LATIN AMERICA TRADE AND TRANSPORTATION STUDY (LATTS) II

Emerging Principles in Freight Investment Decision

Abstract

An extremely important component to effective transportation planning and to this point a weak link in the profession is the lack of useful, practical and concise freight investment principles and tools that can be validated and comfortably used by transportation planners. The primary purpose of this "emerging principles" paper is to document current freight planning tools, techniques and methodologies and to suggest others that may have been underutilized or made recently available for other purposes, but that may have high applicability to freight investment needs. These freight "tools" and approaches have merit as guidelines for incorporating freight into the traditional transportation investment decision process.

This is an emerging field of knowledge and the information contained herein is only a starting point. More information and research is likely to be developed at the Federal level and by research entities such as the Transportation Research Board and the National Cooperative Highway Research Program.

This briefing paper addresses the need for improving the way freight costs and benefits are included in the analysis process, and provides an overview of the types of freight investment decision alternatives that are increasingly being addressed by state DOT decision makers.

The Importance of Addressing Freight in the Decision Process

Domestic freight traffic will increase by 85% through 2020 and international trade will grow by 115% over the same period. Over 80% of this growth in freight movement will be truck related. By 2020, truck traffic is expected to carry 68 percent of all tonnage moved and represent 82 percent of the value of freight moved nationally.

Meaningful performance measures must be developed for freight movement that are relatively easy to research and that "fit" into the traditional transportation planning tool box. In the freight industry, the shippers and receivers (e.g. Wal-Mart) are the influencing parties of how freight moves upon the national and international transportation system. To them, reliability and dependability of the logistics chain and how dollar investment impacts trip time and reliability to speed the delivery process from production to customer represents the key critical component to their industry. Therefore any freight project investment consideration made by the public sector, should in some way consider the impact to private freight transport. This briefing paper

addresses some examples of emerging principles.

Investment Tools for Freight – Efforts at Improving Benefit Cost Analysis

Present methodologies for traditional benefit/cost (b/c) analysis involving transportation planning compare total incremental benefits from project implementation with the associated total incremental costs of undertaking the project. Individual project evaluation tends to focus on particular impacts such as: travel time savings, crash impacts, vehicle operating costs, and capital costs for construction and models currently in use account for travel time savings for passengers, but not for freight. Typical highway b/c models often use the same variables for vehicle operating cost that apply to passenger cars for freight vehicles, as well; a major fallacy and deficiency in transportation modeling and freight planning technique.

According to the Federal Highway Administration's Freight Benefit Cost Analysis Study (BCA Study) completed in February, 2001, the effects of investment and improvement in freight transport and infrastructure is significant and can be explained in a four tier priority of benefits, as shown in the following table.

Four Tiers of Benefits from Improved Freight Transportation

First-tier Benefits	Immediate cost reductions to carriers and shippers, including gains to shippers from reduced transit times and increased reliability.
Second-tier Benefits	Reorganization-effect gains from improvements in logistics. Quantity of firms' outputs changes; quality of output does not change.
Third-tier Benefits	Gains from additional reorganization effects such as improved products, new products, or some other change.
Fourth-tier Benefits	Effects that are not considered as benefits according to the strict rules of benefit-cost analysis, but may still be of considerable interest to policy-makers. These could include, among other things, increases in regional employment or increases in rate of growth of regional income.

Source: FHWA's Freight BCA Study, February 2001

This four tier structure considers economic benefits of improved freight performance in economic and business terms, as opposed to functional system performance terms. Consequently external benefits to other system users are not explicitly addressed. For example, a freight investment resulting in improved safety or mobility for other users of the transportation system such as a reduction in injuries resultant of truck-car crashes or reductions in passenger car commuting times achieved by an improved truck routing system are essentially external to the process.

As the economic BCA of freight investments matriculates through the four tiers, the ability to forecast

becomes increasingly challenging and must be done within the context of the affected industries. For example, understanding and anticipating reorganization effects and efficiency gains from a system-wide improvement in freight performance requires tacit knowledge of operational and supply chain trends within each affected industry. Consequently, BCA tools supporting the four-tiered approach should be applied with tacit knowledge of industries and other related technologies and the tools should not be viewed as “stand alone” methods to generalize impacts among all different types of freight investments.

The four tiered structure is best understood as a conceptual framework for identifying those system improvements where second, third and fourth tier benefits can be expected given rates of technical and managerial innovation likely to be enabled by improved freight performance. This approach should also be seen as a business and economic view of short, intermediate and long term effects of a system improvement and analyzed in a way complementary to the mobility and safety goals that may also drive prospective freight system investments.

The Federal Highway Administration currently has underway new initiatives for evaluating the impacts both social and economic of freight transport improvements and the types of tools needed to effectively account for freight impacts on the national, state, and local transportation systems. Some of the initial findings indicate several items specific to freight and their strengths and weaknesses.

Scale Economies of Transport Improvements – One objective of the FHWA’s research efforts is to account for the "reorganization effects" of freight movement on the transportation system whereby shippers adjust logistical operations in response to lower freight costs. Presently no such tools exist. A strength of developing this capability is that it would be most helpful in quantifying indirect costs and benefits to shippers that presently are not quantifiable. A weakness to this approach is the tendency to focus primarily on indirect effects with emphasis not on direct effects such as the time value to freight.

Developments in the Retail Market and their Effect on Freight Distribution – Another initiative addresses developments in the retail market and effects on freight distribution. This study effort was written from the business point of view and examines the pragmatic impacts of freight distribution on business as opposed to theoretical economic models. Strengths highlighted in this undertaking indicate that the methodology is easily applied to existing business scenarios and quantifies benefits to business critical to maintaining economic health. One of the weaknesses of this approach is its

focus on business vitality, not on systemic evaluation of freight improvements.

Highways, Logistics and Production Performance – This study methodology accounts for manufacturing scale economies; explaining how indirect benefits of freight cost reductions accrue more to businesses with lower scale manufacturing operations. One of the strengths of this approach is that it looks at distribution of cost savings and benefits of improved freight transportation system across different business types and sectors. The weakness to this method is its focus primarily on the distribution of freight benefits, and less on quantifying and measuring the direct benefits themselves.

Alternative Demand Models and their Elasticity Estimate – Other efforts by FHWA have focused on alternative demand models and elasticity estimates for freight. These efforts have focused on the differences in truck freight demand elasticities among different commodity groups and gives different methods of addressing truck demand elasticity. These study efforts recognize the important differences among commodity groups in the economic base as a key variable for freight system improvements. But again, this effort focuses on the distribution of freight benefits and less on quantifying and measuring the direct benefits of freight, themselves.

Estimating the Effects of Carrier Transit-time Performance on Logistics Cost and Service – This methodology accounts for both reliability measures and mean delivery time in quantifying total logistics costs. The upside to this method is that it addresses the two key issues identified as most important from business operations perspective – trip time and trip time reliability. The weakness of this method is that it offers less detail than other studies in accounting for differences among firms and sectors affected by freight improvements.

For the State DOT official, this research offers insight into emerging methods of evaluating freight investments. At the very least, a mix of these methods should become apparent in any future efforts by State DOTs to evaluate freight investments.

Incorporating Trip Time Variability into the Traditional Investment Decision Process

Trip time variance is a key performance metric that should become a focus for future freight planning and investment efforts. Freight transport and deliveries must be punctual in today's just-in-time environment. Missing delivery windows can incur steep penalties and lose customer accounts. Therefore variance in trip time has become a prominent concern for freight service providers. Consistency in delivery and transport time is the key for an efficient and

effective freight logistics system.

The core measure for determining systems performance is the level of service (LOS). The LOS method incorporates an index ranging from LOS A to LOS F, A being the most ideal, and F being the worst. To incorporate the business cost of reliability into the investment process, freight planners should focus on trip time variance at various levels of service and measure variance as a performance metric to determine whether freight transport is getting more or less efficient. The data with which to do this does not exist today, but efforts are underway to gather real-time freight performance measures (travel times and speeds) on various corridors around the nation. An ongoing effort by the Federal Highway Administration (FHWA) and the American Transportation Research Institute (ATRI) is gathering data from actual trucks traveling on US highways that are tied to the OmniTRACS Satellite Mobile Communications System. This research promises to produce real time data that will allow the analysis of trip time variance at peak and off-peak hours. To be applicable to the traditional investment analysis process, this data should be further correlated to the LOS measures associated with highway segments that the trip time and variance data is being gathered for. It is unclear at this point whether the current FHWA/ATRI effort will actually go to the point of correlating LOS with trip variance for various functional class facilities. Nonetheless, this should be further explored.

The Federal Highway Administration, as previously mentioned has also begun to attempt to measure the effects of freight carrier transit-time performance on logistics costs and service. These efforts account for reliability measures and mean delivery time in quantifying total logistics costs which are considered key measures by industry, but to-date, less detail is available to account for differences among dissimilar businesses and business sectors affected by freight improvements.

Understanding the True Cost Per Mile

The University of Minnesota in June 2003 completed "*The Per-Mile Costs of Operating Automobiles and Trucks*" that updated costs for driving a vehicle (both passenger and freight) one additional mile-e.g.-marginal costs that increase when a vehicle is driven more, such as fuel use, routine maintenance, repairs, tires and some depreciation. These benchmarks change as changes are made to the transportation infrastructure and updates of these estimates have not been addressed in quite sometime. The study did not address the time value of freight from an inventory carrying cost, or time reliability standpoint of meeting shipper delivery requirements, nevertheless, it did provide "updated" cost benchmarks for operating passenger and freight vehicles.

Using $1.50 per gallon of gasoline, the cost per mile for passenger vehicle use was determined to be 17.1 cents per mile. For trucks, the cost per mile estimate was determined to be 43.4 cents. For city driving with frequent stops, the cost increased another 9.5 cents per mile. It was determined that very rough pavements increase truck operating costs by an additional 5.5 cents per mile.

It is important to note that these costs per mile are the actual costs of operating the vehicle and do not account for the full economic value of a trip per mile. The former is strictly a measure of the cost to operate a vehicle – vehicle operating cost (VOC). This measure is used, for example, to measure the impact of a particular investment on the cost to operate a vehicle. Savings in vehicle operating costs are considered as a direct economic impact. Accounting for the full economic value of a trip accounts for additional costs such as the value of the driver's time, the inventory carrying costs, the value of the service, etc. Recent TRB-FHWA studies suggest that carriers on average value savings in transit time at between $144 - $192 per hour. The numbers presented herein offer a benchmark for the state DOT to use in future investment analysis efforts.

Truck Only Lanes Development and Selection

Recently, there has been much discussion by public policymakers regarding the public investment in infrastructure to physically separate heavy trucks from passenger traffic lanes to enhance safety of the motoring public and to increase the efficiency of moving cargo (transit time improvement and on-time reliability). Although such considerations have merit in some select high density corridors, costs in right-of-way and capital construction are extremely high where such improvements are most likely to be needed most.

Two recent studies; *"The National I-10 Freight Corridor Study*" (May 2003) and the study on the *"Potential for Reserved Truck Lanes and Truckways in Florida"* (May 2002), have shed some light on this subject.

The National I-10 Freight Corridor Study" (May 2003) conducted by Wilbur Smith Associates for eight state DOTs along the I-10 corridor (CA, AZ, NM, TX, LA, MS, AL, and FL) evaluated seven alternatives to reducing congestion in the I-10 Corridor. Six of these strategies were freight specific, including the concept of auto/truck separation. The study examined the potential impact of "truck-only" lanes using three primary criteria:

- Total daily truck volume
- Volume/capacity ratios
- Total overall vehicle volumes

A secondary variable "service sensitivity" was also given consideration. Service sensitivity was based on commodity information for highly time sensitive freight and the number of trucks making deliveries within 100 miles of an origin.

The analysis indicated four potential corridors along the I-10 based on these criteria. Essentially the study found that truck only lanes may make sense where freight density is extremely high and daily volume to design capacity ratios are greater than one. The study indicates that this approach may make sense in those areas where traditional forms of capacity enhancement or options for modal diversion are limited..

Florida's Center for Urban Transportation Research (CUTR) recently completed a study on behalf of the Florida Department of Transportation entitled "*Potential for Reserved Truck Lanes and Truckways in Florida*" (May 2002). As part of this exercise, a modeling concept was created utilizing evaluation factors weighted differently based on the type and functionality the truckway facility might provide-e.g.-line haul service between city pairs or drayage service within cities on short-haul regions (seaport to terminal). The study evaluated the potential for "truck-only" lanes using a GIS screening tool to identify highways or highway segments having high potential for exclusive truck capacity strategies. The evaluation tool used the following measures to determine the potential for truck only lanes:

- Truck crashes per mile
- Level of Service (LOS)
- Percent of trucks in the general traffic flow, and
- Total truck volume by highway segment.

The CUTR study also introduced a distance to terminals variable that was used in evaluating short-haul truck only facilities within cities.

Of particular note is that these two studies were conducted independently during approximately the same time frame, and both relied on very similar criteria for truck separation criteria. This suggests that the measures used in these two studies provide a basic framework for the state DOT officials to evaluate the use of truck only lanes as an investment alternative.

The conclusions found that screening facilities across modes for potential truck only lanes using the criteria above provides a useful and manageable framework for systematically identifying opportunities for truck only facilities.

Nonetheless, authors of both studies advocated the need for additional research, additional data and possibly additional variables to more fully assess the cost effectiveness of these facilities. Future BCA methods and studies based on the Florida methodology will need to focus on specific economic and financial

variables for developing and applying measures to quantify the cost effectiveness of such investments.

Public Policy and "New Models" for Modal Freight Diversion

Many studies have been undertaken to investigate alternatives to truck only transport of goods that involve diversion of truck volume to other modes of transport where excess capacity may be available to relieve roadway congestion. The earlier example of the Wilbur Smith Associates study under contract to the eight participating state DOTs, examined the I-10 corridor from a multimodal standpoint. With respect to freight investment tools and research, the Study examined seven (7) scenarios including adding traditional capacity, ITS solutions, truck only lanes, truck bypass routes, truck to railroad diversion potential, truck to barge diversion potential and increases in truck productivity. While traditional Level of Service (LOS) was the primary evaluation criteria similar to the CUTR effort, modifications were introduced to better understand the impacts of freights on the infrastructure and operationally within the corridor.

Such studies have experienced mixed findings and conclusions in that the commodities transported by the various modes are more heterogeneous than homogeneous and not necessarily interchangeable between the modes of transportation. Second, the various modes have inherent competitive advantages to their respective modes due to operating efficiencies and transport characteristics unique to their operation. Distance, freight density, and type of commodity transported directly affect shipper choice of mode when transporting unfinished or finished goods. For example, the bulk modes like railroad and barge transport are most competitive and have a higher potential for freight diversion from trucks where very high volume lanes exist between regions; where hauls (without need for transfers) exceed 500 - 1,000 miles, and where end terminals for transfer and/or distribution have capacities to handle large annual volumes (carloads or containers) without negatively affecting throughput capacities.

Generally, freight diversions from truck to railroad or vice versa can be accomplished only in select locations where the aforementioned variables are present. Because shippers and operators are making these decisions in a free market environment, the ability to divert traffic from one mode to another hinges on the ability to change the relative economic efficiencies associated with the current shipment choices. Efficiency gains of one mode relative to another can arise as a result of operational improvements, new infrastructure, regulatory changes and/or deterioration in infrastructure of a competing mode.

Diversion policies and techniques have limitations due to the private

carrier environments. Historically, there has been ambivalence regarding the acceptance of public investment due to the perceived (and actual) "strings attached" when accepting partial public financing. Additionally, when public funds are utilized for project purposes, "transparency" and open access to all phases and elements of the project must be provided. For example, private railroad carriers see this as intrusive to market and business proprietary secrets. This mentality is changing however, in that private carriers acknowledge that today's transportation challenges can not be solved by one party alone. Railroad managements are showing a renewed interest and willingness to consider new approaches to solving capacity and congestion challenges.

To induce modal diversions and to encourage better cooperation between modes in alleviating congestion, key elements are required to develop a "new model" for public railroad investment:

- Acknowledge a public role for markets that private carriers can not singularly justify;
- Consider highway cost avoidance as a benchmark for potential public investment choices;
- Recognize the strengths of each mode and minimize retail market impacts when public involvement decisions are made;
- Acknowledge and address open access concerns of private carriers;
- Encourage modal carrier participation via tolling or other variable use mechanisms;
- Encourage "open platform" rolling stock (flexibility) to maximize the opportunity for modal transfer and interaction;
- Leverage passenger rail investments to include freight use and benefits;
- Offset a portion of passenger railroad investment through franchising for freight.

In summary, traditional railroad intermodal will not naturally assume greater market role unless the proper densities, distances, and capacity are made available to support it. Shared public/private partnerships and investments and new business models as previously discussed will be required for future freight planning. Highway cost avoidance should be considered when undertaking alternative modal analysis for freight and there is always the possibility of leveraging interest in intercity passenger rail as an indirect benefit to improved rail freight service.

Rail-Freight Solutions to Roadway Congestion

A very frequent response to highway congestion is the focus on public policy to divert highway freight traffic to rail as a means for lowering congestion. An ongoing study that

state DOTs should be on the lookout for is the National Cooperative Highway Research Program (NCHRP) Project 8-42, Rail-Freight Solutions to Roadway Congestion. The objective of this project is to develop a Guidebook for assessing the merits of public investment in rail-freight solutions to relieve roadway congestion and for applying tools that demonstrate how best to incorporate rail-freight into urban and intercity transportation decision making. The study will identify: (1) rail-freight solutions for current and anticipated congestion, (2) key factors and stakeholders, and (3) obstacles and strategies to overcome them. The study is expected to be completed by the end of 2004 and the study products will be made available at the NCHRP web site at http://www4.trb.org/trb/crp.nsf.

Conclusion

The development and use of "freight tools" in traditional transportation planning is still in its infancy, however, initiatives are presently underway at the federal and state levels to account for freight transport impacts to the national and international transportation infrastructure. Use of time and trip variance as performance measures for freight seem to be the most likely to be useful to both the public sector and private industry.

The use of truck only or alternative rail in diverting freight from the congested highway system may be plausible, but only where freight densities, distances, and adequate capacity and transfer locations are abundant.

Additional work in developing "freight tools" is necessary, and research is currently underway to develop useful tools for the traditional transportation planner.