Application of Economic Analysis for Transportation Decision-making:

A Guide to the Different Uses of Benefit-Cost Analysis (BCA), Economic Impact Analysis (EIA) and Financial Impact Analysis (FIA)

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ABSTRACT

The systematic analysis of economic benefits, costs and impacts has an important role to play in infrastructure planning. But all too frequently, decision-making relies upon less systematic judgment calls, in part because of uncertainty about how to appropriately apply what seems to be competing approaches featuring benefit-cost, economic impact and financial analysis methods. The resulting confusion can lead to ineffective use of economic analysis and failure to match its capabilities to the requirements of infrastructure investment planning.

This paper presents a critical review of the application of economic analysis techniques for transportation infrastructure investment decision-making, and presents a formal framework for viewing these economic analysis techniques in terms of how they differently cover a three dimensional universe of space, time and impact elements. It then shows how the various analysis techniques can be matched to different stakeholder issues, as well as spatial and temporal information requirements that are applicable at the different stages of transportation investment decision-making. The implications of this type approach can be useful for teaching economic evaluation and for practical application of project appraisal and funding decision processes. Finally, the paper describes how the unified analysis framework in TREDIS can reconcile and cover the various aspects of benefit-cost, economic impact and financial analysis for transportation decision-making.

1. INTRODUCTION

The process of infrastructure Investment planning, funding and implementation involves a series of distinct decisions. And there are various forms of systematic economic analysis -- such as benefit-cost analysis, economic impact analysis and financial or fiscal impact analysis -- that each has a distinct role to be played to inform those various decisions. However, these roles are not always carried out, in part because there is confusion among practitioners regarding the appropriate use of the various economic analysis techniques in infrastructure planning and appraisal. In addition, some proponents argue the superiority of one technique over the others, and some agencies call for reliance on single techniques.

This paper attempts to shed light on these very issues by laying out a systematic framework that can be used to clarify the different types of decisions to be made and their match to the available economic analysis tools. The paper three part process.
• Section 2 lays out the key stages of planning, prioritizing and funding projects to clarify their associated decision issues, audiences and uses.

• Section 3 lays out a framework for distinguishing economic analysis techniques, by demonstrating differences in their coverage of a three dimensional universe of space, time and impact elements (as illustrated in Figure 1).

• Section 4 discusses implications of this framework for matching economic analysis techniques to the decision stages, and how that affects the economic valuation of impacts.

The basic point of going through this sequence of three discussion sections is to demonstrate how active and affected parties represent different impact elements, and operate from different spatial and temporal perspectives that reflect their relative roles. This is illustrated in Figure 1. As a consequence, it is possible to extract insights from different forms of economic analysis that represent these perspectives. By understanding their differences, it becomes possible to increase the usefulness of economic evaluation methods in transportation decision processes.

2. STAGES OF PLANNING AND DECISION-MAKING

There is a formal planning and funding process for every type of public infrastructure investment – whether it be sewer/water, energy or transportation infrastructure. The US transportation planning process is a classic example because it has a series of decision stages that are enshrined in federal and state laws that apply to every State DOT and Metropolitan Planning Organization. Counterpart organizations in other countries often have very similar processes. If we examine the transportation planning decision stages, it becomes apparent that economic analysis has a role in each stage though the issues to be confronted by it differ in how they span the dimensions of time periods, study regions and impact elements. The stages are illustrated in Figure 2 and summarized below.¹

• **Vision and Long Range Plan for Projects.** The initial stage is the development of a long range strategic policies and plans, applying to an area that could be a metropolitan region, state/province or nation. At the heart of this process is a dialogue among elected officials and citizens regarding strategic goals and priorities for future transportation system investments. Typically, they focus on direct improvement in transportation system performance factors (e.g., passenger and freight mobility, and available modal options), as well as other social goals including most notably economic development factors (e.g., growth and diversification to enhance job quality, upward mobility and income levels), and environmental factors (e.g., improvements in livability and quality of life).

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These factors are not substitutable, so they tend to be discussed in terms of minimum acceptable thresholds and a desired/optimal mix of outcomes. In North American practice, metropolitan and state/provincial transportation planning organizations all go through some process of eliciting input from the public and elected bodies regarding these goals and their tradeoffs for agency decisions regarding the long range vision for their area of jurisdiction. The plan is for a specified future year (typically 40 years out, as in the case of a “2050 plan”).

- **Prioritization of Individual Projects.** The second stage is the development and prioritization of a short-run list of projects to be considered by the planning agency for implementation in coming years. The list of nominated projects may include both strategic investments desired for achievement of the long range plan as well as other projects nominated by local officials. These projects are evaluated, typically by rating them in terms of multiple criteria, to enable agency decisions regarding the selection of a short list and prioritization of projects on that list. The criteria vary, but can be classified into five basic classes of desired effects: (a) efficiency of investment, in terms of the benefits received for the investment made, (b) distributional equity, across space and socio-economic class, (c) quality of life, in terms of economic development and environmental consequences for residents, (d), option value, including availability of land, facility and modal alternatives for future times and future generations, and (d) relational effects, in terms of cumulatively reinforcing stated policy goals and supporting the value of already made investments.

- **Alternatives Analysis.** The third stage is the detailed analysis of designs for those projects that were selected in the prior stage to move forward. It encompasses processes such as corridor studies, alternatives analysis and environmental impact assessment. The alternatives to be analyze typically span choices for mode and technology solutions, location or siting, and engineering design features (including capacity). This stage enables much more detailed project cost and transportation impact estimates to be generated, and that appraisal supports agency decisions regarding project design specification and feasibility determination. The criteria considered at this stage include engineering, regulatory and economic feasibility. The EIS process in the US also screens for environmental justice (equity) and adverse cumulative impacts.

- **Project Funding and Implementation.** The fourth stage is the determination of when, whether or how the project can be funded and constructed. It commonly encompasses a pass-fail screening test to confirm that the project passes a “return on investment” test, and it also includes refinement of private and public funding options for the project. This supports agency decisions regarding funding commitments and moving forward to implementation.

It should be clear, at this point, that each stage involves consideration of different issues, with information requirements that vary in terms of whether or not there is a specific spatial area, specific time period or focus on a specific agency view (or impact element). This paper will return later to discuss how these different information requirements match to specific economic analysis methods, but first, it is necessary to lay out the differences that exist among available economic analysis methods.
3. ECONOMIC ANALYSIS METHODS VIEWED FROM THE DIMENSIONS OF TIME, SPACE AND IMPACT ELEMENTS

Various forms of economic analysis can be used for evaluation of proposed transportation plans and project proposals. They include benefit-cost analysis (BCA), economic impact analysis (EIA) and financial impact analysis (FIA, which also includes fiscal impacts on net government revenues). Each applies systematic economic analysis principals to the same core data on transportation system changes, but views them from a different perspective, and these differences span the three measurement dimensions of time, space and impact elements. They can all help inform an economic appraisal process in its broad sense used in North America, where the term “appraisal” refers to a process of extracting broad insights from formal evaluation efforts. (The term is used in a much narrower sense in the UK, where it denotes the application of benefit/cost analysis for project funding decisions.) This section discusses how economic analysis methods differ in coverage.

The Time Dimension. The three forms of analysis all differ in terms of whether they portray a present value, future value or time flow pattern, and thus enable different types of insights to be obtained (as illustrated in Figure 3).

- **Benefit-Cost Analysis (BCA)**
  2 in its classic economic form, compares the discounted *net present value* of social benefit streams and cost streams. As such, it provides a measure of the efficiency of investments in terms of their relative payback value. For transportation projects that may take many years of planning and development, the discounting process is particularly useful as it adjusts for the fact that costs tend to be incurred largely in early years before the project is completed, while benefits tend to occur in later years well after the project is completed. That makes it possible to compare the relative value of competing projects that have different timing characteristics. However, when projected benefits are not expected until far out in the future, they get highly discounted and that makes it difficult or impossible to recognize any benefits of “inter-generational investments” -- i.e., projects intended to preserve options or enable benefits for future generations.

- **Economic Impact Analysis (EIA)**, in its common form, portrays the expected change in the economy of a designated area (region, state or nation) at *future points in time*. There is no discounting. For transportation projects, this can be useful for identifying both the short-term and long-term consequences of projects. The short-term consequences tend to be those associated with construction activities, while the long-term consequences tend to be those associated with cumulative economic growth generated in future years because of changes in productivity and competitiveness (attributable to changes in transportation conditions).

- **Financial Analysis (FIA)** portrays the project impact on *cash flow over time* for affected parties. For investors and operators of transportation facilities and services, this form of analysis portrays the expected outflow of expenditures and inflow of revenues on a year by year basis. When the analysis is done for governmental bodies, it is usually referred to as “fiscal impact analysis.” For transportation projects, this can be useful to

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2 The technique is commonly called BCA (benefit cost analysis) in North America, and CBA (cost benefit analysis) in the rest of the world. The two names are generally considered interchangeable.
establish the “financial feasibility” of obtaining initial project financing as well as the “financial viability” of ongoing operations.

The Space Dimension. The three forms of analysis differ in terms of how they rely on defined study areas, and indeed the breadth of those areas do have consequences for the impact measurement, as illustrated in Figure 4.

- **Benefit-Cost Analysis** may be defined for a specific viewpoint, but often it has *no explicitly stated spatial boundary* for benefit measurement, particularly for transportation analysis. In theory, this makes it appear that benefits of transportation investments are being counted for all users as well as all externality beneficiaries. And indeed, BCA is usually applied in a way that do count the direct benefits of an improved transportation facility for all users of that facility. However, in practice, there are implicit (if not explicit) boundaries of the coverage of affected travelers moving on transportation networks as well as the coverage of external (non-traveler) parties. That occurs insofar as studies done by (or for) regional, state or national agencies, relying on transportation models and data maintained by those agencies – which tend to have limited coverage of external areas and their associated transportation flows. There are also generally accepted policies recognizing that governmental agencies have a fiduciary to spend money wisely for their citizens, meaning that they do not want to invest in projects that largely benefit outside parties. This viewpoint is reflected in the BCA guidance and policy statements of some state and national government agencies. The area of coverage matters because a given transportation project may have additional impacts on external parties. Most commonly, the benefits of a transportation improvement tend to increase as the study region is expanded.

- **Economic Impact Analysis** always has an *explicit spatial boundary* as it represents impact on the economy of specified regions. The regions may be cities, metropolitan areas, states or a nation. Sometimes EIA is carried out to portray the pattern of impacts for multiple contiguous regions, or for different breadths of coverage (e.g., local, state and national perspectives). The impact study area is of substantial importance because economic impacts can reflect changes in the spatial location and flow pattern of imports, export production, capital investment and jobs. Some areas may gain economic activity while others may lose. It was once commonly believed that economic impacts are a “zero sum game,” but that is an overstatement as long as there is net productivity improvement resulting from transportation improvements. Nevertheless, the likely presence of at least some activity relocation effects means that the economic growth impacts of a transportation improvement tend to appear largest for the region that is most directly affected, and appear smaller when a broader study region is defined.

- **Financial Analysis** portrays project impact on specific stakeholder parties (investors, owners, operators and governments) who can be located anywhere, and hence there is no formal impact area. However, projections of revenues associated with tolls and fees are typically based on forecasts of user volumes for the affected infrastructure, which are developed on the basis of trip generation and distribution forecasts that may be driven (in part) by economic impact forecasts for the primary affected region.

The Impact Element Dimension. The three forms of analysis rely on essentially the same engineering estimation and modeling analysis to determine *direct project impacts* on transportation system
characteristics (such as speed, access, time variability and safety), which are calculated over time. But from there, they differ in terms of both (a) the breadth of impact elements that they cover, and (b) the ways in which those impacts are measured, as illustrated in Figure 5.

- **Benefit-Cost Analysis** can in theory cover all forms of impact, including both user and non-user costs and benefits. In practice, it is limited to those impacts that can be measured in quantitative terms and translated into a monetary valuation. The methodology most commonly used to generate BCA relies on a two-step process:
  
  o First, the direct project impacts are allocated by type and trip purpose, and extended (on the basis of VMT and vehicle/trip types) to estimate further non-user implications such as emissions and health effects.
  
  o Second, the direct user and non-user impacts are multiplied by applicable “per unit” valuation factors. These factors are derived from either observed market prices or inferred shadow prices that reflect “willingness to pay” for improved conditions. The statistical analysis can be either revealed preferences (analysis of the relationship between impacts and variation in travel behavior decisions, building/land values or labor compensation rates) or stated preferences (statistical analysis of the relationship of survey responses to hypothetical scenarios).

This methodology is described in a variety of guidance documents; the most well-known is the UK’s WebTAG. It implicitly includes two key assumptions: (a) that there is a constant per unit valuation for each type of impact, making a linear relationship between the size of its change and the size of the associated valuation, and (b) that the relative valuations reflect both tradeoffs among the various types of impacts and their additively for calculating streams of total impacts over time.

- **Economic Impact Analysis** covers macroeconomic impacts on the flow of money in the economy of a designated study area. This means that it is limited to those impacts that affect money flows including costs, expenditures and revenues for at least some sector of the economy (including both households and businesses). The methodology most commonly used to generate EIA is a different two-step process:
  
  o First, the direct project impacts are allocated by type and trip purpose, and translated into direct operating cost, effective market access and other aspects of productivity for economic sectors within the relevant study region(s).
  
  o Second, the direct cost and productivity changes are applied to a regional macroeconomic model that incorporates price equilibrium or cost response mechanisms to estimate effects on the competitiveness, market growth and income of industries within specified study region(s) over time.

The two steps are typically accomplished through a specialized form of regional economic impact simulation model system that is built to incorporate transportation inputs. These impact models will portray impacts in terms of changes over time in a variety of metrics including: employment, wages and payroll (by industry, occupation and region), labor market participation, economic migration, consumption and production levels (by region), domestic and international trade and self-supply, as well as productivity, value added (GDP) and output (by industry and region).
- Financial Analysis portrays the project impact on revenue and expenditure streams and is thus limited to coverage of specific classes of stakeholders that are involved in financing, ownership, leasing or operation of the project facility or its associated services. The methodology that is most commonly used to generate FIA is another form of two-step process:
  - First, direct project impacts are translated into shifts in demand for the facility or service.
  - Second, an accounting framework translates the demand shifts into revenue and expenditure impacts over time for the affected parties.

**Differences in Impact Coverage.** Because the various economic analysis techniques cover different impact elements and also vary in how they represent them in time and space, they lead to different impact measurements and valuations. Figure 6 shows how all three techniques draw from the very same direct transportation impact factors (travel times, distances, volumes, safety, access and reliability), though they then diverge in how their consequences are processed for economic evaluation. Those shown in the box labelled “social welfare” are typically valued on the basis of “willingness to pay,” determined by stated preference or revealed preference studies. Those shown in the box labelled “productivity factors” also have social welfare value, but their valuations typically come from analysis of business data – either business cost data (in the case of business-related travel time and travel expense) or statistical studies of wage or GDP variation among industries and locations (in the case of access and reliability effects). Broader macroeconomic consequences for economic geography and regional growth are typically determined through use of economic impact models.
There are two other consequences of the flowchart in terms of coverage by economic evaluation methods. One is that social welfare factors that have no direct business productivity consequences are covered by BCA but do not typically feed into EIA calculations. The other is that economic geography (spatial relocation) factors that result from changes in relative productivity among areas (but do not add any further aggregate benefit) are covered by EIA but not in BCA. These points are illustrated by the Figure 7 Venn diagram.

**Factors Considered in Economic Analysis Techniques**

- **Benefit/Cost Analysis (BCA)**
  - Personal Time
  - Safety
  - Environmental
  - Social/Livability
  - Productivity Factors
    - Business–Related Time Cost
    - Operating Cost
    - Access/Agglomeration
    - Reliability/Technology Adoption & Labor/Resource Utilization

- **Economic Impact Analysis (EIA)**
  - Economic Geography (Competitiveness)
    - Labor & Capital Flows
    - Export Growth
    - Import Substitution
    - Workforce & Pop. Migration

**Differences in Measurement and Valuation.** Even for impact factors listed in the center of the Venn diagram, their valuations in BCA and EIA can differ. After all, BCA applies independent unit valuations for each of the social welfare and productivity factors and adds them together, while EIA processes the productivity factors in terms of their joint consequences for a broader measure of economic geography outcomes, based on regional economic impact models. There is no reason to expect the two to show the same impact valuations.

This becomes apparent by considering how the GDP impacts specified for BCA use in the UK are limited to a series of additive factors appropriate for calculating benefits in BCA. For instance, the benefit of “output change in imperfectly competitive markets” is calculated as a fixed (10%) uplift to business user benefits. The benefit of increasing labor supply is calculated by applying a fixed (0.10) elasticity of labor supply to the disposable income change achieved via savings in generalized commuting cost, while a fixed (40%) multiplier is applied to calculate the corresponding tax revenue gain. These calculations utilize average ratio factors that represent “rules of thumb,” and as such they are intended to provide a rough estimate of the potentially justifiable uplift to calculations of net benefits. That can be useful for BCA sensitivity analysis applied for funding decisions. But it would be unlikely to shift the ranking of competing alternatives insofar as the same fixed multiplier and elasticity factors are being applied to all alternatives. And of course they are not substitutes for the more detailed analysis of prices and costs, labor supply and labor demand, and tax rates, which could be accomplished in an EIA model.

The simplest example may be to consider labor market participation effects. If there is “full employment” such that everyone who wants a job can get one, then it is indeed conceivable that a reduction in the generalized cost of commuting would increase the net income achievable from working, and thus encourage more people to enter the labor market. But in reality, some regions already have
significant unemployment – labor supply already exceeding demand – so further reduction in commuting cost may not necessarily lead to any further labor supply entry or associated changes in employment and wages. With regional economic models, further effects on labor supply, demand, spatial relocation of business activities and changes in wage rates can all be modeled.

By modeling shifts in labor, capital, imports and exports, it is also possible to show broader long-term impacts on the competitiveness of regional economies. To illustrate this point, consider the following example. A transportation investment generates $10 million/year of cost savings for business within a region or nation. The cost savings enables a local industry, over time, to become more cost competitive relative to foreign producers in world markets, leading to a growth of $50 million/year in local industry sales by the year 2030. The local industry growth may be attributable to growth in exports to foreign markets, or to the substitution of locally produced products for foreign imports. Either way, this activity could be representing perhaps $30 million/year of new wages and GDP for the study area. With this example, there is $10 million/year gain in the BCA calculation and $30 million GDP gain in the EIA calculation.

Yet with this example, there is no actual contradiction between the two economic analysis methods, for the GDP gain ($30 million) occurring in the specified study area reflects a combination of productivity gain ($10 million) and relocation of economic activity between foreign producers and local producers ($20 million). And in fact, there might not even be any actual job layoffs for foreign producers. Since economic development impacts of transportation improvements are typically forecast to occur over a long time period, it may be that the local economy just takes a larger share of long term global growth, or reduces the rate of market share loss from what had been forecast in the base case. Such outcomes might indeed be considered appropriate use of local transportation infrastructure investment funds.

However, it is also possible for EIA to show a smaller impact on economic growth than the value of the productivity gain. For instance, it is possible that the cost savings will accrue to local economic activities that are local-serving and not competitive in world markets. It is also possible that they will occur in the form of energy efficiency and safety improvements for local-serving industries. Reduced requirements for energy and medical care might actually lead EIA to show reductions in output and employment for local energy production and medical care sectors of the economy. In that case, BCA can show a social welfare gain while EIA can show a smaller gain (or even net loss) of activity in the local economy.

There are numerous variations on these outcomes, but the real point to be drawn is that the composition of the benefitting economic sectors and the definition of the study area will affect EIA outcomes in ways that may indeed be of interest to planning and funding agencies. For instance, a recent paper on freight analysis demonstrated how project ranking in a multi-criteria scoring system can also be changed. In that example, proposed improvement to one highway led to larger travel time and cost savings than similar cost improvements to a second highway, a difference that would be reflected in a BCA relying on standard user benefit measures. However, in this case, the second highway had trucks carrying higher value merchandise that was supporting more local employment and income in the study region. With EIA, it was shown that the second highway project would lead to greater GDP gain for the area of jurisdiction of a transportation planning and funding agency.

The composition of the affected classes of travel and affected sectors of the economy can also affect FIA. For instance, changes in the economy predicted by EIA will change tax revenues for government agencies and can also change travel demand forecasts underlying toll and fee revenue projections. When a multi-regional economic impact model is used, then there may also be insights into effects on different toll or fee collection schemes.
Terminology Confusion. While the difference in emphasis among economic evaluation methods used on both sides of the Atlantic is understandable, there is significant confusion in terminology regarding wider economic impacts. The UK guidance, because it is specifically focused on BCA, states that “wider impacts is the term given to some of the economic impacts of transport that are additional to transport user benefits.” These wider impacts are further defined to encompass agglomeration effects, adjustments for imperfect competition and additional tax revenues arising because of labor market impacts. In the BCA context applicable to the UK, those definitions appear quite reasonable. However, that limited definition of wider impacts may not be applicable in the North American context where there is significant additional interest in productivity benefits related to impacts on both supply chains (e.g., reliability effects on logistics and production technologies) and system connectivity (e.g., intercity access to intermodal and global trade gateways). And that definition, applicable for BCA, would also not apply for EIA where further impacts on regional growth are also of interest.

4. MATCHING DECISIONS TO ANALYSIS METHODS

An old saying is that if you are a hammer, everything looks like a nail. A more recent joke among physicists, which was recently repeated in a New Yorker magazine cartoon, notes that if you have an accelerator then everything starts to look like a particle. A parallel can apply to proponents of the classic form of benefit-cost analysis, where some people start to view every decision in terms of BCA. Yet a point of this discussion paper is that this type of attitude sells the economics profession short, as there are actually many forms of economic analysis that can help inform transportation planning decisions, and all are variants of the same core analysis that distinguishes investment costs and subsequent economic (dollar denominated) impacts over time. After all, BCA compares a single total benefit metric against a single total cost metric. Yet one of the most useful types of information that can be extracted from EIA and FIA is insight into the mix or distribution of impacts over time, over space and over various impact elements (types of effects and types of affected parties).

Consider that the visioning and long-range planning stage involves consideration of tradeoffs among alternative future scenarios that represent different combinations of transportation, economic and environmental impacts. The determination of what constitutes the preferred future scenarios depends on the presence of insights into the nature of the different forms of impact, which can include employment and income impacts and their spatial distribution. And to make it real, they are presented for a specific study area and extrapolated to a specific future point in time – a form of analysis that can be informed by EIA. Those insights could not be extracted if the analysis rolled up all of the impacts into a single benefit metric and presented them in terms of a present value.

On the other hand, the project prioritization stage requires rating each project on the same scale, regardless of differences in project location or time scale. BCA is applicable here, as it can provide a net benefit metric that encompasses all classes of travel and trip purpose, and applies across all project locations and time scales. However, most often the economic efficiency measure that BCA provides is seen as just one part of a broader set of rating criteria that can include economic growth impacts and distributional equity impacts, as well as other social impact factors (such as environmental impacts, 3 TAG Unit A2.1, Wider Impacts, Transport Analysis Guidance, UK Department for Transport, parts 1.1.2 – 1.1.4, UK Dept. for Transport, 2014. https://www.gov.uk/government/publications/webtag-tag-unit-a2-1-wider-impacts
cumulative effects and future options). For that reason, some form of appraisal table or multi-criteria rating system is commonly utilized for the prioritization process, and such systems (at least in the US) very often include EIA outcomes.

At this juncture, it is also useful to address the misconception that any impact outside of formal BCA must be a qualitative factor, as otherwise it would be included in BCA. That is incorrect. Actually the reason is that BCA is fundamentally an economic efficiency factor and many of these other impacts are not efficiency measures or are not currently measurable in terms of present values. But in most cases they can indeed be quantified and also measured in money terms.

For instance, achievement of desired goals for economic growth can be measured in terms such as changes in wage rates and labor market participation rates, drawn from an EIA. Distributional equity impacts can likewise be measured in terms such as the impact on variation in income among regions. Achievement of goals for preserving options for future generations can be estimated in terms of their potential future (non-discounted) value. Cumulative effects among combinations of multiple projects can also be measured in terms of their combined effect. The reason why they are considered separately from BCA is not that they cannot be measured or represented in monetary terms; rather it is because equity impacts cannot be easily turned into an efficiency measure, future option impacts cannot be easily turned into a present value, and cumulative impacts cannot be easily split among related projects.

(The phrase used is “cannot be easily turned into an efficiency measure” because it is theoretically always possible to create a “shadow price” that represents the willingness to pay for each of these social goals; the problem is that the process of doing can be difficult and raise new questions about the derivation of the values, and that could weaken the perceived legitimacy of the analysis, and/or obscure insights into tradeoffs between efficiency and non-efficiency considerations. It is for that reason that some form of appraisal table or multi-criteria rating system is nearly always employed by transportation agencies for their project investment prioritization processes.)

The stage of EIS and alternatives analysis turns the focus of analysis back to how different siting and design features of a project will affect its impact area -- now or in the future. That can requires forms of economic and environmental analyses that are clearly tied to a specific study area, and hence EIA can be particularly useful here although BCA can also be applicable.

Finally, the stage of project funding and implementation requires consideration of public and private financing options for project development as well as ongoing operation and maintenance. At this stage, FIA is clearly required in addition to BCA because it is quite possible to otherwise development project concepts that have a positive welfare return to society but lack the cash flow characteristics necessary to be feasible for any organization or agency to implement.

Adaptation to Local Context: the US – UK Contrast. The ways in which economic analysis methods are applied can also differ depending on the context in which it is used. This is illustrated by the different ways that these methods are applied in the US and the UK.

In the US and Canada, there is a federal model of governance in which state and regional agencies make most of the planning, prioritizing and funding decisions regarding transportation investments. These agencies tend to set long range plans and utilize multi-criteria rating factors (for prioritization) that reflect a regional economic development growth objective, as well as other mobility, social and environmental factors of concern to their constituents. Commonly, user benefits are valued as in BCA, but wider economic development impacts on regional economic growth (including effects on
employment and GDP) are usually considered as separate rating items in prioritization processes. The wider economic impacts are often defined to include supply chain logistics and trade flow impacts, and calculated via EIA.\(^5\)

In the UK, by contrast, there is a strong central government role in project appraisal and prioritization, leading to a highly standardized national BCA rating process (WebTAG) that enables all proposed projects to be considered on the same national basis, utilizing standardized valuation coefficients and elasticity factors that can be used by local or regional proponents of projects without requiring any further models. The guidance does explicitly cover urban agglomeration and labor supply effects on GDP. However, it does not cover supply chain logistics, trade or intercity travel benefits, and its appraisal table covers economic development in terms of local regeneration rather than regional growth.\(^6\)

This difference from US and Canada practice may be explained by differences in context. In contrast to the UK, both Canada and the US have significant cross-border trade movements, a more spatially dispersed population, longer travel distances, higher regional growth rates, more decentralized (regionally oriented) planning processes, and greater levels of export of agricultural, mining and manufacturing products. In other words, the UK guidance is optimized for the UK context, while methods used in the US and Canada tend to reflect supply chain, trade and regional growth considerations that are more relevant to their specific context. Other nations may be expected to adopt processes also optimized for their own governmental and economic contexts.

**The TREDIS Framework.** TREDIS is a recently-developed, cloud-based software system that is fundamentally a very large accounting framework for calculating and then tracking the social benefits, economic impacts, and costs of transportation projects and programs over time and space. Its relevance for this paper is that it illustrates the concept of applying the very same transportation project impact data to simultaneously drive benefit-cost analysis and economic impact analysis as well as financial cash flow and fiscal impact analysis. It attempts to span all of the impact elements of the Figure 6 flowchart and the Figure 7 Venn diagram, while covering all modes of transport (air, marine, land, non-motorized, etc.), in a multi-regional context that can extend space (communities, regions and nations) and time periods (past and future). The core system is freely available, though the analysis of regional economic impacts, governmental fiscal impacts and related wider benefits can only be enabled with the addition of local economic datasets and forecasts that are not free. The most interesting aspect of this type of framework is that it enables viewing of BCA, EIA and FIA results from a choice of local perspective, local/regional perspective or national perspective – and users can see the difference between those perspectives. It also enables viewing of financial cash flows from the perspectives of public sector parties or private sector parties.

This type of multi-perspective approach sounds straightforward in concept, but actually runs up against a broad set of challenges because of differences among modes in how passenger and cargo uses as well

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\(^6\) This difference can also be observed by comparing the Venn diagram in Exhibit 7, which reflects factors of interest in North America, with a similar diagram appearing in earlier UK guidance. Transport, Transport, Wider Economic Benefits, and Impacts on GDP, 2005. [http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/economics/rdg/webia/webmethodology/sportwidereconomicbenefi3137.pdf](http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/economics/rdg/webia/webmethodology/sportwidereconomicbenefi3137.pdf)
as transportation improvements are measured. Nevertheless, this approach can have significant value, insofar as it can validate the local benefit perceptions of communities and the narrow impact concerns of stakeholders, while still sorting out the net broader impacts at a larger, state/province or national level. In fact, this type of accounting approach also makes it possible to inform decisions regarding who should pay for transportation improvements -- by distinguishing cases where a project in one state actually supports broader inter-state commerce or national interests, or alternatively cases where a state agency is being asked to support projects with purely localized benefits for specific communities or industries.

5. CONCLUSIONS

The transportation planning process involves a sequence of stages that involve a variety of different decisions to be made by a variety of different public and private parties. These include decisions regarding the determination of needs, costs, benefits and feasibility associated with proposed transportation investment programs, packages and individual projects. To date, much of the analysis has suffered from a lack of explicit determination and clarity regarding the applicable scope of project impacts and concerns across time frames, impact areas and affected parties. That lack of clarity has worked to undermine the credibility of economic analysis methods and made them too often appear as “black box” outcomes that cannot be easily explained or understood. To overcome this problem, it is suggested that economic impact, benefit/cost and financial feasibility studies should be more explicitly framed in terms of their inter-related aspects.

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