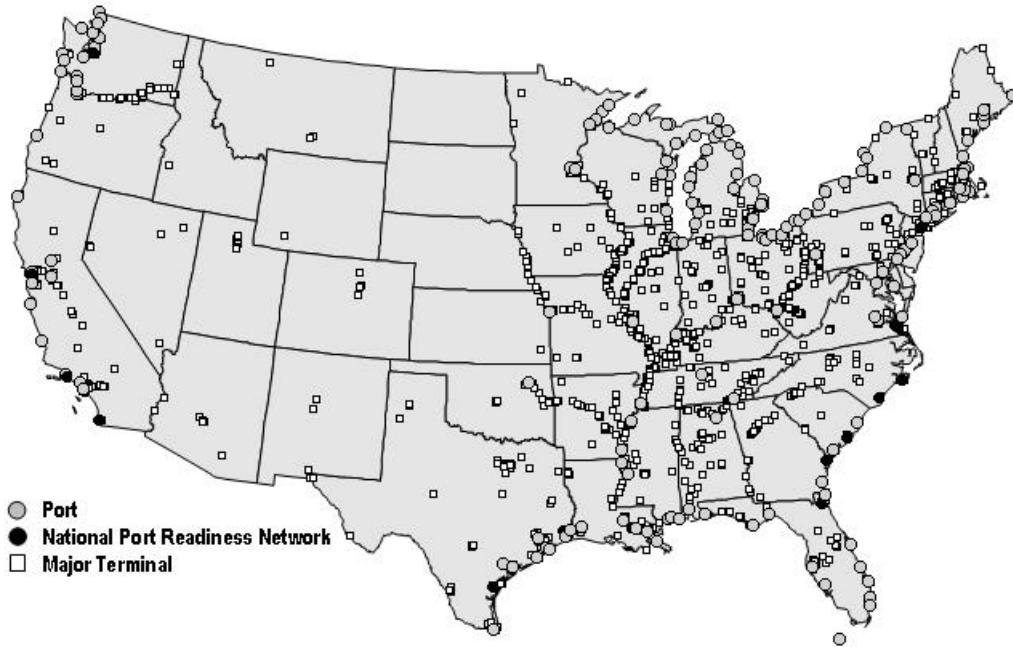


Figure 5: Ports and Transport Terminals in the United States, 2000. Source: Compiled from US Bureau of Transport Statistics (2001), The National Transportation Atlas Data and from USDOT, Maritime Administration.

There is a wide array of other transport terminals supporting the logistical operations of freight and passengers. The Bureau of Transport Statistics records 224 ports and 3,062 major intermodal terminals in the United States (Figure 5), all of which are potential targets for disruption. These facilities handle the requirements of national freight distribution with the important function of intermodal transfer, which is transferring freight from a mode such as a ship to a train and vice-versa. Furthermore, large quantities of freight and vehicles are continuously converging to these facilities (see Figure 6 below). 15 ports among the most important on the continental USA are part of the National Port Readiness Network, whose goal is “to ensure military and commercial port readiness to support deployment of military personnel and cargo in the event of mobilization or national defense contingency” (USDOT, Maritime Administration). They are thus key parts of the maritime / land interface supporting the logistics of national security, both military and civilian.

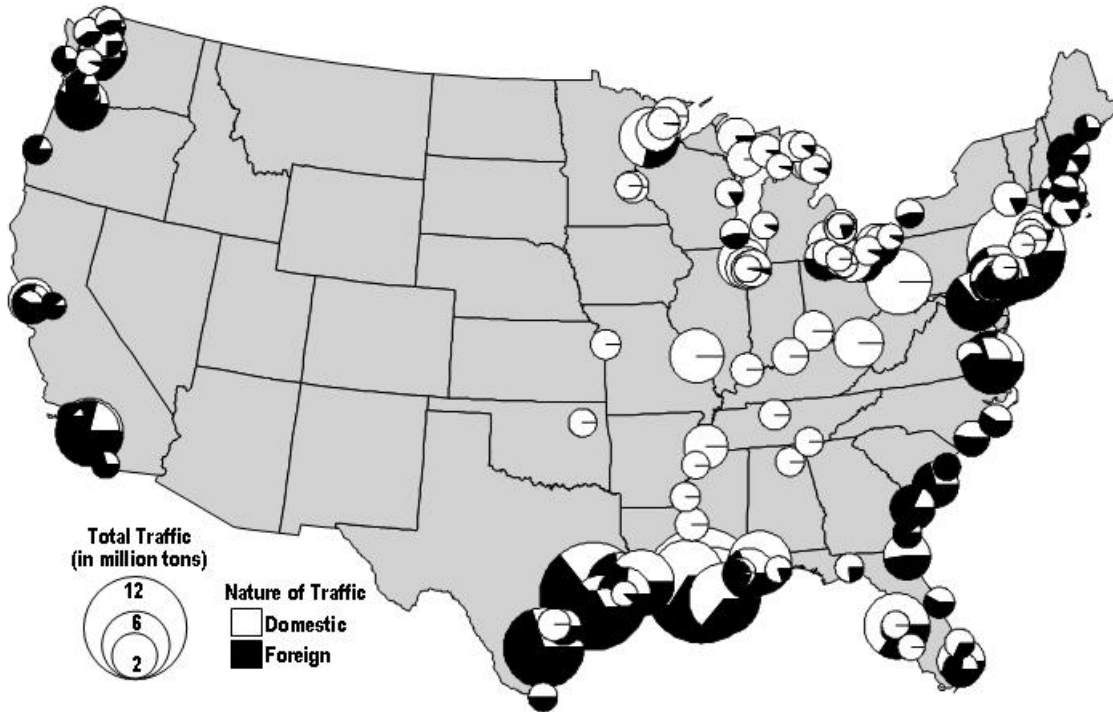


Figure 6: Traffic at Major American Ports, 1998. Source: Compiled from US Army Corps of Engineers, United States Waterway Data, 2000.

The maritime transport system shows a similar level of concentration than in the air transport system, with the 15 largest ports handling 50% of all the American maritime traffic. Overall, the 150 most important ports (Figure 6) handled in 1998 more than 2.48 billion tons of which 45.8% were foreign (either in origin or destination). Foreign maritime traffic is highly imbalanced with 65.5% of it being imports and 34.5% exports, a strong indicator of a systematic negative trade balance. The United States has four major maritime facades that have achieved some level of geographical and commercial specialization and their levels of vulnerability can be linked with their levels of foreign trade, both in volume, nature and origin. The West coast has the most concentrated port system, with three major clusters: the Puget Sound ports, such as Seattle, the San Francisco Bay ports, such as Oakland, and the San Pedro Bay ports such as Los Angeles. It is in these three clusters that the greatest growth of maritime traffic has occurred, because of the boom in imports from Asia. The vulnerability of such a concentrated system was made evident in the Fall of 1999, when the railways in Los Angeles failed to cope with the volume of imports, and ships had to be re-routed elsewhere. This resulted in significant costs and delays to US importers, just prior to the Christmas rush.

Illegal movements of drugs and illegal immigration

The magnitude of the traffic in freight and passengers crossing at international borders makes it difficult to control illegal activities, which is a significant national security issue. In a world marked by strong and growing economic disparities, as well as social conflicts, natural disasters and geopolitical instability, it is not surprising that migration pressures have been enhanced, especially towards developed countries. International transportation is a key factor in these movements. According to the Immigration and Naturalization Service (INS, 2000), there were over 800,000 legal immigrants per year in the United States between 1994 and 1998. To this

figure, must be added approximately 5 million undocumented immigrants (as of 1996), which represent about 1.9% of the total American population. Illegal immigration is estimated to be growing by about 275,000 each year, which means that roughly 25% of all migration movements are illegal in intent. The pattern is repeated in Western Europe, where it is estimated that there are approximately 500,000 illegal immigrants entering each year. In recent years stricter controls on transportation, notably on the airlines, have been imposed in an attempt to curb illegal immigration. However, the problem continues to grow in other modes, and especially in intermodal freight transportation. The container, the foremost expression of civilian freight logistics, has become a preferred mean to undertake illegal immigration, which may compromise national security. Intermodal traffic is contributing to the problem, because only a small proportion of containers inspected at borders, and an untold number of illegal immigrants have entered North America and Europe this way. Sometimes the results are tragic, such as the case of 58 illegal Chinese who were found to have suffocated in a container when it was inspected at Dover, England, in 2000.

Containers are also central to the trade in banned substances. Drug dealers and arms smugglers have exploited the anonymity of the container to carry out their illegal business. The sheer volume of containers that are transported around the world legitimately makes it very difficult for authorities to identify and apprehend those that are being used. This characteristic was an advantage for forwarders handling high value freight, since a container offers a higher level of protection against damage and theft, by freight handlers such as Stevedores. However, the same advantages can become a negative factor when the container favors the smuggling of drugs, arms or stolen goods. Between 5 and 10% of all containers entering the United States are inspected by custom officers.

The United Nations estimates the worldwide market for illegal drugs amounting to \$400 billion a year, which represents about 8% of all international trade. Since drug production and consumption differs geographically, this industry relies massively on physical distribution systems to operate. Drug traffic to the United States is using strategies inspired from the logistics industry, and the drug trade may be considered as one of the most efficient forms of logistics in the world today. For instance, the cocaine production of several organizations in Columbia, the most important producer, undertakes a complex but efficient distribution from remote coca producing regions to American consumers. Due to the poor quality of the Columbian road network and to possibilities of land interception, a significant part of internal drug shipments are made by air transportation. Shipments of several tons are then consolidated in freight centers along the Pacific and Caribbean coasts. From these points, loads are shipped by high-speed boats either directly to Mexico, a major transit point, or transferred to ships at high seas. Some of this illegal traffic gets intercepted, but about 269 metric tons reach the United States each year where it is assembled at major distribution centers such as Chicago, Dallas, Los Angeles and Las Vegas. Then, it is a simple issue of using well-established domestic retailing networks to distribute the drug to consumers.

Humanitarian Aid

The last 50 years have witnessed a proliferation of humanitarian crises. This is a trend linked to global issues such as overpopulation and geopolitical instability related to the excessive exploitation of resources, ethnic/social conflicts and environmental degradation. These issues have required the massive deployment of relief resources and infrastructure. The relief efforts tend to be increasingly critical and time sensitive. The World Food Programme of the United Nations is a major agency responsible for the logistics of global food relief. Between 1989 and 1999, WFP shipped more than 30 million tons of food, mainly for emergency relief and refugee

support. This represents an average of over 2.7 million tons per year. The last decade has seen a significant and disturbing shift in humanitarian aid priorities, which have emphasized the importance of freight distribution systems. In 1989, 70% of WFP’s resources went to development and 30% to relief. As of 1999, 80% of the assistance was targeted to relief needs in emergency situation (WFP, 1998). This shift obviously involves a higher reliance on logistics, an issue acknowledged by the WFP: “Rapid assessments of transport infrastructure prior to the initiation of WFP food operations are important for determining the level of resource mobilization required for logistics and in identifying weak links in the delivery chain of relief aid” (WFP, 1999).

Conclusion: The Issue of Logistical Vulnerability

This chapter underlined two major dimensions on the role of logistics on national security issues. The first is military, while the second is civilian. While military issues have received a lot of attention, globalization has underlined the growing importance of civilian issues and the emergence of new vulnerabilities. The conventional perspective of vulnerability leans on the transport modes themselves, especially air transportation which is highly visible and may involve high casualties when an accident occurs. However, this perspective must be expanded to consider the organization of physical distribution systems that can be defined by the level of logistical vulnerability they face.

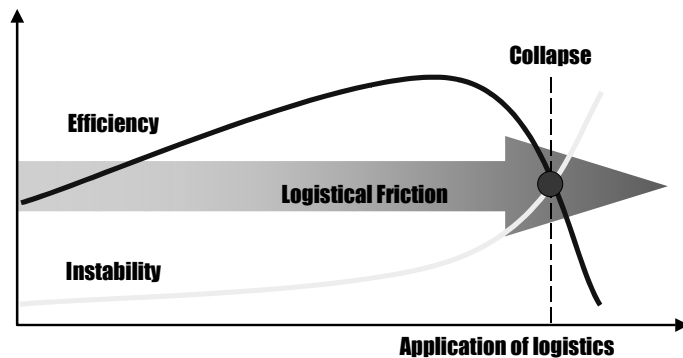


Figure 7: Logistics and Instability of the Transportation System. Source: Adapted from J-P Rodrigue (1999) “Globalization and the Synchronization of Transport Terminals”, *Journal of Transport Geography*, Vol. 7.

Figure 7 underlines two conflictual perspectives related to logistics and its application, efficiency and instability. From one hand, significant improvements in terms of efficiency are achieved by logistics, such as cost reduction (inventory) and time savings. From the other hand, the application of logistics also promotes some instability within the distribution system, notably through the perspective of diminishing returns. At some point the application of logistics may eventually be counterproductive as the level of dependency increases. The more a physical distribution system is tightly synchronized and depends upon mobility, the more vulnerable it can become. Logistical vulnerability is thus an important figure to appraise, especially over the more vulnerable civilian sector. This is a challenging issue as such a large volume of passenger and freight traffic cannot be thoroughly secure and it would be unrealistic to claim otherwise. As such, this trend underlines that the national security of the United States, or of any other nation, in an age of globalization and containerization is dependent upon the stability and welfare of its trade partners. However, keeping attention on key logistical platforms would help mitigate this highly complex issue involving modes, terminals and distribution centers.

Postscript – When Theory becomes Practice

The post September 11 context underlined logistical vulnerabilities that will have a vast array of impacts on the civilian logistics industry trying to cope with and adapt to new security requirements. Among the trends that can be identified so far are shifts towards modes which are less likely to be disrupted by security issues, as well as to ports of entry offering lower delays in clearance procedures. Already, several carriers have shifted a greater share of their shipping to trucking and rail, which are less subject to security regulations than air freight. The maritime industry has also been facing challenges, especially for containerized traffic bound to the United States, which has seen increased levels of inspection, up to 10% of all transshipped containers at some ports, while the national average used to be around 2%. Additional security measures at seaports, such as monitoring cargo and crew manifests, are also being implemented. However, since the maritime shipping industry mainly involves well known carriers and importers, this process is perceived as not presenting too many difficulties. A greater reliance on coastal shipping can consequently be expected.

While the debate is who will pay for the extra security requirements (and presuming that the public purse will not pay for it all), what may become important is how the security regulations will be applied, and how they may interfere with JIT (Just-in-Time), modal choice and supply chain requirements. This is already evident at the Canadian and Mexican borders where parts and components required on both sides of the border have been held up and crossing delays have increased substantially in the weeks following the September 11 events. About 70% of the \$1.3 billion a day trade between Canada and the United States relies on trucking. As a result, several companies are scaling back their operations from JIT to Just-in-Case, where maintaining buffer stocks will be more the norm. This may also have consequences on manufacturing strategies with a switch from global supply chains to sourcing which depending on the needs would be more continental, national or regional in scale. Under such a circumstance, border crossing security agreements within NAFTA, are of utmost priority. Potentially as important may be the differential efficiencies of security clearances, in which a higher cost port or airport might gain advantages over competitors by superior and faster security clearance procedures. Thus, security may come to be as important a factor as technological efficiency and other 'traditional' factors in determining comparative advantage.

Bibliography

Bureau of Transportation Statistics (2000) *The Changing Face of Transportation*, BTS00-007, USDOT, Washington, DC.

Bureau of Transportation Statistics (1999) *National Transportation Statistics*, USDOT, Washington, DC.

Castles, S. and M.J. Miller (1998) *The Age of Migration*, Second Edition, London: The Guilford Press.

Dicken, P. (1998) *Global Shift*, Guildford, New York.

Graham, B. (1995) *Geography and Air Transport*. Wiley, Chichester.

Gritton, E.C. P.K. Davis, R. Steeb, and J. Matsumura (2000) *Ground Forces for a Rapidly Employable Joint Task Force: First-Week Capabilities for Short-Warning Conflicts*, RAND, MR-1152-OSD/A.

Immigration and Naturalization Service (2000) *Illegal Alien Resident Population*,
<http://www.ins.gov/graphics/aboutins/statistics/illegalalien/>.

O'Sullivan, P. and Miller, J.W. (1984) *The Geography of Warfare*. Croom Helm, London.

Timothy L. Ramey (1999) *Lean Logistics: High-Velocity Logistics and the C-5 Galaxy*, RAND,
MR-581-AF.

World Food Programme (1998) *From Crisis to Recovery*, Policy Issues, Agenda Item 4,
http://www.wfp.org/eb_public/EB.A_98_English/eitem4_a.pdf.

World Food Programme (1999) *Transport and Logistics – Logistics Preparedness*,
<http://www.wfp.org/logistics/transport/prepare.htm>.