Introduction

Planning and policy efforts at all levels of transportation planning aim to increase levels of walking and bicycling. In many cases, initiatives are motivated by a desire to reduce automobile use and its attendant environmental consequences (e.g. pollution, natural resource consumption). Alternatively, efforts are prompted by concerns about livability, public health or physical inactivity. In response, urban planners, transportation specialists, elected officials and health advocates are all looking to non-motorized travel to address myriad concerns, whether they relate to congestion, the environment, health or quality of life.

An important element in any effort to spur more walking or cycling requires adequate facilities to encourage their use. For walking, this includes pavements, public spaces and/or road crossings. For bicycling, this includes relatively wide kerb lanes, on-street or off-street bicycle paths, and even secure parking or showers at the workplace. Opponents of bicycle projects bombard decision-makers with cost information because data on costs are relatively easy to obtain. Benefits, however, are considerably more difficult to estimate, and though the bicycle planning community makes many advocacy-based claims, methodologies for valuing cycling facilities’ benefits are in short supply. In response, planners and other transportation specialists often find themselves justifying such spending with the claim that these facilities benefit the common good and that they induce increased use. Especially in austere economic times, they are often grasping for ways to ‘economize’ such facilities.

Procedures to value the benefits of road or transit-related investments for planning purposes are relatively well established, but this is not the case for
projects to accommodate non-motorized modes, particularly cycling. The value of investing in cycling facilities is often questioned, given that cycling in the US accounts only for approximately 0.8% of all trips (US Department of Transportation, 2003) causing some to term it a ‘fringe’ mode (Gordon & Richardson, 1998). But bicycle facilities presumably provide benefits to those who actually use them, and potentially to others, who are affected indirectly.

This research introduces a web-based tool, Guidelines for Analysis of Investments in Bicycle Facilities (‘the guidelines’), which provides planners, policy officials and decision-makers with a consistent framework to guide decisions about cycling facilities. This article serves to sketch the overall analysis strategies used to uncover reliable estimates of their costs and benefits. Our purpose herein is to provide an overview piece – applicable to practising planners and of interest to the general research community – as other publications individually describe many of the detailed analyses underlying many of the specific findings described herein. The reader is encouraged to consult several other publications that provide much of underlying primary research on which the guidelines are based (referenced in later sections, where appropriate).

The next section of this article discusses the overall framework of the guidelines, their primary audience and their overall design and application. The subsequent section walks the user through the underlying research involved in each of the three modules – to estimate (1) the costs, (2) the number of users and (3) the economic benefits. In each these areas, we highlight the scope of what is included in the estimates and the underlying research, with an eye towards needed future research. The final section shares reflective observations about the guidelines and future areas for refinement.

**Overall Framework and Description of the Guidelines**

The guidelines provide planners and project managers with an online tool to supply them with estimates of the cost, demand and benefits associated with a given bicycle facility. They were developed at the University of Minnesota (Humphrey Institute of Public Affairs and Civil Engineering), in collaboration with Planners’ Collaborative consulting firm, and the University of North Carolina-National Highway Safety Research Center, and have been housed on the website of the Highway Safety Research Center since the beginning of 2006 (see http://www.bicyclinginfo.org/bikecost/; Figure 1). They are designed to be accessible to a variety of professions and to introduce a consistent framework that could be used across a variety of facilities. The overall framework of the guidelines is presented in Figure 2, oriented around the user wanting to know at least one aspect of a proposed facility: its costs, the estimated number of users and/or the economic benefits the facility would generate.

We assume the user has a particular facility in mind, existing or proposed. Regardless of the output information the user seeks, they are prompted to enter general characteristics of the region or the given facility (e.g. type of facility, when and where it will be built). The user is then directed down one of two paths. The first path asks either for additional information about specifics related to the cost and construction of the facility. The outputs from this worksheet include the
capital cost of the facility and annualized maintenance costs. The second path orients the user towards better understanding of the demand induced by the facility and additional information that is needed to calculate the economic benefits. Outputs are twofold, including ranges of estimates for existing and new cyclists as well as monetary estimates of the range of benefits associated with the facility.

The opening page provides the user with useful information that is available through various links. For example, there is a link to the Bicycle Encyclopedia, a glossary of terms used throughout the guidelines and in the process of planning for and constructing bicycle facilities. The opening webpage includes a primer describing various design considerations when planning or constructing a bicycle facility. Also included is a guide to using the tool and a complete description of the
approaches and research methodologies used in researching and developing the
guidelines (available as copy of the full research report on which the guidelines
were based).

Throughout the guidelines, several accompaniments provide the user with
additional information in the form of ‘i’ buttons (i) – to provide definitional and
input information enabling the user to better understand the information being
requested (Figure 3). The explanations associated with the ‘i’ button and the
glossary appear in separate popup windows so to retain data the user enters. The
guidelines were designed with different types of users in mind, who very likely
have differing needs and access to differing levels of input information.
Depending on the user’s interests, the guidelines can produce different outputs.
If the planner or project manager requests information about costs, they will
receive information about the capital cost and annual maintenance costs. If they
request information about the demand, an output will provide ranges for the
estimated number of existing and new cyclists. If the user requests information
about the benefits, they shall receive dollar amounts for the expected mobility,
health, and recreation benefits (sample output shown in Figure 4). Assuming
relatively cursory information is entered to each of the prompts, the user can
navigate to an output in roughly 10 minutes. In several cases, the guidelines are
flexible to account for relatively detailed input material querying, for example,
relatively sophisticated GIS information. In these cases, it is not unreasonable to
assume a sample run would take around an hour.

![Figure 3. Information from 'i' buttons explaining the input variables provided in separate popup windows.](image-url)
Modules of the Guidelines

Costs

The first part of the guidelines, computing costs, are the most straightforward. They develop cost estimates for bicycle facilities, the basis of which are actual cost values for different elements of a bicycle facility. Relying on researched costs from around the US, one or more cost values were obtained for each element of cycling infrastructure. Where multiple cost elements were uncovered, the value considered to be most reliable, representative, or up to date was relied upon.

The cost worksheet (Figure 5) of the guidelines solicits the users for information about a particular facility being considered. Such parameters include factors related to the length, width, materials used, security, lighting and landscaping. The guidelines provide a baseline for prices and labour costs. However, if the planner or project manager has more accurate or applicable data for a given area or facility, they can override the default values (e.g. if they have a quote for how much it will cost to lay the concrete for a facility).

Inflation

The Producer Price Index for highway and street construction was used to adjust construction costs to the base year. The Consumer Price Index for housing was used for property costs. Both indexes are compiled by the US Bureau of Labor Statistics. Data for the years 1987 – 2003 were collected for both indexes.
All construction values were normalized to a base year of 2002. Inflation factors were developed to convert unit costs from 2002 levels to the build year. Growth rates for both the construction and property costs were projected from the 1987–2003 data by the growth function embedded within Microsoft Excel. The Growth function predicts the exponential growth using the existing data. The projected growth rates were then used to predict construction and property costs up to the year 2012 based on the mid-point of construction entered by the user.

**Geographical Considerations**

Cost values for each element were gathered from a number of sources around the country. In order to normalize each cost element to a national level, a construction cost index by state or region was developed. The base index is the Construction Cost Index as published in the *Engineering News Record* (ENR, 2003). This ENR index was chosen because it identifies regional construction costs relative to the national base of 1.00. The index identifies 36 major construction markets throughout the country.

Not all major cities are listed in the ENR index, nor are all states represented. To fill in the geographical gaps in the index, the 36 construction markets were mapped and then abutting states and regions with similar characteristics were assigned similar values. Several states had considerable variance in the construction costs for urban centres due to high labour and/or material cost (specifically, New York City, Boston, Philadelphia and the Bay Area in...
California). We therefore developed separate indices for select urban areas and the remaining portion of the state. The geographic index was applied to selected unit costs to normalize base values geographically. When the model user enters a project location (city and state) into the cost model, the model applies the geographic index to the construction cost to reflect cost for that state or urban area.2

Demand

The second part of the guidelines aims to provide robust estimates for the number of cyclists expected to use a given facility – an endeavour within the research community that is long on aspiration but, unfortunately, terribly short on execution. Generally speaking, research efforts to reliably determine the extent to which new facilities induce heightened levels of cycling from existing users, new users expected to cycle or a combination of both are still in their infancy. Differing analyses focus on cities as the unit of analysis (Nelson, 1997; Dill, 2003), individual facilities as the unit of analysis (Evenson et al., 2005), the role of culture (Rietveld & Daniel, 2004) and how close one needs to live to a facility to see heightened levels of use (Krizek & Johnson, 2006; Krizek et al., 2007b). In terms of correlating new facilities with more cyclists, unfortunately, the story is not clear.

Mixed findings from existing research can be traced back to wrestling with issues such as endogeneity (self-selection), seasonal fluctuation of use and reliably measuring levels of bicycle use (Krizek et al., 2007a), particularly in the United States, where rates are so relatively low. Notwithstanding the shortcomings involved in drawing conclusions from cross-sectional research, a reliable pattern emerges in terms of environments more conducive to cycling. For example, evidence exists to suggest features of the built environment matter (Pikora et al., 2003); that is, where there are bicycle facilities, there are more cyclists. In addition, factors such as increased density and various sociodemographic characteristics of residents correlate well with higher levels of use (e.g. college-age students or populations in the 20 – 40 year age cohort).

Our procedure to estimate the demand for cycling facilities synthesizes knowledge available from previous research with the following four assumptions.

1. Because census bicycle commuting rates are available for all US cities, we use these as the basis for estimating overall levels of cycling in an area around a facility (Barnes & Krizek, 2005).
2. All existing bicyclists within the vicinity of a new proposed facility will shift to the new facility, assuming there is no comparable facility within the immediate area.
3. Residents who live closer to facilities are more likely to use them than residents living further away. Thus, the more residents living within close proximity to facilities, the more people will use the facility. Research pursued as part of the project and more fully described elsewhere, uncovered that urban residents are more likely to ride a bicycle if they live within 1600 m
(1 mile) of a facility than if they live outside this distance (Krizek & Johnson, 2006). Furthermore, the likelihood of bicycling increases even more at 800 and 400 m. We therefore estimate existing and induced demand using 400, 800, and 1,200 m buffers around a facility.

4. The fourth assumption addresses the amount of new users that may be induced, an extremely sensitive topic within the research community. Anecdotal accounts far and wide suggest that new facilities are successful in inducing new users; when an attractive cycle path is built – especially one that connects origins and destinations to which people travel – people use it. Some of the users are existing cyclists that come for a superior riding experience (see assumption 2), though there are some new cyclists that are born. By and large, rates of cycling increase (Barnes et al., 2006, p. 16).

However, such enthusiasm needs to be considerably tempered by the fact that there is extremely minimal research documenting a causal effect between facilities and new users (see, for example, Evenson, 2005). Until more robust research emerges that uses longitudinal data to document how a facility attracts new cyclists, our best strategy assumes that the proposed facility will induce new bicyclists as a function of the number of existing bicyclists within the area. The strength of the function depends on characteristics of the proposed facility.

General findings from the research, combined with the above assumptions, provide the basis for information prompted by the guidelines. At the Demand/Benefits Inputs stage (Figure 6), the user is queried about the residential density within 400 meters, 400–799 meters, and 800–1,200 meters of the facility to estimate the bicycle commute mode share. Should such statistics be too onerous for the user to uncover, the average density for the Metropolitan Statistical Area is used as a default value, though the user is strongly encouraged to adjust such values for more reliable estimates. Lastly, the planner or project manager is asked to enter the median household size and other basic sociodemographic characteristics from the census as well as median property value in the area surrounding the facility.

We base our estimates of existing bicycling demand on US Census journey to work mode shares (US Department of Transportation, 2003), an approach proven elsewhere (Barnes & Krizek, 2005). We establish the number of residents within 400, 800, and 1,200 m buffers of the facility by multiplying the area of each buffer by a user-supplied population density. To identify the number of existing daily bicycle commuters who will shift to the new facility, we multiply the number of residents in each buffer (R) by 0.4, assuming that 80% of residents are adults and 50% of adults work and therefore commute. We then multiply this number of commuters in each buffer by the region’s bicycle commute share (C).

\[
daily \text{ existing bicycle commuters} = R \times C \times 0.4
\]

Adult commuters represent only a portion of adult bicyclists. We compared US Census (US Department of Transportation, 2000) commute shares to National
Household Transportation Survey (NHTS; US Department of Transportation, 2003) data and found that the total adult bicycling rate ranges from the Census commute rate at the low end, to 0.6% plus three times the commute rate at the high end (Barnes & Krizek, 2005). This allows us to use readily available Census commute shares to extrapolate total adult bicycling rates ($T$).

$$
T_{\text{high}} = 0.6 + 3C \\
T_{\text{moderate}} = 0.4 + 1.2C \\
T_{\text{low}} = C
$$

We multiply the estimated low, moderate and high rates by the number of adults in each buffer to arrive at the total number of daily adult cyclists. We multiply the number of residents in each buffer by 0.8 to account for the approximate 20% (Metropolitan Council, 2003; US Department of Transportation, 2003) of the population that are children. Our calculations do not include children because their cycling behaviour is less likely to be influenced by the presence of a facility. In addition, the benefits of cycling on children are different from the influence of cycling on adults.

$$
\text{total daily existing adult cyclists} = R \times T \times 0.8
$$

We then multiply each of the existing cycling groups (commuters and total adults) by the likelihood multipliers found from our research ($L$) (minus one).
For each buffer, we provide an estimated number of induced cyclists in each group.

\[
\text{new commuters} = \sum (\text{existing commuters} \times (L_d - 1)) \\
\quad \quad \text{with } d = 400 \text{ m; 800 m; 1,200 m}
\]

\[
\text{new adult cyclists} = \sum (\text{existing adult cyclists} \times (L_d - 1)) \\
\quad \quad \text{with } d = 400 \text{ m; 800 m; 1,200 m}
\]

Where

\[
L_{400\text{m}} = 2.04 \\
L_{800\text{m}} = 1.54 \\
L_{1,200\text{m}} = 1.21
\]

**Economic Benefits**

The third module focuses on estimating the value of economic benefits from such facilities. Past research suggests bicycle facilities are likely to produce disparate economic benefits depending on the specific context (a recreationally oriented cycle path in a rural area will likely produce different benefits than a facility in a major urban commuting area, for example) (Krizek, in press). The central challenge for urban planners, policy officials and researchers is to focus on the benefits of bicycle facilities that pointedly satisfy certain criteria. Such criteria are invariably related to the setting, the purpose, and overall context of the application. For example, several exercises from international settings compare the economic impact of cycling to entire ‘large-scale’ settings. These applications are quite general in nature. After reviewing existing literature on the subject and canvassing available methods, we determined that the most appropriate benefits to measure are those that can be: (1) measured on a community, municipal or perhaps, regional scale; (2) central to assisting decision-makers about transportation/urban planning; (3) estimable via available existing data or other survey means; (4) converted to measures comparable to one another; (5) measured for both users of the facility and non-users (i.e. the community at large).

The benefits estimated in the guidelines are informed by previous research and include *direct* benefits to the user (in the form of what we refer to as mobility, health and safety benefits) and *indirect* benefits to society (in the form of decreased automobile use, increased livability and fiscal savings). Other benefits certainly exist and the beneficiaries suggested above are not always clear. Our aim in this application is not to dismiss their significance but merely suggest that practical considerations related to data, methodologies and measurement often preclude more detailed analysis. The six benefits mentioned usually have different beneficiaries. These range from society-at-large to individual users (potential and current) to agencies; there is crossover between beneficiaries for each benefit. Consider, for example, that the most common argument in favour of building
cycle paths is that an increase in facilities will result in increased levels of cycling. This assumed increase in cycling will be derived from: (1) existing cyclists whose current levels of riding may be heightened (because of more attractive facilities), and/or (2) potential cyclists whose probability for riding will be increased. There are potential benefits for two different populations of beneficiaries (current and potential cyclists). However, if any of these heightened levels of cycling result in decreased automobile use, then an third beneficiary results, society-at-large, in terms of possibly reduced resource consumption.

We next overview the procedures used to estimate each type of benefit. More detailed descriptions of each are available where cited, or elsewhere (Krizek et al., 2006).

Direct Benefits to Users

According to our framework, benefits that can be reliably estimated and those that would be realized by users include benefits that increase their mobility, health, level of recreation and safety. Each benefit is estimated as a product of how many users are likely to be taking advantage of the facility multiplied by the value ascribed by the various benefit.

Mobility. To calculate the mobility benefit we used a robust stated preference analysis to discover that bicycle commuters are willing to spend, on average 20.38 extra minutes per trip to travel on an off-street bicycle path when the alternative is riding on a street with parked cars (Tilahun et al., 2007). Commuters are willing to spend 18.02 minutes (M) for an on-street bicycle lane without parking and 15.83 minutes for a lane with parking. Assuming an hourly value of time (V) of $12, the per trip benefit is $4.08, $3.60 and $3.17, respectively (Kruesi, 1997, p. 33). We multiply the per trip benefit for the appropriate facility by the number of daily existing and induced commuters, then double it to include trips both to and from work. This results in a daily mobility benefit. Multiplying the daily benefit by 50 weeks per year and 5 days per week results in an annual benefit:

\[
\text{annual mobility benefit} = \frac{M \times V}{60} \times (\text{existing commuters} + \text{new commuters}) \times 50 \times 5 \times 2
\]

Recreation. To develop a reliable measure for the value of the recreation benefits we analysed a wide variety of studies of outdoor recreational activities (non-bicycling). These studies generated typical values of about $40 per day in 2004 dollars (San Francisco County Transportation Authority Department of Parking and Traffic, 2004). If a typical day of recreation is about four hours, this would be about $10/hour. Note that this is an estimate of the net benefits, above and beyond the value of the time taken by the activity itself. This estimate is also in line with a recent study of urban cycle paths in Indianapolis, which used the travel cost method to find typical implied values per trip of about $7–20 (City and County of Denver City Engineering Project Management Office, 2002, pp. 1–42).
Both NHTS and Twin Cities TBI (Metropolitan Council) reveal that the average adult cycling day includes about 40 minutes of cycling. We use this, plus some preparation and cleanup time to arrive at the assumption that the typical day of bicycling involves about an hour of bicycling activity, thus we value a day at $10 (D). We multiply this by the number of new cyclists minus the number of new commuters:

\[
\text{annual recreation benefit} = D \times 365 \times (\text{total new cyclists} - \text{new commuters})
\]

**Health.** Approaches to value the user’s direct benefit related to health vary considerably in methodology and scope. First, annual per capita cost savings for an ‘average’ person who engages in 30 minutes of physical activity on a daily basis vary between $19 and $1,175 with a median value of $128. Second, some studies are disaggregate in nature and estimate costs by inpatient, outpatient and pharmacy claims; others compare average healthcare expenditures of physically active versus inactive individuals. Third, some use a dichotomized approach to operationalize physically active individuals while others employ a modifiable health risks approach and do so in a relatively continuous scale. The studies are difficult to compare, however, because some include different conditions, outpatient and pharmacy costs, and actual paid amounts rather than charges. Nonetheless, existing literature provides adequate, though developing, methodologies for estimating the public health impact of bicycle facilities in terms of economic impacts.

The above thinking and approaches have recently been made more accessible to planners, decision-makers and the public through the Robert Wood Johnson’s Active Leadership Program. The guidelines rely on a series of averages, available as a physical inactivity calculator (Robert Wood Johnson Foundation, 2005) to estimate the financial cost of physically inactive people to a particular community, city, state or business. It also supplies companion resources and information you need to reallocate resources and plan for healthier workplaces and communities that are more supportive of physical activity.

**Safety.** The most reliable strategy to estimate safety benefits stems from the concept of safety in numbers, where the likelihood of bicycle-automobile crashes interact in a non-linear manner (the exponent for growth in injuries is roughly 0.4) for an entire metropolitan area. Applying this concept, one would need to calculate the total bicyclists at the metropolitan level (X). Then one could compute \(1 \times X \times 0.4\). This number provides the additional bicycle safety cost of adding bicyclists. The cost of car crashes could even be reduced by the proportional reduction in cars on the road. Then, each additional bicyclist increases the total number and thus total cost of bicycle crashes (though not the per unit cost). In low-volume portions of the nonlinear relation, the decrease in fatality rate outpaces the increase in volume so that, even with more cyclists, the number (not just the rate) of fatalities decreases. Values for the benefits and costs of such crashes could be obtained from third party sources (e.g. http://www.oim.dot.state.mn.us/EASS/), which typically summarize the cost per injury of car crashes per type.
Indirect Benefits to Society

The benefits we assume to apply more generally to society at large come in the form of decreased automobile use, increased livability and fiscal savings.

Automobile Use. Decreased automobile use is the most publicized claim advocated by supporters of bicycle facilities. To the extent that bicycle facilities induce substitutes for what would otherwise be automobile trips—a claim that is somewhat dubious and difficult to ascertain—then there would be economic benefits to society in the form of reduced congestion, reduced air pollution and user cost savings (we recognize the latter applies more so to the user). Such benefits, where applicable, apply largely to commuter and other utilitarian travel, as we assume that recreational cycling does not replace automobile travel.

The best way to uncover a value for such is to multiply the total benefit per mile by the number of new commuters, multiplied by the average commute round trip length from NHTS (L). We then consider two offsetting adjustments that ultimately leave the total number unchanged. First, there are utilitarian riders in addition to commuters and some of these trips will replace automobile trips. Second, not all new bicycle commuters and utilitarian riders would have made the trip by car; evidence from NHTS suggests that something less than half of bicycle commuters use driving as their secondary commuting mode. For simplicity, we assume that these two factors offset each other, and thus the total amount of new bicycle commuter mileage is a reasonable number to use to represent the total amount of new bicycle riding substituting for driving.

The benefit per mile of replacing automobile travel with bicycle travel is a function of location and the time of day. There will be no congestion-reduction benefits in places or at times when there is no congestion. Pollution-reduction benefits will be higher in more densely populated areas and lower elsewhere. User cost savings will be higher during peak periods when stop-and-go traffic increases the cost of driving.

Congestion savings are estimated to be between zero and five cents per mile, and pollution savings from one to five cents per mile, depending on conditions (Barnes, 2004). We assume the high end of this range in central city areas, the middle range in suburban areas and the low end in small town and rural areas. For simplicity, we assume that all commuting and utilitarian trips are during congested periods. User cost savings were determined to be three cents per mile during congested peak periods and zero cents otherwise; thus, these are scaled by location in the same way as congestion savings (Barnes, 2004). Overall, the savings per mile (S) are 13 cents in urban areas, eight cents in suburban areas and one cent in small towns and rural areas:

\[
\text{reduced automobile use benefit} = \text{new commuters} \times L \times S \times 50 \times 5
\]

Livability. To the extent access to bicycle facilities are cherished and further a community’s livability, the dollar value people place on proximity to bicycle paths
should be capitalized in the prices of homes that are nearby. Therefore, measuring how much home-owners value proximity to bicycle facilities can be determined using hedonic modelling techniques to value housing attributes. Though relying on perceived impacts on property values, Crompton (2001) found predominant sentiment to be that the presence of a cycle path had a neutral impact on the saleability or value of property; in fact, some residents believed cycle paths reduced property values. The only other work based on actual sale prices (Lindsey et al., 2004) found that Marion County (Indiana) residents were willing to pay a slight premium to live within a quarter of a mile of the county’s flagship multipurpose cycle path; however, proximity to other multiuse greenway trails had a statistically insignificant but negative effect on property values. Our own revealed preference analysis of the effect of access to cycling-related infrastructure on home values (Krizek, 2006) showed: (1) three different types of bicycle facilities (on-street, road-side, non-road-side) are valued by residents differently, (2) that bicycle facilities have different values in the city than they do in the suburbs, and (3) in some instances, bicycle facilities are not even considered an amenity.

We use findings from our own analysis, which showed the effect of moving a median-priced home 400 m closer to a roadside bicycle facility reduces the sale price by $2,272, while moving a home 400 m closer to an off-street bicycle facility increases its value by $510 (Krizek, 2006). While proximity to any type of bicycle facilities in the suburbs reduces home sale prices, the negative effect of a roadside bicycle path is $1,059, while a non-roadside facility has a negative effect of only $240 (Krizek, 2006).

_Fiscal._ Finally, to the extent that rights of way for bicycle facilities could be procured earlier than later, then society reaps a benefit in the form of reduced costs. First, the price of land may rise faster than inflation. Second, acquiring the land now may ensure it is not developed, while not acquiring it now may require the destruction of recently constructed buildings. Placing a bicycle facility along the right of way is relatively inexpensive, ensures a transportation use for the corridor (ensuring it will not be viewed as a park land) and provides user benefits instead of allowing the land to lie fallow.

The economic value of right-of-way preservation can be estimated by multiplying the probability of use in the future by the difference of the net present value of future cost if not preserved and the present cost. Since acquiring a right of way that is already developed would be more expensive, this should output a positive value. The probability of future use is an important variable that is usually case specific, but it gets at the idea of preserving options. For example, a plan may suggest three alternative rights of way for a cycle path. The probability of any cycle path would then be less than one-third. Thus, the right-of-way preservation benefit would depend on the difference in costs multiplied by that probability. There are similar ways of estimating this value that might produce different results.

For example, the present cost of the right of way (ROW) could be estimated in the cost category; then consider ‘selling’ the right of way in the future to the other
transportation project as part of the salvage value of the bicycle facility. This salvage value is an estimate of the market value of the land. If the net present value of the salvage value exceeds the present cost, there may also be a right of preservation benefit. In such deliberations, it would be important to account for the discount value of completing the project – the present value of using available funds to complete a project and buying land for future projects later. For example, a benefit/cost ratio of 1.1 that would imply that one million dollars spent on a project will generate stream of benefits worth 1.1 million in present dollars. We could take this as the baseline and compare early ROW purchase to it. That is, the baseline is that some amount of money ‘x’ greater than $1 million will be spent to buy ROW in the future.

To estimate the present value of using the million dollars to buy ROW for future use, delaying a hypothetical project that would have been done with that money, consider how that benefit stream would change. First, a given project may eventually generate the same stream of benefits, but delayed by ‘n’ years, giving a lower present value. However, the money that is saved (x minus $1 million) by not paying a higher price later for the land, means that an additional project can be done at that time, yielding extra benefits, again starting ‘n’ years in the future.

Conclusions and Future Development

Spurred by concerns related to traffic congestion, public health or quality of life, communities worldwide are increasingly interested in increasing rates of cycling. An important part of such efforts relates to the planning for cycling facilities. A central problem troubling planning efforts is that cycling currently lacks the tools and methodologies that are available for automobiles and transit related to forecasting and benefit/cost calculations. This article overviews and describes the workings of an online tool to help cycling stand on equal footing with these other modes.

The guidelines have undergone extensive testing from communities nationwide. Initial feedback suggests users appreciate its easy-to-use accessibility by virtue of being online and its versatility. For example, a neighbourhood group with minimal resources is able to input minimal specifications to obtain ballpark estimates; likewise a professional planner could enter highly detailed information to obtain more accurate cost, demand and benefit estimates. National groups have commented on the value of its consistent framework.

The tool helps move the practice of transportation planning for bicycle facilities from anecdote to testable evidence by developing robust methodologies, analysing the results and translating the results into guidelines useful for the practising planner. Notwithstanding the valiant strides the tool makes in moving forward the practice of bicycle planning, we continue to make refinements, mainly in the area of relaxing many of the assumptions embedded within the calculations. We continue to conduct primary and secondary research to best account for:

- The number of new users induced by constructing a new bicycle facility. What research can be relied on to demonstrate the phenomenon, ‘if you build it, they will come’.
The drawing power of different bicycle facilities for cycling for recreation versus cycling for commuting.

The differing impact of bicycle facilities by population segments. A new off-road facility may have a larger impact for families with children versus more skilled cyclists with fewer constraints related to their cycling environment.

The differences in cyclists’ value of time. Individuals may value time differently by geography (urban versus rural areas), temporally (morning versus evening), purpose (commuting versus recreational travel) etc.

The differences in having a tool available for general purposes that enable comparisons across a variety of settings versus tailoring it for relatively specific applications.

Further research to inform each of these dimensions will produce more reliable and better estimates for the costs, demand and benefits of bicycle activity and bicycle facilities. We encourage and anticipate others refining and adding to these methods, which will ultimately lead to sharper research results as well as better policy decisions on bicycle facility investment. Advancements will help further the ultimate goal of providing a tool for urban planners, policy officials and decision-makers that stands on equal footing with other modes of transportation in the form of an easy-to-use, defendable assessment of the costs, demand and benefits of a bicycle facility.

Acknowledgements

Funding for this work was provided by the National Cooperative Highway Research Program (Project 7–14) and the Minnesota Department of Transportation. Several individuals were instrumental in devising the guidelines including David Levinson, Nebiyou Tilahum and Katherine Reilly (University of Minnesota), David Loutzenheiser and Don Kidston (Planner’s Collaborative) and Bill Hunter (UNC-Chapel Hill).

Notes

1. The Bicycle Encyclopedia of 73 terms includes a mix of definitions and illustrations.
2. Data related to cost was not uncovered for either Alaska or Hawaii. The user may use the default national values, though it is suspected that construction costs in both states may be higher than average due to their remote locations. The user is encouraged to enter construction factors if known.
3. Three different groups provided written comments to the online tool: active living by design partnership communities (4), specifically targeted individuals familiar with bicycle planning issues (5) and responses to a general announcement of the beta form of the online tool sent to interested email groups (5).

References


Online Guidelines for Bicycle Facilities

City and County of Denver City Engineering Project Management Office (2002) 1999 Cost Data (Denver, CO, City and County of Denver City).


