A Benefit/Cost Analysis of SRTS Programs in New Jersey

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Contents

Executive Summary

This paper looks at the economic, health, and environmental elements that would be included in a benefit-cost analysis for Safe Routes to School (SRTS) infrastructure and non-infrastructure projects. A benefit-cost analysis would assist decision-makers in prioritizing transportation projects for investment. Researchers found few examples of benefit-cost analysis tools currently in use in transportation agencies. However, the Caltrans model could inform development of a tool that would be appropriate for assessment of New Jersey Department of Transportation SRTS projects.

Introduction

The New Jersey Safe Routes to School (SRTS) Program enables and encourages safer and more accessible walking and bicycling environments for school-aged children through education, training, research, and funding. Funding for the Safe Route to School Program can be regarded as an investment to create a better, safer living environment and promote healthy lifestyles for students. This report explores systematic approaches to conducting a benefit-cost analysis of SRTS programs in New Jersey. The purpose of a benefit-cost analysis is to assist stakeholders in making informed, logical decisions on whether to invest, or to continue to invest, in a program or project. Several resources are available for applying monetary figures to the costs and benefits of active transportation in general and SRTS programs in particular. The following is a synopsis of preliminary research and a working bibliography.

Economic, Health, and Environmental Benefits

Safe Routes to School (SRTS) programs generate economic benefits and cost reductions, directly and indirectly. As yet, few research studies have analyzed the direct economic effect of walking and biking on the incidence of chronic disease, such as diabetes and cardiovascular disease in the United States. However, physical activity has been shown to improve cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health markers and body composition in children and adolescents, and reduce the risk for numerous adverse health outcomes, including hypertension, diabetes, heart disease, and some cancers in adulthood (CDC 2016).

The economic benefit and cost reduction of SRTS programs varies with the characteristics of communities. Infrastructure costs and benefits vary with the size and number of installations. This section outlines some of the economic, user, health and environmental benefits as well as how active transportation can reduce costs.

Economic benefits

Active transportation infrastructure and non-infrastructure Safe Routes to School programs have a positive economic impact for businesses. Studies have found that more pedestrian and cycling activity in a commercial area generates more income per month than areas accessed mainly by automobiles (Bushell, et al. 2013). Bicycle infrastructure improvements have a positive overall impact on businesses, and result in an increase in economic activity in areas with bike lanes and bike racks, despite the controversy about the potential loss of parking spaces when implementing these bicycle-related improvements (Bushell, et al. 2013). For example, a study found that in 2011, active transportation-related capital investments (e.g., sidewalks), businesses (e.g., bike shops), and events (e.g., bicycle races) generated $497.46 million for the New Jersey economy (Brown and Hawkins, 2012). Additionally, the study concluded that the estimated tax revenues gained from these active transportation-related activities of $49 million (nearly three-quarters of the investment amount), suggests that governments are receiving a good return on their investment (Brown and Hawkins, 2012). Improved pedestrian and bicycling infrastructure can also have a positive impact on real estate values. Data shows that homes near bicycle paths have higher sales prices and that areas with pedestrian amenities have higher rents, revenues, and resale values (Bushell, et al. 2013). These findings suggest that communities should give active-transportation projects significant consideration as a generator of economic assets.

User Benefits

User benefits provided by improved active transportation infrastructure include: increased user convenience and comfort; improved accessibility for non-drivers; option value; and increased community cohesion and security resulting from more people walking along local streets (Litman, 2018). According to the Victoria Transport Policy Institute, in a typical community, 20-40% of residents cannot drive due to age, disability, or poverty, and thus must rely on other modes of transportation (Litman, 2018). The Victoria Transport Policy Institute recommends using three evaluation methods to measure the value to users of walking and cycling improvements. These include avoided costs, contingent valuation, and hedonic pricing (Litman, 2018). Avoided costs are the savings a user would have from reduced expenditures on motorized travel, costs of owning a car, or exercise equipment (Litman, 2018). Contingent valuation uses user surveys to determine their willingness to pay for specific facilities or improvements (Litman, 2018). Hedonic pricing measures the value of infrastructure improvements by the increase in local property values (Litman, 2018). Option value is the value people may place on having an option available, even if they do not currently use it (Litman, 2018). In addition to the user benefits listed above, there are also equity benefits, benefits of congestion reduction, vehicle cost savings, and reduced chauffeuring burdens (Litman, 2018).

Cost Reduction

Active transportation projects can also curb overall infrastructure spending and costs. The cost reduction of prioritizing active transportation infrastructure and SRTS programs can yield generous cost savings. Bike and pedestrian infrastructure can be extremely low cost compared to new roadway projects that can cost tens of millions of dollars (Bushell, et al. 2013). An analysis of SRTS programs and their fiscal impacts finds that SRTS programs provide economic benefits by reducing the need to bus or drive students who encounter hazardous walking conditions (McDonald et al. 2014). Motorized transportation operating expenses for school districts total approximately $30 billion, $0.9 to $1.3 billion of which are related to transporting students short distances (less than 1 mile) (McDonald et al. 2014). Investment in better walking and biking infrastructure around schools results in economic savings and cost reductions.

Safe Routes to School programs address three categories of costs: student transportation expenses, external costs, and medical costs (see Table 1) (Muenning at el.; McDonald at el.). Bicycling and walking-related infrastructure improvements and other improvements generate economic benefits in the form of increased employment, wages and salary, and gross domestic product (GDP). For example, the $63 million investment in 250 active transportation-related projects in New Jersey in 2011 resulted in an estimated $149.63 million in economic output/activity with accompanying effects on various economic sectors. These projects generated 648 jobs, approximately $44.57 million in wages and salary, and an estimated $75.62 million to New Jersey's gross domestic product for that year (Brown and Hawkins, 2012). A benefit-cost analysis for Safe Route to School projects will use calculations of the economic benefits and the cost reductions generated by these projects, along with the estimated improvement costs of Safe Routes to School infrastructure projects.

Table 1. Cost Reduction Generated from Safe Route to School

No.	Cost	Description	Monetary Costs
1	**Student Transportation Expenses**		
1.a	School Bus Service Costs	This is the cost to the public sector for school bus operations and infrastructure.	\$956/ pupil [a]
1.b	Hazard Busing	Hazard busing is a school bus service provided to students who do not meet the distance threshold between their residence and school, but their walking conditions are unsafe. Measurement of hazard busing costs should consider percentage of students using hazard busing service and the proportion transformation from normal cost to hazard busing.	\$956/pupil × % of hazard busing Pupil × Proportion
1.c	Private Vehicle Costs	The cost for students reaching school by private vehicles. Private vehicle costs include time cost (35% - 60% of hourly wages [b]). However, some parents place a positive value on driving their children to school due to the opportunity to spend time with their children.	\$13.60/hr [c] × travel time (hr) × % of Private-vehicle Pupil

No.	Cost	Description	Monetary Costs
2	**External Costs**		
2.a	Health Impacts of Vehicle Emissions	An external cost from vehicle emissions that may cause increases in the incidence of asthma, respiratory illness, etc. Harmful pollutants include ozone, PM_{10} and $PM_{2.5}$ (particular matter), CO, NO, SO_2, and Lead.[d]	PM: \$337,459/short ton [f] SO_2: \$43,600/short ton [f] (2016\$)
2.b	Climate Impacts of Greenhouse Gas Emissions and Climate Change	Emissions contain pollutants that are harmful to the climate, which are CO_2, CFC_s and HCFC, CH_4, NO_x, N_2O, and VOC (volatile organic hydrocarbons).[d]	CO_2: (2020) Social Cost of CO_2 per metric ton of CO_2 – Discount Rate \$12 – 5.0% / \$43 – 3.0% \$64 – 2.5% / \$128 – 3.0% (95^{th}) (Applied at high, medium, low level with different discount rate) [e] VOC: \$1,872/short ton [f] NOx: \$7,377/short ton [f] (2016\$)
2.c	Time Costs Imposed on Other Road Users Due to Congestion	If students walk or bike to school, the number of their parents' automobiles on roads may decline and ease congestion during peak hours. As traffic changes are dynamic, using congestion cost software for NJ is recommended.	Estimate in Congestion Model 4 - https://www.nj.gov/transportation/refdata/research/reports/FHWA-NJ-2014-015.pdf

No.	Cost	Description	Monetary Cost
3	Medical Costs		
3.a	Injury and Fatality	Refers to the direct cost of crashes resulting in injuries and fatalities. USDOT defines the value of statistical life (VSL) as the cost of fatality ($9,600,000). The costs of injuries are defined by relative disutility factors by injury severity level (AIS) multiplied by VSL[e] presented as follow: AIS Level – Severity – Fraction of VSL AIS 1 – Minor – 0.003 AIS 2 – Moderate – 0.047 AIS 3 – Serious – 0.105 AIS 4 – Severe – 0.266 AIS 5 – Critical – 0.593 AIS 6 – Unsurvivable – 1.000	Fatality: $9,600,000 (2016$) Injury: VSL × AIS (Should be applied with rates of fatality and injury severity)
3.b	Chronic disease, (e.g. Diabetes and Cardiovascular Disease)	By walking or biking to school instead of traveling by bus or car, students have better opportunities to exercise and cultivate a healthier lifestyle, to further control the risk of chronic diseases.	N/A

[a] New Jersey Student Transportation Current Expenditures 2013-14
[b] Source: Department of Transportation 2011
[c] New Jersey Minimum Wage in 2018
[d] Transportation Cost and Benefit Analysis II – Air Pollution Costs, Victoria Transport Policy Institute
[e] Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, United States Government
[f] Benefit-Cost Analysis Guidance for Discretionary Grant Programs, US Department of Transportation (2017)

Health and Environmental Benefits

The health and environmental benefits of active transportation and Safe Routes to School Programs include physical health and crash reduction. There is a positive association between the physical health and fitness of men and women and active commuting (Gordon-Larsen et al. 2009). As obesity rates continue to increase around the world, physical activity is more important now than ever. Research suggests that just 30 minutes of physical activity a day can have significant health benefits; walking and cycling are among the most practical and effective ways to be physically active. A growing body of evidence suggests that the built environment influences the likelihood that people will use active transport for their daily travel (Pucher, et al. 2010). Walking and cycling increase rates of caloric expenditure and thus could have a major influence on health (Pucher, et al. 2010). Data show that, “European countries with high rates of walking and cycling have less obesity than do Australia and countries in North America that are highly car dependent" (Pucher, et al. 2010). In an examination of cross-sectional health and travel data for 14 counties, all 50 U.S. States, and 47 of the 50 largest U.S. cities found statistically significant negative relationships between active travel and self-reported obesity at all three levels. At the state level, findings showed a statistically significant positive relationship between active travel and physical activity, and a statistically significant negative relationship between active travel and diabetes. In summary, the researchers concluded that the more people used active transport, the lower they reported being obese and the lower the level of diabetes. The more active transport utilized, the higher the rates of overall physical activity (Pucher, et al. 2010). In addition to lower rates of diabetes and obesity, active transportation improves physical health by improving cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health markers in children, adolescents, and adults (CDC 2016). Additionally, improvements to pedestrian and cycling infrastructure can lead to an overall reduction in motorist crashes and decrease in speeding, which help create safer environments for pedestrians and bicycle activities (Bushell, et al. 2013).

Another benefit of active transportation is the reduction in carbon emissions. One study conducted in New Zealand used the Integrated Transport and Health Impacts Model to evaluate New Zealand's Model Communities Programme, which funded investments in various walking and cycling infrastructure (Chapman, et al. 2018). Comparing two cities with various amounts of walking and biking infrastructure, the study found that the reduction in carbon emissions alone was enough to justify the program (Chapman, et al. 2018). The benefit/cost ratio was found to be around 11:1 (Chapman, et al. 2018). The reduction in air pollution from switching to walking or cycling from driving can have large positive impacts on health.

Costs of Active Transportation

Infrastructure Costs

Infrastructure costs of bicycle and pedestrian facilities is a key factor in determining prioritization, decision-making, and allocation of funds. The costs of constructing bicycle and pedestrian infrastructure varies based on area type (urban/rural, terrain), location (intersection, midblock), and type of facility (shared-bike lane, crosswalk with median, pedestrian crossing signals, etc) (Pulugurtha, et al. 2016).

The most recent NJ SRTS Resource Center tables of bicycle and pedestrian infrastructure costs can be found in the Appendix.

Non-Infrastructure Costs

In addition to the infrastructure costs of projects, there are also non-infrastructure costs: operating and fleet costs, environmental costs, and user costs. Operating and fleet costs include school bus service, hazard busing, and private vehicle costs. Environmental costs include health impacts from vehicle emissions, climate impacts of greenhouse gas emissions and climate change, and time costs imposed on other road users due to congestion. User costs include traffic or parking delays, costs to users of equipment such as shoes and bicycles, increases in travel time costs due to slower modes, and increases in crash risk (Cooper and Danziger, 2016).

Active Transportation Benefit-Cost Analysis

Case Study - Road Diet for Livingston Avenue in New Brunswick

A benefit-cost analysis for a road diet on Livingston Avenue in New Brunswick analyzes the trade-offs between increases in travel time associated with the road diet versus the benefits of crash reduction (Noland et al. 2014). Livingston Avenue (also known as County Route 691) is a major local street corridor that connects downtown New Brunswick with US Route 1 to the south and has been identified as having a high rate of pedestrian crashes compared to overall county roads in Middlesex County (Noland et al. 2014). The costs and benefits of the road diet conversion are estimated using standard approaches to evaluating the costs of travel delay and the costs of crashes (Noland et al. 2014). The value of time was estimated using the median household income of New Brunswick residents and the benefits of crash reduction were estimated using the value of a statistical life (Noland et al. 2014). Using the dollar value for crash reduction and increase in travel times, the report concludes that there are positive benefits even if there is only a 10% reduction in crashes or if the cost of the road diet conversion is as high as $10 million (though the expected cost is around $60,000) (Noland et al. 2014). The report concluded that "the City of New Brunswick and Middlesex County would achieve substantial benefits from a road diet conversion of Livingston Avenue" (Noland et al. 2014).

Overview of Caltrans and BUILD Models

Caltrans Benefit/Cost Tool

The Caltrans Benefit/Cost tool is a Microsoft Excel tool that uses travel characteristics for an infrastructure project to calculate a benefit-to-cost ratio. To develop a benefit-cost calculator, there need to be established benefit factors, a method for quantifying/monetizing benefits, costs, and appropriate countermeasure, crash reduction factors, and discount rate (Cooper and Danziger, 2016). The Caltrans tool provides two outputs for benefits: the increase in active transportation, which has multiple effects, and the potential for crash reduction (Cooper and Danziger, 2016). There are four categories of effects for the benefits of the increase in active transportation: improved conditions, increased activity, reduced vehicle travel, and land use impacts (Cooper and Danziger, 2016).

The Caltrans tool has specific inputs for SRTS projects. Assumptions used include: 180 days of school; a 2 mile distance to school = 1 hour walk (1 mile- composite for bike and walk distance back and forth to school); the value of time for children was the same as for adults since the tool does not quantify the time of parents chauffeuring their kids to school; and safety benefits are assumed to be the same as for non-SRTS infrastructure projects. The data inputs needed to run the benefit-cost tool for a SRTS infrastructure project include:

- Number of students enrolled in the school/s
- Approximate number of students living along school route proposed for improvement
- Percentage of students that currently walk or bike to school

- Projected percentage of students that will walk or bike to school after the project is completed

The data input needed for non-infrastructure projects include:

- Number of students enrolled in the school/s
- Number or percentage of students that currently walk or bike to school
- ATP funds requested
- Duration of outreach (months)
- Number of targeted participants, a subset of a population of town or city
- Number or percentage of residents or participants that currently walk or bike
- Project cost of the outreach

The resulting output is calculated over the lifetime of the project, which is assumed to be a 20-year investment. The summary analysis breaks the savings into five categories:

- Mobility - Value of time, Total pedestrian environmental impact per trip
- Health - Value of health, Annual health benefits
- Recreational - Value of time spent doing recreational activities
- Gas & Emissions - Avoided VMT, Fuel saved, Emissions saved
- Safety - Cost savings per crash

These outputs take into consideration a variety of parameters that can be changed to reflect the location such as hourly wage and gasoline price per gallon. The Caltrans Benefit/Cost tool can be used as a model for SRTS projects. The tool has a built-in section for SRTS infrastructure and non-infrastructure projects and calculates costs/benefits for other active transportation projects. Using this tool could help governments and developers prioritize SRTS projects supported by the quantified costs and benefits of projects as compared to new roadway construction projects (Caltrans 2007).

Better Utilizing Investments to Leverage Development (BUILD)

The U.S. Department of Transportation has also developed a benefit-cost analysis tool to help determine funding priorities. The new BUILD Transportation Discretionary Grant Program (Better Utilizing Investments to Leverage Development) provides funding for road, rail, transit, and port projects. Previously known as Transportation Investment Generating Economic Recovery, or TIGER Discretionary Grants, the program has $5.6 billion for nine rounds of National Infrastructure Investment projects (U.S DOT, "About BUILD Grants," 2018). Use of the benefit-cost tool was required for all projects to in order to receive funding through the TIGER grant program. Although the BUILD program has no such requirement, the US DOT suggests that a benefit-cost analysis be conducted. To aid with the analysis, the US DOT has produced a detailed guide report that explains the role of Benefit-Cost Analysis in funding decisions, general principles to follow, guidelines for monetizing and calculating benefits, cost considerations, and submission guidelines (US DOT, Benefit-Cost Analysis, 2018).

Outlined under the General Principles section of the report are impacts of transportation infrastructure improvements, baselines and alternatives, demand forecasting, inflation adjustments, discounting, analysis period, and scope of the analysis. The Benefit-Cost Analysis should address each of these general principles (US DOT, Benefit-Cost Analysis, 2018).

The Benefits section of the report provides acceptable approaches for assessing the most commonly included benefit categories. Benefits should be estimated and presented on an annual basis throughout the entire analysis period (US DOT, Benefit-Cost Analysis, 2018). Value of travel time savings is calculated in dollars per person hour. For example, the recommended hourly value of travel time savings for a personal vehicle is $14.20 (US DOT, Benefit-Cost Analysis, 2018). Applicants are encouraged to rely on localized data or analysis that is specific to the corridor being improved and, where available, by time of day (particularly when travel time savings are being generated by reductions in peak-period delay) (US DOT, Benefit-Cost Analysis, 2018). Vehicle operating cost savings is another way to measure benefits and this guidance provides standard national-level per-mile values for marginal vehicle operating costs from the American Automobile Association for light duty vehicles and from the American Transportation Research Institute for commercial trucks (US DOT, Benefit-Cost Analysis, 2018). Included in the operating costs are fuel, maintenance and repair, tires, depreciation, and in the case of trucks, truck/trailer lease or purchase payments, insurance premiums, and permits and licenses (US DOT, Benefit-Cost Analysis, 2018). The values exclude ownership costs that are generally fixed such as tolls, taxes, annual insurance, and registration fees (US DOT, Benefit-Cost Analysis, 2018). To determine the safety benefits, applicants should determine the types of crashes the project is likely to affect and the effectiveness of the project in reducing the severity or frequency of these crashes (US DOT, Benefit-Cost Analysis, 2018). USDOT recommends monetizing reductions in injuries using the Maximum Abbreviated Injury Scale (MAIS) (US DOT, Benefit-Cost Analysis, 2018). Other benefits to consider include noise pollution, quality of life, and property value increases. The USDOT currently does not have recommendations for approaching emission reduction benefits.

Both capital and operating/maintenance costs used in the Benefit-Cost Analysis should reflect the full cost of the projects (US DOT, Benefit-Cost Analysis, 2018). Capital expenditures should be categorized in nominal dollars (estimates), real dollars, and discounted real dollars (US DOT, Benefit-Cost Analysis, 2018). When comparing costs and benefits, applicants can use the net present value or the benefit-cost ratio (US DOT, Benefit-Cost Analysis, 2018).

Regional Analysis of Active Transportation Benefits and Costs

Southern California Association of Governments (SCAG), the regional planning organization for a six-county area, has used REMI's (Regional Economic Models, Inc.) TranSight, an input-output econometric model, to analyze the regional effects of active transportation. Their 2016 report looks at current active transportation regional trends, health benefits of active transportation, and the effect of active transportation on regional employment and economic growth. The study looks at the public health and economic benefits of building and maintaining infrastructure elements including sidewalks, bike facilities (lanes, paths), and complete street design to inform the development of regional planning documents. The report appendices provide further detail on the methodology and findings of analyses (Urban Design 4 Health and AECOM, 2016).

Recommendation and Next Steps

The research presented in this literature review supports the value of conducting a benefit-cost analysis to emphasize the economic, health, and environmental benefits of active transportation infrastructure and cost savings compared to new roadway construction projects. Conducting a benefit-cost analysis could help governments and funding agencies prioritize Safe Routes to School projects. This research has found that there are several established resources to assist in conducting benefit-cost analyses for these projects. In particular, the Caltrans tool provides a model that NJDOT could adopt for use in the evaluation of SRTS projects.

Next steps include:

- Adapt the Caltrans benefit-cost analysis tool for use by NJDOT, MPOs, and other organizations.
- Pilot the analysis tool using a NJ Safe Routes to School project.
- Conduct interviews with other SRTS organizations about the tools and approaches they use.
- Develop a framework for applying a benefit-cost analysis on future case studies/projects.

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