

Introduction: Accessibility & BCA Analysis White Paper

The Boston Region Metropolitan Planning Organization (MPO) and the Metropolitan Area Planning Council (MAPC) recently participated in T4America's 2016 Transportation Leadership Academy, which was created in partnership with the Federal Highway Administration (FHWA). The Academy was designed to provide participants with best practices and tools to develop a robust performance management system and incorporate that system into planning and project prioritization.

As a follow up to that Academy, the Boston MPO and MAPC sought additional information on national best practices for project evaluation and selection, particularly how other transportation agencies use benefit-cost analysis and how agencies and planners use access and economic vitality to ensure that the projects scoped, chosen and funded are the best projects. This paper summarizes some of the ways transportation agencies use these measures and reviews the positives and negatives of each.

After reading this paper, the Boston's transportation leadership will have a better understanding of:

- Ways to evaluate the impact of a transportation investment on economic vitality and jobs and other essential services access;
- Options for applying benefit-cost analysis to justify projects; and
- How Massachusetts' and Boston's transportation agencies use performance management methods that are similar to and different from national best practices.

By referencing this document, Boston's team can determine where there are opportunities for improvement of Boston's current practices and paths to operationalization.

Executive Summary

This paper examines three processes that MPOs and state DOTs have used to understand the economic impact of transportation investments and to compare benefits and costs of projects overall. They have also been essential in helping each organization develop trust with stakeholders and members of their community. The categories are:

- Single-use tools, specifically to rate and rank potential projects (Examples: US Department of Transportation, Minnesota Department of Transportation, Colorado Department of Transportation, Oregon Department of Transportation);
- Statewide performance and project selection and evaluation process (Examples: Virginia Department of Transportation); and
- Processes integrated into and utilized in all stages of project development (Examples: Metropolitan Transportation Commission, Puget Sound Regional Council, Sacramento Area Council of Governments, Southeast Michigan Council of Governments).

Part A: Boston's Current Best Practices for Transportation Project Evaluation

The Boston area and MassDOT each use performance measures to evaluate and prioritize transportation projects. While these entities are seeking assistance to analyze and improve these measures, it is important to point out that they are at the forefront of this issue generally. That can make improvement difficult because, when you are leading the pack, there are few entities ahead of you from which to learn. Luckily, there are some and they are discussed specifically in the next section.

Boston MPO uses six objectives with multiple criteria under each:

- Safety – crash severity value, crash severity rate, truck-related safety, bicycle safety, pedestrian safety
- System Preservation – improves substandard roadway bridges, substandard pavement, substandard traffic signal equipment, transit assets, substandard sidewalks, emergency response, response to extreme conditions
- Capacity Management/Mobility – reduces transit vehicle delay and vehicle congestion and improves pedestrian network and ADA accessibility, bicycle network, intermodal accommodations and truck movement
- Clean Air/Clean Communities – reduces CO₂, reduces other transportation related emissions, addresses environmental impacts, is a green community
- Transportation Equity – serves Title VI/nondiscrimination communities
- Economic Vitality – serves targeted development site, consistent with compact growth strategies of MetroFuture, provides multimodal access to activity center, leverages other investments (non-TIP funding)

Projects get points for each of these objective areas— for example safety gets up to 30 points and economic vitality up to 18. A project can earn points for addressing the criteria under each of the objectives or, in some cases, can lose points for doing harm to certain priority criteria.

MassDOT applies eight goal areas to evaluate transportation projects, some of which overlap many of the areas that the Boston area uses:

- Condition – Preservation and fixing assets in poor condition
- Mobility – Improvements to accessibility, service quality, person throughput, and new services
- Safety – Safety for users of all modes, operators and public riders
- Economic Impact – Connectivity improvements to job centers, priority development areas, capacity increases, support of transit oriented land use
- Environment – Greenhouse gas reductions, consumption of natural resources
- Cost Effectiveness – Cost per user per lane mile, operating costs/revenue, operational sustainability, future capital cost savings
- Social Equity – Environmental Justice (EJ), Title VI, and municipal equity
- Policy Support – Consistency with Initiatives and Plans

Each goal area gets a certain amount of points ranging between 5-25 that vary based on the mode of transportation.

The Boston area is specifically interested in the extent to which regions are able to measure the impact of transportation investments on economic vitality and the use of benefit-cost analysis in projects evaluation. In looking at **economic vitality**, transportation agencies usually struggle and only consider whether transportation projects speed up traffic. Congestion is represented by a slow-down in traffic speeds, which is interpreted as bad for the economy. A typical solution, therefore, is to increase traffic speeds, which is interpreted as good for the economy.

This argument is undercut by the simple fact that free flowing traffic can always be found in economically depressed areas, and congestion often accompanies economic success. A better application of congestion mitigation benefits is to understand that first there must be a significant level of congestion before lowering it has benefits. This is not to say that reducing congestion should not be a goal for a transportation agency. It is merely to point out that congestion reduction is not a proxy for economic vitality – it is often just the opposite.

At both MassDOT and in the Boston region, the agencies use their economic measure to consider whether the project supports the type of development they want in the areas they want to see it. Some other agencies take a similar approach, such as Virginia DOT that considers whether transportation projects are coordinated with local plans. The idea is that if a transportation project is in the place where the region or state wants the development and it comports with local plans then it is very likely to support economic development. Still, most agencies using this approach also express discomfort with relying only on these measures, feeling that it doesn't fully get at what they intend.

The economic measure that is gaining the most traction across the country and that most clearly connects the transportation system to the economic opportunity of area residents is access to destinations, including jobs, core services, and other places people need to go. This measure (referred to as "accessibility" throughout the paper) is considered by understanding the transportation network, motor vehicle speeds, the availability and quality of other modes of travel, and the location of important destinations.

While the concept of access to destinations has been written about for decades, the availability of an advanced tool for GIS (Sugar Access) and detailed data for transit service and the location of important destinations has made this measure much simpler to calculate and quantify. Many agencies are using a particular tool developed by [CitiLabs](#) called [Sugar Access](#), including Virginia DOT, Utah DOT, Washington DOT, Hawaii DOT, Sacramento Council of Governments, and the Oahu Metropolitan Planning Organization.

Further, Virginia's SMART SCALE has already started to use an access measure for non-work necessities too – such as groceries, banks, health care, and education. Many other agencies are starting to prioritize and measure access as a way to promote equity and connectivity across their transportation networks. This is important for several reasons. First, work trips make up only 30 percent of vehicle miles traveled (VMT). But they get all of the focus because they happen all at the same time. Second, people have different approaches to these trips with different tolerances for time traveled for each mode, so what we learn about work access is not directly transferable to other needs. For example, people want car trips for non-work purposes to be shorter than a car commute to work but are willing for non-work walking trips to be longer than a walking commute. Third, it is these non-work trips that can be truly devastating to lower income households. The single mom might be able to handle an inconvenient commute, but an inconvenient trip to drop kids off at school and daycare then an inconvenient commute then a difficult pickup and stop past the grocery may be close to impossible.

Access to destinations seems to be the most effective, quantifiable and systematic way to address the connection between transportation infrastructure and services to economic opportunity and productivity. It also is extremely difficult to argue with as a goal, since everyone agrees that the transportation system should connect people to the things they need. It is inclusive of vehicle speeds and recognizes congestion reduction as one way to improve accessibility; however, it is one of many factors that go into an accessibility score. Other ways to improve accessibility (many of which may be more feasible and cost-effective) are supplying more direct routes, crossing or removing barriers (such as railroads or expressways), providing better transit service, and moving jobs and services closer to those who need them.

In terms of *benefit-cost analysis*, there is a larger gap between the MassDOT approach and Boston area approach. MassDOT does not actually conduct a BCA but rather a cost effectiveness evaluation. A cost effectiveness evaluation is meant to consider the degree to which something is effective or productive at delivering a particular result in relation to its cost. In the case of MassDOT, it is the cost per user per lane mile along with operating costs, operational sustainability, and future capital cost savings.

A BCA, on the other hand, is supposed to compare the overall benefits of an investment to the community versus the cost. In fairness, most BCAs do not actually accomplish this. In attempting to compare similar values, benefits are monetized in a BCA. So instead of comparing all benefits to costs, we compare only some benefits (those that happen to be more easily monetized) to costs. And this can produce an incomplete result.

Some agencies are trying to fix this by finding ways to monetize additional benefits. There has been a great deal of work over the last couple of decades to find ways to do this even though many of these non-traffic benefits have not found their way into most BCAs. For example, T4America's parent company, Smart Growth America, recently worked with the Minnesota DOT to monetize the health benefits of active transportation as well as the stormwater benefits and disbenefits of various transportation projects.

Another strategy to address benefits that are not easily monetized is to separately measure those areas. In other words, the agency would look at a list of qualitative benefits, such as congestion reduction, environmental protection, safety, state of repair, in addition to a BCA. The problem with this approach is that it undercuts the purpose of a BCA, which should be comprehensive. Instead of comparing the summation of benefits to the total costs, this approach measures several benefits, one of which is whether the benefits exceed the costs.

A different way to put monetizable benefits and non-monetizable benefits on equal footing is to score all the benefits of a transportation project, quantitatively or qualitatively, and then divide that score by the cost. In doing so, you may not be comparing money to money, but you are still getting a ratio that shows you which projects get the most benefit compared to the cost.

Applying this approach to project-level analysis can help Boston to recognize the relative value of smaller scale projects that could otherwise go unnoticed.

In terms of Boston's overall approach to applying performance measures to transportation project selection, T4America takes a broad view. There are many ways to do this right so long as all of the region's priorities are fairly addressed, the measures are clear and understandable, and project sponsors can see how they might improve their project score and chance for funding. Boston has clear and balanced regional goals that are spelled out clearly for project sponsors (and boosters) to see.

T4America has 3 suggestions for the Boston area.

First, *consider using access to jobs and access to non-work necessities as one of your economic measures, if not your primary one.* This measure gets at providing people access to jobs and other needs but by transportation and land use improvements – and projects that do both will perform best.

Second, *consider cutting some of the existing criteria down.* Boston currently has 28 criteria. This is too many for the average person to remember them all without referencing a cheat sheet. Also because each criterion gets so few points, no single criterion can have much of an impact on the score making the region's priorities harder to identify.

Finally, *compare the cost of the project to all of the benefits, not just the ones most readily monetized.* This can be done by finding a way to monetize each criteria or by dividing the final score by the cost to see which projects have the best ratios. By doing so you will be able to understand which projects get the most benefit for their cost and will encourage more low-cost solutions, like active transportation, transportation demand management strategies, and operational solutions.

Below in Part B and C are examples of other transportation leaders that are experimenting with best practices in benefit-cost analysis and performance measurement. You will notice that no example is perfect but there is something to be learned from each one.

Part B: Best Practices in Benefit Cost Analysis

US DEPARTMENT OF TRANSPORTATION

Tool: Benefit-Cost Analysis

Boston target measures addressed: Economic Vitality + Accessibility

Overview:

As part of its project selection process in programs such as the Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grant Program, the US Department of Transportation (USDOT) requires applicants to submit a Benefit-Cost Analysis (BCA). Through nine rounds of funding, USDOT has made clear that it expects the BCAs submitted for each project to measure marginal benefit of the submitted project over alternative projects, including a no-build scenario. The USDOT provides guidance to applicants on how to measure certain benefits, including Economic Competitiveness, which includes *travel time savings* and *operating cost savings*.

Travel time savings means savings that “result from transportation improvements whose purpose is to expand capacity or improve state of good repair.”¹ USDOT makes the distinction between isolated benefits, like a 30 second improvement in boarding time, and a corresponding reduction in posted time schedules. In other words, does a 30 second improvement at one or more stations allow for, say, a 5-minute reduction across the corridor’s right of way. To monetize this, USDOT provides a Value for Travel Time that can be used as a multiplier for the number of forecasted future affected users of the improvement.² The number of forecasted future affected users can be derived from a ridership projection and/or transportation demand model.

Operating cost savings affect freight- and passenger-related activities. For freight activities, the “savings” represent the marginal benefits of the project as they cascade through a supply chain - monetary savings that can be passed to customers as a result of the project. For passenger activities, the “savings” represent either an alternative mode to private vehicles, or a way for the private vehicle to be operated more cheaply. It is important to not double-count savings. For example: if a freight-related project would pass savings onto shippers and then to consumers, USDOT requires that the entirety of these savings is split among affected groups.

There are some benefits, such as Accessibility, that USDOT categorizes as a Quality of Life benefit and recommends that applicants not quantify. The guiding document notes that the methodology behind a scientific measurement is “not well developed or widely established.” However, applicants are encouraged to discuss topics including: mode-shift and a corresponding congestion reduction and operating and travel time savings, emissions reductions, mobility benefits for upgrades to existing trails. In this guidance, USDOT fails to acknowledge new tools, like Sugar Access, that quantifies multimodal access to jobs and other necessities by all modes.

¹ (https://www.transportation.gov/sites/dot.gov/files/docs/TIGER_VIII_NOFA_BCA_Appendix.pdf)

² (https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf)

USDOT uses the BCA as a single factor that is only evaluated in projects that score well on a qualitative evaluation of each project's impact on the primary criteria: improvements to safety, state of repair, economic competitiveness, quality of life, and environmental sustainability. Projects well-reviewed under the primary criteria must demonstrate that its benefits exceed the costs. If they do then the project can proceed. If they do not then the project is disqualified.

Lesson Learned:

USDOT's BCA process is used to help applicants demonstrate the marginal benefit of the project they are asking USDOT to help fund. While a BCA is supposed to be a measure of all project benefits versus all costs, by USDOT's own guidance, their BCA process only measures some benefits versus all costs. The benefits they encourage applicants to quantify are ones that have been quantified for 50 years with well-established methodologies for monetization. However, it is not reflective of studies done and data that have come available over the last decade or two.

Some of USDOT's underlying assumptions are questionable, such as:

- USDOT views all development as the same. USDOT doesn't recognize the difference in cost to serve or agglomeration benefits of high-density development versus sprawl.
- USDOT takes the position that property value increases are a result of decreased congestion and, therefore, are captured by monetizing the benefit of reduced congestion. While reduced congestion may be one thing that improves property value, there are too many examples of communities with increasing congestion and increasing property values – not to mention economically struggling areas losing people and congestion – for this to be a direct relationship.

While USDOT's BCA approach has been around for a while, it is not very current and fails to measure all quantifiable benefits versus costs.

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT)

Tool: Benefit-Cost Analysis, PRISM

Boston target measures addressed: Economic Vitality

Overview:

The Corridor Investment Management Strategy ([CIMS](#)) brings together local, modal, and state partners in Minnesota to identify innovative and collaborative investments to improve the Minnesota trunk highway system.

CIMS uses a competitive project solicitation process, including a benefit-cost analysis calculated using an analysis tool created by the consulting firm WSP, called PRISM. This tool allowed MnDOT to focus on high return-on-investment projects by awarding dollar values to benefits that typically aren't quantified.³

³ http://www.icoet.net/icoet_2013/documents/papers/ICOET2013_Paper202C_McVoy_et_al.pdf

The tool compares social, economic, and environmental factors of Capacity Development scenario to the same factors in a No Build situation. The economic factor itself is quantified by measuring travel time, travel time reliability, vehicle operation costs, life cycle costs, loss of agricultural land, and induced economic activity. The breakdown of the BCA's economic area can be found below. MnDOT quantifies each of the six economic factors with at least one data measurement point to transparently understand the benefits.⁴

- Travel time uses data from vehicle hours traveled, average bus headways, average bus occupancy, and bicycle miles traveled.
- Travel time reliability uses data from vehicle hours traveled.
- Vehicle Operation Costs uses data from VMT.
- Lifecycle costs uses data from initial construction costs, operating and maintenance costs, rehabilitation costs, infrastructure replacement costs, and expected lifecycle of Major Capital items.
- Agricultural Land uses data from quantity of agricultural land affected.
- Induced economic activity uses data from initial constructions costs used to determine the creation/retention of non-project construction jobs relative to the size of the project.

Project Costs and Effort:

MNDOT contracted with WSP to create a specific application -- the PRISM tool -- for the CIMS project. A team of three consultants from WSP worked for about 9 months on adapting PRISM to meet MNDOT's needs. The project cost \$250,000 and does not include MNDOT staff time hours.

Lesson Learned:

Minnesota's PRISM tool allows MnDOT to expand the types of projects that they can evaluate and fund by transparently comparing projects on the basis of having high ROI and benefiting the three priority areas of MnDOT: social, economic, and environmental.

The data points that the PRISM tool collects provides a better picture of the economic benefits of projects and attempts to non-traditional benefit areas, including public health and stormwater impacts. However, the economic lens remains focused on traffic flow improvement as a proxy for economic success in spite of the fact that reduced congestion is often associated with low employment and economic downturns.

COLORADO DEPARTMENT OF TRANSPORTATION

Tool: Benefit-Cost Analysis

Boston target measures addressed: Economic Vitality + Land Use

Overview:

Colorado Department of Transportation conducted two BCAs studies to assess the social, environmental, and economic benefits of the Advanced Guideway System (AGS) project, a high-speed transit system for a 120-mile segment of the I-70 Mountain Corridor from Jefferson County to Eagle

⁴ <http://www.dot.state.mn.us/cims/pdf/CIMS%20Solicitation%20Criteria%20Summary.pdf>

County Regional Airport. One study focused on the operating ratio and the other calculated the project BCA.

The operating ratio divided the sum of all passenger revenue by the projected operation and maintenance cost of the project. The project benefit-to-cost ratio considered the following economic and land use benefits: reductions in VMT, reductions in vehicle hours traveled (VHT), reductions in highway delay, reductions in aviation delay, increases in property tax revenue around stations, increases in employment from construction and operation of the AGS, and increases in state personal income through the infusion of major federal grants assumed to partially fund the AGS.

Vehicle Miles Traveled and Vehicle Hours Traveled

Both VMT and VHT are well utilized performance measures across the country and are known for their accuracy and ability to capture the full extent of vehicle travel. The AGS feasibility study calculated the reduction in VMT as a result of individuals switching from other modes of travel to the AGS. For VHT, the study translated the time individuals spend traveling to their destinations into dollar figures, with an average wage rate totaling \$23 per hour.⁵

Increase in real estate value – Officials wanted to calculate the long term financial benefits of transit-oriented development around the stations of the proposed AGS. Their calculations took into consideration increased land values and increased property, sales, and other types of taxes.

Operations and non-basic jobs – The value of labor from operations was assumed to be half of the overall operations expenditures projected cost. Based on the Bureau of Economic Analysis, it was assumed that for every operations job, 1.5 jobs would be created. The impacts included “jobs, incomes, and output of individuals involved in operating the system; the additional jobs and earnings created by the operations; and an estimate of the induced impact related to the spending of operations workers.”

Project Costs and Effort:

According to the CODOT Advanced Guideway System project manager, this study cost \$1.8 Million and was completed over a span of two years. CODOT had limited expertise building railway or guideway, so the entire project was done using outside consultants.

Lesson Learned:

Benefit-cost analyses rarely include transit-oriented development benefits within their calculation. This AGS Study provides an example of how land use benefits can be calculated and included within the scope of a benefit cost analysis. This approach also quantified job benefits and found a way to look at project impact on mode shift and not just traffic flow.

METROPOLITAN TRANSPORTATION COMMISSION

Tool: Benefit Cost Assessment

Boston target measures addressed: Accessibility

⁵ <https://www.codot.gov/projects/AGSstudy/final-ags-feasibility-study/chapter-6-benefit-cost-analysis.pdf>

Overview:

The Metropolitan Transportation Commission of the Bay Area has integrated performance measures throughout every level of their project selection and funding process. The three-prong project assessment process for Plan Bay Area 2040 includes a target assessment, benefit-cost assessment, and simple geographic impact assessment. To be cognizant of time and resources, MTC only conducted a benefit-cost analysis for proposed projects costing at least \$100 million.

The benefit cost assessment quantitatively assesses projects using the MTC Travel Model One and [Integrated Transport and Health Impact Modeling](#). The benefits measured in the assessment include accessibility (travel time and cost), reliability, emissions, physical activity, and noise. The valuations and explanations of the benefits can be found page 43 of [this report](#). Cost was calculated by taking “capital costs and dividing by the expected life of the capital investment and then adding one year of net operating and maintenance costs in 2040.”⁶

Accessibility benefits were calculated using person hours of travel for vehicles, transit, and freight/truck. Person hours of travel is building traction across the country as a more accurate way of measuring travel time. Instead of performance measures solely focusing on the movement of vehicles, like VMT measures, the person hour of travel can capture the larger delay impact on a full bus of transit riders rather than just counting the bus as another vehicle on the road, no different from a car with a single occupant. By including Person Hours of Travel in a BCA, agencies can level the playing field when it comes to assessing all modes of transportation and prioritize congested corridors that support and encourage transit.

Due to its strong “Fix it First” approach to transportation infrastructure, in 2016, MTC added crucial measures within their project assessment process to support the inclusion of State of Good Repair (SOGR) projects. For the benefit-cost analysis specifically, MTC staff calculated the increased vehicle operating and maintenance costs as a result of roads not in a state of repair as well as how transit failure rates due to repair problems translated into per-boarding and per-mile delays affecting passengers.

Project Costs and Effort:

MTC has been steadily working on improving their project selection process over the last ten years. Most of the work is done by a small team (1.5 full time-equivalent employees), and major refinements take place during the immediate run up to the next long range transportation plan. Their staffing capacity includes people with modeling and data analytics expertise. MTC also hires summer interns who research new strategies on improving the BCA and project assessment process. For example, summer interns helped research how to include of SOGR projects in project evaluation and funding process.

Lesson Learned:

In most of MTC’s goal areas there were measures commonly applied in the transportation sector that they could have used. Instead they considered carefully whether those more typical measures sufficiently addressed the outcomes they were trying to achieve and found them wanting. They still went with some pretty typical measures. But both in the case of congestion and state of repair, they improved on the typical measure by choosing more traveler-centric measures rather than system

⁶[http://2040.planbayarea.org/sites/default/files/2017-07/Performance Assesment DPBA2040 Supplemental%20Report 3-2017 0 0 0.pdf](http://2040.planbayarea.org/sites/default/files/2017-07/Performance%20Assesment%20DPBA2040%20Supplemental%20Report%203-2017%200%200%200.pdf)

approaches, such as trading vehicle delay for a measure that allows MTC to better understand how traffic congestion impacts the individual users of the system.

PUGET SOUND REGIONAL COUNCIL (PSRC)

Tool: Benefit Cost Analysis

Boston target measures addressed: Economic Vitality + Land Use

Overview:

The Puget Sound Regional Council (PSRC) uses a benefit cost analysis process for transportation project and program evaluation as part of their Transportation 2040 long range plan.⁷ Their methods compare a build case for a transportation network where the project or program has been implemented against a baseline case where the project or program has not been implemented. In other words, the benefit cost analysis tells PSRC the relative magnitude of benefits and costs that accrue over time to the Puget Sound region as a result of implementing the new program or project compared to doing nothing.

PSRC's customized benefit calculator tool takes into account the user benefits that PSRC could monetize – mostly traditional mobility and operations measures. Examples of such benefits and costs captured by PSRC's tool include travel time, cost savings, numbers of trips taken by various transportation modes, and reliability.

PSRC uses their benefit cost analysis tool in conjunction with other components of its modeling suite, including their land use (UrbanSim), air quality (MOVES and Mobile 6.2), and travel models.⁸

Integration ensures consistency across these modeling tools, improving their sensitivity and accuracy. Creation of these tools was necessary to support the new policies outlined in the region's VISION 2040 and Transportation 2040 long range plans.

Project Costs and Effort:

According to PSRC staff, performance measurement is based on desired regional outcomes in the VISION 2040 plan and has evolved over the last several years to respond to the changing needs in the Puget Sound region. The measures are developed in-house by staff. Criteria are updated on an ongoing basis. The cost of these operationalizing measures depends on the type of measure PSRC is looking at and on factors like: data required, level of familiarity with the desired outcome, and the capacity of the staff over the span of the plan's implementation.

Lesson Learned:

PSRC uses a relatively traditional BCA in conjunction with other modeling tools to capture the benefits of both what can be easily monetized and the trends that cannot. This approach is used in their long range plan but not in their TIP, so while it helps the region understand the impacts of their broad approach, it does not directly affect what is built.

⁷ <https://www.psrc.org/sites/default/files/t2040update2014appendixh.pdf>

⁸ https://www.psrc.org/sites/default/files/appendix_k_-_data_analysis_and_forecasting_at_the_psrc.pdf

Part C: Best Practices in Performance Measures

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT), OFFICE OF INTERMODAL PLANNING AND INVESTMENT, AND VIRGINIA DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION

Program: SMART SCALE

Boston target measures addressed: Accessibility + Economic Vitality + Land Use

Overview:

The SMART SCALE Process is a method that is designed to provide the Commonwealth Transportation Board (CTB) with the best information to make programming decisions for new capacity projects. The five-step method includes eligibility/funding, project application, project screening, evaluation/scoring, and prioritization/programming. Unlike many transportation funding and evaluation processes, the entirety of the SMART SCALE is made available to the public on a [user-friendly website](#), that uses plain language and includes helpful resources to assist residents in understanding the process. By having a public facing system, Virginia Department of Transportation, Office of Intermodal Planning and Investment, and Virginia Department of Rail and Public Transportation ensures that decision-makers are held accountable to taxpayers.

In the evaluation/scoring step, projects are scored on five factors: safety, congestion mitigation, accessibility, environmental quality, and economic development. If the project is in an area with 200,000+ people then they are scored on a sixth factor, land use. VDOT seeks to incorporate economic development into many of their factors: accessibility, land use, and economic development. The additional economic development factor captures the economic-related outcomes not included in the other two factors (accessibility and land use).

Each factor is quantified using specific data points. The measures of accessibility and economic development used in the first two rounds can be found below, and a list of all factor areas and their measures can be found on page 4 of [this document](#).

Accessibility is calculated using three factors:

- Access to jobs accounts for 60% of the accessibility score and uses a GIS tool called Sugar Access to measure the change in cumulative jobs accessibility within 45 minutes. For transit projects, it measures the change in cumulative job accessibility within 60 minutes.⁹
- Access to jobs for disadvantaged persons accounts for 20% of the accessibility score and uses Sugar Access to measure the change in cumulative job accessibility within 45 minutes for disadvantaged populations. For transit projects, it measures the change in cumulative job accessibility within 60 minutes for disadvantaged populations.
- Access to multimodal projects accounts for 20% of the accessibility score and assesses how the project creates interconnections between modes and encourages transportation demand management.

⁹ http://vasmartscale.org/documents/201606/sstechnicalguide_final_9_8_2016.pdf

Economic development is calculated using three measures.

- Project support for economic development accounts for 60% of the economic development score and Virginia uses a checklist to measure if the project is in line with regional and local economic development (eg, site plans are developed, utilities are in place, etc.). The state is reevaluating this measure because it is difficult to confirm local sponsors' claims that they have met the criteria on the economic development checklist.
- Intermodal access and efficiency accounts for 20% of the economic development score and assesses the degree to which the project increases access to intermodal locations, interregional freight movement, and/or freight intensive activities.
- Travel time reliability accounts for 20% of the economic development score and measures how the project will improve reliability that benefits businesses and economic activity.

Land Use is calculated using two measures (which VDOT updated in October of 2017), and is only calculated if the population size is greater than 200,000. This measure now focuses on non-work accessibility, which VDOT defines as “the number of key non-work destinations that are accessible within a reasonable walking distance.”¹⁰

- Measure 1 calculates the amount of population and employment located in areas with non-work accessibility non-work accessibility.
- Measure 2 tracks the increase in the amount of population and employment in areas with high non-work accessibility.

After data is collected and calculated, the factors are then weighted differently based on location. For example, in highly urbanized Northern Virginia, congestion gets the greatest emphasis, while in rural southwestern Virginia the focus is on economic development and safety.

The total factor score is then divided by the SMART SCALE cost to produce the Final Score. In other words, only the cost to the state is used to divide the benefit score, providing a strong incentive for the project sponsor and project supporters to provide funding match to the project. The project's Final Score is then ranked and presented to the CTB and the public for comment. The CTB takes public comments into consideration and finally approves the Six Year Improvement Program (SYIP) document. This document is updated annually and allocates funds for year one and plans funds for years two through six.

All asset management projects, including bridge repair/replacement, pavement repair/replacement, and guardrail replacement are excluded from the SMART SCALE process. State of Good Repair funding is not distributed through the prioritization process, but can be used towards a project which will reduce the amount of SMART SCALE funds needed.

Project Costs and Effort:

From project start to implementation, SMART SCALE and its corresponding long range plan took about a year and a half to get running. This was a quick timeline for an effort of this scale and involved several consultants. The State Smart Transportation Initiative created the accessibility criteria from scratch and a separate consultant was contracted to put together the long range plan. According to one of the consultants involved in the process, the effort to create SMART SCALE was “substantial.”

¹⁰ http://smartscale.org/documents/sstechnicalguide_errata_sept2017_v2.pdf

VDOT estimates the approximate SMART SCALE development cost to date is approximately \$1.6 million (\$770,000 for staff and consultant support, and \$800,000 for IT services related to web-based application portal). The annual operating costs are estimated to be \$800,000 which includes staff time to assist localities with application development and evaluation, consultant support for training and communications, and maintenance of the web-based application portal.

Lesson Learned:

While not a traditional BCA, in some ways SMART SCALE is a more complete benefit-cost tool. A BCA is supposed to compare all benefits to the cost of the project. But in reality, they compare only the benefits that can be easily monetized to the cost. Through SMART SCALE, Virginia has found a way to put all the benefits that they have prioritized for the state on equal footing, whether or not they are easily monetized, and divided that by cost. Additionally, they have chosen to divide the benefits by the cost to the state. This does not give a full picture of whether the benefits exceed the costs; however, it ensures that the benefits are large enough to justify the state's portion and rewards project sponsors that contribute a larger match.

METROPOLITAN TRANSPORTATION COMMISSION

Program: Plan Bay Area Project Performance Assessment and Target Assessment

Boston target measures addressed: Accessibility + Economic Vitality

Overview:

The Metropolitan Transportation Commission of the Bay Area has integrated performance measures throughout every level of their project selection and funding process. The three prong project assessment process for Plan Bay Area 2040 provides a rigorous, and consistent framework and consists of a target assessment, benefit-cost assessment, and simple geographic impact assessment.¹¹

While MTC uses a BCA to evaluate high cost projects, they employ performance measures more generally to all projects and to establish goals for the region. MTC has evolved from using typical performance measures such as mobility, reliability, and traditional highway-related measures to a target assessment that qualitatively scores transportation projects in 7 goal areas of climate protection, adequate housing, healthy and safe communities, open space and agricultural preservation, equitable access, economic vitality, and transportation system effectiveness.¹² Within each goal are target measures that set specific numeric standards. Projects can receive both positive and negative scores on the target measures, for a total ranging between -13 to +13. This creates a range that MTC finds helpful in promoting high performing projects and eliminating projects that are not.

Below are some goals and corresponding regional targets that address equitable access, economic vitality, and transportation system effectiveness.

The equitable access goal focuses on how transportation and housing can work together to create equitable access to economic opportunity and prevent trends of displacement.

¹¹ [Plan Bay Area 2040: Draft Performance Assessment Report](#)

¹² [http://2040.planbayarea.org/sites/default/files/2017-07/Performance Assesment DPBA2040 Supplemental%20Report 3-2017 0 0 0.pdf](http://2040.planbayarea.org/sites/default/files/2017-07/Performance%20Assesment%20DPBA2040%20Supplemental%20Report%203-2017%200%200.pdf)

- Decrease the share of lower-income residents' household income consumed by transportation and housing by 10%
- Increase the share of affordable housing in PDAs, TPAs, or high opportunity areas by 15%
- Do not increase the share of low- and moderate-income renter households in PDAs, TPAs, or high-opportunity areas that are at risk of displacement

The economic vitality goal includes consideration of access to jobs – and more specifically higher paying jobs for residents in the region – and reducing delay on freight networks.

- Increase by 20% the share of jobs accessible within 30 minutes by auto or within 45 minutes by transit in congested conditions
- Increase by 38% the number of jobs in predominantly middle-wage industries
- Reduce per-capita delay on the Regional Freight Network by 20% Plan Bay Area 2040

The transportation system effectiveness goal has a strong focus on both state of good repair goals and the importance of non-auto mode share.

- Increase non-auto mode share by 10%
- Reduce vehicle operating and maintenance costs due to pavement conditions by 100%
- Reduce per-rider transit delay due to aged infrastructure by 100%

Project Costs and Effort:
See above.

Lesson Learned:

MTC uses a broad array of performance measures, striving to seamlessly integrate land use and transportation into evaluation and funding processes. Their accessibility measures not only consider access but also ward against displacement. Performance measures in the region are used to set goals and evaluate individual projects.

OREGON DEPARTMENT OF TRANSPORTATION

Tool: Mosaic

Boston target measures addressed: Accessibility + Economic Vitality + Land Use

Overview:

Oregon DOT developed a transportation evaluation tool that is based on least cost planning and the goals of the Oregon Transportation Plan.¹³ This tool is solely meant for planning level analysis, it is not intended to be used for selection, project prioritization, or project level analysis. The tool, titled Mosaic, compares bundles of projects including roadway/capacity, transit, and active transportation projects by assessing “the value measured in dollars” and “the value informed by stakeholders.” This tool uses 30 indicators within nine social, environmental, and economic categories. The nine categories include:

¹³ <http://www.oregon.gov/ODOT/Planning/Pages/Mosaic.aspx>

- accessibility;
- economic vitality;
- environmental stewardship;
- equity;
- funding the transportation system/finance;
- land use and growth management;
- mobility;
- quality of life and livability; and
- safety and security.

Similar to SMART SCALE, all information about the tool can be found on a user-friendly platform that is designed with citizens, decision makers, and transportation professionals in mind.

The accessibility category broadly measures the degree to which the action or plan eases “access to opportunities and destinations that give rise to the need for travel.”¹⁴ The category is measured using three general indicators: ease of connections, modal availability, and proximity. Ease of connections addresses the completeness of a network, or the ease to which users can make connections between transportation networks and network redundancy. The specific indicator collects data on the “location of industrial jobs in relation to the regional freight network.”¹⁵ Modal availability addresses the availability of transportation modes and uses three specific indicators to measure it: the amount of multi-use paths and bicycle boulevards, population and employment within a quarter mile of a transit stop served by at least 30 vehicles per day, and sidewalk coverage.^{16,17,18} The final accessibility general indicator is proximity which refers to “aspects of land use that increase access to and between common destinations.”¹⁹ Proximity uses two specific indicators: population within a certain time between work and home, and a transportation cost index.

Oregon considers under economic vitality whether the “bundle of actions” contribute to Oregon’s economic prosperity. The category is measured using three general indicators: the economic impact of more efficient transportation services, economic impacts of spending for construction, and structural economic effects. The economic impact of more efficient transportation services measures two specific indicators: changes in employment by industry and wage and changes in transportation costs by industry.^{20,21} The second general indicator measures the economic impacts of spending for construction by measuring the number of jobs created or retained by bundle.²² The final economic

¹⁴ <http://www.oregon.gov/ODOT/Planning/Pages/Mosaic-Categories.aspx>

¹⁵ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicator-Industrial-Job-Location.pdf>

¹⁶ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicator-Multi-Use-Paths.pdf>

¹⁷ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicator-Population-Employment-Transit.pdf>

¹⁸ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicator-Sidewalk-Coverage.pdf>

¹⁹ <http://www.oregon.gov/ODOT/Planning/Pages/Mosaic-Categories.aspx>

²⁰ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicators-Changes-Employment.pdf>

²¹ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicators-Changes-Transportation-Costs.pdf>

²² <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicators-Jobs-Created.pdf>

vitality measure accounts for any structural economic effects, such as changes in productivity from increased connectivity and changes in the total value of exports and imports.^{23,24}

Mosaic's land use category uses two general indicators – land value and density of population and employment – to understand if the bundle of actions results in development that improves spending decisions on travel, housing, employment, and infrastructure. The land value measure gathers data on the relative land value change of both build and no build scenarios.²⁵ The density of population and employment measures the number of jobs and people in a certain area.²⁶

Project Costs and Effort:

The MOSAIC tool was created by a consultant over a period of two years and at a cost of \$1 million dollars. The legislature mandated ODOT create this tool on behalf of the state's transportation commission. Since its creation, there have only been two applications of this tool, a test application by ODOT and a real-time application by an MPO in Oregon. It is not mandated that any agency use MOSAIC and the ODOT consultant stressed that the barrier to using MOSAIC isn't necessarily its cost but, rather, the buy-in from Oregon agencies without a requirement from the state.

Lesson Learned:

Oregon DOT put a great deal of energy into developing a tool that allows the state to understand the impact that the building of a suite of projects could have on the state as a whole. They put typical traffic measures on par with other high priority outcomes like access to jobs and equity. However, the Mosaic tool is only applied to planning and not project selection. Further, as opposed to SMART SCALE in Virginia, the Mosaic tool is static. No updates or improvements have been made to more accurately capture benefits or to widen its applicability.

SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS (SEMCOG)

Tool: SEMCOG Performance Measures

Boston target measures addressed: Accessibility + Economic Prosperity

Overview:

The Southeast Michigan Council of Governments (SEMCOG) worked with partners and members to identify five high priority regional outcomes that they use to monitor if they are creating a successful and sustainable region. The five outcomes address reliable/quality infrastructure, desirable communities, access to service/jobs/markets/amenities, healthy attractive environmental assets, and economic prosperity.²⁷

²³ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicators-Changes-Productivity.pdf>

²⁴ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicators-Changes-Total-Value.pdf>

²⁵ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicators-Relative-Land-Value-Change.pdf>

²⁶ <http://www.oregon.gov/ODOT/Planning/Documents/Mosaic-Specific-Indicators-Population-Employment-Change.pdf>

²⁷ <http://semcog.org/Performance-Measures>

SEMCOG measures access to service, jobs, markets, and amenities using two key performance measures: the rate of export activity and transit ridership. Export activity is an important measure for the Southeast Michigan area as much of their economy rests on the auto manufacturing economy.²⁸ The seven transit providers in the region collect their transit ridership numbers on a monthly basis and report them to the National Transit Database.²⁹

SEMCOG evaluates economic prosperity by using eight performance measures: The percent population age 25+ with an associate's degree and the percent of population with a bachelor's degree or above, the change in real regional Gross Domestic Product, real per capita personal income growth, poverty rate, labor underutilization rate, change in jobs, and economic diversity employment composition.

Project Costs and Effort:

As part of their 2040 long-range plan, SEMCOG staff developed these five outcomes. The outcomes and corresponding measures were all developed in-house and SEMCOG estimates it took a period of couple months.

Lesson Learned:

SEMCOG engaged stakeholders and the public to identify priorities and went beyond typical traffic measures to understand economic and opportunity trends in the region. These are useful measures for monitoring trends but have not been applied to project selection to ensure that their regional transportation investments are sending the trends in the appropriate direction.

SACRAMENTO AREA COUNCIL OF GOVERNMENTS (SACOG)

Program: MTP/SCS Performance Measures

Boston target measures addressed: Land Use

Overview:

The Sacramento Area Council of Governments (SACOG) has used a performance assessment process to improve their Metropolitan Transportation Plan/Sustainable Community Strategy. SACOG required local jurisdictions to demonstrate how a proposed transportation project would help the region make progress towards at least three of the following seven policy priorities:

- Reduce VMT per capita
- Reduce congestion
- Increase multi-modal travel and choice of transportation options
- Provide long term economic benefit
- Improve goods movement
- Improve safety and security
- Demonstrate state of good repair benefits

²⁸<http://semcog.org/Plans-for-the-Region/Performance-Measures/Access-to-Services-Jobs-Markets-Amenities#RateofExportActivity>

²⁹<http://semcog.org/Plans-for-the-Region/Performance-Measures/Access-to-Services-Jobs-Markets-Amenities#RateofExportActivity>

SACOG then created 11 prime performance measures to specifically evaluate how a proposed project would help the region make progress towards the seven performance outcomes, selecting the transportation projects that would best achieve progress:

- Square miles of farmland converted to development
- Square miles of vernal pools affected by development
- Share of new homes near high-frequency transit
- Share of new jobs near high-frequency transit
- Transit costs recovered by ticket
- Total homes in environmental justice areas near high-frequency transit
- Share of trips by transit, bike, walk
- VMT
- VMT in heavy congestion
- Travel time spent in car per capita
- Weekday passenger vehicle CO2 emissions

These measures have been used for planning purposes to understand the impacts of their TIP, but SACOG is planning to use these measures for project level evaluation starting with their 2020 plan.

Project Costs and Effort:

In 2017, SACOG convened a Project Performance Assessment Working Group that reviewed and updated their project performance assessment, which includes benefit-cost analysis and performance outcomes. This internal group contracted with an outside consultant for \$50,000 to act as a sounding board and provide technical advice. SACOG estimates that staff effort of the group is equivalent to one FTE, or 15,000-18,000 staff time hours.

Lesson Learned:

SACOG was one of the first transportation agencies to use performance measures in their program. While they are just beginning to look at project level evaluation, they have chosen some unique measures to understand how transportation project impact the region and land use. It will be interesting to see if they can apply some of them (like square miles of farmland converted to development) to individual projects. Additionally, SACOG has a very interesting congestion measure -- VMT in heavy congestion -- that focuses on heavy congestion impacting a large number of people for a lengthy period of time, rather than many measures that treat all congestion as if it is the same.

PUGET SOUND REGIONAL COUNCIL (PSRC)

Tool: Performance Measures

Boston target measures addressed: Economic Vitality + Accessibility

Overview:

The Puget Sound Regional Council uses a list of 11 Regional Outcomes³⁰ to evaluate proposed transportation projects and plans on how well they implement regional policies in both VISION 2040

³⁰ <https://www.psrc.org/our-work/regional-planning/transportation-2040/regional-outcomes>

and Transportation 2040. Within the Regional Outcomes, the agency tracks 7 Regional Performance Measures that quantify the region's transportation progress. These performance measures include:

- Corridor Travel Time
- Commute Mode Share
- Bridge Condition
- Vehicle Miles Traveled
- Park and Ride Usage
- Transit Boardings
- Ferry Ridership³¹

PSRC utilizes nine prioritization measures to evaluate how well transportation projects implement the region's goals in VISION 2040. Each project is scored within defined categories and may receive up to 10 points for each one. Four of the prioritization measures relevant to this discussion are as follows:

- **Jobs:** This measure addresses the extent to which projects support existing and new businesses as well as job creation including access to areas with high concentrations of jobs and job-related training opportunities.
- **Social Equity and Access to Opportunity:** This measure addresses the extent to which projects improve environmental health, access to opportunity, particularly to minority, low income, elderly, youth, people with disabilities, and non-vehicle owning populations.
- **Support for Centers:** This prioritization measure addresses the extent to which projects support population and employment - both existing and new in centers. Centers are identified focus areas within the region where Vision 2040 concentrates future growth. In addition, the measure addresses the extent to which projects support transit oriented development, development of housing in centers, accessibility to/from/within the center, and compatibility with the character of the community in which a project is located.
- **Travel:** This measure addresses how well projects are expected to reduce congestion and delay, and improve flow.³²

After projects are scored for the nine prioritization measures, the highest scoring projects are funded for implementation until funding is exhausted.

Project Costs and Effort:
See above.

Lesson Learned:

PSRC evaluates and prioritizes projects using a simple and transparent scoring system addressing all of their regional goals. The PSRC approach is not as quantitative as others, but it puts all of their regional priorities on equal footing and creates an understandable way to justify funding one project over another.

³¹ <https://www.psrc.org/regional-performance-data>

³² <https://www.psrc.org/sites/default/files/t2040update2014appendixp.pdf>