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Intermodalism
Multimodal Transportation vs. Intermodal Transportation

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Modes and Sectors in Transportation

The nation's transportation system is more than the sum of its components: its strength also depends on the synergies that result from connections and integration of modes and from the collaborative efforts of key players in the public and private sectors. In fact, most trips – freight and passenger – use more than one mode. This characteristic of transportation is a natural reflection of the evolution of transportation technologies and systems appropriate to different trip lengths, purposes, and commodities. For example, certain modes offer potential cost and service advantages by virtue of speed, capacity, or routing and scheduling. In addition, new technology—in vehicles, systems operations, and information systems—can alter these characteristics.

Developing a policy for the multiple modes of freight and passenger transportation that is more deliberately intermodal—in order to improve the performance and service levels offered—can provide important public and private benefits. But realizing these potentials takes place in the complex context of markets, programs, budgets, and other real-world constraints. The trade-offs involved suggest a range of complex public policy issues. This paper explores the origin and dimensions of some of these issues.

Modes—There is a natural fit between carriage, commodity, and trip. For example, long-distance freight may be most cheaply transported by rail if heavy or bulky, but lighter, high-value goods with a premium on reduced transport time are better suited to air shipment. Both heavy and light goods may reach their final destination via a truck link. In passenger transport, the value of time implies air travel for longer trips, while the efficiency of door-to-door travel favors use of the automobile for the shorter home to airport connection. Thus, a substantial portion of total freight and passenger travel is, in practice, "multimodal," reflecting the natural advantages of various modes in terms of cost and time to the shipper or traveler. However, poorly coordinated interchanges and connections between modes often erode the advantages of multimodal trips.

Sectors—Freight is jointly provided by the *private* sector—which provides the direct services, vehicles, equipment, and some infrastructure (railroads)—and the *public* sector, which provides the major infrastructure, including highways, ports, airports, airways, and inland waterways. A mix of private enterprise and the public sector provides passenger transportation, depending on mode. This combination of modes and sectors is shown in the following exhibit:

INTERMODAL SYSTEM ELEMENTS					
System Element	**Mode** Note: *public-sector ownership in italics*				
	Air	**Rail**	**Water**	**Truck/Bus**	**Auto**
Carriers	Air cargo carriers	Railroads	Shipping lines	Motor carriers, Intercity bus carriers, *City bus carriers*	Household
Conveyance	Airplanes	Trains	Ships & barges	Trucks, Intercity buses, *Local Buses*	Cars
Terminal	*Airport*	Rail freight terminals, *Rail passenger terminals*	*Ports*	Truck terminals, *Bus terminals*	Home, parking
Infrastructure	*Airways*	Railways	*Waterways*	*Roadway*	*Roadways*

Source: after CSI for FHWA

Intermodalism

Terminology—The term "intermodal" is variously defined, but has at its core the deliberate linkage and management of multiple modes. In recent decades, shippers and providers in freight transportation as well as public sector providers of passenger transportation increasingly have recognized that the natural advantages of multiple modes can be more effectively captured through deliberate integration of multiple modal operations. "Intermodalism" is a coordinated and sequential shipment or passenger movement involving two or more modes: rail/truck, barge/ship, plane/truck, bus/rail, or rail/auto. The advantages of intermodalism, in both freight and passenger transportation, can be reinforced by focusing on improved physical *connections*, operational *coordination* and integration, and enhanced information and c*ommunication* systems for both operators and customers.

Objectives—The objective of intermodalism is to make optimal use of the different modes and improve the connections among them. The most aggressive definitions of intermodalism emphasize the seamless, efficient, and sustainable dimensions, including:

- Lowering the costs and improving the service offered freight or passengers by using each mode for the portion of the trip for which it is best-suited
- Reducing the burden on overstressed infrastructure and increasing total efficiency by shifting to modes that have higher capacity
- Reduced cost and time and inconvenience currently associated with intermodal interchange
- Increased economic productivity and efficiency, thereby improving competitiveness at enterprise, regional, and national scales
- Improved energy consumption, air, and environmental quality

Context for Freight Intermodalism

Trends—Intermodal operations are part of broad trends in freight transportation that have supported improved service and reduced costs. In the later half of the 20th Century, patterns of production and distribution became more geographically dispersed on a regional, national and even global basis, often leading to longer supply chains and distribution networks and emphasizing the role of transportation. During the 1970s and 1980s deregulation of rates and entry fostered total reorganization of the carrier industry. More recently, increased global competitiveness has introduced just-in-time logistics (JIT), associated with lean manufacturing and supply-chain management, to reduce the cost of delivering goods to national and global markets. These changes in the conditions of demand synergized with improvements in the efficiency of supply, particularly the technology innovations such as containers, double-stack rail service, mega-containerships, computer and satellite-based cargo and vehicle tracking systems. As a result of the above factors, overall freight operations have expanded and improved across all modes.

In the next two decades, the nation's output will increase by 70 percent, freight traffic will increase by 40 percent, and container traffic will more than double. However, the major efficiency improvements stimulated by deregulation and the productivity benefits of early technical developments, such as containerization and public investment in the interstate highway system, have largely been realized. In this context, improved intermodal operations take on special significance.

Intermodal Strategies—Within the private freight industry, intermodalism is a key part of the competitive drive for increased service and reduced costs. In the both the freight and passenger sectors, the strategies are to achieve seamless, dock-to-dock (or door-to-door) integration, which is achieved by physical integration, operational integration (schedules), and integration of information technology (documents, tracking information access). The "intermodal" approach was dramatically initiated in the mid-1950s by a freight service provider (SeaLand) with the combined provision of containers on multiple modes. During the 1980s, double-stack container trains, and containers on steamers, barges and trucks

began to drive significant changes in land, air, and ocean shipping. While the term "intermodal" is closely associated with the use of transferable containers, it also refers to bulk freight transfer and air/truck package express. The well-known Federal Express model for next-day package delivery is a symbol of intermodal innovations.

Continuing improvement in intermodal operations has been powered by a range of technical, operational, and business innovations, including:

- Improvements in equipment (containers, cranes, piggyback trailers, information technology)
- Increases in scale (megaships, large-combination trucks, larger aircraft)
- Standardization of equipment (boxes and chassis) and electronic documents
- New information technology such as Intelligent Transportation systems (ITS) and Electronic Document Interchange (EDI) for shipment-information interchange, equipment and cargo tracking, and traffic control
- Cross-modal mergers and alliances, and the emergence of third-party logistics services suppliers (3PL) and networks

The importance of technology and information in the evolution of improved intermodal service is signified by the comment of one major package carrier that it was *"no longer a trucking company with technology, but rather a technology company with trucks*."

Context for Passenger Intermodalism

Trends—Passenger transportation modes in the United States were historically private. Among passenger modes, however, only air and intercity-bus transport remain commercially viable while intercity-rail and urban transit have evolved into highly subsidized activities. As a result, intermodal policies and improvements are a matter of public policy. On longer trips, despite some attempts to coordinate air, bus and rail schedules, fragmented public-agency services typically leave it to the traveler to arrange use of multiple modes. There is rarely city bus transportation to intercity rail stations that is scheduled around train arrival times. Urban bus and rail terminals – potentially intermodal -- are often abandoned or overlooked, although several cities are sponsoring new developments. Airport access is increasingly congested, a condition exacerbated by security-systems bottlenecks. Even the newest major air terminal in the United States (Denver) was built without a rail link. Parking is in short supply at rail and transit terminals.

Intermodal Strategies—Urban transit intermodalism in the United States has seen some modest improvements—especially in feeder bus service and park-ride facilities. However, such efforts pale in comparison to approaches in the rest of developed world. For instance, many cities in Western Europe, Southeast Asia, and Latin America boast of highly integrated systems for scheduled, door-to-door trip making that are competitive with automobile travel, including:

- Single operators of rail and bus modes
- Integrated fares and schedules
- Effective, available, ubiquitous real-time information
- Reliable, prioritized transit operations
- Physical integration via terminals and park-ride facilities

In those settings, the practice of single-agency responsibility, very large public subsidies, high gas prices, and a commitment to automobile alternatives frame the range of intermodal conventions.

Economic Significance

Freight—In freight transportation, advances in transportation technology and logistics strategies, including the expansion of intermodal services, have produced savings averaging $20 billion per year in

the 1990s ($1000/household!) through support of just-in-time logistics. Overall business logistics costs dropped from 16.1 percent of the U.S. gross domestic product in 1980 to 10.1 percent in 2000. While purely intermodal movements account for a minority of U.S. freight activity, intermodal freight is critical in international trade, in the transport of many high-value-added products, and in military supply. The number of containers moving though ports has doubled over the last few decades and continues to grow rapidly. It has also been a major source of trucking-industry cost-savings and rail-industry revenue growth.

Passenger---The economics of public transit suggest that improved intermodal service would be costly, given the dispersed nature of home-based trips. Therefore, it must be considered within the framework of such indirect benefits as providing a more attractive alternative to automobile travel, improved service for transit dependents, and significant external benefits in terms of sustainable environmental and community quality.

Freight Intermodalism and the Public Interest

Public-Sector Stakes—From a public-sector perspective, the importance of freight intermodalism stems, in part, from the clash between growing demand and constrained-systems expansion, and from the demand for improved service. Between 1980 and 2000, freight demand rose 3 percent, or nearly doubling, while the basic highway infrastructure grew less than 2 percent and rail systems actually contracted. The increased national and global scale of commerce has focused concentrated freight flows on key hubs and threatens to overwhelm the available systems capacity. The resulting congestion is not surprising, and it degrades the reliability and predictability of shipment by road, rail, and air systems.

To the degree that high capacity carriers—railroads and waterways—can be more efficiently integrated on an intermodal basis, some of the freight-on-highway demand may be relieved. At the local level, the negative impacts of freight operations in local communities also may be alleviated. Improved efficiency in the freight sector also serves national economic interests in the globally competitive economy and promotes environmental sustainability. Therefore, there is a natural public interest in seeking cooperative, public-private approaches to making the best use of each mode. Indeed, in Europe, regulatory policy and government subsidies are mobilized to foster these ends, while in the US there is a reliance on market forces.

Key Challenges to the Expansion of Freight Intermodalism— To fully capture its potential, improvements in intermodal transportation must focus on a wide array of technical, operational, and institutional challenges. These include:

- Fragmented industry and regional government that introduces considerable complexity into negotiation of public-private partnership solutions
- Gaps in end-to-end visibility of equipment, shipments, and travel conditions that reduce operational leverage—owing to fragmentation, arms-length sectoral relationships, conflicting regulatory objectives, and uneven investment in IT
- Congestion at terminals, ports, and border-crossings is related to publicly controlled facilities whose expansion is limited by community impacts of local operations (drayage) or financial constraints
- Uneven modal capacity—the advent of double stacking and megaships creating demands for increased throughput, constrained by expansion space and inside-the-gate inefficiencies
- Inconsistent standards involving equipment (containers, chassis, electronic documents)—both domestic and international, and the reliance on voluntary, private standards-setting organizations
- Urban congestion and/or the lack of intermodal terminal/port road access offer instances where constraints in one mode impact the ability to capitalize on the advantages of another
- Public grade crossings and structure clearances that often impede private service improvements (such as double-stack container trains) constitute important financial barriers

- Security requirements introducing new uncertainties into the logistics chain and require backsliding in inventories and warehousing
- Community impacts of drayage or terminal expansion that must be considered in cooperative regional transportation and access planning
- Private-sector financial limitations necessitating public-sector credit support or partnering to finance large-scale improvements in public and private infrastructure required at major chokepoints
- The utility of improved information regarding current roadway traffic conditions in supporting efficient routing, timing, and mode choice

Passenger Intermodalism and the Public Interest

Public-Sector Stakes—From a public-sector perspective, the importance of improvements in intermodal passenger transportation is parallel to that of freight. Between 1980 and 2000, passenger demand grew by 2.5 percent, or nearly doubling, while the basic highway infrastructure grew less than 2 percent. Extensive auto dependency, on both an urban and an intercity scale, continued to expand while passenger rail service contracted and airport capacity was constrained. Urban transit systems have made significant investments in new rail systems but have not managed to increase their modal share. The resulting congestion is not surprising and degrades the reliability and predictability of personal travel.

The service advantages of improved intermodal convenience to the traveler may increase the attractiveness of transit alternatives to the automobile in a range of contexts. But realization of the potential benefits (for example, reduced airport congestion or parking costs) and avoidance of the opportunity costs (more intercity highway investments) is uncertain without a set of other reinforcing policies (land use, congestion pricing).

Key Challenges to the Expansion of Passenger Intermodalism—Improvements in passenger intermodal transportation are well understood—from a conceptual and a technical perspective—because there are many examples in other parts of the world. However, many public transit operators suffer from resource constraints and are preoccupied with rail systems improvements provision to the detriment of providing more convenient door-to-door service. In any case, the challenge to intermodalism in passenger transport is integral to the public institutional setting—particularly the costs of significant improvements in major American metro areas and the constraints to visible success presented by the significant advantages of automobile travel. This context may suggest focusing on low-cost/high-impact options such as operational integration, including "virtual terminals," integrated fares, and timed transfer.

Outstanding Public Policy Issues

Recent Policy—In the immediate future, a large fraction of the challenges to improved intermodalism, as cited above, have both private- and public-sector dimensions. Public policy—federal and state—is just beginning to recognize the significance of the need for greater public-private cooperation. Triggered in part by the national policy commitment of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), there has been the beginning of greater focus on intermodalism. This includes additional attention to urban passenger transportation improvements and also, in the freight sector, ways to improve freight efficiency and reduce impacts. TEA-21 emphasized the freight side in its recognition of the planning, finance, and operational-management dimensions.

Intermodalism as Policy—It should come as no surprise that many of the challenges facing intermodal service overlapped with those already the focus of highway and passenger transportation improvement programs—infrastructure, finance, operations, and regulation. Within that context, federal and state support for intermodal transportation has concentrated on four areas:

- Encouragement for intermodal facilities in statewide and regional plans, focused on expanding hub terminals and intermodal access to them
- Support for coordinated planning for interregional freight and passenger corridors of regional and national significance, including ad hoc state and regional entities
- Eligibility for financial support in overcoming major bottlenecks—typically intermodal access to ports, airports, and terminals -- through new types of federal loans and credit support
- Research to support improved systems operations and management, including improved trucker and traveler information systems

Public support and cooperation in overcoming these barriers to increased intermodalism is essential—but challenging. Four areas deserve special attention:

- **Evolving Intermodal Policy—**There is a lack of a national mandate for intermodalism within the policy frameworks at all levels of government. The economic benefits of improved highway operations for goods movement (reduced delay and incidents) are not ordinarily factored into state DOT policy. Nor is the value of improved intermodal interchange recognized in program structures. The private sector perspective is rarely incorporated in strategic planning and the freight element of programs is focused primarily on regulatory matters. To provide more than lip service, public policy and programs must focus on the intersections between public infrastructure improvement and management and private operator interests in a manner that supports more efficient intermodal operations.

- **Integrating Freight into Planning** —Public-private cooperation in freight planning is in its infancy. For example, intermodal terminal access is still problematic, often involving private access over local roads to state-owned intermodal facilities. The public wants the goods, but not the trucks, trains, and ports that deliver the goods. Within the passenger arena, conventional urban transportation planning is focused on automobile and highway impacts and new rail systems, but rarely does such planning consider significant measurable improvements in door-to-door public transportation service that would require an intermodal focus. Innovative concepts to support more efficient intermodal operations need to be systematically incorporated into the planning process. Methods are also needed to support realistic evaluation of these options.

- **Providing Financial Support—**The resource issues must be recognized in transportation-funding and finance. On the freight side, it is important to maintain public neutrality among competing private entities, such as ports or carriers, and to seek efficient solutions. Public policy must continue to rely on the market and user fees as the appropriate means of finance. However, opportunities for public-private partnerships and indirect project financial support are not inconsistent with market considerations. For both freight and passenger transportation, policy must respond to the large size of the some projects, their impacts, costs, risks, and long timelines—considerations that discourage easy solutions. Financial innovations are already in evidence but need further refinement and expansion to cover a wider range of contexts.

- **Improved Operations—**It is increasing clear in both passenger and freight transportation that significant expansion in basic infrastructure (public or private) is decreasingly practical. Furthermore, there is often competition at some point in multimodal or intermodal travel between passenger and freight movements and overlap between public and private systems (see the exhibit on page 1). While new forms of carriage and containers have made important contributions to improved intermodal efficiency, future improvements are likely to be largely dependent on how well the systems and services are operated—making the most efficient use of the available capacity. While general systems management and operations benefit freight and transit operation, more emphasis can be placed on that subset of tactics that addresses freight and transit most directly, such as dedicated facilities and prioritization.

Long-Term Objectives: From Modes to Performance

In both freight and passenger transportation, it is increasing apparent that the ownership of a system and "modal business as usual" does not provide the basis for improved transportation service. It is the *performance* of systems that counts to customers in this just-in-time society. In freight transportation, the increased "mainstreaming" of intermodalism is now reflected by the fact that some shippers and carriers, who traditionally defined their businesses by a *mode* (for instance, trucking companies or railroads), have begun to redefine themselves in terms of *service characteristics* (reliability, transit time, cost) rather than as operators of a mode. At the same time, logistics service providers—who provide services according to cost, time, and other performance characteristics—are increasingly removing both shippers and customers from the actual, first-hand relationships with modal service providers, introducing new modal flexibility. The long-term promise is to reduce modal suboptimization and capture the full benefits of modal differences within the price-service offerings to customers.

In passenger transportation, where the same type of market-driven service provision does not exist, this service-and-performance perspective competes for limited tax resources with both capital expansion and current operations, with no opportunity to directly capture the indirect benefits of improved operations. In this context where public decisionmaking substitutes for the market and performance is not a driving force, intermodalism requires enlightened policymaking.

The bottom line is that the more demanding 21st century shippers and traveler customers are not interested in modes. Their objectives are improved performance, as defined by cost, time and convenience. Intermodalism provides an important path to those objectives.