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Logistics Solutions in the Supply Chain: Economic Benefits of Safety and Environmental Impacts

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16. Abstract

State and federal highway officials regularly consider supporting investments in private infrastructure which reduce highway truck traffic including rail transload and truck cross-docking facilities. Public contributions to support the formation and expansion of such facilities can potentially contribute to the efficiency of our national transportation system. This is because shipping firms can reduce freight costs and the public at large can benefit from the avoided costs of congestion created by heavy trucks. Benefit costs analysis is typically used to evaluate the efficiency of highway capacity expansion projects. There is a similar need for benefit costs analysis techniques to analyze the efficiency of public investments in transload and cross-docking facilities.

A challenge arises because the methods for benefit costs analysis may be different for transload and truck cross-docking facilities than for other highway capacity expansion projects. Benefit cost analysis of highway capacity expansion projects such as adding lanes to highways typically examine aggregate changes in travel time and miles traveled for all vehicles traveling on the highways of an impacted region. Benefit cost analyses of rail transload facilities appropriately focus on freight cost savings for shippers when long-haul freight is transferred from trucks to rail, a mode which has significantly lower freight costs per ton-mile. Road user savings related to truck travel from these investments are largely captured by these freight cost savings. However, this method does not capture benefits for other vehicles on the road, such as passenger cars, or other trucks. Freight trucks impose congestion “externalities” on these other vehicles such as increased travel times, increased risk of an accident and increased vehicle operating costs. Freight trucks and trains also impose pollution externalities on society at large. Benefit costs analysis of transload facilities and cross-docking facilities need to capture the benefits of reducing these externalities along with estimates of freight costs savings.

This report provides a proposed approach for conducting benefit costs analyses for transload and cross docking facilities and examines two recent studies of potential facilities located in the Upper Midwest. The report further assesses the degree to which existing studies measure and include the value of avoided externalities for other vehicles and society at large in benefit costs analysis, along with freight costs savings. The report also considers whether any additional, unnecessary benefits are included.

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Executive Summary

State and federal highway officials regularly consider supporting investments in private infrastructure which reduce highway truck traffic including rail transload and truck cross-docking facilities. Public contributions to support the formation and expansion of such facilities can potentially contribute to the efficiency of our national transportation system. This is because shipping firms can reduce freight costs and the public at large can benefit from the avoided costs of congestion created by heavy trucks. Benefit costs analysis is typically used to evaluate the efficiency of highway capacity expansion projects such as new highways, new bridges or adding lanes to highways. There is a similar need for benefit costs analysis techniques to analyze the efficiency of public investments in transload and cross-docking facilities (which are also a capacity expansion). Specifically, there is a need to rank the relative return of investments in transload facilities compared to other highway capacity expansion projects.

A challenge arises because the methods for benefit costs analysis may be different for transload and truck cross-docking facilities than for other highway capacity expansion projects. Benefit cost analysis of highway capacity expansion projects such as adding lanes to highways typically examine aggregate changes in travel time and miles traveled for all vehicles traveling on the highways of an impacted region. Analyses look at travel time savings, reduced accidents, reduced vehicle operating costs for all types of vehicles on the highway system, including passenger cars and trucks. Benefit cost analyses of rail transload facilities appropriately focus on freight cost savings for shippers when long-haul freight is transferred from trucks to rail, a mode which has significantly lower freight costs per ton-mile. Road user savings related to truck travel from these investments are largely captured by these freight cost savings. However, this method does not capture benefits for other vehicles on the road, such as passenger cars, or other trucks; for example, trucks from outside of the region where the transload facilities may be built. Freight trucks impose congestion “externalities” on these other vehicles such as increased travel times, increased risk of an accident and increased vehicle operating costs. Freight trucks and trains also impose pollution externalities on society at large. Benefit costs analysis of transload facilities and cross-docking facilities need to capture the benefits of reducing these externalities along with estimates of freight costs savings.

This report provides a proposed approach for conducting benefit costs analyses for transload and cross docking facilities and examines two recent studies of potential facilities located in the Upper Midwest. The report further assesses the degree to which existing studies measure and include the value of avoided externalities for other vehicles and society at large in benefit costs analysis, along with freight costs savings. The report also considers whether any additional, unnecessary benefits are included.

In general, the two Upper Midwest studies carefully measured the value of freight cost savings due to transload facilities (and a cross-docking facility in the case of one study) and estimated the benefits of avoided air pollution externalities. However, the studies usually did not estimate the benefit of avoided noise pollution, or the reduction of externalities imposed for other vehicles on the highway due to greater truck congestion (one study did consider the external costs due to increased travel time). Further, the studies were found to “double-count” some road user benefits for trucks that were already captured in freight costs savings.

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Chapter 1 Introduction

Rail transload and truck cross-docking facilities yield savings in the logistics system by facilitating the movement of long-haul freight from truck to rail (rail freight has lower average hauling costs per ton mile) and consolidating freight from multiple shippers into full truckloads. Such facilities, however, are not available in or near many locations given the required scale of demand among shippers needed to support a facility and its annual operation. Manufacturers in regions without ready access to transload and cross-docking facilities will face higher freight costs and consumers in those regions face higher costs for imported goods. This potential for lower producer and consumer costs has generated interest in expanding and establishing transload facilities within regions. Given that many private facilities are present throughout the United States, public entities often consider supporting the formation or expansion of transload and truck cross-docking facilities through public-private partnerships, where public entities help pay for required investments. Again, this would help both businesses and consumers save money if public dollars are spent wisely. As a result, there will also be potential implications for state and local economic growth and development.

Another motivation for public support arises due to the externalities associated with freight transportation. Additional transportation of freight by truck creates "externality" costs to third parties besides a truck hauling freight and the provider of a highway (typically a state transportation agency) including congestion externalities for passenger cars and other trucks in the form of 1) slower average travel speeds as more trucks on a highway slows travel, 2) higher vehicle maintenance costs due to more frequent slowing and accelerating, and 3) increased accident frequency for the same reason (Kong, 2016). Hauling more freight by truck also creates greater pollution and noise externalities for non-road users. Reducing truck mileage using cross-docking facilities or transferring long-haul freight from trucks to rail via transload facilities would reduce these externality costs, providing a potential motivation for public investment in these facilities.

Hauling by rail does not create congestion externalities as rail lines are owned by the rail companies hauling the freight. Congestion created by hauling additional freight can therefore be reflected in the rate charged by railroads. Hauling freight via rail, however, does also contribute to pollution externalities but at a lower rate per ton-mile of freight since less fuel is consumed per ton of freight hauled. It is uncertain whether noise externalities are greater for freight hauled by truck or by rail (Forkenbrock, 1999; Walker, 2016).

The presence of potential cost savings for shippers and congestion and pollution externalities creates an incentive for public investment in transload and truck cross-docking facilities, and a need for cost benefit analysis of these investments. Specifically, a transportation agency might consider whether the benefits from a reduction in freight hauling costs, congestion externalities and pollution externalities due to an investment are larger in present value than the cost of the investment. Further, since highway funds are scarce, not all investments where benefits exceed costs can be funded. This creates a need to rank and compare the net benefits of investments in transload or cross-docking facilities with the net benefits of other investments that expand highway capacity.

Chapter 2 General Approach to Benefit Cost Analysis

Benefit cost analysis of highway capacity expansion projects such as adding lanes to highways typically examine aggregate changes in travel time and miles traveled for all vehicles traveling on the highways in an impacted region. Analyses look at travel time savings, reduced accidents, reduced vehicle operating costs for all types of vehicles on the highway system, including passenger cars and trucks. These savings are listed in Table 1 below. By lowering travel costs, investment in highway capacity also may encourage more trips. Benefit cost analyses typically include an estimate of the number and value of such “induced” trips. Induced trips occur when the investment over the cost of the trips has fallen below the benefits that some business and personal travelers gain from each trip. The degree to which the benefits of new trips exceed travel costs is what determines the benefits of induced trips. The benefits of induced trips, therefore, is another benefit category included in Table 2.1. Reduced vehicle travel and less congested vehicle travel can also lead to a reduction in pollution. Air and noise pollution impact society as a whole and not just highway users. Reducing air and noise pollution is another potential benefit from highway capacity investments and is also included in Table 2.1.

Table 2.1 Benefit Categories Included in Benefit Cost Studies of Highway Investments

Category	Vehicles Included
Driver and Passenger Time Savings	All vehicles on the road
Reduced Accident Costs	All vehicles on the road
Reduced Vehicle Operating Costs	All vehicles on the road
Air and Noise Pollution Externalities	All vehicles on the road
Benefits of Induced Trips	New vehicles on the road

The standard approach for calculating the benefits of highway projects does not translate directly into the analysis of transload and cross-docking facilities. Some of the benefit categories included in Table 2.1 should also be included, but others need to be modified. Further, an analysis of transload and cross-docking facilities will measure the freight cost savings for shippers, which would create a new benefit category. The next section proposes a method for a benefit cost analysis of transload and truck cross-docking facility investments.

Chapter 3 Benefit Cost Analysis for Transload and Cross-Docking Facility Investments

Table 3.1 provides a proposed method for a benefit cost analysis of public investments in transload and cross-docking facilities. Such a study would include a new benefit category for freight cost savings. Freight cost savings for a transload facility would be the decline in shipping costs as long-haul freight trips are switched from truck to rail, given that hauling costs for rail are significantly lower per ton-mile of freight. Freight cost savings for a cross-docking facility would be the decline in hauling costs when partial truckloads are consolidated onto a single truck. These freight cost savings are the first category included for benefit cost studies of transload and cross-docking facilities in Table 3.1.

These freight cost savings capture the benefits for the shippers who purchase freight services and ultimately, their customers who enjoy lower prices. Road user benefits also accrue to other vehicles on the highway. Benefit categories therefore need to be modified in Table 3.1. Travel time savings cannot look at the total decline in vehicle travel time on the highway system when transload and cross-docking investments remove trucks from the highway. Rather, the appropriate benefit category is the travel time savings for other vehicles on the road, such as passenger cars or other trucks, for example, trucks from outside of the region. These vehicles will achieve a faster average speed with fewer trucks on the highway.

The same could be said for reduced accident costs. Most truck accident costs, like driver time, are part of the cost of operating a truck, and therefore, already reflected in freight rates. For example, vehicle insurance purchased by trucking firms pays for a considerable share of the cost of truck-involved accidents. Further pain and suffering or other accident costs for truck drivers that are not covered by insurance are likely to be reflected in higher wages for drivers, and therefore still reflected in operating costs. There may be some accident costs that are born by the public sector or drivers of other vehicles, but a large share is born by trucking companies as part of their operating costs and therefore encapsulated in the freight rates they charge. As a result, most of the benefits from avoided truck accidents are already captured in the modeled freight cost savings as freight is switched from truck to rail.[1] The full value of avoided accidents should not be included again as a benefit of investment in transload facilities – to do so would be to count that benefit twice. Additional savings from reduced accident costs should focus on the decline in accidents in other vehicles due to less congested roads.

Table 3.1 Comparison of Benefit Categories Included in Benefit Cost Studies of Rail Transload Facilities versus Highway Investments

Category	Transload and Cross-Docking Facilities	Highway Investments
Reduced Freight Costs	Trucks Using Facility	Not Included
Driver and Passenger Time Savings	Other vehicles on road	All vehicles on the road
Reduced Accident Costs	Other vehicles on road	All vehicles on the road
Reduced Vehicle Operating Costs	Other vehicles on road	All vehicles on the road
Air and Noise Pollution Externalities	All vehicles on the road and rail	All vehicles on the road
Benefits of Induced Trips	All new vehicles trips	All new vehicle trips
Highway Maintenance Costs	Not included*	Not included*

* There may be a need to include some highway maintenance costs if these costs are not fully covered by fuel taxes, tolls or other relevant road user fees

[1] There is an increase in rail accident costs as freight is switched for rail but this also is already reflected in reduced freight hauling costs. The net reduction in freight hauling costs is the decline in truck freight rates plus the increase in rail freight rates.

A similar argument could be made for vehicle operating costs. Costs such as fuel, vehicle maintenance and wear and tear on a vehicle and its tires are already part of the per mile operating cost of trucks. These costs are avoided when trucks drive fewer miles, but this is already captured through the measured reduction in freight costs. It would be double counting to consider the reduction in vehicle operating costs again. The only relevant operating cost benefit would be the reduction in operating costs for other vehicles on the road. Some such operating costs would be avoided since fewer trucks on the road imply a less congested highway and a smoother flow of traffic, implying better gas mileage and less vehicle and tire wear and tear.

The situation is different for pollution externalities, as seen in Table 3.1. Trucking firms do not pay for the cost that pollution from truck emissions imposes on the rest of society, or the noise pollution generated by heavy trucks. Therefore, the reduction in pollution as truck freight miles are transferred to rail freight miles (rail generates less air pollution per freight mile) is not reflected in the reduction in freight costs. The reduction in air and noise pollution among all vehicles on the highway should be measured and included as a benefit, as it is for studies of other highway capacity investments. In the case of transload facilities, air and noise pollution from trains should be netted out of the benefits as freight is switched from truck to rail.

The situation is the same for induced trip benefits as for pollution benefits. Additional, “induced” shipments of freight into and out of the region is an important benefit for rail transload and cross-docking facilities. These benefits should be measured and included. Note that in the case of transload facilities, induced travel would primarily occur through increased rail freight. However, there would also be a modest increase in regional truck freight miles as additional freight is hauled to or from the rail transload facility.

A final potential issue is highway maintenance costs. Heavy freight trucks contribute to highway maintenance costs by contributing to highway wear and tear. However, it is important to remember that freight trucks also generate funds to support highway maintenance through various taxes, such as taxes on diesel fuel and tolls and other per-mile charges in some states. Revenue largely covers maintenance costs (Forkenbrock, 1999; GAO, 2011). The cost of these taxes would be reflected in freight rates, and therefore, once again already captured in the measured reduction of freight costs. Further, as long as required maintenance is carried out and funded by trucks, the degradation of highways due to heavy truck travel does not impose costs on other vehicles. In other words, there is no “externality” created for other vehicles, which makes sense since the cost of highway maintenance is an issue between trucking companies and the state agencies which own highways. Table 3.1 indicates that most savings from highway maintenance costs should be excluded from a benefit cost analysis. However, it is appropriate to include some avoided highway maintenance costs to the extent that diesel fuel taxes, tolls, and other per-mile charges do not fully cover the highway maintenance costs imposed by trucks. For example, Forkenbrock (1999) found combination trucks do not pay 22 percent of imposed highway maintenance costs.

Chapter 4 Examples of Benefit Cost Analysis from Iowa and Nebraska

Table 3.1 shows a recommended approach to conducting a benefit cost analysis of public investments in transload and truck cross-docking facilities. To consider how benefit cost analyses are actually being conducted, we examine two recent studies in the mid-America region, one from the State of Nebraska and one from the State of Iowa. Respectively, these are the *Benefit Cost Analysis Narrative of the Technical Memorandum to Accompany Central Nebraska Transload's 2020 BUILD Grant Application* (Quetica, LLC, 2020) and *Appendix E: Benefit Cost Analysis, Upper Midwest Transportation Hub Manly Iowa, Tiger Discretionary Grant Application* (HDR, 2014). Tables 4.1 and 4.2show the benefits categories considered in each study with the recommended benefit categories for analysis of transload and cross-decking facilities (Table 3.1).

4.1 The Iowa Study

Table 4.1 compares the approach in the Iowa study with the suggested approach. A key takeaway is that the Iowa study uses an appropriate approach for several major benefit categories. The Iowa study carefully estimated the expected freight cost savings as long-haul freight would be transferred from truck to rail due to the studied transload facility investment. This benefit category accounted for 29% of the total estimated benefits of the project. The Iowa study also estimated travel time savings for other vehicles utilizing highways as truck traffic is removed from the highway system (FHWA, 2020) and transferred to rail. This benefit category accounted for 8% of the total estimated benefits of the project. The Iowa study further estimated the value of avoided air pollution costs as truck traffic is removed from the highway system, although it did not consider avoided noise pollution costs. This benefit category accounted for 10% of the total estimated benefits of the project.

In addition to noise pollution, the Iowa study also did not include several other categories of external benefits including avoided externality costs due to vehicle operation and accidents. Having more vehicles on a highway causes heavier traffic in which other vehicles slow and speed up more frequently to navigate, reducing fuel mileage, increasing wear and tear on vehicles, and increasing the likelihood of accidents. These challenges may be especially high when there are more large freight trucks on the highway system. Taking trucks off the highway therefore would mean both lower accident costs for other vehicles as well as lower vehicle operating costs. These benefits were not measured and included in the Iowa study. The Iowa study also did not include the value of induced freight shipping to society. Lower shipping costs would make more shipping profitable, implying that more utility (consumer surplus)-increasing economic activity would occur in society. Induced freight hauling was measured in the Iowa study but the benefits from induced freight were not included in the economic benefit calculations.

The Iowa study also estimated and included several categories of benefits which would have already been largely captured through the measured reduction in freight costs. Most avoided highway maintenance costs when trucks are removed from the highway system would have been captured in estimates of freight cost savings, due to avoided diesel fuel taxes and tolls. Estimates in Forkenbrock (1999) imply that 78 percent of these avoided maintenance costs would have been accounted for in freight costs savings. This benefit category accounted for 14% of the total estimated benefits of the project in the Iowa study.

The avoided accident costs involving trucks removed from the highway system also should have been largely captured in estimates of freight costs savings. Specifically, trucking companies bear a significant share of these costs through their insurance and the "wage premium” for truck drivers, which would be reflected in freight costs. This benefit category accounted for 39% of the total estimated benefits of the project. The efficacy of including reduced truck accidents among project benefits depends on what share of truck accident costs are born by the trucking companies. Some accident costs might be financed with other sources, such as Medicare or other public insurance, or not be compensated such as pain and suffering for injured vehicle drivers which are not compensated by insurance. Forkenbrock (1999) estimates that the personal liability and property damage insurance purchased, and workers compensation insurance paid, by trucking companies account for 41% of the cost of truck-involved accidents. Another study examined the sources of funding for crash costs for all motor vehicles and found that private insurance accounted for 54% of accident costs (Blincoe, et al., 2015). This estimate does not include potential additional private sources that help cover accident costs such as compensating differentials in the wages of truck drivers to account for the uncompensated risk of the occupation.

Table 4.1 Benefit Categories Included in Iowa Transload Facility Study

Category	Ideal	Iowa Study	Discrepancy
Reduced Freight Costs	Trucks Using Facility	Trucks Using Facility	None
Driver and Passenger Time Savings	Other vehicles on the road	Other vehicles on the road	None
Reduced Accident Costs	Other Vehicles on the road	All vehicles on the road	1) Included benefits for a**ll avoided costs** of shippers using facility, 2) Did not include benefits for other vehicles on the road
Reduced Vehicle Operating Costs	Other Vehicles on the road	Not Included	Did not include benefits for other vehicles on the road
Air and Noise Pollution Externalities	All vehicles on road and rail	Air Pollution for all vehicles on the road & rail	Did not include benefits from avoided noise pollution
Benefits of Induced Trips	All vehicles on road and rail	Not Included but Measured	Did not include benefits from induced trips
Highway Maintenance Costs	Most Costs Not Included for trucks using facility	All costs Included for trucks using facility	Included value for **all avoided costs** of trucks using facility

Source HDR, Inc. (2014), *Appendix E: Benefit Cost Analysis, Upper Midwest Transportation Hub Manly Iowa, Tiger Discretionary Grant Application*

Therefore, the estimate that just 41% of accident costs are paid from private sources may be an underestimate. Nonetheless, this estimate does provide a way to characterize the share of avoided accident costs that would be "double-counted," since this share of the benefit of reducing truck-involved accidents would have already been reflected in freight rate savings. As noted earlier, the estimated accident cost benefit of a rail transload facility accounted for 39% of total benefits in the Iowa study, which was a present value of $490.2 million in benefits from avoided truck-involved accidents when truckloads are switched from highway to rail. Assuming there are similar issues regarding the cost of rail accidents (Brod, et al., 2013), if 41% of the benefits of avoided accident costs are double counted, the estimated present value of this benefit would instead be $289.2 million.

To summarize, the study of an Iowa transload facility captured many of the benefits to society form building the proposed facility to switch truck freight onto the rail system. The study appears to have excluded some benefits of the investment, in particular the benefits of induced freight loads, reduced noise pollution and external vehicle operating costs for other vehicles utilizing the highway. The study also appears to double count some benefits already captured in the measured reduction in freight costs. Double-counted benefits include the most benefits from avoided highway maintenance costs as heavy truck trips decline and part of the benefits of avoided accident costs.

4.2 The Nebraska Study

Table 4.2 compares the approach in the Nebraska study with the suggested approach. A key takeaway is that the Nebraska study uses an appropriate approach to estimate the expected freight cost savings as long-haul freight would be transferred from truck to rail due to the studied transload investment. The Nebraska study also considered freight cost savings due to a cross-docking facility. In all, freight costs savings accounted for 45% of the total estimated benefits of the project. The share for this benefit category was higher than in the Iowa study, in part because the Nebraska study appropriately did not include most reduced highway maintenance costs as a benefit.

The Nebraska study, like the Iowa study, did include the benefits all avoided accidents costs as trucks were removed from the highway system (cross-docking facility) or transferred from the highway system to rail (transload facility). As noted earlier, this represents "double counting" to a significant degree as a meaningful share of these costs are reflected in freight rates and therefore already captured in the reduction in freight costs. However, this benefit category accounted for only 16% of the total estimated benefits for the Nebraska project.

The Nebraska study estimated the value of avoided air pollution as truck traffic is removed from the highway system (cross-docking facility) and transferred from the highway system to rail (transload facility). This benefit category accounted for 39% of the total estimated benefits of the project. The Nebraska study, however, did not estimate the value of avoided noise pollution and include that in project benefits.

The Nebraska study also did not include the benefits from several types of avoided externalities. Other vehicles on the highway travel faster on average and face lower vehicle operating and accident costs when the number of freight trucks is reduced. The Nebraska study did not estimate and include the benefits of these avoided externalities.

The Nebraska study also did not include the value of induced freight shipping as the transload and cross-docking facilities lower regional shipping costs. Such additional productive economic activity would generate both more profits for businesses and more utility for consumers.

To summarize, the study of a Nebraska transload facility captured the benefits to society from lower freight costs resulting from proposed investments in a regional transload and cross-docking facility. The primary concern with the Nebraska study is that it did not include avoided external costs for other road users among the estimated project benefits.

Table 4.2 Benefit Categories Included in Nebraska Transload and Cross-Docking Facility Study

Category	Ideal	Nebraska Study	Discrepancy
Reduced Freight Costs	Trucks Using Facility	Trucks Using Facility	None
Driver and Passenger Time Savings	Other vehicles on the road	Other vehicles on the road	Did not include benefits for other vehicles on the road
Reduced Accident Costs	Other Vehicles on the road	All vehicles on the road	1) Included benefits for a**ll avoided costs** of shippers using facility, 2) Did not include benefits for other vehicles on Road
Reduced Vehicle Operating Costs	Other Vehicles on the road	Not Included	Did not include benefits for other vehicles on the road
Air and Noise Pollution Externalities	All vehicles on road and rail	Air Pollution for all vehicles on the road & rail	Did not include benefits from avoided noise pollution
Benefits of Induced Trips	All vehicles on road and rail	Not Included	Did not include benefits from induced trips
Highway Maintenance Costs	Most Costs Not Included for trucks using facility	No costs Included for trucks using facility	Did not include **some avoided costs** of trucks using facility

Source: Quetica, LLC (2020), *Benefit Cost Analysis Narrative of the Technical Memorandum to Accompany Central Nebraska Transload's 2020 BUILD Grant Application*

Chapter 5 Summary

State and federal highway officials consider supporting investments in private infrastructure which reduce highway truck traffic including rail transload and truck cross-docking facilities. Benefit cost methodologies are needed to assess these public-private investments so that these projects can be compared with alternative highway investments (such as capacity expansion projects). This report proposes an approach for conducting benefit costs analyses for transload and cross-docking facilities and also examines two recent studies of potential facilities located in the Upper Midwest.

A benefit cost analysis of transload facility investments appropriately focuses on savings for shippers when long-haul freight is transferred from trucks to rail, a mode which has significantly lower freight costs per ton-mile. Likewise, analysis of cross-docking facility investments appropriately focuses on freight cost savings. The benefits from investments are largely captured by these freight cost savings but should also include avoided external costs for other vehicles on the highway and for the general public. One implication is that some categories featured in benefit costs analysis, like the accident costs of trucks, should not be included, or at least not fully included, in the calculation of benefits. In particular, trucking companies bear a significant portion of these accident costs through their insurance, implying that much of the value of avoided truck accidents is already captured in measured freight cost savings.

Several benefits costs studies of rail transload facilities were examined to get a sense of how these studies are conducted. The studies carefully measured the values (i.e., benefits) of freight cost savings due to transload facilities (and cross-docking in the case of one study) and estimated the benefits of avoided pollution externalities. However, the studies usually did not estimate the benefit of avoiding other types of externalities (for example, noise pollution, vehicle operating costs) when transload facilities help reduce truck traffic on the highway system. Studies also tended to double count some of the benefits from avoided truck-involved accidents, and one study appeared to double count a significant share of the highway maintenance costs generated due to truck travel. Future studies could be improved by addressing these concerns.

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