Measuring the Impacts of Bicycle Infrastructure Through Monitoring and Evaluation

Organization

Vancouver, BC and Minneapolis, MN.

Status

Implemented in 2006 in Vancouver and 2007 in Minneapolis. Both programs are ongoing.

Overview

A large body of research identifies an array of benefits of increasing the mode share of cycling. Some of these benefits include increased mobility, improved air quality, decreased congestion, and improved safety (Nation Cooperative Highway Research Program, 2006). While a common justification for bicycle infrastructure projects is based around the mantra "build it and they will come," such investments are not always successful. Cities require reliable and verifiable proof their investments in bicycle infrastructure are in fact attracting more bicyclists. For this reason, numerous cities – in this case Vancouver, BC and Minneapolis, MN – are monitoring their bicycle infrastructure networks to validate their assumptions, justify investments, and inform the design and location of future facilities. Some of these techniques include analyzing secondary data such as crash statistics and census data, and gathering primary data such as bicycle counts and surveys.

Resources

Cycling in Vancouver
http://vancouver.ca/bike

Cycling in Minneapolis
http://www.ci.minneapolis.mn.us/bicycles/index.asp

Benefit-Cost Analysis of Bicycle Facilities
http://www.bicyclinginfo.org/bikecost

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Community Context

Across North America, cities are increasingly looking towards non-motorized modes of transportation to alleviate traffic congestion, improve air quality, and increase the standard of living for residents. According to the 2006 Census of Canada, the average mode share for bicycle commuters across the country is 1.3%. The figure for the United States is significantly lower at 0.4%.

Vancouver, BC and Minneapolis, MN have actively promoted bicycling and expanded their bicycle infrastructure. Both cities are widely considered among the best for cycling in each country. Each has also recently approved bicycle transportation plans to further expand their bicycle infrastructure and facilities, improve bicycle safety, and increase the mode share of bicycles. Moreover, both cities have taken care to monitor and measure the use of their facilities and have noted steady increases in their bicycle mode share over that period.

Vancouver, BC

Vancouver is British Columbia's largest city, with a population of 578,000 in the city proper and 2,116,000 in the metropolitan area. Since constructing its first bicycle lanes in 1985 and approving its first Comprehensive Bicycle Plan in 1988, it has seen its bicycle mode share increase steadily. Vancouver's current bicycle mode is 3.7%, significantly higher than the national

average. Mode shares are as high as 12% in some Vancouver neighbourhoods.

To date, Vancouver has constructed more than 400 km of on- and off-street bicycle routes throughout the city. Bicycle routes in Vancouver include painted bicycle lanes, residential streets with bicycle priority, and separated bike paths.

Minneapolis, MN
Minneapolis is the largest city in Minnesota with a population of approximately 385,000 in the city proper and 3,268,000 in the metropolitan area (including the state capital, St. Paul). In 2005, Minneapolis received $22 million from the United States Department of Transportation's (USDOT) Non-motorized Pilot Program. These funds were used to develop innovative non-motorized transportation programs and monitor their impacts on traffic congestion, environmental and personal health, and energy use.

Minneapolis' bicycle mode share is significantly higher than the United States national average at 3.8%. This figure gives Minneapolis the second highest share of bicycle commuters in the fifty most populated cities in the United States, slightly behind Portland, Oregon with 3.9%. In 2010, *Bicycling Magazine* ranked Minneapolis as the "Top City for Cycling" in the United States.

Minneapolis has more than 200 km of on- and off-street bicycle paths. During 2010, the City plans to add an additional 70 km of on-street bike lanes to the network as well as more than 15 km of bicycle boulevards and 8 km of off-street bicycle paths. The City also provides bike lockers throughout its downtown, at the University of Minnesota campus, and at major transit stations for an annual membership fee. A limited number of these locker facilities have showers available for commuters.

Policy Context

Vancouver, BC
Since the mid-1980s, Vancouver has worked to improve cycling as an alternative mode of transportation in the city and has carried out ongoing monitoring and evaluation of its work. This support is reflected in various policy documents over this period.
In 1985, City Council formed the Bicycle Advisory Committee with the mandate to, among other things, "evaluate bicycle facilities and promote motorist and cyclist awareness, competence, and safety." However, by the time the City passed the 1999 Bicycle Plan, it was determined that "little information [had] been gathered to measure the effectiveness of the routes for cyclists and their acceptance by residents" (City of Vancouver, 1999).

Vancouver's 1997 Transportation Plan committed the City to "undertake regular monitoring and review of transportation services…to establish how transportation patterns are developing, and to recommend additional policies and measures needed to achieve the Transportation Plan's policies and targets." Among the action initiatives for carrying out this policy was designing a "monitoring and review program for transportation as a basis for guiding future policies and budgeting" (City of Vancouver, 1997).

The 1999 Bicycle Plan builds on the policy statements for monitoring bicycle usage from the 1997 Transportation Plan. Its recommendations included:

- Counting bicycles using both automated and manual methods to better determine bicycle volumes along the bikeways and other streets.
- Conducting bicycle cordon counts on a regular basis to accurately measure the modal split for bicycles and the effectiveness of cycling programs and initiatives.
- Monitoring vehicle traffic along the bikeways and taking remedial actions where needed.
- Monitoring collisions involving cyclists to identify intersections or locations requiring modifications and to ensure a decline in the number and severity of bicycle collisions.

- Analyzing crime statistics to ensure that there is a continued lack of correlation between crime and the presence of a bicycle facility (City of Vancouver, 1999)

In May 2010, funding was approved to develop a monitoring strategy to evaluate the effectiveness of investments in bicycle infrastructure and "provide staff and Council with information needed to understand and verify observations and assumptions, obtain regular feedback, and assess whether the objectives of the Cycling Program are being met" (City of Vancouver, 2010). The new program has a mandate to:

- Collect the information needed to develop a greater understanding of cycling program initiatives most likely to increase bicycle mode share;
- Collect the baseline data needed for defensible evaluation of the new Cycling Plan; and
- Build on recent advancements in automatic bicycle counting to facilitate efficient, timely and transparent reporting (City of Vancouver, 2010).

Minneapolis, Minnesota

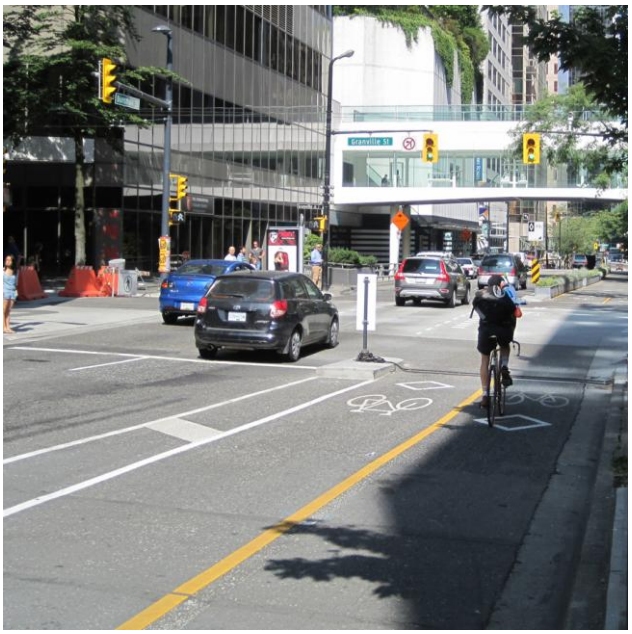
Minneapolis' commitment to bicycle transportation is reflected in numerous policy documents. Some of these documents include the Capital Improvement Budget, the Comprehensive Plan, various city ordinances, and Access Minneapolis, Minneapolis' transportation plan. In 2001, City Council approved the Bicycle Master Plan Map, outlining the future directions for bicycle infrastructure in the city. Currently, the Public Works Department is working on a new Bicycle Master Plan which will, among other items, update the 2001 Bicycle Master Plan Map. The objectives of the new Bicycle Plan are to:

- Increase the mode share of bicycles in Minneapolis; and,
- Improve the safety of cyclists in Minneapolis.

The new Bicycle Master Plan will also be based around the "Six Es" of bicycle transportation planning developed by the League of American Bicyclists:

- Equality;
- Engineering;
- Enforcement;
- Education;
- Encouragement; and,
- Evaluation

The evaluation objective refers to the "measurement of the effects of the other Es using relevant research, methods, and testing" (League of American Bicyclists, n.d.).



Pneumatic Tube Counter on Dunsmuir Street, Vancouver

Rationale & Objectives

Many major North American cities have developed and approved bicycle transportation plans to facilitate the expansion of bicycle infrastructure and facilities, promote bicycle mobility, improve bicycle safety, and increase the mode share of bicycles in the city. Like any planning document, objectives and milestones are outlined in these bicycle master plans. Many of these milestones are based around monitoring the number of cyclists using the bicycle facilities and infrastructure to evaluate their effectiveness.

Since 1996 in Canada and 1980 in the United States, national censuses have tracked bicycle mode shares for trips to work. However, census

data alone cannot provide a complete picture since these figures only represent trips to work and not recreational trips. Moreover, the data does not indicate whether the bicycle infrastructure itself is being used. To determine whether investments in bicycle infrastructure are having an impact, many cities are applying methods to complement census data and evaluate the effectiveness of bicycle infrastructure investments.

In addition to measuring the growth in bicycle usage, monitoring bicycle infrastructure usage provides valuable information for siting new facilities. Poorly sited infrastructure projects may not see the desired levels of usage. Examples of this can be seen in some of the neighbourhoods in Vancouver where bicycle infrastructure exists, but the mode share remains low. Monitoring the usage of bicycle infrastructure provides evidence to confirm or dispel the common assumptions.

Actions & Results

Vancouver, BC
Vancouver has been conducting bicycle counts since 1993, when the City incorporated bicycle and pedestrian counts into its regular traffic counts. The Adanac Bikeway – stretching from Vancouver's eastern boundary into Downtown Vancouver – is one of the oldest bikeways with regular counts at determined locations along the route. Data over the period indicate that overall usage has increased and that the number of cyclists using the route increases with proximity to the central city. Early bicycle counts in Vancouver were conducted manually over a one-hour period during peak traffic hours. Since beginning counts on the Adanac Bikeway in 1993, the City has seen approximately a 300% increase in users.

In 1998, the City began using automated counting devices to measure bikeway usage, allowing the City to monitor usage patterns over extended periods. The devices used in Vancouver include infrared sensors, pneumatic tubes, and inductive loops. These devices, however, are generally less reliable than manual counts and have certain limitations. For example, since certain counters classify the vehicle type according to the vehicle's axel type, it is unable to distinguish between motorcycles and bicycles. As well, the counters were unable to record vehicles (including bicycles) travelling slower than 16 km/h.

Although it may seem at odds with the goals of a bicycle count program, counting vehicles is also important for the evaluation of bicycle networks. Many residential streets in Vancouver are designated bikeways. The City has implemented traffic calming measures along many of its bikeways in an effort to limit the amount of vehicles on the route to those using it for local access. Counting vehicles along bikeway routes provides valuable information about whether traffic calming measures are having an impact and, in turn, providing a safe route for cyclists.

Cordon counts enable planners to determine how many cyclists are entering a given area on any given day. Vancouver uses this method to determine the number of cyclists commuting to the downtown from outlying areas. Researchers first establish the bounds of the area and then determine entry and exits points for the area. Since first carrying out cordon counts for the downtown, Vancouver has seen the average amount of cyclists entering the downtown on any given day increase nearly two-fold.

Minneapolis, MN
Although Minneapolis has been carrying out bicycle counts since the mid-1970s, the city had not conducted a comprehensive city-wide count until 2007. Counts from the mid-1970s focused on limited geographic areas, such as the downtown area and University of Minnesota campus. Since 2000, however, the city has been carrying out bicycle counts across the city, although on a 'spot-by-spot' basis. Since 2007, 12-hour counts have been conducted annually. These counts are supplemented with two-hour counts four times per year conducted by Transit for Livable Communities, a local nonprofit bicycle advocacy group.

In addition to quantitative data, Minneapolis also collects qualitative data to assess its bicycle

infrastructure. The City carries out these surveys 'sporadically' to help understand some of the perceptions of and barriers to bicycling in the city. The City sends out surveys through a listserve with more than 2,000 recipients and uses community groups and non-profits to get the word out.

Methodology

As with any primary research, it is important to establish a clear methodology when monitoring bicycle usage. Vancouver's methodology takes into account two main concerns -- scheduling and location. Minneapolis addresses similar concerns in its reports. In addition, both cities take into account weather conditions during the counts.

Scheduling
Clearly outlining the timing for bicycle counts can help eliminate discrepancies in data. To record peak commuter hours, Vancouver uses a recording time between 7am and 9am in the morning and between 3:30pm and 5:30pm in the evening. To record seasonal variations, automatic counters are used throughout the year and manual counters once per season. Staff also outlines the days during which counts occur. Recording days include Tuesdays, Wednesdays, and Thursdays, excluding those occurring before a holiday.

Locations
Establishing the locations for monitoring provides a consistent base against which other data can be compared. For regular count locations, staff in Vancouver developed criteria to determine where to locate counters. Points for conducting counts are located:

- Within 1 km of the entry and exit point;
- At all intersecting major bikeways;
- Between arterials; and,
- Where possible, on off-street paths along the bikeway.

Seasonal/Weather Variations
Since many cyclists use the bike facilities year-round, Vancouver monitors bicycle usage throughout the year, noting weather conditions. However, weather is an important determinant for many riders when planning their commute. Recording the weather conditions provides context to the data and helps researchers better understand peaks and troughs in the data.

Inductive Loop Counter on Burrard Street Bridge, Vancouver

Monetizing Benefits

The inputs for bicycle infrastructure investments are easy to estimate, as the costs of gravel, asphalt, paint, and labour are already monetized values. The benefits of bicycle infrastructure, on the other hand, are far more difficult to assess. Although Vancouver has not made any attempt to monetize these benefits, it intends to examine the field more closely since receiving funding for the new monitoring strategy in May 2010. While Minneapolis has made attempts to monetize the benefits, staff have found it difficult to quantify many of the benefits and arrive at consensus on the measures from various agencies.

Krizek et al. (2006), for the National Cooperative Highway Research Program (NCHRP) in the United States, has developed a set of guidelines for estimating the monetized benefit of bicycle infrastructure. Similar measures have not been developed for Canada. As such, all figures are measured in US dollars. Monetized benefits are based around the number of new cyclists a program attracts. Therefore, monitoring the

number of cyclists is at the root of monetizing the benefits of any intervention.

Deriving figures from stated preference surveys, researchers have developed an approach for monetizing the benefits of investments in bicycle infrastructure. Some of these benefits include:

- Mobility Benefit;
- Health Benefit;
- Recreational Benefit; and,
- Reduced Auto Use Benefit.

Using these measures, bicyclinginfo.org developed a cost calculator for bicycle infrastructure projects for different United States cities using United States Census data. If a city is not on the list, users can manually input the necessary data (e.g. current bicycle mode share, population density in relation to the proposed facility) from their census tract. Based on the information, the calculator provides an estimate of demand (new commuters) for the proposed facility and the monetized benefits (mobility, health, recreation, and reduced auto use). As well, based on the type of facility selected and the scope of the project, the calculator will estimate the capital costs. For more information visit http://www.bicyclinginfo.org/bikecost/.

Challenges

City staff responsible for bicycle count programs in Vancouver and Minneapolis identified several challenges to effectively monitoring bicycle facilities. Some of these challenges include:

- **Determining Causality:** There are many factors that influence people's choice to ride their bicycles. With so many factors at play, facility usage may not be attributable to the development of the facility or infrastructure alone. For example, while Vancouver was able to demonstrate that more cyclists used the Burrard Bridge after removing a traffic lane and installing a safer, traffic separated bike lane, staff felt that the rate of increase in riders could also be partly attributable to the significant media attention the somewhat contentious project received.

- **Balancing Technology and Labour:** Using volunteer labour for manual counts can save a significant amount of money. However, coordinating a large group of volunteers can be difficult. Automated counting devices perform best on off-street bicycle paths. When used for on-street paths, meandering vehicles may accidentally trigger automated counting devices.

Best Practices

While Vancouver and Minneapolis have worked to develop their bicycle monitoring strategies, they are not the only cities to do so. Current research and transportation planning literature identifies many best practices when evaluating bicycle infrastructure investments. Some of these include:

- **Be Clear.** Successful evaluation requires clear study objectives and indicators, or measures. Indicators should be measurable so researchers can determine whether or not the program is having the desired or intended impact. Objectives and indicators of success should be established at the beginning of the study.

- **Use multiple methods.** Census data alone cannot provide a complete picture of bicycle usage. As such, other methods are necessary to more reliably determine the levels of use. Vancouver's bicycle count program has embraced this by using automated counting devices and permanent counting stations in its evaluation methodology.

Resources

The extent of each city's bicycle network and desired scope of analysis are the primary determinant of costs for bicycle counting programs. However, other decisions will impact

the costs of a program. For example, the decisions as to whether to pay manual counters, seek volunteers, or acquire automatic counting devices will also influence the budget.

Vancouver's bicycle count program recently received $400,000 from Council, some of which has already been used to purchase more automated counting devices. A portion of this funding will be used to develop and administer a survey on the quality of the bicycle network. A consulting company will administer the survey.

On the other hand, Minneapolis relies heavily on volunteer support to carry out its bicycle counts. Its 2007 bicycle counts were conducted by the Public Works Department with support from various non-profits operating in the city. Volunteers came from various non-profit groups through the city, including Transit for Livable Communities and Americorps.

Lessons Learned

Based on the experiences of staff in Vancouver and Minneapolis, the following lessons can prove to be valuable to other departments beginning to monitor their bicycle infrastructure investments.

- **Start early.** Single usage counts provide little information for evaluation. The more data available, the richer the evaluation. Baseline data is important to note difference in usage in a given area before and after a design intervention.

- **Build Partnerships.** Coordinating a large group of volunteers to conduct manual counts can be difficult, while using city staff can lead to higher costs. Building partnerships with non-profit bicycle advocacy groups can mitigate these issues and provide valuable labour support. Transport for Livable Communities in Minneapolis provides support for the City's annual bicycle counts and conducts its own counts.

- **Act Strategically.** There are nearly limitless survey points to select from when beginning a bicycle monitoring program. Departments carrying out these counts have limited resources and need to choose the counting locations wisely. Identifying 'pinch points' and 'travelsheds' – points at which people from a wide geographic area are funneled into – can help strategically distribute resources across the city. Moreover, these locations are valuable for determining how many people are using the facilities from a wide area. Bridges are one of the most common of these points.

- **The more data the better.** Collecting more data improves the reliability of results. If the resources are available, longer counts are always preferred. Vancouver tries to use a minimum two-week period for its counts, but longer counts are even better. The longer the period, the more reliable the department's estimation of use and total number of cyclists is.

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