

Executive Summary

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In March 1996 the Transportation Research Board convened 140 prominent professionals from industry, academia, government, and the military to discuss the possibility of developing a framework for intermodal transportation research—one that would respond to a nexus of intermodal interests among three sectors of intermodal activity: the private/commercial sector, the public sector, and the U.S. military (Figure 1). TRB organized the conference at the request of the Defense Advanced Research Projects Agency (DARPA), U.S. Department of Defense (DOD), and the Office of Intermodalism, U.S. Department of Transportation (DOT). The conference and town hall meeting were designed to review current practices as well as the future vision of these three communities. The event brought together innovators from each of the three sectors to discuss the internal and external forces that are shaping their intermodal logistical activities.

What we are here to do:

- Present a preliminary framework for intermodal research issues.
- Suggest that the intermodal future will be most efficiently addressed by a robust partnership involving the world-class U.S. commercial intermodal community, the U.S. Department of Defense, the U.S. Department of Transportation, and local, state, and international counterparts.
 - Obtain your professional critique and input on the framework as a dynamic project rather than a static document.
 - Discuss intermodal strategies aimed at
 - removal of institutional barriers,
 - strategic partnering,
 - technology investment approaches,
 - management of a transport “system,”
 - development of intermodal management tools,
 - improving system capacities, and
 - determining responsibilities for funding and carrying out research agenda.

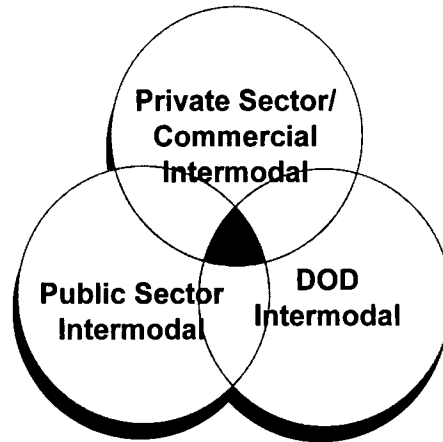


FIGURE 1 Three sectors of intermodal activity—the private/commercial sector, the public sector, and the U.S. military sector—create a nexus of intermodal interests and research issues.

What we are not here to do:

- Present a static approach to an intermodal future.
- Replace the resident excellence of the
 - military command structure or
 - the U.S. Department of Transportation’s modal administrations.
- Advocate any specific technologies or programs.
- Advocate any specific companies or research laboratories.

The conference was designed to examine and test four basic hypotheses that suggest a rationale for a research framework to study the integrated use of multiple modes of transportation. These four hypotheses were the focus of this conference.

1. Integration of Transportation Modes Is Crucial: Intermodalism Adds Value. Intermodal transport is a value-added complement to modal transport, not a substitute. The capital-intensive, infrastructure-building era has largely ended in this country and is being replaced by an intermodal era—the focus shifts from building to managing for optimization. There is additional economic value to be derived from transport: it comes from exploiting the existing infrastructure to increase capacities. This integration of modes should take full advantage of the potential offered by rapid advances in information technology.

2. A Nexus of Interests Has Formed: An Enterprise-Level Response Addresses All Sectors. There is a nexus of interests in the United States that must be addressed on a transportation enterprise level. It encompasses the public intermodal, the private intermodal, and the military transportation systems. These three transportation sectors realize that intermodalism is an inevitable and strategic method of doing business.

3. Complex and Multiple Imperatives Drive the Need: Now Is the Time to Respond. A multiplicity of imperatives drives today’s needs. Those imperatives include global, economic, and social trends; customer demand; information technology advances; and a just-in-time operating strategy for both people and goods. Intermodal transportation has developed at a different pace and along different timelines for each community; but now, in an era of doing more with less, there is a tacit mandate for the three sectors to forge a new framework for cooperation. Emerging from the conference came the clear understanding that the efficiency of one of the sectors of intermodal activity will directly affect the efficiency of the other two.

4. *Coordinated and Collaborative Research Highlight Complementarity: Benefits Are Multiplied.* Coordinated research and analysis of applied intermodal practices can yield benefits to consumers, shippers, and military transporters. Some aspects of the nexus of interest are more clearly defined than others, and research and oversight will help better define areas of complementarity, etc. Collaborative research efforts can multiply those benefits to a broadly defined set of public interests (that own, maintain, and regulate or promote the nation's transport infrastructure), to the intermodal private sector (which moves the goods and directly contributes to the nation's global competitiveness), and to the military sector (an exceptionally large and unique user of intermodal transport infrastructure and services).

To investigate these hypotheses, background papers were commissioned, and key panelists examined the driving forces behind intermodalism; thus, a framework was presented. The presented papers, the various panel presentations, and the open forum discussions suggested a logical progression for envisioning an intermodal future and developing a national research program to support it. From different vantage points, the three communities examined what has changed, the pace of that change, what is working, and what needs to be done. From these discussions, a framework to guide future progress emerged. The entire conference was structured as an interactive forum with a town hall meeting on the second day to elicit the collective opinions of the participants. Major themes were identified that confirmed a ground swell for change is under way and that the time has come for a serious national reorientation that focuses on intermodalism.

PARTNERSHIPS THAT BUILD ON RESPECTIVE STRENGTHS

The three communities comprising the nexus are at significantly different points in their intermodal evolution. Leading the discussion on intermodal innovation was the private sector, which has been growing more intermodally efficient since the rail, trucking, and shipping industries were deregulated in the 1970s. Industry, with 20 years of intermodal expertise and clear bottom-line imperatives, has positioned the U.S. commercial intermodal system to serve as a world-class model with technological expertise that could be adapted to the public and military sectors.

DARPA, as the research arm of DOD, has launched the "Transtech" program to support advanced logistics. The department has also been developing its transportation systems along intermodal lines since the creation of U.S. Transportation Command (TRANSCOM), which is the Defense Department's single manager for defense transportation. Desert Storm/Desert Shield immediately sharpened the need for strategic management of the total trip through advanced logistics and in-transit visibility. In short, DOD, the single largest shipper in the nation, has significant intermodal challenges to bring to the nexus.

DOT brings significant technical expertise as well as national priorities to the discussion of intermodal logistics. The Transportation Department's move toward unified intermodal transportation management intensified with the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). That legislation advanced the vision of a national intermodal transportation system that is economically efficient, environmentally sound, and provides the foundation for the nation to compete in the global economic arena. The Act set the stage for the Transportation Department to build on and add value to its modal strengths; and it opened the door for flexible financing for multiple transport options based on need rather than categorical funding.

The public intermodal sector (DOT, states, and localities) owns and manages the majority of the nation's infrastructure. Ownership gives the public sector the unique ability to promote, regulate, and manage a transportation system that can leverage synergies between the strengths of each sector, thereby promoting a unified transport system.

CHANGING NEEDS, CHANGING MANDATES

The issues facing the U.S. transportation community today include new regulatory and financial concerns, increased global competition, and a new set of national security requirements. "Doing more with less" summarizes the financial imperative emerging in both the public and private sectors. The ramifications of this imperative are so profound that the topic dominated the conference discussions. For public sector agencies, doing more with less means managing with increasingly limited funds for research and infrastructure investment. For DOD it means making greater use of commercial services to meet national security needs. For private sector firms, it means improving customer service while simultaneously reducing costs. Nevertheless, a common theme emerged from these divergent concerns: the need to maximize the use of existing assets through leveraged partnerships and the need to integrate or rationalize systems by applying new technologies to manage intermodal transport (Figure 2).

The challenges of the global economy have also become more pressing in the last 5 years. Expansion of the international marketplace is generating new demands for transportation services with more competition among firms. Geographically divergent locations for manufacturing and commerce result in more international cargo and passenger movements. Increased competition generates more pressure to reduce costs while expanding service to new markets.

Private sector firms have been factoring global competition into their business strategies for several years; however, conference participants observed that public sector agencies need to become more cognizant of America's membership in a much larger community. Practical considerations, such as facilitating and handling more international freight and passenger movement through U.S. gateways, were highlighted. Domestic market pressures that require intermodal solutions are just as significant as the obvious congestion at key ports such as Los Angeles and Long Beach in California. Concerns about falling behind the rest of the world in transportation infrastructure investment and technology deployment were voiced. Participants also saw the opportunity to learn from the experiences of other countries. Just as other countries studied U.S. operations before investing in their own facilities, conference participants felt that U.S. organizations could benefit from evaluating best practices and emerging technologies overseas.

In addition, the military is emerging as a major new customer for commercial services and civilian facilities, bringing extraordinary challenges to the transportation community. The end of the cold war refocused the Defense Department's transportation objectives. The emphasis is now on rapid deployment for delivering strategic support and supplies to any place

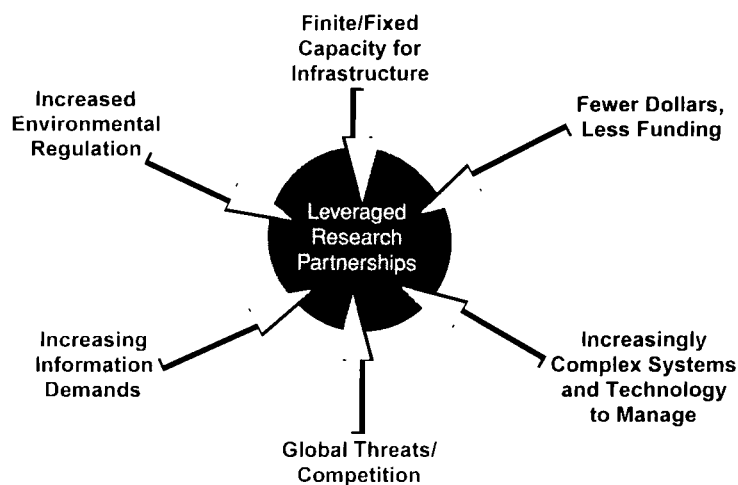


FIGURE 2 External institutional pressures demand that more be accomplished using fewer resources. A solution is intermodal transportation leadership through leveraged research partnerships.

in the world at the right time in the proper quantities. Increased budgetary constraints also require the military to rely more on commercial services to meet its needs.

Because the department is already a major transportation user, spending in excess of \$2 billion annually on commercial freight services alone, its emphasis on intermodalism cannot be overlooked. DOD relies on commercial providers for 90 percent of its peacetime passenger and freight transportation needs and an estimated 85 percent of its wartime movements. The military will soon place even greater demands on the civilian transportation system: by 2001 the department must be able to respond to two nearly simultaneous and geographically divergent major regional contingencies (MRCs), each the size of Desert Storm. An evaluation of Desert Storm concluded that the logistical operation could have been shortened by 100 days and decreased by one million tons had there been more coordination of planning and execution, optimization of lift scheduling, and greater visibility in the process. Nevertheless, Defense is still concerned that, even optimized, such surges—i.e., their need to ship 7,000 containers a week, along with troop and rolling stock movements—could overwhelm the commercial transportation system and the public infrastructure. Meeting the new military requirements will necessitate an assessment of existing U.S. transportation facilities to identify where they can be reconfigured to handle such massive short-term surges and where auxiliary capacity may be necessary. Like the private sector, the military is seeking to improve in-transit visibility and control so that it can respond to situations faster, with greater agility, and at lower costs. Concerns were voiced about the ability of current information and logistics systems to keep up with, track, and, if necessary, redirect the vast quantities that have to be moved.

ADAPT BEST PRACTICE: THE U.S. PRIVATE SECTOR IS LEADING THE WAY

In the past 5 years the private sector has led the way by proving that an integrated transportation system makes economic sense. Commercial providers have also developed the information systems necessary to enable in-transit visibility and management and demonstrated the benefits of partnership arrangements.

The systems approach (intermodalism) to providing transportation services grew from the private sector's embracing the "total trip" concept—managing and profiting from a movement from point of origin to final destination. Those in the private sector realized early on that the customer is more concerned about receiving the shipment at the right time and place and at the lowest price than in knowing how the shipment got there. Routing and modal selection are then optimized to provide the best door-to-door service at the lowest price.

In many cases, intermodalism—the use of more than one mode during the trip—is the most cost-efficient way to facilitate the total trip move. Intermodalism does not replace or compete with modal transportation. Rather, private sector transportation providers are improving the efficiencies of individual modes and then using intermodal connections and information technologies as system integration tools.

The total-trip concept, which originated in the freight area, is now being adapted to passenger movements. Better connectivity between modes is being advanced through a variety of approaches including joint terminal planning and advanced, coordinated passenger information systems, such as kiosks and web sites. The military has also embraced the concept and is trying to optimize the movement from "factory to foxhole."

Information systems are enabling a new era of highly coordinated logistics. In-transit visibility and management, that is, knowing where your shipment is at all times and having the ability to redirect it, is becoming commonplace in the commercial distribution industry. Kodak, Wal-Mart, and many other firms can respond to their customers faster and more flexibly, while reducing costs, through the use of advanced information systems and partnership arrangements with transportation providers. "Just-in-time" was the first wave—replacing inventory with transportation. Information management is the second wave—replacing the need for physical possession of inventory with the real-time, in-transit management inven-

tory. In-transit visibility is being realized through the development of advanced logistics software, communications technologies, electronic tagging of cargo and equipment, and remote sensing.

The potential of these information systems to improve customer service and cost efficiency goes beyond the commercial goods movement industry. Just as the total-trip concept spread from the freight sector to passenger and military operations, advanced information systems will make the same progression through the transportation community.

Partnerships are another success story from the private sector. Beneficial partnerships have occurred within modes (such as vessel-sharing agreements among shipping lines and code-sharing agreements among airlines) and between modes (such as agreements between trucking firms and railroads). Successful partnerships allow each partner to capitalize on their strengths. In the same vein, public-private partnerships are evolving; in a financially constrained environment, partnerships present a logical approach to advance transportation projects and investments.

SEIZE THE LEADERSHIP OPPORTUNITY: HARVEST INTERMODAL SYNERGIES

A “nexus of need” exists. DOD relies increasingly on commercial freight and passenger services for the strategic mobility requirements related to national security. DOT, along with state and local agencies, recognizes that passenger and freight transportation practices are changing. The public sector must, therefore, change the way it conducts business so that it may respond accordingly. Finally, private sector transportation organizations are seeking to maintain their world-class status and look to the public sector for continued infrastructure investment, system safety enhancements, capacity management, modified regulatory requirements, and policies that advance the technology.

The framework to move forward should address the nexus of needs, as well as help the transportation community go beyond today’s paradigm, by exploring and disseminating new intermodal technologies in order to move people and goods. With increasing budgetary constraints, the research undertaken must also be cost effective, either benefiting multiple end users who will partner to support it financially or producing research that can be leveraged to solve a variety of related problems (Figure 3).

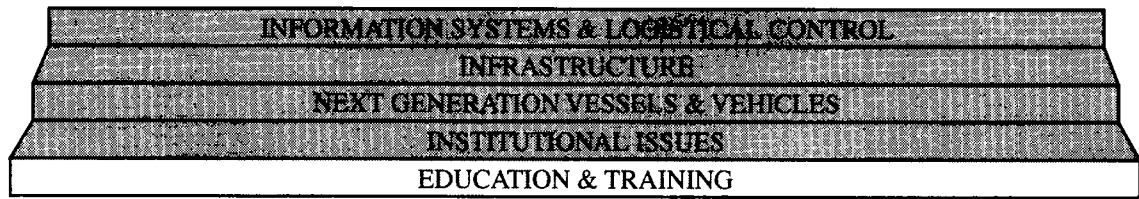
Within this framework, five broad categories of initiatives were identified:

1. resolution of institutional issues aimed at integrating end-to-end services from several providers;
2. best-practices research, data bases, and T² technology transfer;
3. exploration of surge or peak capacity requirements and solutions;
4. advancement of information technologies, while protecting security and privacy of information; and
5. examination of system impacts of next-generation vessels and vehicles.

- Resolution of institutional issues is crucial to the continued competitiveness of the U.S. transportation system. Conference participants urged public sector agencies to move from a regulatory relationship with the private sector to more of a partnership arrangement to facilitate transportation in today’s globally competitive, financially constrained environment.

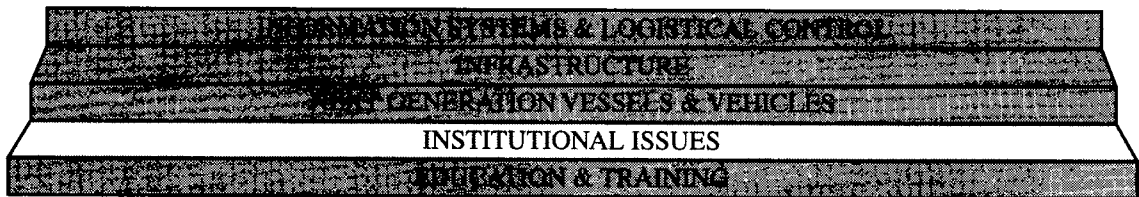
- Best-practices research would examine current practices, benchmark best-practices, and recommend action where needed. Current U.S. operation and investment practices, technology applications, and institutional relationships as they affect the movement of passengers and freight would be identified and assessed. Current U.S. best-practices would be used as a benchmark by other countries against which to compare themselves. Best practices from the private sector that are applicable for the military and public sector agencies would also be identified, allowing the U.S. transportation community to build on its own strengths.

FIGURE 3 *continued*



	Commercial	Military	Public
Strengths	World class intermodal leaders that provide: - Management Models - Service Delivery Models - Training Models Logistics/Intermodal Associations - CLM - Freight Stake holders Network World Trade Center(s)	Generates Nation's most complex transport surges Logistics systems emphasis - DARPA - DLA - Service Branch Logistics Partnership Learning Models - CRAF, VISA - NDTA Military Academy(s)	National Intermodal Initiative, ISTEA National Highway Institute University Level Programs
	Needs	Mechanisms to effectively and efficiently partner with the military and public sectors	Adaptation of interoperable environments while ensuring - Asset Control - Asset Visibility

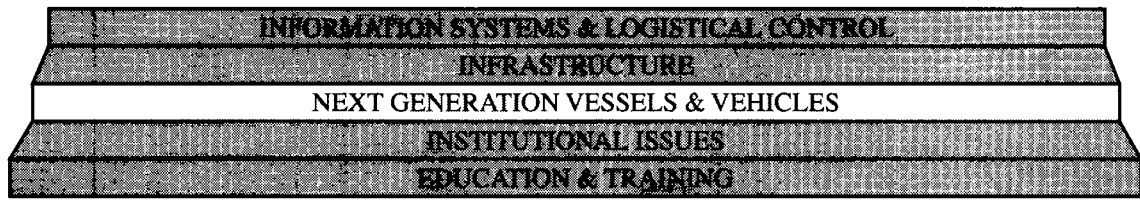
Disseminate Best Practices



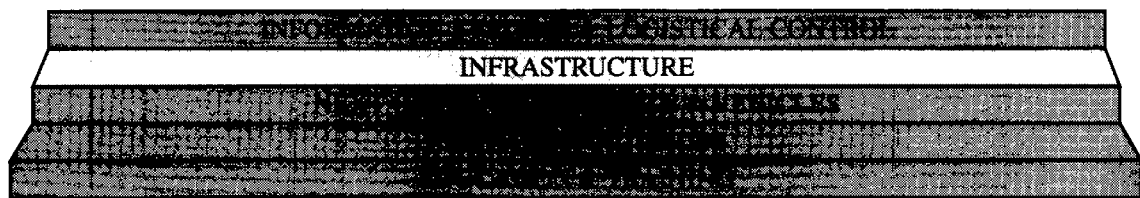
	Commercial	Military	Public
Strengths	World-class intermodal practices - Maximize returns from capital assets - Performance-based transportation - Customer driven transportation	User of both commercial and public systems National security mandate - High-level complex demands with maximum agility - R&D resources and technology expertise	Can mediate conflicts between system users Can regulate for system efficiency or deregulate Can stimulate change through focused seed funds, grants Protector of social and environmental aspects of transportation
	Needs	Challenge to understand and accommodate military and public transport cultures Often military and public needs (which detract from commercial needs) do not complement	Seeks cost-efficient, flexible, and rapid deployment response capability Seeks interoperable integration of corporate and public models

Partnership Building Tools

FIGURE 3 *continued*



	Commercial	Military	Public
Strengths	FastShip(s)	FastShips	Smart Cars/Trucks
	Smart Cars/Trucks	Jumbo Airships	ITS intermodal initiatives
	Advanced Train Control	Expanding intermodal role in deployments	Oversees green factors of new vehicles/vessels
	Iron Highway	Advanced component technologies	
	Road Railer	System level perspective	
	Jumbo Airships		
	AEI 5th Generation Container Vessels		
Needs	Impacts and cost to public and military Leverage solutions	Impacts on and cost to commercial and public system	Impacts and cost to total system Need complete information for stewardship role
	Enterprise level understanding of new vessel/vehicles		

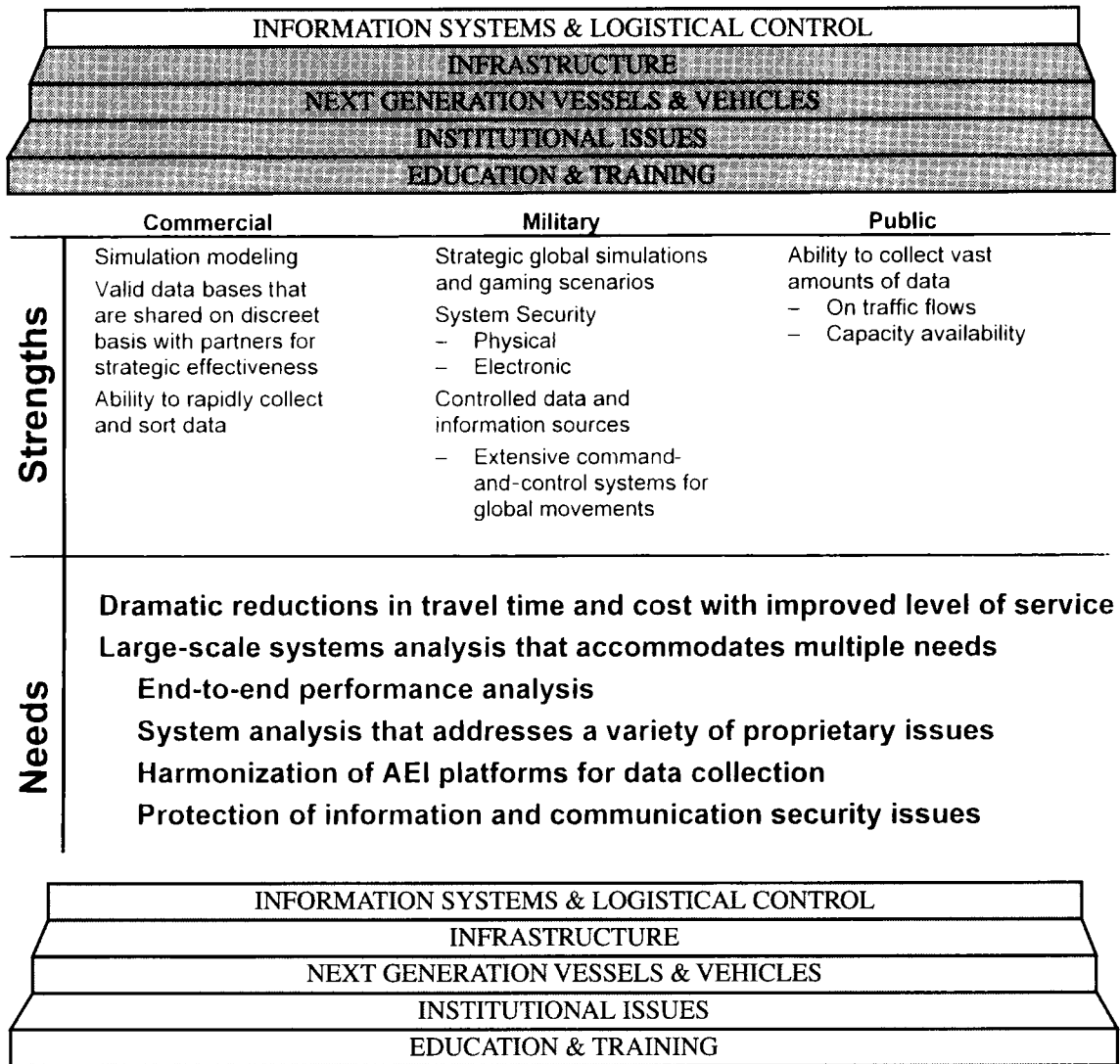


	Commercial	Military	Public
Strengths	Strategies to minimize capital asset expenditures wherever possible Ability to invest in optimization strategies	Superior ability to deliver transport on a command-and-control basis	Can stimulate <ul style="list-style-type: none"> - Modal shifts - Modal optimization - Improved hub access Funds, oversees <ul style="list-style-type: none"> - Highway complex - Ports—navigation systems - Some public terminals - Transit properties - Airports - Traffic control systems
	Public infrastructure operational dependencies <ul style="list-style-type: none"> - Highways - Ports - Access to congested terminals 	Limited intermodal infrastructure ownership necessitates: <ul style="list-style-type: none"> - Increased partnerships for joint use of public and private facilities - Immediate access to public and private infrastructure for capacity surge requirements 	Management strategies that: <ul style="list-style-type: none"> - Focus on and fund intermodal solutions - Adapt commercial models - Balance conflicting system demands - Minimize capital asset expenditures

Integrated operational planning for joint use of public and commercial infrastructure

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FIGURE 3 *continued*



Summary of Intermodal Research Issues

- There is a need for an intermodal research partnership driven by
 - Common reasons
 - Shared commitments
 - Diminished resources
- Significant challenges to this partnership exist
 - Varying cultures and dispositions
 - Varying strategic needs
- An action plan is vital to realize
 - Benefits of current technologies, particularly information technology, to optimize transportation
 - Tighter links between U.S. Department of Defense public-commercial sectors
 - Intermodal R&D resources and program coordination
 - Increased level of partnering with the private sector

ilarly, commercial operators are seeking new ways to improve throughput at their facilities. Research in this area may involve investigations of new technologies, modal shifting, and operational approaches for increasing the efficiency of existing facilities, as well as analyses of optimal locations for capacity management.

- Advancing information technologies could lead to improved efficiencies throughout the transportation community, resulting in new economic opportunities, and improved national security. Within this context, DOD identified two urgent research initiatives: (a) the need to formulate cost-effective approaches for linking divergent information and logistical systems, with an emphasis on enhancing in-transit visibility across modes and transportation providers; and (b) the need to conduct research that will improve the security of information systems and data transmissions.

- A systems-level evaluation of next-generation vehicles and vessels was also called for by conference participants. For example, participants sought an evaluation of the next generation of railcars, ships, airplanes and over-the-road vehicles. Any innovation such as improved capacity or speed of the vehicle/vessel immediately affects intermodal system performance. Capacity and investment decisions must be viewed from an intermodal system perspective.

MOBILIZING FOR INTERMODAL REALITIES

The four hypotheses structuring this event were all answered in the affirmative.

1. YES, there is a nexus of interests, but that nexus will require nurturing and leadership so that it can do more with less. External leadership under a neutral structure is needed to ensure success. Ideally the departments of Defense and Transportation will partner to remove barriers and promote high-risk research and development of mutual interest.

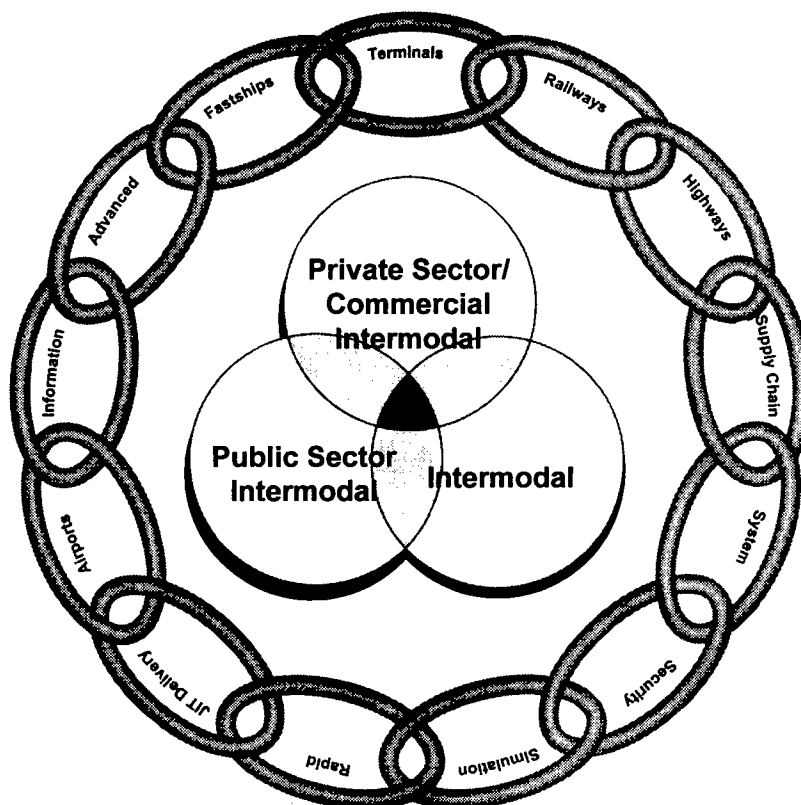


FIGURE 4 Leveraged partnerships for research benefits.

2. YES, changing times necessitate changing responses. The intermodal vision remains the same—the need for an efficient, fully integrated intermodal transportation system. The need is even more imperative today than it was 5 years ago.

3. YES, intermodalism is a value-added complement to the existing transport enterprise. This was convincingly conveyed by all three sectors.

4. YES, coordinated research and dissemination of best intermodal practices will yield benefits; but without such an effort, the intermodal advantage that the current systems enjoy could be lost. Without integrated intermodal research to support and build on current practice the modal components will be suboptimized. Collaborative research will multiply benefits (Figure 4); this is a natural corollary of the three preceding conclusions.

CONCLUSION

The conference closed with a general agreement on the vision, the framework, and the need to elevate cooperative efforts. Commercial transportation services must maintain and enhance their world-class status. There is a military imperative to meet national security transport requirements at a commercial equivalent level. Finally, DOT and other public sector agencies play an immensely important role in promoting an intermodal system and in supplying the infrastructure to facilitate and sustain civilian and military transportation.

The U.S. transportation community can reach the next level of sophistication and efficiency by leveraging the nexus of intermodal needs, capitalizing on emerging technologies, and creating partnerships for mutual benefit. Funds will be needed to support intermodal cooperative research, and a leadership structure must be forged between these three communities to realize the intermodal future. Absent such action, U.S. economic competitiveness and national security will become increasingly vulnerable to threats from foreign industrial competitors and global political instability.