Performance Measures for Evaluating Multi-State Projects

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MID-AMERICA FREIGHT COALITION

The Mid-America Freight Coalition (MAFC) is a regional organization that cooperates in the planning, operation, preservation, and improvement of transportation infrastructure in the Midwest. The ten states of the AASHTO Mid-America Association of State Transportation Officials (MAASTO) share key interstate corridors, inland waterways, and the Great Lakes. The MAFC is funded by the National Center for Freight & Infrastructure Research & Education and the DOTs of the ten member states.

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16. Abstract. Freight transportation projects require an analytic process that considers the impacts of geographic and industry distribution of project benefits, intermodal impacts, and reliability, as well as the traditional benefits of time savings, safety enhancements, and environmental benefit. This report outlines a method by which this analysis could be done. It uses the Chicago CREATE project as a case study.		
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Introduction

The states of the Mid-America Freight Coalition (MAFC) have expressed a need to have better tools that allow projects of potentially regional significance to be better analyzed and understood. Projects of regional or national significance must be demonstrated to have such a broad reach. As they develop these projects of broad reach, transportation agencies are often urged to respond to the freight-moving community's needs for reduced transit times, greater safety, and increased reliability. They are also urged to produce projects that improve environmental quality and to be mode-neutral in solving transportation problems.

Benefit-cost analysis is the tool that is typically used to differentiate between competing projects. It played an important role in the TIGER project evaluation process. In its simplest terms, it compares the net present value of all benefits to be derived from the project (the numerator) to the net present value of all of the costs associated with a project over the projected life of the project (the denominator). If the ratio of benefits to costs is greater than one, the project is assumed to have a net positive return to society. Among competing projects, the one with the greatest ratio is assumed to be the most desirable.

Typically, benefit-cost analysis deals with major benefits related to freight and other transportation projects.

1. Reduced travel time.
2. Safety.
3. Environmental improvements.

These traditional measures of a project fail to capture the broader economic impacts that should be derived from a freight-related project. For a number of years, the relationship of transportation investments and economic activity has been defined within the structure shown in Figure 1.

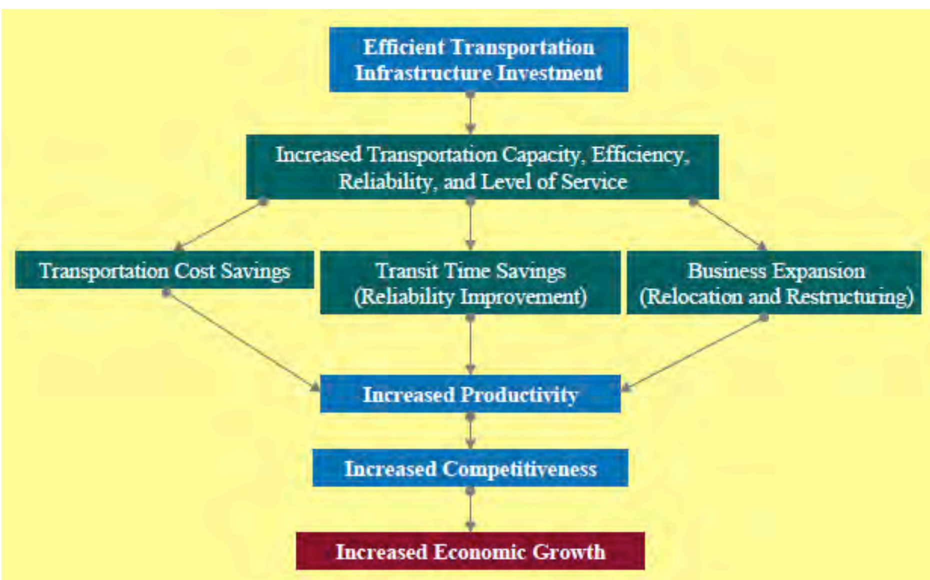

Figure 1: Transportation Investment and Economic Growth

Figure 1 comes from an ICF Consulting study (1), but FHWA and others have adopted the basic idea. It says that a transportation investment will impact (one hopes will reduce) travel time and (one hopes increase) reliability. Reduced travel time and increased reliability increase productivity and market access. These in turn increase competitiveness and economic growth.

The question then is: Whose competitiveness and economic growth capacity is increased? Traditional benefit-cost analysis implicitly assumes that those benefits will largely accrue to the project sponsor, or those who support that sponsor with taxes. In fact, if you consider a project like the one illustrated in Figure 2, a relatively few of those benefits may be enjoyed by residents of the sponsoring jurisdiction. Instead they will accrue to other users of the facility with origins and/or destinations in adjoining or more distant jurisdictions.

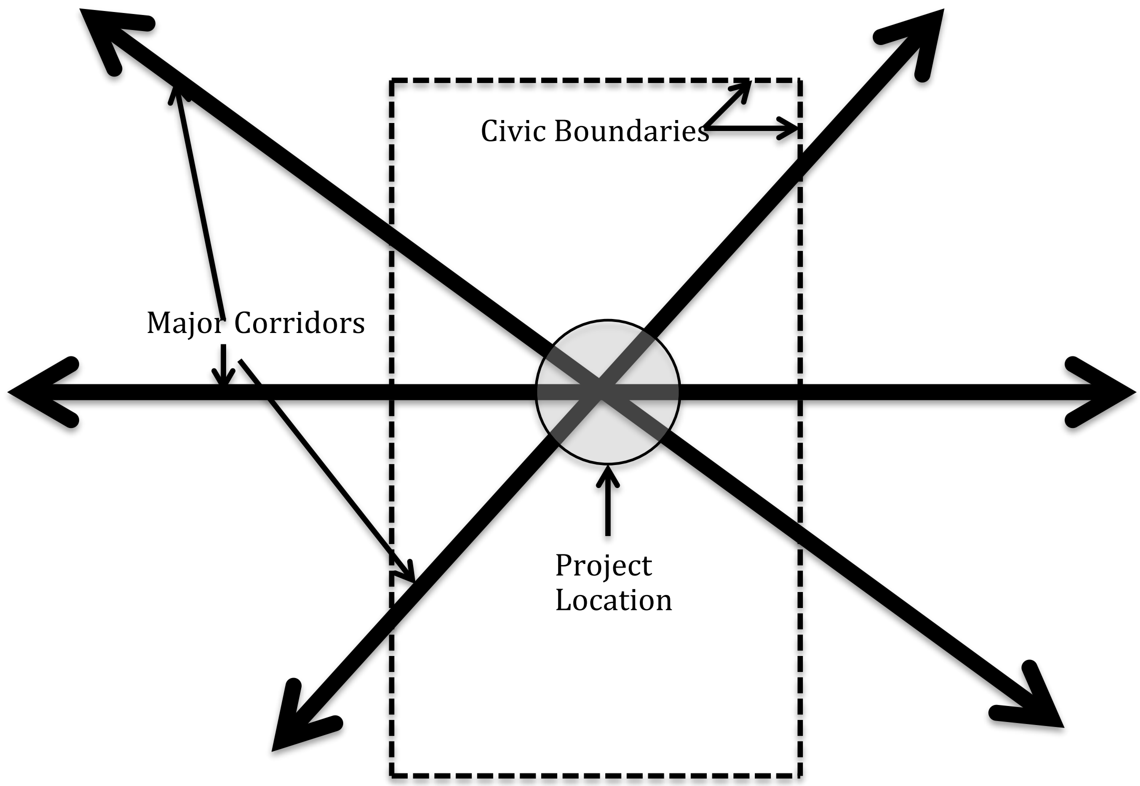

Figure 2: Freight Projects and Jurisdictions

Some trucks may start and stop with the host jurisdiction; some may either start or stop there; and some may simply pass through. In any of these cases, we can assume that the business shipping the product will benefit by having reduced costs and increased competeviness as a result of the project. We can also assume that the business to which the product is being shipped will have similar benefits. Therefore, if we knew the origins and destinations for each of the trucks, and if we knew that all products had the same value of time and safety assigned to them, we could also assign proportionate benefits to each jurisdiction.

This is not an abstract issue. It exists at the Cincinnati river crossing, the Baltimore rail tunnel, in Chicago, and many other locations. It is a barrier to project financing and completion. The sponsoring agency may not have the resources to pursue projects with huge costs, and they may not perceive the immediate benefit from the project since much of that benefit falls to others outside of their jurisdiction. In the absence of tools that allow the benefits for those outlying jurisdictions to be quantified, those who benefit tend not to be vocal supporters of the project. Lacking the resources, the sponsoring agency fails to act; lacking demonstrated support, the federal government fails to act; and lacking information and authority, the benefiting jurisdictions fail to act.

Being mode-neutral when approaching transportation issues can be a challenge. Could a more economical or otherwise desirable investment in another mode alleviate the problem? Will the planned investment have a negative impact on other modes? These questions are illustrated in Figure 3.

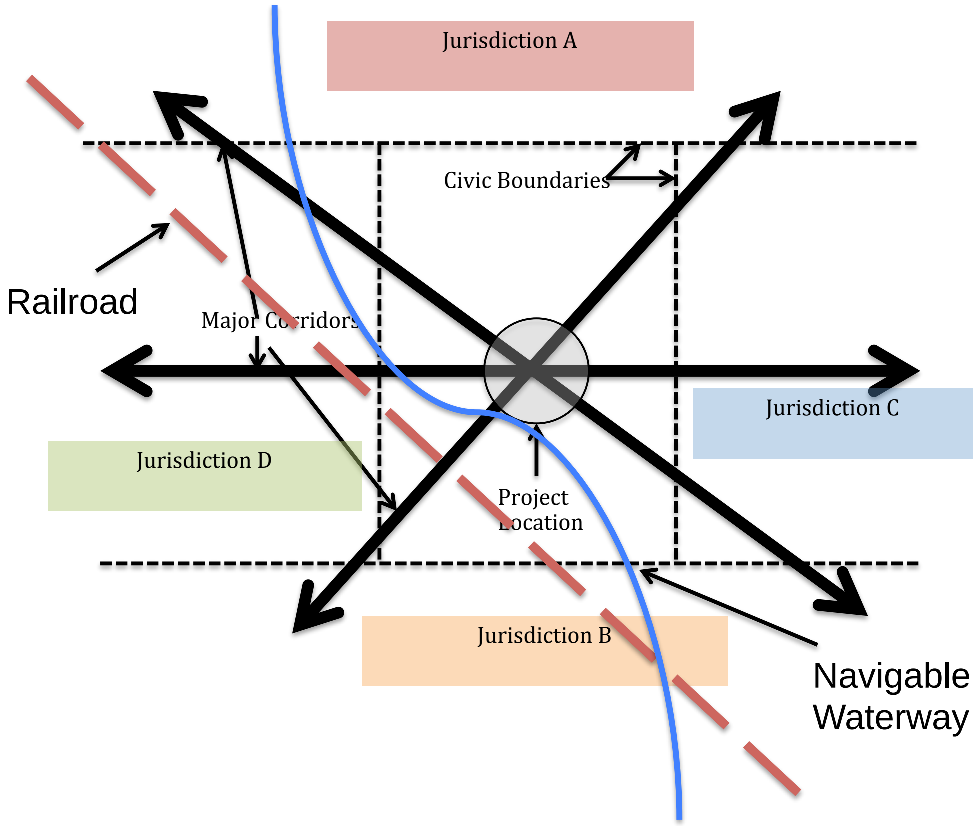

Figure 3: Intermodal Analysis

These modal impacts are often raised in the context of a proposed improvement, usually a highway improvement, but they cannot be analyzed within the context of a project. They must be seen at a system level, which means at least at a multi-state level and with knowledge of the products being moved.

To summarize, the transportation community needs a tool to analyze freight projects that:

1. Captures the time, reliability, and safety benefits that are important to the freight moving businesses.
2. Can deal with environmental concerns and issues.
3. That recognizes the broader economic reach of freight projects by allocating benefits to specific jurisdictions and industry groups.
4. Can deal reasonably with intermodal issues.

Existing tools deal with time, safety, and environmental issues. They do not comprehend reliability, the broader economic impact of freight projects, or the potential intermodal consequences of a project.

Literature Review

The literature relevant to this topic deals with three specific but overlapping areas: 1) the economic impact of transportation investments; 2) modal choice; and 3) performance measurement. While the body of literature on these topics is huge, only fairly recent articles with relevant information are discussed in this section.

Cambridge Systematics, in the *Guide to Quantifying the Economic Impacts of Federal Investments in Large Scale Freight Transportation Projects* (2), attempts a more complete analysis of the impact of transportation investment by considering modal shifts, the cost impacts in classes of business, and the national benefits and costs as well as localized benefits and costs. To do this they make use of several network models and models that estimate the modal shifts that may occur if the efficiency of one mode is made significantly better.

Key bits of information that are needed for this analysis are the origin-destinations of freight vehicles, the type of product being moved, and the philosophies being employed to manage supply chains. As the guide notes, much of this information may be incomplete, particularly when the non-highway modes are under consideration.

The basic model used throughout the Guide is shown in Figure 4:

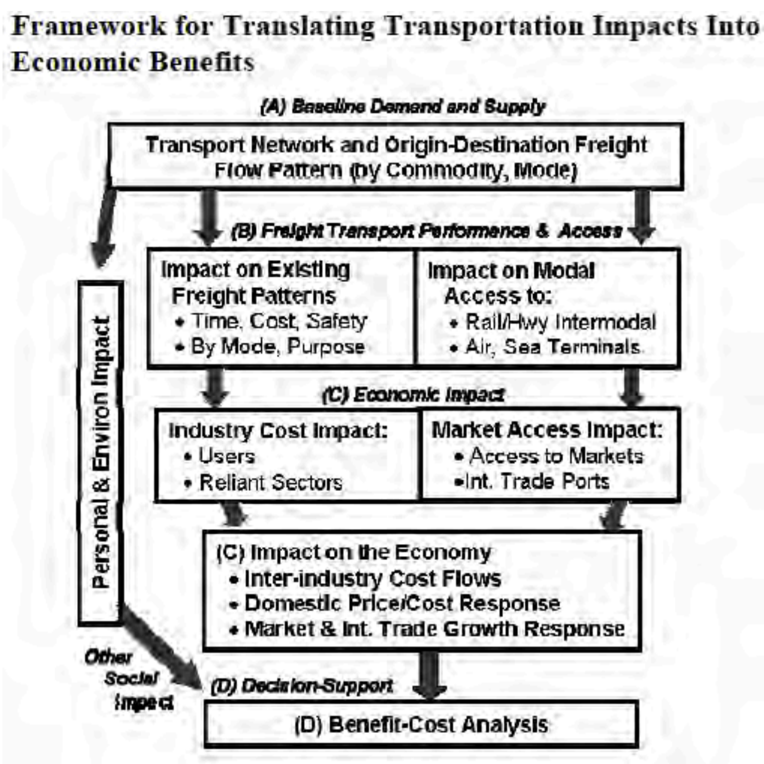

Figure 4: Economic Analysis Framework

The Economic Development Research (EDR) Group introduces the useful concept of "traded industries" to distinguish between those industries that redistribute wealth within the community and those that bring new wealth to it by selling products or services outside of the community (3). Figure 5 illustrates their approach.

Figure 5: Traded Industries

The traded industries are a subset of the total economy. They require transportation facilities to access markets. Investments that improve that access benefit industry. To identify the investments that will have an impact and to analyze that impact, EDR recommends a three-step process:

1. Identify those routes and facilities that have a disproportionately large potential for important economic impacts.
2. Measure the extent to which sensitive economic activities are affected by those facilities.
3. Estimate the potential economic benefit from improving those facilities, or the potential economic loss from failing to do so.

Weisbrod reviews the history of modeling in the effort to understand the economic impact of transportation (4). After critically discussing historic approaches, he recommends a new approach. In this approach, he urges analysts to consider eight factors:

1. Consider economic impact factors beyond just the value of daily average travel time and travel cost savings, including the potential value of highway system connectivity and peak period reliability improvements for both commuting and goods movement.
2. Consider the importance of multimodal implications, such as how a highway project can affect access to jobs, recreation, airports, rail intermodal terminals, and border crossings.
3. Consider the potential for changes in transportation conditions to hit certain industries that are particularly dependent on schedule reliability for time-sensitive deliveries.
4. Consider the need for analysis methods that can identify when transportation impacts are magnified or constrained by other local economic growth factors, such as utility infrastructure, financing, labor skills, and capacity for growth.
5. Avoid confusion by using analysis methods that can separate economic (flow of dollar) impacts from value of benefits that do not directly affect the flow of dollars.
6. Distinguish areas of impact: (a) local, (b) state, (c) national, and (d) global impacts, and show results for the level of study area that is most appropriate for those who will be using the analysis results.
7. Distinguish benefit and cost perspectives: (a) savings for travelers, (b) savings for all users including freight shippers and recipients, (c) generation of income in the economy, and (d) the value of all benefits to society, and report results as appropriate for those who will be using the analysis results.
8. Select modeling approaches that stress the particular types of causal factors and access elements of most relevance to the type of transportation project being considered and its

location context, recognizing that various economic responses and market mechanisms can be of differing relevance depending on size of the project and scale of the study area.

Weisbrod also considers the impact of congestion—which can be seen as the lack of investment—on businesses (5). He notes a significant impact on businesses, but one that varies by business type and with the coping strategies used by the businesses. The paper outlines the complexity of the issue and the limitations of the data available to analyze it.

Iacono and Levinson reviewed the literature of analyzing the impacts of transportation (6). They begin with the use of benefit-cost analysis to analyze impacts at a project level. They then move to a macroeconomic level and an analysis at a regional level. Their view of regional is the metropolitan level.

The Federal Rail Administration considers the unique aspect of modal choice (7). They note the complexity of the issue and offer the following model to deal with that complexity:

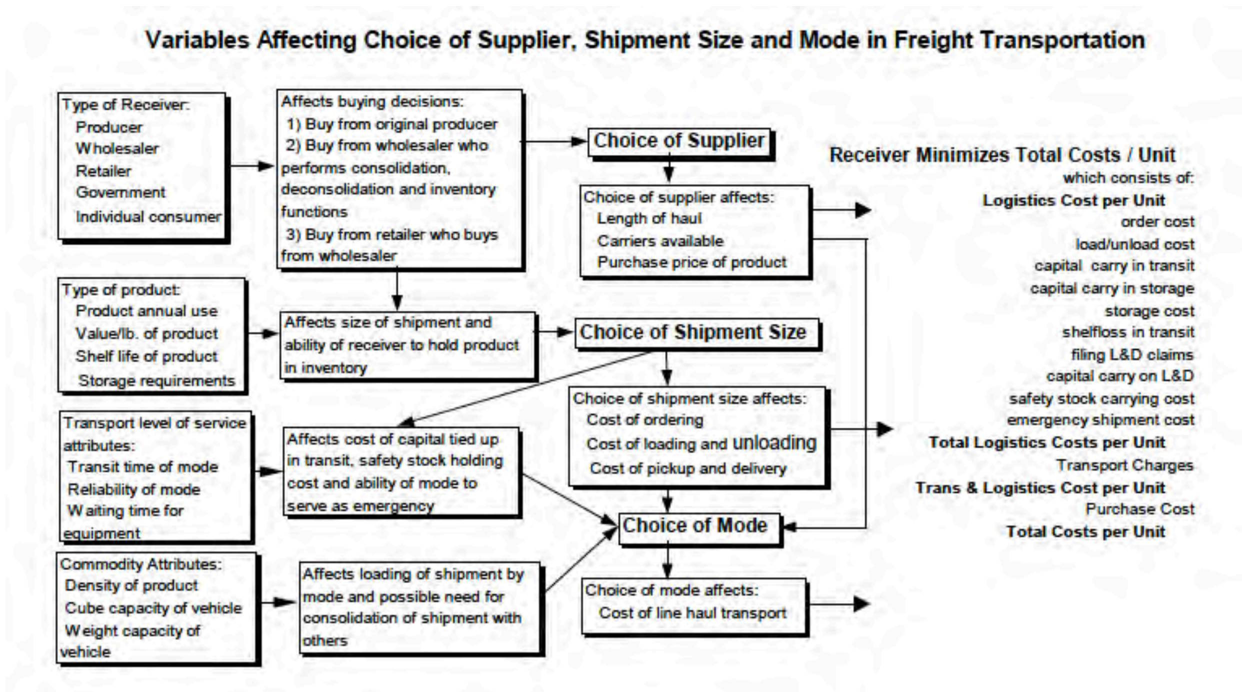

Figure 6: Modal Choice Analysis

To work the model, twenty-one specific data items are required:

1. Serial Number
2. Commodity Description
3. Commodity Code—Standard Transportation Commodity Code*
4. Pounds per Year*
5. Pounds per Shipment*
6. Value of Commodity—Dollars per pound*
7. Origination State
8. Destination State
9. Origin FIPS
10. Destination FIPS
11. Observed Mode (Truck)*
12. Truck rate per mile for 3S2*

13. Truck highway miles*
14. Truckload per shipment*
15. Number of Trailer on Flat Car (TOFC)/Number of Container on Flat Car (COFC) (0)*
16. Rail Junction Frequency (0)*
17. Observed Rail revenue per hundred weight (cwt) (1)*
18. Rail variable cost per cwt*
19. Rail miles*
20. TOFC pickup mile
21. TOFC delivery miles

Note: Items denoted with an asterisk are required fields for performing logistics cost calculations and comparisons. Default values for performing truck to rail intermodal diversions are noted in parenthesis in italics following the item.

The analyst attempting to address the modal shift question would first have to identify freight that might be subject to shift, either as a result of an investment or a change in policy, most often a change in truck size and weight laws.

Cambridge also looked at the specific example of the Interstate System, as it celebrated its fiftieth anniversary, to analyze the economic impact of that system investment (11). They find a large impact, noting that the interstate overlaid a sixty-five mile per hour system over a twenty to forty mile per hour system. They summarize the impact of the total investment, as compared to incremental improvements to the old system with the analogy of the "Big-Bang" theory of the creation of the universe.

DeCorla-Souza looks at the use of the STEAM software for doing benefit-cost analysis (9). He compares it to the previous SPASM system and finds several benefits:

1. The model accepts input directly from the four-step travel demand model.
2. It post-processes outputs from the travel-demand model to provide more accurate highway travel speeds under congested conditions.
3. It performs risk analysis to describe the level of uncertainty in the model.

AECOM, in the FHWA guide to benefit-cost for freight projects, considers four types of benefits (Table 1) (10).

Table 1: Four Types of Benefits

Table 1: Effects of Improved Freight Transportation	
First-order Benefits	Immediate cost reductions to carriers and shippers, including gains to shippers from reduced transit times[1] and increased reliability.
Second-order Benefits	Reorganization-effect gains from improvements in logistics[2]. Quantity of firms' outputs changes; quality of output does not change.
Third-order Benefits	Gains from additional reorganization effects such as improved products, new products, or some other change.
Other Effects	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.

The paper reviews past efforts in evaluating the impact of freight transportation projects. It notes that transportation can affect the economy in four ways:

- Changes in productivity and national income,
- Changes in the structure of the economy,

- Impacts on international trade and competitiveness, and/or
- Quality of life improvements as dictated by safety, health, and other social impacts.

Finally, Cambridge summarized the current state of performance measures in transportation agencies as reported at a forum on the use of measures in planning and programming (8). One participant offered a five-step model for the use of measures (Figure 7).

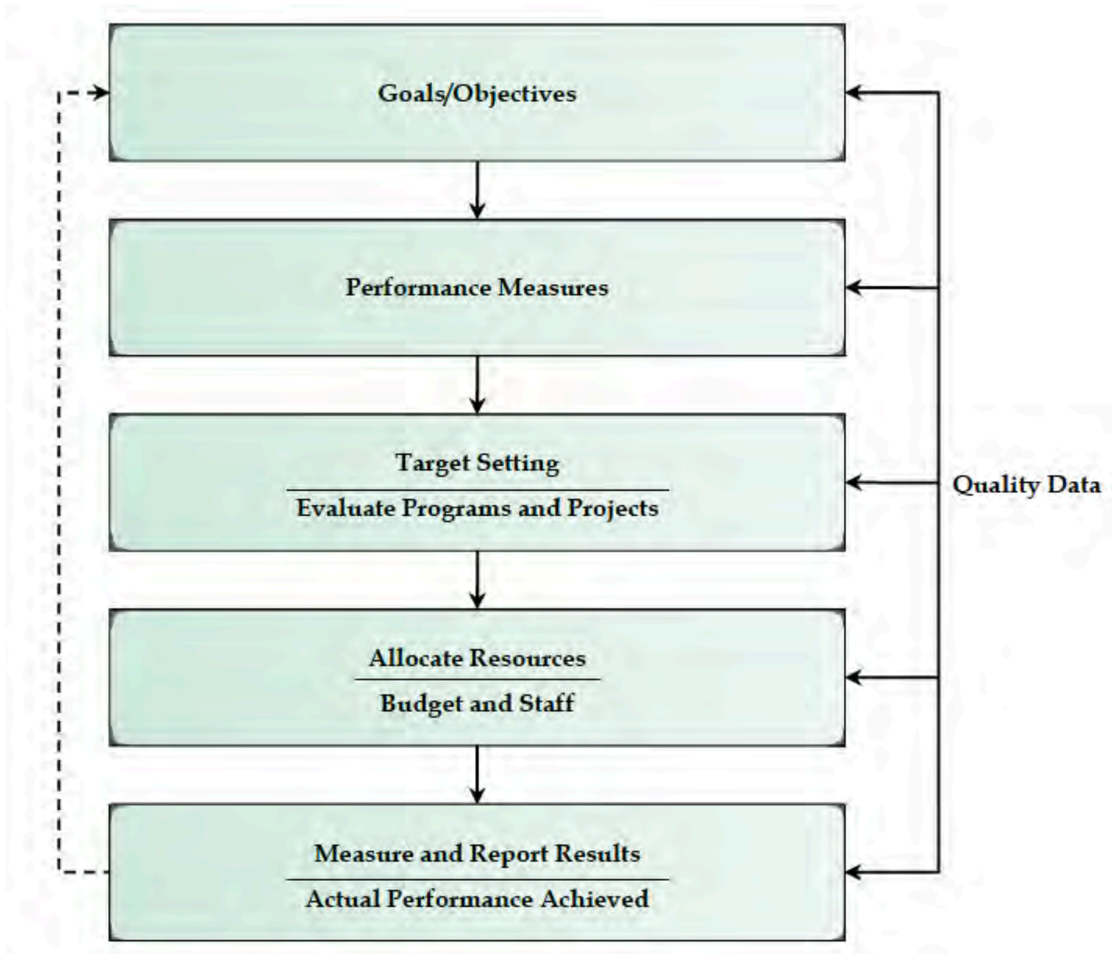

Figure 7: Framework for Performance Measurement

At another point, it was noted that "…some transportation system performance goals, such as greenhouse gases and freight system connectivity, require a multi-state/national perspective. Given that national goals require considerations beyond a state or local focus, accomplishing national goals will require collaboration across state borders. Achieving an effective level of multi-state collaboration, however, may require national leadership to unite state and local agencies" (8).

The forum concluded with an action plan that made several recommendations.

- Synthesize existing practice, literature, institutional relationships, and other research/policy efforts by creating an on-line repository for best practices.
- Increase coordination among governing entities to establish a cohesive performance management process.
- Provide Federal guidance to facilitate the necessary coordination, input, and collaboration among agencies.

- Increase collaboration across Federal agencies, state DOTs, MPO, transit agencies, and non-transportation partners on strategies to reach common transportation goals.
- Continue the comparative measure effort to allow for effective comparisons across agencies, including the formation of a US-based transit benchmarking organization.
- Initiate a pilot study that incorporates a state DOT, MPO, transit agency, and rural organization to illustrate a regional implementation of an integrated performance management process and explore the institutional relationships between planning partners.
- Conduct additional capacity-building peer exchanges to continue the discussion among organizations.
- Improve and expand the use of national data sets, such as HPMS, NBI, and NTD, and their associated management tools to inform performance-based planning and programming.

The Need

This tool(s) needed would have two fundamental uses. The first deals with providing information to transportation leaders and leaders in industry on the benefits, and/or the negative impacts, that an improvement project or an existing bottleneck has for various industries and jurisdictions. This should help to foster support for needed regional and national projects, allowing them to move ahead in a more orderly and expeditious manner. Projects like the three mentioned earlier should be completed if the US is to maintain its competitive advantage. Our current state-focused transportation decision-making processes tend to build high walls at state borders. Leaders are often measured by what goes on within a state's borders rather than by how much more efficient a transportation corridor becomes. This tool would begin to create openings in those walls, perhaps broadening the views of leaders.

The next use deals with national decision-making processes. The economic recovery act provided funding for projects selected by the USDOT that were said to have national significance. Many leaders inside and outside of Congress have lauded the TIGER process as one that should be retained in future transportation authorizations. They have also argued for performance-based programs. A tool such as this would allow truly national projects to be defined in a manner that is much clearer than the economic analysis tools that have been available in the past. It would also provide a robust tool for defining performance in terms of economic return on investment.

For both of these uses, this tool could have a major impact.

The tool will have to include elements from several of the studies reviewed above. Like the Cambridge Guide, it will have to include economic impacts by industry (2). Like the Guide and the FRA tool (2, 7), it will have to consider the impact on modal patterns. Like the Guide and Wiesbrod's model (2, 4), it will have to consider the geographical distribution of benefits. Also like Wiesbrod's model (4), it will have to consider a broader definition of economic and environmental impacts. Like Cambridge's Report (8), it will have to consider a multi-state and systems level perspective.

In short, the tool must have several abilities: 1) a method of dealing with time, safety, and environmental benefits; 2) a method of dealing with reliability; 3) a method of allocating defined benefits to those from jurisdictions beyond the sponsoring jurisdiction; 4) a method of assigning benefits to broad industry groups; and 5) a method of analyzing intermodal impacts. These five elements are necessary if the tool(s) are to provide the information and incentive for others to become advocates for projects from which they will benefit.

Four primary benefits of freight transportation projects are usually associated with the measures shown in Table 2.

Table 2: Benefits and Measures

Benefit	Measure
Reduced Travel Time	Time to move from origin to destination
Reliability	Variation in travel time On-time arrivals
Safety	Number of freight-related crashes

Benefit	Measure
	Severity of freight-related crashes
Environmental	Air quality Tons of pollutants

Existing data sources allow us to estimate and monetize all of the benefits and measures listed above, but traditional analytic processes deal only with time, safety, and environmental issues. Existing data sources generally will not allow benefits to be allocated to specific geographic areas or industries, nor will they allow a reasonable consideration of intermodal impacts.

CREATE

To illustrate the importance of the desired tool, we will focus on the Chicago Region Environmental and Transportation Efficiency (CREATE) program (11), which is public-private partnership between the US Department of Transportation (USDOT), Illinois Department of Transportation (IDOT), Chicago Department of Transportation (CDOT), Metra, Amtrak, and the Association of American Railroads (AAR).[1]

Figure 8: CREATE

The overall goal of this project is to address existing inefficiency of the region's rail infrastructure by investing in the critically needed improvements. Chicago is the most important rail hub in the nation. It consists of about 2,796 miles of rail network spanning an area of about 16,000 acres.

[1] The AAR is representing BNSF Railway (BNSF), Canadian National (CN), Canadian Pacific (CP), CSX, Norfolk Southern (NS), Union Pacific (UP), and switching railroads Belt Railway Company of Chicago (BRC) and Indiana Harbor Belt Railroad (IHB).

Almost 37,500 rail cars travel through the Chicago hub each day. This is projected to increase to almost 67,000 by the year 2020. The infrastructure is already severely congested and hence major infrastructure changes are necessary if the current and future demand is to be met successfully.

According to the CREATE feasibility plan (11), the primary goals of the program are improving the efficiency and reliability of local and national passenger and freight rail service in and through the Chicago region; reducing motorist, passenger rail, and freight rail delays to travel in and through the Chicago region; reducing highway and rail traffic congestion in the Chicago region; improving rail-highway grade crossing safety in the Chicago region; providing national, regional, and local economic benefits; providing environmental benefits for the Chicago region; and providing national, regional, and local energy benefits.

Table 3 lists the primary objectives of the CREATE program along with performance categories and indicators that could be used to appropriately measure and track these objectives.

Table 3: Primary Objectives of CREATE and Associated Freight Performance Categories and Indicators

CREATE Objectives	Performance Category	Potential Performance Indicators
Improve safety at proposed grade-separation location.	Safety	Changes in the freight-related crash and accident rates
Eliminate conflict between rail corridors and road network.	Mobility and Accessibility	Changes in Travel Time Changes in hours of Freight and passenger delays
Eliminate conflict between passenger and freight rail.	Mobility and Accessibility	Changes in Travel Time Changes in hours of Freight and passenger delays
Reduce fuel consumption and emissions from idling locomotives and vehicles.	Cost	Avoided cost from reduced fuel consumption due to reduced idling
	Environmental	Avoided emissions from reduced fuel consumption due to reduced idling
Limit congestion on the region’s highway.	Mobility and Accessibility	Changes in Travel Time Changes in hours of Freight and passenger delays
Modernize and increase the capacity of rail facilities to meet future traffic increases.	Mobility and Accessibility	Changes in Travel Time Changes in hours of delays
	Reliability	Deviation of Travel Time
	Economic Impact	Jobs Created

CREATE Objectives	Performance Category	Potential Performance Indicators
		Contribution of Investment to GDP Volume and Value of goods transported
	Cost	Avoided Highway Construction and Maintenance due to Modal shift
	Environmental	Avoided vehicular emissions due to Modal shift
Foster smooth and efficient flow of goods and people within and through the region, as well as to and from other parts of the united states, including international traffic of freight.	Economic Impact	Jobs Created Contribution of Investment to GDP Volume and Value of goods transported
	Operational Efficiency	Vehicles Miles Travelled Passenger Miles Travelled Average Speed
Improve the efficiency and reliability of the corridors to Better serve national security.	Operational Efficiency	Vehicles Miles Travelled Passenger Miles Travelled Average Speed

In many ways CREATE is an ideal project to use to illustrate the issues in project analysis. It has a very broad impact on the region and the nation; it is very high in cost; and it has had difficulty in finding the needed support to be fully funded. At the same time it is a very difficult project to use since it is really a collection of projects. Any of the component projects could be analyzed as a single project. Each of those single projects will have different impacts on the region and the nation.

What Can Be Done

Data Sources and Availability

As could be expected, a major hindrance for creating the tool under discussion is data availability, conformity, and reliability. Table 4 displays a theoretical checklist that can be used to collect data categories listed above, with sources collected for this study.

Table 4: Regional Freight Flow Data Checklist

Category	Available Metric	Source(s)	Coverage
General Freight Flows/Relationship between States and Regions/Global trends	Tonnage, Value, Mode, by Commodity	Freight Analysis Framework V. 3	National, to FAF region level
	Tonnage, Value, Mode, by Commodity	Commodity Flow Survey 2007	State-level
	Value of Exports, General Imports, and Imports for Consumption	U.S. International Trade Statistics	National
Infrastructure Usage	AADT, AADTT, V/C Ratio	HPMS 2008	Highway
Commodity-specific movements	Tonnage, Value, Mode, by Commodity	FAF Disaggregated Database	County
Modal split	Percent Tonnage/Value, by mode	CMAP	Metro Area, County
Industry Information	# of establishments, # of employees, payroll	County Business Patterns 2010	National, State, County
Volume/Truck and Traffic Counts	AADT, AADTT	State-specific traffic ATR and WIMs on major corridors	Roadway
	Bi-directional count, by vehicle type	Illinois Tollway Authority	Toll facility entry/exit locations
Capacity/Characteristics	Volume to capacity, roadway condition rating	HPMS, State-specific transportation	Roadway

Category	Available Metric	Source(s)	Coverage
		studies	
Travel Time	Average speeds, Average travel time	Gary-Chicago-Milwaukee Corridor	Gary-Chicago-Milwaukee Interstate Corridor
	Average truck speed	ATRI GPS Performance Measure data	Select interstate highways
	Average peak travel time	Local Traveler Surveys and Modeling	Varies
Safety (Crash statistics)	Large Truck Crashes	NHTSA	National, State, County
Predicted transportation impact (throughput, capacity, volume)	Varies	Local/state agency	Project and surrounding area
Diversion	Passengers to rail, freight tonnage to rail	Varies (Amtrak/CREATE in this case)	
Industry impact	Economic development impact	Impact studies	
Specific safety improvements	Crossings closed, crossing improvements	CREATE	

The major problem with existing data sources is our inability to correlate one data set with another. For example, solid estimates exist of commodities moving between counties across the country and of the tonnage moving by truck, rail, and water in given corridors, but it is impossible to develop, from this data, reasonable estimates of specific commodities moving on specific modes in specific corridors.

Using Existing Data

Within the limitations of the available data a number of useful analyses can be done. First of all, the impacts of the project can be defined within the traditional benefit-cost framework. The project-level work done by the CREATE project team have done this (Figure 9). Many have been monetized, yielding a very large return for the investment, but many impact are only listed under “additional benefits.” Several of these additional benefits will accrue to shippers outside of the region.

Regional Economic Benefits of the CREATE Program	($ Millions)
Rail Passenger Service	
✓ Commuters' time saved	$190
✓ New highway construction reduced	77
Motorists	
✓ Reduced delays at grade crossings	202
Safety	
✓ Highway accidents reduced	94
✓ Grade crossing accidents reduced	32
Construction	
✓ Wages, materials, and other purchases (including 16,217 employee-years)	2,194
Air Quality	
✓ Emission reductions (valued at CMAQ grant levels)	1,120
Additional Benefits	
✓ Improved rail freight service to Chicago region	
✓ Enhanced delivery of emergency services	
✓ Lakefront land use increased	
✓ Facilitate reduced "rubber tire" interchanges	
✓ Energy conservation	

Figure 9: Regional Benefits of CREATE

One approach to estimating these other benefits was done by the University of Illinois' Regional Economic Analysis Laboratory (REAL) analysis of the American Recovery and Reinvestment Act (ARRA) investment impacts, which funded several CREATE projects. REAL estimated economic impact of CREATE ARRA-funded projects across 13 commodity groups based on an interregional commodity flow model (ICFM) and also translated time savings into cost savings based on project estimates. The analysis includes fairly detailed breakdowns of how CREATE improvements could impact railroad and highway shares across the Midwest states and between US regions at an aggregate level. Table 5 below provides an example of the type of information estimated in the REAL model.

Table 5: Larger Benefits of ARRA-Funded CREATE Projects

	Output (millions of dollars)	Income (millions of dollars)	Employment (jobs)
Agriculture, Forestry and Fisheries	12.14	3.21	150
Mining	10.51	2.56	50
Construction	13.86	5.55	120
Food and Kindred Products	18.68	2.25	50
Chemicals and Allied Products	21.60	4.18	40
Primary Metals Industries	12.35	2.18	30
Fabricated Metals Industries	9.91	2.59	50
Industrial Machinery and Equipment	9.45	2.08	30
Electric and Other Electric Equipment	13.41	2.91	50
Transportation Equipment	28.05	6.19	70
Other Nondurable Manufacturing	50.05	10.00	210
Other Durable Manufacturing	16.08	4.27	90
Transportation, Services, and Government Enterprises	330.91	124.92	3,330
Total	**547.00**	**172.88**	**4,240**

Source: Regional Economics Applications Laboratory, University of Illinois, 2009.

With the available data, the geographic reach cannot be exactly quantified, but they can be inferred. The CREATE project team has attempted to do this in two ways.

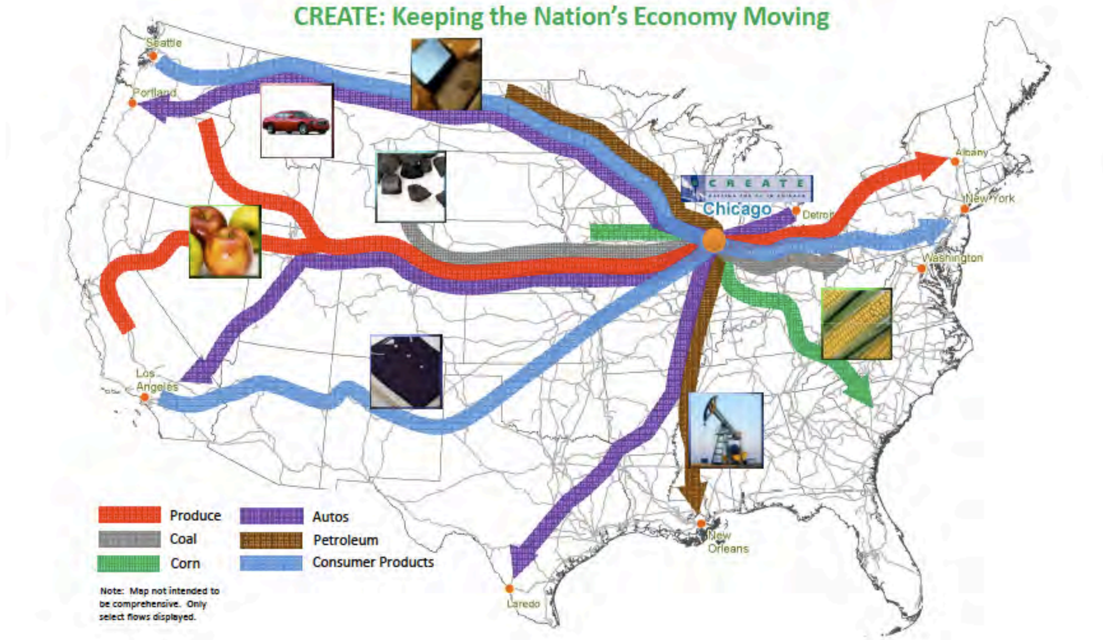

Figure 10: National Flow of Commodities from CREATE

Figure 10 outlines the commodities that flow to Chicago, where they begin and end. Produce, coal, corn, autos, petroleum, and consumer products are the major commodities moving through Chicago. Figure 10 also illustrates the importance of the West coast ports for consumer products and of the Powder River coal fields for the movement of coal. The national importance of the city for the movement of freight is clear.

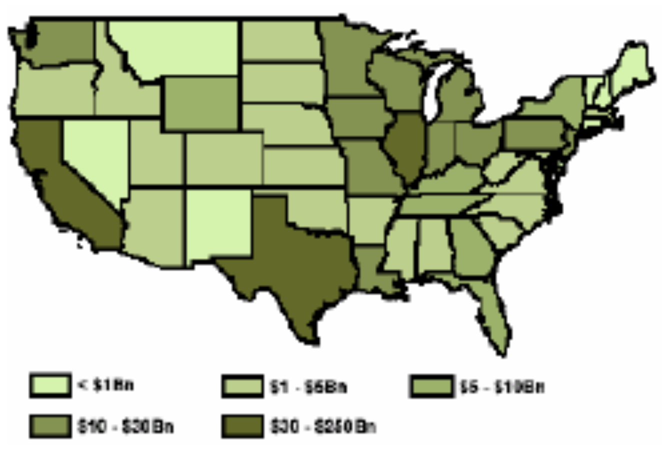

Figure 11: Trade by State

Figure 11 shows another approach taken by CREATE staff to demonstrate the importance of the city for freight. It illustrates the distribution of freight moving through Chicago. The darker colored states have a larger share of that freight. California and Texas are the major partners, followed by Washington and the states of the MAASTO region.

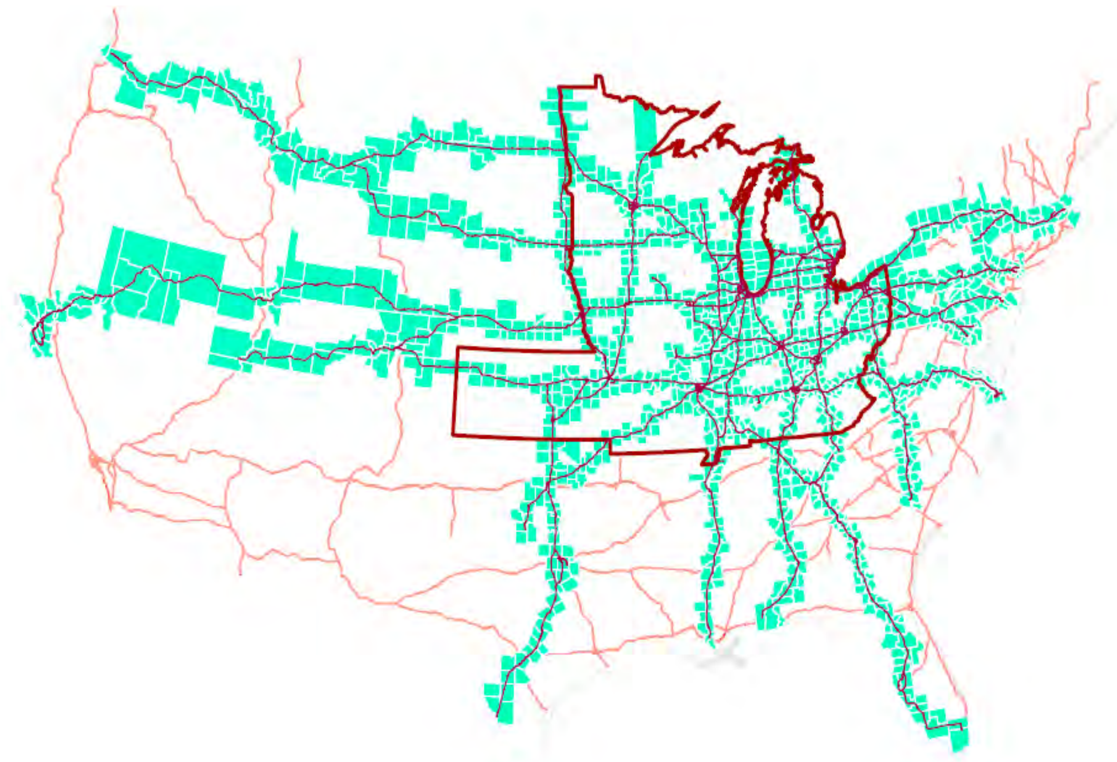

Figure 12: National Reach of Chicago Interstates

Another approach simply considers the connectivity of major routes to the balance of the country. Figure 12 displays connectivity of MAFC interstates throughout the country. Of the MAFC's 963 counties, 539 are along the region's interstates. Expanding these roadways to the rest of the US, 1,230 of the total 3,234 in the US are connected.

This approach can be extended by looking at the connectivity and importance of specific routes. The I-80 corridor is an example of how an agency could evaluate a freight investment. The corridor spans the US from east to west and intersects the CREATE region. Figure 13 illustrates the major metropolitan areas connected by I-80.

Figure 13: Overview of I-80 Metro Areas

Table 6 shows both establishment and commodity data, parsed to a specific level, both by NAICS codes and SCTG. It is possible to assemble a network of allied industry clusters that could be affected by any given infrastructure project. While it is a fairly simplistic view, it does provide a view understanding how any particular region's freight relates to a bigger view.

Table 6: I-80 Corridor Statistics

I-80 Corridor Statistics:	
Number of Establishments:	1,095,129
Number of Employees:	17,588,046
Average Truck Speed:	Mean: 57.5 mph Minimum: 5.5 mph Maximum: 63.43 mph
Total distance:	3,270 miles
Estimated total corridor travel time:	57 hours drive time

Chicago Area Corridor Statistics:	
Total miles:	166 miles (I-80 from US 45 through Indiana)
Average Travel Time:	174.98 minutes (min average) 223.5 minutes (max average)
Annual Average Commercial vehicles entering I-80 from I-294:	39,140 (2008), 33,540 (2007)
Annual Average Commercial vehicles exiting I-80 to I-294:	38,860 (2008), 33,050 (2007)
Annual Average Commercial vehicles I-80 outbound to Indiana:	63,220 (2008), 61,900 (2007)
Annual Average Commercial vehicles I-80 inbound from Indiana:	62,430 (2008), 62,390 (2007)

Using a corridor approach lends itself to identifying multiple transportation and economic characteristics. Corridor-wide statistics are shown in the top-half of Table 5, while complementary statistics for the Chicago segment(s) of I-80 are on the bottom-half.

It is evident the impact Chicago has on a corridor. For example, the 166-mile portion that makes up the Indiana through Chicago segment of roadway can account for a 70 minute fluctuation in travel time (average vs. maximum average) depending on time-of-day, day-of-week, and other variables. The cause of this variation is shown in Figure 14. The red and yellow points indicate areas in which the capacity of the route is constrained at least part of the time.

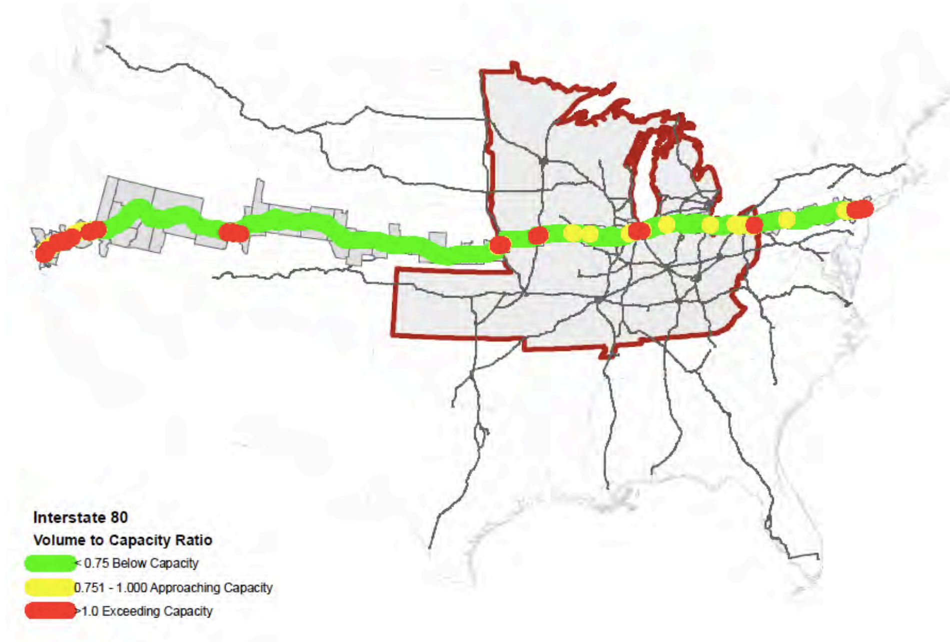

Figure 14: I-80 Corridor Summary Statistics

Likewise, it suggests that an investment that could improve efficiency in a particular area of the corridor could produce compounding efficiencies throughout the corridor. While I-80 is used an example, equivalent information can be queried for all corridors intersecting MAFC states.

Another approach to understanding the flow of traffic from the region is found in the Gary-Chicago-Milwaukee Corridor Coalition, which maintains a detailed database of travel times based on ITS information for the coverage area (Figure 15).

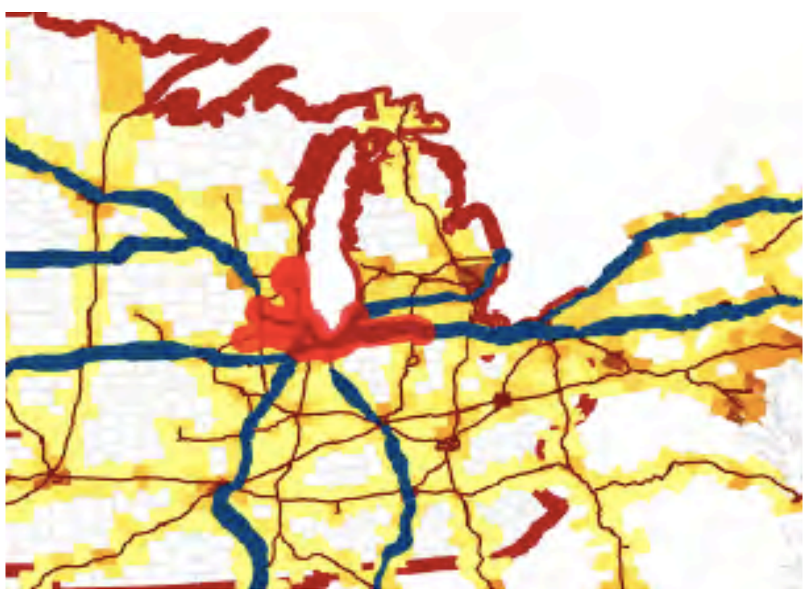

Figure 15: GCM Corridor Travel Time

GCM Corridor has collected 330 million travel times since October of 2004, and includes variables to add detail such as specific timeframes and days of week/weekends per highway segment. Output is in the form of travel minutes and includes average, and minimum and maximum averages, as well as average sample days for the given segment.

Publicly available truck traffic count information detailed bi-directional traffic counts, by vehicle type from the Tollway's entry and exit points could add another level of specificity. For the purposes of this project, the primary entry/exit points are:

- I-94: Plazas 20 and 21
- I-39/90: Plazas1 and 4
- I-88: Plaza 69
- I-80: Plaza 47
- I-355: Plaza 99

This data offers some indication of the direction of trucks coming to and leaving Chicago, but it does not give origins or destinations.

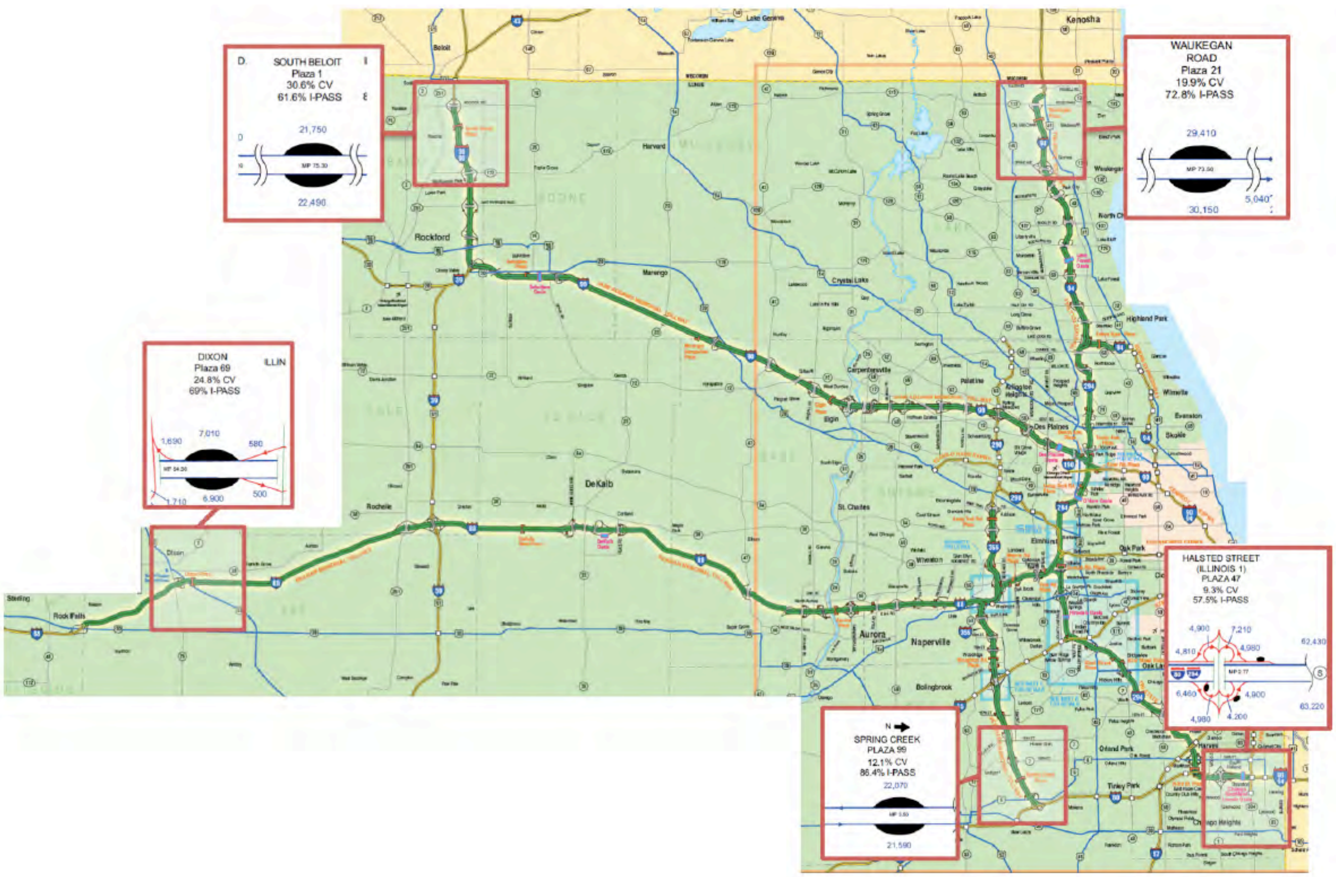

Figure 16: Illinois Tollway Commercial Vehicle Count Locations

A similar analysis can be done of the rail network, but given the substantial rail infrastructure that. Given the muddled nature of Figure 17, it is clear the type of data presented for highways would yield nothing more than a statement that all class I railroads come together in Chicago and collectively they serve North America.

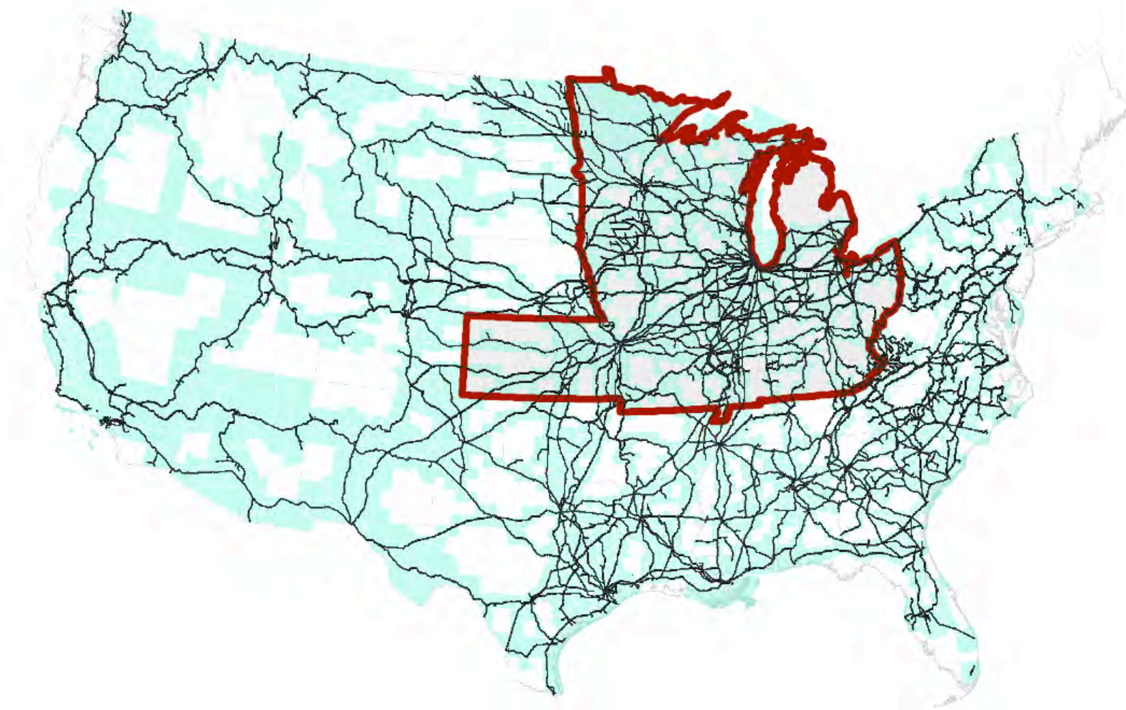

Figure 17: Class I Rail Connectivity

With the available data we can shed light on many issues related to freight projects. We can define project benefits within the traditional forms of benefit cost analysis. We can illustrate in general ways the reach of a project. We can identify the general origins and destinations of major commodities. We can illustrate the numbers of metropolitan areas impacted by a corridor. What we cannot do is specifically identify industries or geographic regions that will benefit from a project. Not being able to allocate benefits to industries, we cannot adjust the calculations of those benefits to reflect the specific circumstances of an industry. Not having origin-destination and commodity information, we cannot be a creditable job of evaluating intermodal issues.

A Better Analytic Tool

Our current understanding of freight-related projects is incomplete. Even those features of our analysis that might exist are often not brought together in ant useful or meaningful manner. If we are to better understand freight-related projects, we will have to add significant new analytic components to our processes and we will have to pull all the parts of our analyses together to form a more understand whole.

Benefit-cost analysis is the most often used tool in analyzing all transportation projects. It has performed well in adding rigor to our decision-making processes. Typically, it provides sound estimates of time saving, safety improvements and environmental improvements to be found in a project. It does not deal well broader economic impacts such as the synergy that might be found with improved market access. It does not deal with the impacts and cost of the lack of reliability. It does not address intermodal impacts. It does not deal with the industry specific impacts of transportation time and reliability. And it does not address the geographic distributions of the benefits of a proposed project.

Figure 18: Traditional Project Analysis

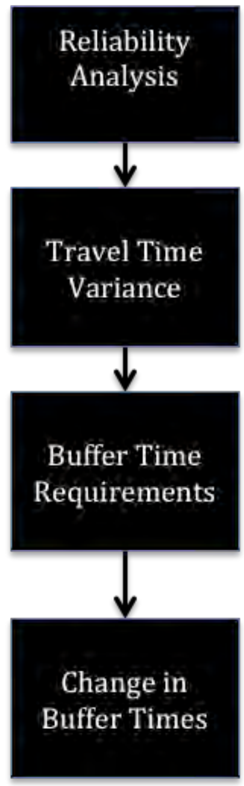

Figure 19: Reliability Analysis

Even with these short-comings, the traditional benefit cost analysis produces much of the information that is critical to understanding a project. As illustrated in Figure 18, estimates of air quality, speed, and safety changes can be applied to estimates of traffic volume and make-up to yield a good estimate to projects benefits. When those benefits are related to costs, an easily understood expression of the economic impact of the project can be produced, the benefit-cost ratio. Existing data sources and analytic techniques would allow us to supplement benefit costs with estimates of reliability. Figure 19 shows an analysis of a project's impact on travel time variance might indicate a reduction in the buffer time requirements. For the freight industry, this effectively means an even greater reduction in travel times.

Modal shift can occur if one mode is made more attractive because of a change in infrastructure. To estimate any shift, information on the origin and destinations of specific commodities will be required. This information can be combined with the relative costs of the modes in question and estimates can be made of potential shifts. If all of the data required is available, the FRA modal shift model (7) can be employed. If is not, a reasonable qualitative analysis can be done with some understanding of the modal options available joining the O-D pairs and of the commodities being shipped. Figure 20 offers a conceptual view of the conditions that dictate truck-rail modal shares.

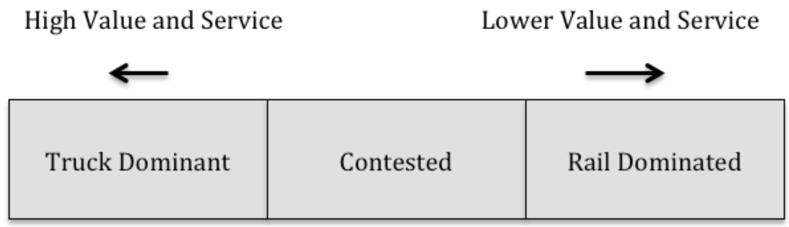

Figure 20: Modal Choice

Trucking tends to dominate commodities that require a high level of service and have a high value. Rail tends to move those commodities that require less service and have a lower value. Commodities in the middle, or commodities moved in corridors with sound intermodal service, fall into the contested category. Products in this realm will tend to move with acceptable levels of service by the mode that offers the cost advantage. An understanding of these basic relationships, of the commodities moving and the service available between O-D points will allow the analyst to arrive at reasonable qualitative conclusions.

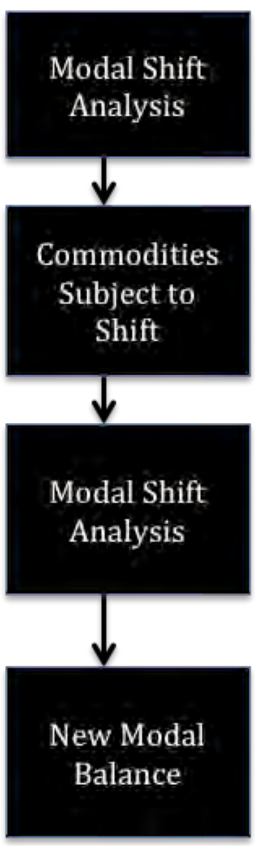

Figure 21: Modal Shift Analysis

Figure 22: Distributional Analysis

Figure 21 provides an overview of modal shift analysis. It will produce a new modal balance, which may affect the traffic volumes and splits used in the benefit cost analysis.

The final bit of analysis deals with geographic impacts: Which jurisdiction and which business sectors will benefit from a freight improvement. The key pieces of information that must be added to the traditional analysis are origin and destination and commodity. With these pieces of information, it will be possible to allocate the benefits related to speed, reliability and safety calculated in previous steps to locations and businesses (Figure 22). With these pieces of information, it will also be possible to adjust the values of time and safety assigned in the benefit cost analysis.

The cost of bottlenecks is not the same for all products. While the cost of operating a truck and paying a driver may be identical, other factors will come into play. For example, a tractor, with a price tag of several hundred thousand dollars moving from the Caterpillar factory in the Midwest carries with it a cost of ownership that increases the value of the time required to move it to market. Similarly, a load of produce moving from California has a diminished value the longer it spends in transit. A load of scrap paper has no similar factors that increase the value of time or safety. Monetizing and assigning benefits could be much more accurate if the nature of the product was also included in the calculation.

Air quality benefits will require another, and very complex, step. That is the use of a meteorological model to estimate the chemical changes in air pollutants and the atmospheric distribution of those pollutants. State air agencies in those states that have battled to reduce volatile organic compounds use such models; the analysis may not be possible in other states.

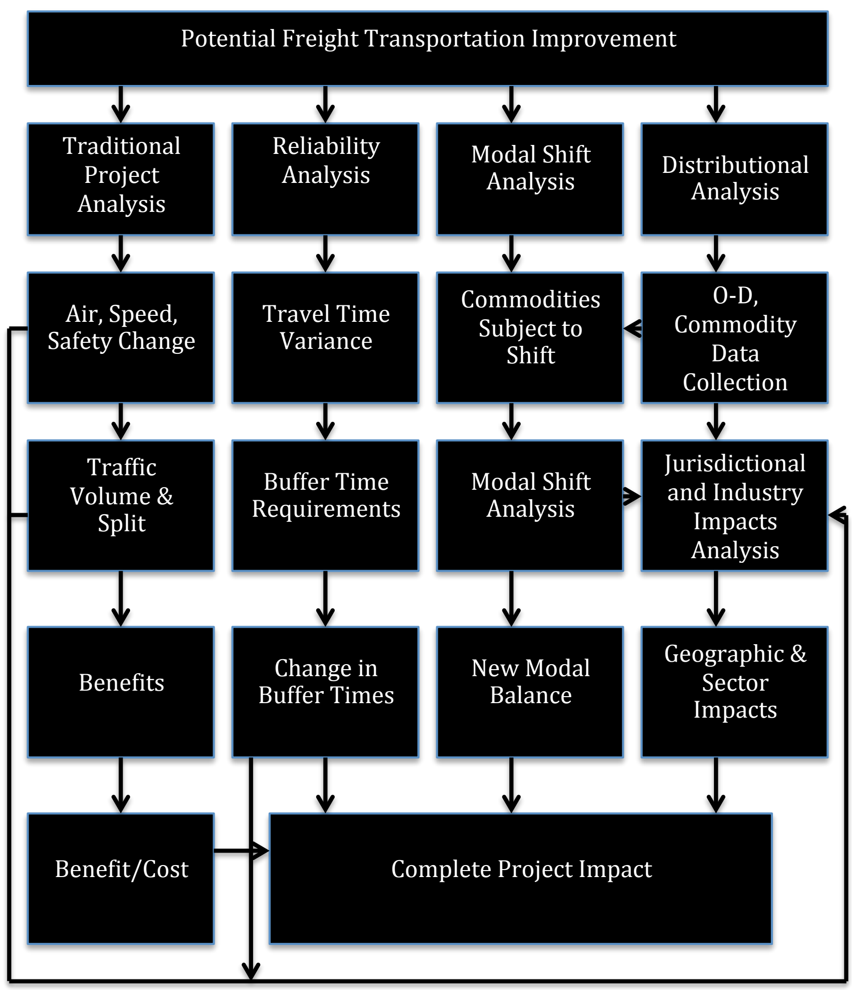

Figure 23: A More Complete View of Freight Projects

The result of these four analytic processes will be a more complete picture of the impacts of a proposed freight improvement project. Figure 23 illustrates how all of these parts can be brought together. A significant amount of interaction is required between the streams of information.

It does require more information than is typically available for project level analysis. That added information is listed below along with potential sources or ways in which it can be collected.

1. Variance in travel time for trucking is most easily calculated through mobile communications data, such as that provided for many high volume corridors by the FHWA and ATRI. For rail projects in which public participation is contemplated, the rail company should be asked to provide that information.
2. Reduction in travel time variances has to be estimated as part of the project planning and design processes. Just as estimates of time-savings or accident reductions are made in the planning and design processes, changes in travel variances can also be estimated.
3. Origin-Destination information for trucking will have to be generated through some type of traffic intercept study. Such studies can be designed to be minimally intrusive and reasonably accurate. For rail, O-D data could be provided by the rail companies.
4. Commodity information would have to be collected as part of the intercept study outlined above. For rail, commodity data could be provided by the rail companies.
5. Meteorological information is available from many state air agencies.

Some might argue that collecting this cost-prohibitive, but the cost of deferring needed projects or of making less than optimal investment decisions can also be very great.

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