

# **Incorporating Economic Impact Metrics in Transportation Project Ranking and Selection Processes**

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**ABSTRACT**

*Incorporating Economic Impact Performance Metrics in  
Transportation Project Ranking and Selection Processes*

A growing number of federal, state and local transportation agencies are now including economic development and productivity impact measures in their processes for prioritizing and selecting projects for funding and implementation. However, they face a range of alternative project rating mechanisms and different performance metrics that relate transport improvements to economic growth. The mechanisms include multiple criteria analysis ratings, benefit-cost calculations and composite scoring systems – each incorporating different transportation and economic factors. While alternative rating mechanisms and metrics have been summarized in prior literature reviews, this paper seeks to critically examine their differences and implications for project selection. It shows that alternative rating systems actually share a common underlying theory but reflect different factor weights. However, the difference in factor weights does affect project selection, as illustrated through an empirical analysis of alternative rating approaches developed in Kansas. The findings from this research can help any transportation agency involved in ranking and selecting among alternative transportation project proposals, by enabling refinement of performance metrics, analysis methods and their interpretation for use in future decision-making.

## **1. Introduction**

**Issue.** Local, regional and state transportation agencies have traditionally decided on transportation project priorities and investment on the basis of engineering considerations. They tend to focusing on traffic flow needs to meet a given pattern of demand, and projects are most commonly rated by measures of traveler time savings, cost savings and safety enhancement (AASHTO, 2003). However, it has long been recognized that non-user impacts --including environmental, social and economic impact factors – should also be considered. As will be discussed later in this paper, various transportation agencies have made effort to capture some or all of these additional factors in their processes for ranking and selecting proposed new projects for funding and implementation.

Among non-user impacts, both economic productivity benefits and broader impacts on business location decisions are of particular note because expanding local jobs and income is frequently brought up as a specific motivation for proposed new transportation investments. That motivation and resulting expectations are not always reasonable, highlighting the need for careful consideration of economic effects. A growing number of federal, state and local agencies now include productivity and economic development impact considerations in their project ranking and selection processes. Since a very wide range of different measurement approaches are being used, there is naturally a question of how the choice of benefit or impact measurement methods can affect ranking results and funding decisions.

This paper critically examines similarities and differences in the factors being considered by alternative project rating and selection methods, and the relative weights being given to those factors. It presents results of research that compares alternative rating schemes being used by transportation agencies, to highlight both common assumptions and differences in factors being measured and considered. It then presents results of an empirical analysis of alternative ranking approaches developed in Kansas, which demonstrates how alternative ranking priorities can affect project selection outcomes.

**Public Goals.** There are many motivations for transportation capital investment, and specifically capacity enhancement projects. Some investments are made to maintain publicly-desired standards for travel conditions (in terms of speed, cost, safety and reliability) in the face of growing demand and aging facilities that threaten to degrade those conditions. From an economics perspective, investments are also made to respond to changing business requirements for freight shipping and customer access, changing population patterns affecting job and shopping access needs, or changing technology opportunities, logistics processes and/or intermodal connectivity requirements. Yet other investments are made to maintain national (or regional) competitiveness for business retention and growth, or to address equity needs pertaining to specific groups.

Many public agencies recognize a responsibility to acknowledge and consider a wide range of impacts – affecting both users and non-users – in their project ranking and selection processes. In practice, a range of different approaches are available for portraying project benefits, ranging from monetary valuation of specific user benefits to broader multi-criteria analysis ratings. There are also major differences in the way that various agencies define the scope of their

responsibilities, in terms of both topic areas and spatial areas. So depending on the agency and level of government involved, only a subset of all possible societal impacts may enter into the benefit or impact calculus. The end result is a wide range of different approaches and measurement systems being used, with limited understanding of the ways in which different metrics end up affecting decision results.

## **2. Range Of Rating Approaches**

A scan was conducted of the rating schemes currently in use by US federal, state and regional agencies for ranking and selecting proposed transportation projects. They can generally be categorized into three approaches: (1) classic benefit-cost analysis, (2) multi-criteria “scorecard” analysis and (3) composite rating schemes. Interestingly, all three stem from the same theoretical basis, which is that there is a social “utility function” representing a relative value to society of each proposed project. And all three attempt to represent the relative value of that social utility (among competing project proposals) by compiling positive and negative impact elements into a common set of metrics, and then applying factor weights to calculate aggregate ratings that enable comparison among competing projects.

However, in practice, each of the three approaches covers a different set of impact factors and applies a different form of weights to them. The primary contribution of this paper is to illuminate the systematic differences in factors and weights used by those approaches and their practical implications for project selection. To highlight these differences in the context of economic development considerations, we distinguish five classes of transportation project impact. They are: (a) travel benefits, (b) environmental & community impacts, (c) transport factors driving non-travel productivity gain, (d) other factors affecting local economic growth, and (e) economic growth outcomes. While these categories overlap, they do represent different perspectives for measuring project impacts. (Consequences of their overlap are discussed later.)

### *Use of Benefit-Cost Analysis (BCA) for Ranking and Selection*

In its classic form, BCA approach considers a range of different benefits and cost factors, and applies unit valuation factors to translate all of the various benefits and costs into monetary terms (which may be either actual cost or willingness to pay estimates that are derived from either stated preference surveys or statistical studies of observed behavior). Factors occurring at different points in time can be discounted accordingly. Through that common monetary valuation, the various benefits can be combined and the various cost elements can be combined, for comparison purposes (FHWA, 2003).

Traditional BCA has known limitations in its coverage of social considerations, including a lack of sensitivity to wealth differentials, distributional impacts on vulnerable groups, and inter-generational impacts (Ackerman and Heinzerling, 2004; Zerbe, 2007). However, there are further criticisms of BCA metrics as implemented for transportation decision-making, related due to the fact that BCA is often implemented using narrow user benefit measures that miss non-user impacts on business productivity and competitiveness (Eddington, 2006; Weisbrod, 2008). This can distort project selection. For instance, the practice of focusing solely on traveler benefits can undervalue freight-related projects insofar as it ignores or under-values additional

cost savings benefits to freight shippers and consignees, as well as freight logistics and industry production economies enabled by transportation improvements. In addition, BCA based on narrow traveler benefit measures can be biased to favor urban projects because changes in vehicle-miles of travel (VMT) and vehicle-hours of travel (VHT) tend to be greatest for high volume urban roads, and those measures alone do not capture potential market access and connectivity benefits for rural areas.

Two approaches have emerged to addressing this line of criticism. The first approach is to adopt a two step process: (1) first, conduct of BCA assessment of traditional user impacts in monetary terms (focusing largely on travel time, cost and safety considerations, consistent with AASHTO, 2003), and (2) a qualitative consideration of other impacts such as economic development, environmental and community impacts. Both Minnesota DOT and California DOT have evolved spreadsheet models for the first step and then recognize a second step to capture additional qualitative factors. This approach is applied when considering the selection of proposed projects among those competing for fixed state funding. Minnesota also uses a similar approach in selecting projects for its statewide transportation plan (Minnesota DOT, 2009).

The second approach is to broaden the BCA process to encompass a wide range of non-user benefits. The US DOT has recently taken this approach in its application and selection criteria for transportation project funding grants under the TIGER (Transportation Investment Generating Economic Recovery) program. In that case, the guidelines for calculation of benefits go beyond the traditional user benefits to explicitly encompass a range of non-user benefits. These include "economic competitiveness" (through measures of productivity associated with travel efficiency, reliability and access changes), "livability" (through measures of the availability of multi-modal options and health improvement), and "environmental sustainability" (through measures of the value of energy efficiency and reduction of air pollution and carbon emissions) (US DOT, 2010).

Exhibit 1 summarizes the types of factors that are included in the USDOT approach. Basically, this approach starts with traditional traveler benefit and environment impact estimates, and then provides a place for adding non-traveler business productivity impacts (that are beyond what is covered in the traveler and environmental impacts). This can capture effects of improved market access, connectivity and reliability changes affecting business productivity. In practice, additional business impact models or analysis tools are necessary to estimate those effects. When done, the adoption of broader and more inclusive benefit measures is fully consistent with BCA theory, as discussed by Zerbe (2007). This "wider BCA" approach has also been recommended for transportation project evaluation in the UK (Eddington, 2006).

Yet even the "wider BCA" approach, as implemented by the US DOT grant program guidelines, excludes local community impact and localized business outcome measures that are addressed by other methods adopted by state DOTs. From the viewpoint of federal program funding, the exclusions can be appropriate. From the viewpoint of state agencies, though, local impact factors may still be appropriate considerations. Indeed, while not shown in the chart, the BCA approaches used by Minnesota and California do allow for additional local factors to be considered through the open-ended second step in their two-part assessment processes.

**Exhibit 1. Economic Development Criteria Used in Project Rating Systems**

Rating Criteria	BCA	MCA			Rating
	USDOT	OH	WI	MO	KS
<b><i>Traveler Benefit and Environment</i></b>					
Travel time, operating cost, level of service	X	X	X	X	X
Safety (accident rate)	X	X	X	-	X
Pollution emissions	X	X	X	X	-
<b><i>Transportation Drivers of Business Productivity Gain</i></b>					
Intermodal facilities & multi-modal access	(x)	X	(a)	X	(a)
Reduce congestion, traffic bottlenecks, vol/capacity	(x)	X	X	X	X
Connectivity to key statewide corridors	(x)	-	X	X	(a)
Labor market access	(x)	-	(a)	-	(a)
Predictability (reliability) of travel times	(x)	-	(a)	-	(a)
Connectivity to export markets or global gateways	(x)	-	X	-	(a)
Concentration of trucks for goods movement	(x)	X	(a)	X	X
Industry productivity /competitiveness of freight costs	(x)	-	X	-	(a)
<b><i>Transportation Drivers of Localized Economic Growth</i></b>					
Industry site access for business development	-	X	(a)	-	(a)
Location in economically distressed area	-	X	-	X	-
Supports cluster development /in-fill/redevelopment	-	X	-	X	X
Supports local economic development initiatives	-	-	-	X	X
Local public support	-	-	X	-	X
Leveraging local private investment	-	X	-	-	-
<b><i>Economic Growth Outcomes</i></b>					
Jobs(support job growth/reduce unemployment)	-	X	X	-	-
Gross Regional Product (income generated)	-	-	-	-	X

“X” = factor explicitly included as an element of the rating system;

“(x)” = factor implicitly allowed via calculation of additional productivity impact

“(a)” = factor implicitly included in the ratings as a component of the TREDIS economic model calculation of job or GRP impacts;

“-” = factor not formally recognized as a separate element of the rating system, but may still be considered through other elements of the broader project selection process

Abbreviations and Sources: BCA = Benefit-Cost Analysis; MCA = Multi-Criteria Analysis; USDOT = US Dept. of Transportation (2010), OH = Ohio DOT (2008), WI = Wisconsin DOT (2007, 2009), MO = Missouri DOT (2009), KS=Kansas DOT (2010)

*Use of Multi-Criteria Analysis (MCA) for Ranking and Selection*

MCA is a method that allows for both qualitative and quantitative factors to be considered as decision criteria for ranking or selecting projects. Whereas BCA requires that all positive and negative effects be measured in money units, MCA allows consideration of broader impacts that may be assessed using any qualitative or quantitative rating scale (Macharis et al, 2009). For transportation project assessment, impacts may span economic, environmental and social impacts. Each factor is assigned a weight so that all impacts of a proposed project can be summed and comparison made amongst competing projects. Since MCA does not require factors to be converted into monetary terms, it allows for consideration of benefits beyond efficiency or productivity factors covered by BCA. It allows for consideration of distributional impacts, including local investment and activity shifts deemed to be socially desirable. It also allows for consideration of factors that may be interconnected or overlapping in measurement, since all ratings are along relative scales and there is no calculation of the total value of benefits.

Exhibit 1 (previously shown) summarized the types of factors included in the MCA approach as implemented by state transportation departments in Ohio (2008), Wisconsin (2007, 2009) and Missouri (2009). In each case, MCA ratings were developed to aid in prioritizing major new highway system capacity projects proposed for state funding. While the factors that are explicitly recognized do vary among states, in general they span a range of impact dimensions -- including user and environmental benefits, drivers of business productivity, drivers of localized economic impact and economic growth outcomes.

Several distinct elements of the MCA approach are notable. One is the inclusion of economic growth (job or income) outcomes by several states. This provides a way to give greater weight to projects that add income for state residents rather than merely expanding business productivity. Job or GRP impacts may be forecast using economic models such as TREDIS<sup>1</sup> or REMI<sup>2</sup>, or information obtained from local or regional economic developers. Another notable element of MCA is the recognition of benefits associated with policy synergies – i.e., transportation projects that support other public policy objectives including support for clustered or in-fill land development, redevelopment of old industrial areas and location in economically distressed zones. These factors generally affect the distribution of benefits rather than efficiency effects, but they can still be valid objectives for public agencies. Such effects would be missed by a BCA focusing just on efficiency. Finally, it should be noted that all of the agencies identified in the table have processes for public input to their decision-making process, and most include consideration of public support as a factor in their project ranking.

Other state DOTs and metropolitan planning organizations (MPOs) have also employed MCA to rate transportation proposals for their long-range capital investment plans, in each case considering economic development factors in addition to direct traveler benefits. For instance, Virginia DOT included factors such as intermodal access, truck concentration and local economic distress, as well as congestion reduction, in their project ratings. The Chicago Metropolitan Agency for Planning included factors such as labor market access and infill development, location in economically distressed areas, as well as job and income growth outcomes among the factors affecting selection of projects for their long-range plan (CMAP, 2010). Boston's MPO rated projects in terms of factors including integration with land use and economic plans, support for sustainable land development, service to existing activity centers and connecting links for economic activity (Boston MPO, 2009). The San Francisco MPO included access to airports and seaports, as well as ability to accommodate growth in movement of both people and freight, for their regional plan (MTC, 2009). While the factors vary among areas and agencies, reflecting differences in local values and priorities, they share a common attempt to place value on projects that can affect job and income growth in addition to transportation flow and other social factors.

#### *Use of Composite Factors for Ranking and Selection*

The third approach is to develop composite scores that rate each proposed project via a set of alternative measurement perspectives that also incorporate public input. Kansas has been a

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<sup>1</sup> TREDIS denotes Transportation Economic Development Impact System; see [www.tredis.com](http://www.tredis.com)

<sup>2</sup> REMI denotes Regional Economic Models Inc; see [www.remi.com](http://www.remi.com)

leader in exploring and developing this approach to select projects for the statewide long-range plan (Kansas DOT, 2010). Their scoring system calculates a numeric score for each project, based on the sum of three radically different scoring systems: an engineering score (worth up to 50 points), a local consult score (worth up to 25 points) and an economic impact score (worth up to 25 points). The three scores are added to develop the composite total. The components are:

- *Engineering Score.* This system provides ratings based on calculations of project impact on traffic flow, and the state's priority formula system. It rates projects by considering six factors: (1) current congestion in terms of the volume/capacity ratio, (2) predicted future congestion in twenty years, (3) current truck volume per lane, (4) the expected five-year accident rate, (5) expected five-year fatality rate and (6) level of traffic. Each of these engineering factors is assigned a different number of potential points.
- *Local Consult Score.* This system relies on ratings calculated by KDOT district staff on the basis of feedback heard at local consultation meetings. It reflects the outcome of local meetings held with area public leaders, business leaders and residents in each district of the state, concerning their preferences and priorities for the various projects proposed in their area. The scores reflect responses to a standardized set of queries concerning perceived local safety, regional business impact, highway system connectivity extenuating costs and other factors including local support and readiness.
- *Economic Impact Score.* This system calculates a score based on the anticipated change in statewide job generation over the next twenty years, along with change in the present value of economic benefits (measured as the impact on statewide Gross Regional Product plus the value of personal time and safety benefits that do not drive GRP changes). The two-part rating was recommended by an external economic impacts working group, to reflect the interest of Kansas citizens in job generation but also their interest in increasing business growth and income generation. It relies on the TREDIS model to generate those values on the basis of business productivity and cost competitiveness factors, including major project impacts on economies in labor and delivery markets, supply chain processes and intermodal connectivity, as well as direct impacts on transport costs.

The composite scoring done in Kansas has many similarities to the other two approaches, and also some notable differences. The *engineering score* tends to incorporate the same types of traveler benefits recognized in both the BCA and MCA approaches. The *local consult* score is the most innovative element, as it accounts for local priorities which reflect societal values that can be politically important. By recognizing local values and desires, it makes the state transportation department more responsive to citizen input. Kansas is not alone in that regard. For instance, some factors in that local consult score were also included in the rating systems of Wisconsin (which included local support) and Missouri (which included local economic initiatives). Finally, the *economic rating* is driven by many of the same connectivity and reliability factors included in the MCA ratings (and theoretically possible to include in the expanded BCA approach). However, the Kansas economic rating also accounted for impacts on labor market access and business delivery scale economies, which are not otherwise captured and which can be a particularly important driver of economic growth in a rural state such as Kansas.

The Kansas scoring system, like the MCA approach, combined transportation system efficiency, broader business productivity and local impacts. Like MCA, it relied on pre-set weighting factors that are subject to debate. However, it had one very notable advantage, which is that it gained widespread public support that ultimately helped to win legislative approval for further transportation investment. That support occurred for three reasons. First, the Kansas scoring system was defined in a manner that incorporating direct public input and opportunity for ongoing local collaboration. Second, it included consideration of local values in the public consult scoring, even though they sometimes generated different priorities than those reflected by use of national engineering and economic considerations. Third, all three scores were shared with the public and their derivations were presented to allow for public response and revision. Because it used an economic model that broke out elements of the economic impact calculation in a generally transparent manner, KDOT also showed the economic impact results on their web site, along with details about the modeling assumptions used to create each project’s score. This allowed for stakeholder feedback on both the analysis results and key inputs to that analysis.

*Comparison of Rating Systems*

To compare the alternative rating and selection approaches, the table draws from a study of economic development factors to show historically important mechanisms by which transportation system changes lead to impacts on economic development (Weisbrod, 2008). For each of these factors, Exhibit 2 then shows whether they have been incorporated to date in any of the previously-discussed applications of BCA, MCA or Composite Scoring. In general, the table shows that all three approaches have been able to address a very wide range of economic impacts for purposes of ranking or selecting transportation projects. And all three approaches can potentially be expanded in the future to incorporate additional economic impact factors.

**Exhibit 2. Inclusion of Transportation System Changes Affecting Economic Development in Alternative Approaches to Benefit or Impact Measurement**

<b>Explanatory Factors Affecting Local Economic Development</b>	<b>Benefit-Cost Analysis (BCA)</b>	<b>Multiple Criteria Analysis (MCA)</b>	<b>Composite Rating</b>
Labor market access (scale, diversity)	*	X	X
Delivery market access (scale, diversity)	*	*	X
Truck route and intermodal connectivity	*	X	X
Driver and passenger travel cost	X	X	X
Driver and passenger time (congestion)	X	X	X
Travel time reliability	X	X	X
Passenger safety	X	X	X
Freight cost	X	X	X
Freight time	X	X	X
Freight reliability/scheduling	*	*	X
Freight safety, spoilage or loss risk	*	*	*
Logistics/distribution productivity	*	*	X
Manufacturing productivity	*	X	X
Local Economy (distress)	-	X	X
Local Support	-	X	X

“X”=factor explicitly included in prior studies for calculation of expected benefits or impacts;  
 “\*”=potential factor—not explicitly used to date, but could be applied; “-” =factor not applicable

However, that is not to say that the three approaches are equivalent. They differ in both measurement metrics used and weights applied to them. BCA focuses on efficiency measures and is generally not designed to reflect distributional equity or policy synergy considerations (though those factors can still be addressed separately). And finally, while all of the methods are used in a selection process that considers the magnitudes of benefits relative to costs, this is done in a variety of different ways. The comparison of benefits to costs is internalized in the BCA approach. In some applications of MCA (e.g., Ohio), the user benefit/cost ratio is used directly as one of a series of rating factors. Other agencies consider costs alongside MCA or composite score ratings when final selection and funding decisions are made.

#### *Under-Counting or Double-Counting*

A final issue concerns the fear that some approaches may either under-count or double-count benefits. All of the rating systems (both MCA and composite ratings) include transportation impact factors that overlap or are interdependent. For instance, the Ohio rating system recognizes both volume/capacity and truck percentage as separate rating factors in addition to the user benefit/cost ratio, though clearly both also affect calculation of the user benefit/cost ratio. Local public support (considered by Wisconsin and Kansas) may also reflect local safety, congestion reduction and reliability improvements. And of course job or GRP growth outcomes may also be driven by the same factors defining user benefits, business productivity gain and localized impacts. If each of those impacts is valued in money terms and then all are added together to derive a total benefit in a BCA context, there would be significant double counting.

Yet in the context of MCA, there is not necessarily any bias or error involved. Rather, the use of partially overlapping factors provides a way to include a wider range of impacts and ultimately the various factor ratings are combined to give greater weighting for some aspects of travel impact. For instance, the weighting of truck concentration, industrial site access and freight delivery costs may combine to give greater effective priority to highway projects that serve key freight corridors. That outcome may not necessarily differ from that of a CBA process in which freight logistics and reliability factors are given added value for their contribution to business productivity.

The composite rating scheme used by Kansas also raised questions about the implications of having three rating systems that shared some common factors. For instance, safety impacts can affect both the engineering and local consult scores. Similarly, time delay may affect both the engineering and economic impact scores. However, each of the three perspectives effectively gives a different relative weight to each of these factors, and the calculation of the total composite score reflects an average of those weights. The interpretation, then, is that the composite rating gives weight to social and economic impact factors that would not otherwise be captured in standard engineering-based valuation of impacts.

So, for ranking projects there may be a case that any of the alternative rating approaches may be appropriate as long as the desired set of impact factors is covered and the set of relative factor weights is deemed acceptable. However, if there is a need to screen for projects that have total benefit exceeding total cost, then there is a different need -- to ensure that the calculation accounts for total net value without over- or under-counting of its elements.

### 3. Implication of Alternative Benefit Perspectives

Today, some transportation agencies make their project rankings and selections based primarily on engineering approaches that focus on traffic flow, relying on traveler benefit calculations. On the other hand, other agencies select projects based in part on economic impacts, while yet others make decisions largely on basis of local community desires and associated political pressures. Each perspective has proponents. However that raises a question of just how different are the projects selected by each of these approaches?

It is possible to learn about those implications by examining the differences in outcomes associated with the three types of perspectives and scoring systems developed in Kansas. There, the “engineering rating” is generally reflective of a travel efficiency analysis, a perspective that gives particular weight to projects with congestion reduction and safety improvements. The “local consult rating” gives greater added weight to local travel and connectivity improvements. And the “economic impact rating” gives greater weight to business-related access and productivity benefits that ultimately increase jobs and income. As a result, different sets of projects can be selected if one focuses on any one of these perspectives.

To illustrate the point, Kansas DOT allowed its project data to be used by the author to assess how project rankings and selection outcomes could differ under alternative scoring systems. A total of 111 potential projects proposed for the statewide long-range plan were analyzed, and they were ranked under four different scoring methods: (1) the engineering perspective, (2) the local consult perspective, (3) the economic impact perspective, and (4) a composite perspective reflecting the sum of the other three scoring systems. Under each scoring approach, the top ranked projects were selected based on a hypothetical scenario in which \$5 billion is available for future project funding. Results are shown in Exhibit 3.

**Exhibit 3. Difference in Top-Ranked Projects Selected with a \$5 billion Funding Pool**

Results	Scoring System Used			
	Engineering Scores	Local Consult Scores	Economic Scores	Composite Scores
Number of Projects Selected	45	46	48	43
Aggregate Jobs Added (Yr. 2030)	24,661	26,538	45,693	41,760
Aggregate GDP Added (Yr. 2030)	\$9.6B	\$11.5B	\$19.7B	\$18.2B
Total Wider Benefit (Yr. 2030)	\$12.0B	\$13.7B	\$22.8B	\$20.8B

These results show that, in this case, the different ranking systems did not significantly affect the total number of projects that can be selected within a fixed funding pool. However, they do show a significant difference in the selection of individual projects using the various rating systems. This is demonstrated by the differential in employment and income impacts associated resulting from the selections, with selections under some rating systems calculated to generate almost double the level of economic growth impact as others. It is not surprising that the “economic impact” rating lead to the greatest impact on jobs and income added, as that scoring system was optimized to maximize that impact. However, it is notable that the “composite rating” led to almost as much expected economic impact, while adding greater consideration for additional engineering and local consultation outcomes. It is also notable that

the “local consult rating” led to greater expected economic impact than the engineering score alone. These findings do not indicate that any one rating system is superior to the others; they merely indicate that different rating systems lead to selection of different projects.

Another way to view the differences between rating systems is to examine the degree of correlation between rating scores. “Pearson's product-moment correlation coefficient” is a statistical measure of the degree to which two variables are linearly related, where 1=perfectly correlated and 0=not at all correlated. The correlation between “economic impact scores” and “engineering scores” is relative low in this case: only 0.12 for rural projects and 0.26 for urban projects. These low correlations may reflect differences in factors being measured, as economic growth estimates are relatively unaffected by safety and personal travel time improvements which increase engineering scores, while economic impacts can be raised by reliability improvements that do not directly affect engineering scores. The correlation coefficient between “economic impact scores” and “public consult scores” is substantially higher at 0.33, rising to 0.44 for rural projects. This differential may reflect the sensitivity of economic impact scores to market access and connectivity impacts -- concerns that are particularly relevant for rural areas.

Finally, the difference among rating systems can be demonstrated by the extent to which different projects are most likely to be selected, depending on the rating system being used. For instance, the analysis of Kansas data showed that “economic impact scores” were more likely to support passing lanes on rural roads and new interchanges in urbanized areas, while “engineering scores” were more likely to support upgrades of rural roads to 4-lane expressway corridors. The adopted “composite scores” achieved a balanced mix of all project types.

#### **4. IMPLICATIONS FOR PERFORMANCE TRACKING**

There is growing interest in the development of performance metrics that can be used to track the actual impacts of transportation investments. And in this context, there is a logical connection between (a) the enhanced set of economic impact factors that can be considered in assessing benefits of proposed projects and (b) economic impact elements that can be measured in evaluating the benefits of past investments. This logical connection comes from the two key questions that typically motivate performance tracking:

- 1) Are transportation funding programs and investment strategies actually leading to the types of benefits that were desired and anticipated?
- 2) To what extent are initial projections of benefit (made before construction) later borne out by observed reality (after project completion)?

Interest in addressing these questions has led studies proposing lists of potentially measurable performance and impact metrics for transportation investments (e.g., Cambridge Systematics, 2006). However, the effort required for assembling data on the many measurable characteristics of transportation systems can be time consuming and resource intensive, leading to a gap between proposals for ongoing tracking of performance metrics and success in implementing them. The design and value of performance tracking may both be enhanced if they can reflect a

clear logic showing how they lead to outcomes affecting the people's lives, jobs and well being. And that is precisely where Exhibit 3 comes in, for many of the factors that drive economic benefits and development impacts (jobs and income) can also be observed and tracked. By establishing a match between factors used in assessing potential projects and metrics tracked in post-project evaluation, the social benefit or return on transportation investments may be better assessed.

In practice, it is often difficult to determine the extent to which observed changes in overall economic growth and development of an area are attributable to prior transportation investments. But by adopting factors listed in Exhibit 2 as performance metrics to be tracked, there is an opportunity to relate observed economic impacts to observed changes in transportation system performance, through indicators of factors of importance to different economic market segments. Specifically, factors relating to travel time, congestion, reliability and safety can be directly observed and measured for a sample of roads and facilities during peak and off-peak periods. Differences in conditions for freight, passenger car and intermodal connectivity can be tracked by observing travel times and reliability on selected freight corridors, commuter corridors and air/rail/sea port access corridors during applicable periods. Through such an approach, performance tracking measures can be related to many of the same factors used in project ranking and selection processes.

## **5. CONCLUSIONS**

The critical review and analysis of highway project selection methods in this paper lead to five key findings:

1. *Economic Impact Factors* –Transportation projects do have economic impacts on non-users, affecting productivity, competitiveness and growth of jobs and income. Transportation agencies at the federal, state and local levels are recognizing that those impacts are of public interest as factors affecting project selection in developing long-range and short-range transportation plans, and in allocation of limited program funds.
2. *Relationship of Transportation Changes to Economic Impacts* – Changes in average travel time and transportation cost can affect household income and business productivity, but additional economic impacts can also occur as a result of changes in travel time reliability, inter-modal connectivity, job market access and truck delivery access. Those additional transportation effects can be measured and estimated, as demonstrated by their inclusion in the project ranking and selection processes of various federal, state and local agencies.
3. *Project Ranking and Selection Methods* – No single approach for project ranking and selection is universally accepted and there is not necessarily any right answer concerning which method is best. There are pros and cons to the use of BCA, MCA and composite rating systems. In general, BCA methods have the advantage that they can incorporate a wide range of transportation factors that lead to non-traveler impacts on business productivity, and they can be used to calculate the value of benefits net of costs. On the other hand, MCA and composite rating methods have the advantage that they can cover not only business productivity factors, but also factors relating to local economic development

conditions and needs, and the location of benefits. But they cannot directly calculate the value of benefits net of costs. As a consequence of these differences, transportation agencies have adopted a range of differing approaches for their project selection processes. Some have adopted BCA, others have adopted MCA and yet others have recognized a role for both methods to aid in decision-making. It is possible to define economic impact factors and weights so that both BCA and MCA can lead to similar rankings.

4. *Use of Economic Impacts in Decision-Making* – Transportation agencies that include economic productivity and impact factors in their project selection processes do tend to recognize common classes of impacts, including transportation access and reliability factors that affect business productivity as well as job and income growth outcomes. However, each of the agencies has had its own unique set of metrics for the specific economic impact factors to be considered, and its own set of weights or values assigned to them. That finding should be interpreted not as evidence of confusion about economic impacts, but rather, as an indicator that each state or local area has its own unique set of needs, priorities and values to be applied for decision-making.
5. *Resulting Effect on Project Selection* – The inclusion of economic productivity and impact factors does make a difference in project assessment, as it can affect the prioritization of proposed projects and lead to different types of projects being selected for funding or inclusion in future plans. For that reason, transportation agencies must understand the implications of both current practice and proposed changes in the use of project assessment methods. The analysis to date suggests that those approaches which are most inclusive in their coverage of productivity and local impact factors are most likely to be more acceptable to the public and more reflective of public values.
6. *Moving Forward* – Many transportation agencies have been and still are reviewing the processes they use for project ranking and selection, including definition of factors and determination of their weights. Many of the transportation agencies cited in this paper have been reviewing ways to incorporate more quantitative performance metrics in place of qualitative ratings in the use of MCA, when possible. Even among agencies using BCA metrics, which have been criticized in the past for ignoring factors that cannot be put in monetary terms, there is growing interest in attempts to expand the set of factors that can be measured and included (see for example, Weisbrod et al, 2009). Future research is needed to further enhance access to information and methods for measurement of economic impact elements and the transportation factors affecting them.

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