Memo

To	:	Kristen Simpson
From	:	Kees van Ommeren, Siebe Visser
Date	:	25 September 2014
Subject	:	Results “quick scan” social cost benefit analysis Seattle

Quick scan social cost benefit analysis 2nd Avenue Seattle

In this memo we present the results of a ‘quick scan’ Social Cost Benefit Analysis for the 2nd Avenue project in Seattle. We want to emphasize this analysis was a **quick scan** with partially Dutch indicators; the results should be seen in this light. We would be happy to do a full SCBA on one of your cycling projects in the planning phase in the near future, thereby using only American indicators and perform further analyses.

The case

In order to show the basics of Social Cost Benefit Analysis for cycling we asked you to give us some figures about a project in Seattle. You sent us some information about the bicycle lane that has just been built on Second Avenue. Before the project there was no separated bicycle lane and the crossings with Pike Street and Yesler Way were not adjusted to cyclists. As a result of this poor cycling infrastructure there were **61 collisions in the past 4,5 years**. Half of those, including one fatality, were from left-turning vehicles. The project includes separated left turn signals for cyclists, which will be of positive influence on the safety for cyclists. The investments in the cycle lane at Second Avenue were **between $1.2 and $1.5 million**.

The average daily volume was 1.100 in a week you measured, three times higher than before the project, but you don’t expect the volume to stay that high. For the current analysis the number of cyclists is not of great importance, because we **don’t expect any modal shift or travel time savings**. In a sensitivity analysis we did ‘play’ with the assumption that there would be a modal shift from car and public transport to cycling due to the project. The **total modal share of the bicycle** in the city is included; 3,3% in 2012. In the different scenarios we assumed a different growth rate of this modal share.

We give three different scenarios which we call **negative** (high investment, low growth of modal share, low reduction of traffic injuries), **positive** (low investment, high growth of modal share, no

traffic injuries on 2nd Avenue) and **middle** which uses the average of indicators from the negative and positive scenario. Notice that the change in modal share is not due to the 2nd Avenue project, but based on predictions by the 2012 Center City Commuter Mode Split Survey. All the input factors are given in table 1.

Indicators and Model

With these figures we were able to calculate the costs and benefits using American indicators as much as available, complemented with Dutch indicators from earlier CBA's we performed in the Netherlands. To monetize traffic accidents we use the *value of statistical life* (VSL) set by the U.S. Department of Transportation (2014). For non-fatal accidents we calculated an average of five stages of severity, running from 'minor' to 'critical'.[1] The monetary value is based on the VSL for fatal accidents.

Table 1: input for the CBA

	Negative	Middle	Positive
Costs			
Investment costs	$1.500.000	$1.350.000	$1.200.000
Maintenance costs (annually)	5% of investment	2% of investment	1% of investment
Cycling numbers			
Current number of cyclists	400	400	400
Modal share bicycle	3,3% in 2012, 10% in 2041	3,3% in 2012, 10% in 2031	3,3% in 2012, 10% in 2026
Safety			
Fatal accidents before project (annually)	0,2	0,2	0,2
Cyclists injured before project (annually)	6,6	6,6	6,6
Reduction accidents	30%	60%	100%
Value of statistical life (fatal accident)	$9.200.000	$9.200.000	$9.200.000
Value of traffic injury (average)	$336.628	$336.628	$336.628

We calculate all costs and benefits for the 100 years to come and express these values in **Net Present Value (NPV).** This means that all amounts are brought back to what the worth would be today. To calculate NPV's we use a **discount rate of 5,5% per year**. The basic idea behind this calculation is the following: an amount of $1000 dollars today is worth more than the same amount 5 years later. You could earn interest from the bank or by investing this $1000 (e.g. 2%) so that your $1000 today will be more than $1100 five years later. In the same way a benefit due to better road safety in 2020 has to be calculated back to its value today. This step in the CBA is especially important when comparing different alternatives – for instance a separated bicycle path versus a mixed traffic solution. Effects of both alternatives can come up at different moments during those hundred years. To make them comparable we have to express them in comparable values which is NPV.

[1] Thereby making an assumption about the fractions of accidents allocated to these five categories (see "indicators used at the last pages of this memo)

Results

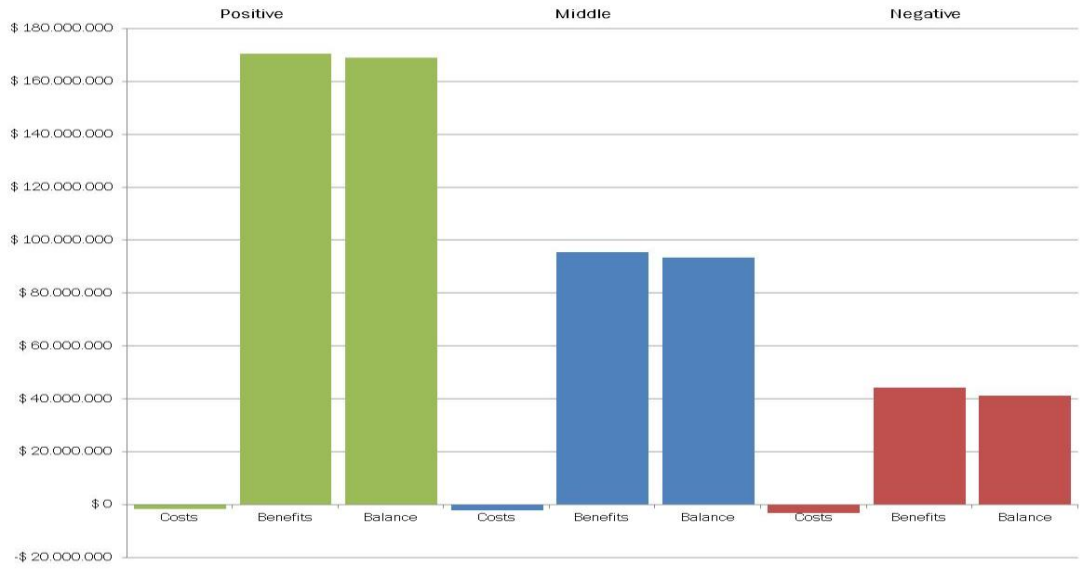
The CBA model we used for this analysis is based on our webtool for CBA on cycling investments in the Netherlands.[2] We changed indicators and economic growth figures to the U.S. situation and then calculated the costs and benefits in NPV. Table 2 below shows the results for three scenarios.

Table 2 Costs and Benefits in three different scenarios (Net Present Values)

	Negative	Middle	Positive
Investment costs	-$1.500.000	-$1.350.000	-$1.200.000
Maintenance costs	-$1.356.500	-$488.300	-$217.000
Safety	$44.091.700	$95.297.100	$170.388.600
Balance	**$41.235.200**	**$93.458.800**	**$168.971.500**
Cost/Benefit ratio	**15**	**52**	**120**

All three scenarios have a very positive balance of costs and benefits. The investment of $1.2 - $ 1.5 million and maintenance costs between $0,2 and $1,3 million gives us **between $41 and $169 million in safety benefits**. Even in the most negative scenario the benefits due to the adjustments on Second Avenue are 15 times higher than the investment and maintenance costs (cost/benefit ratio). Even though this project only ensures one type of benefit – an increased safety – the benefits outweigh the benefits by far (also see figure 1 below).

Figure 1 Costs, benefits and balance of costs and benefits due to the adjustments on Second Avenue in three scenarios (all Net Present Values)

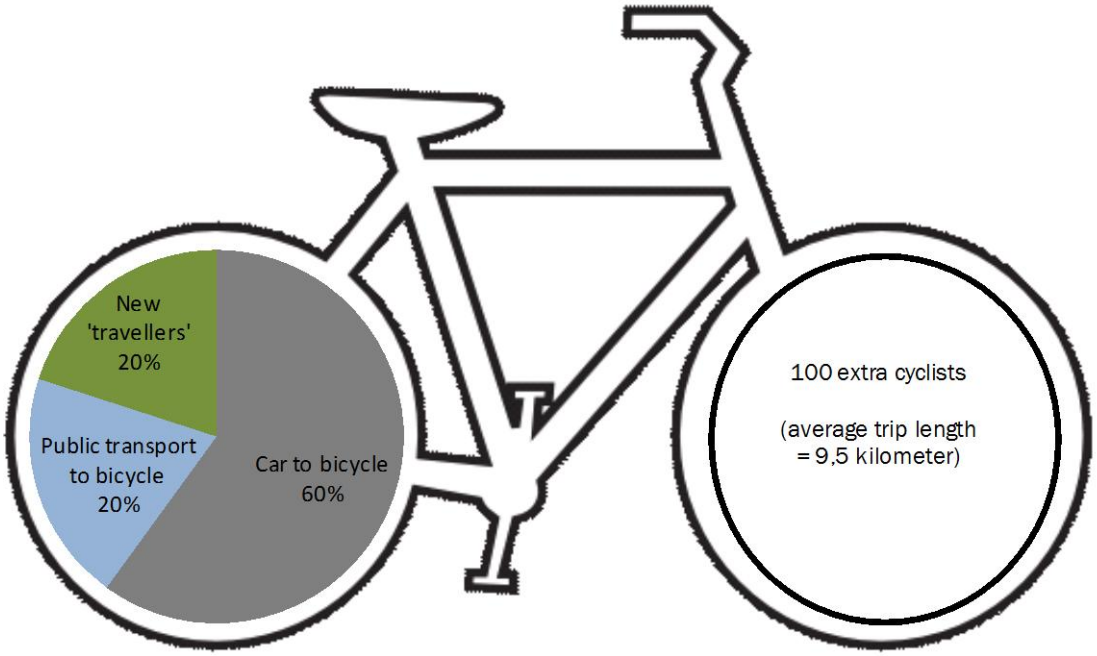


[2] http://www.fietsberaad.nl/mkba-fiets/index.cfm?action=nieuweinfrastructuur

Sensitivity analysis: Including changes in modal shift

There is no change in travel choice mode expected due to the Second Avenue project. Therefore only benefits from an increased safety were included in the CBA above. In order to give you an idea of other potential benefits (and costs) from investments in cycling we performed a sensitivity analysis by assuming that the project does induce a modal shift from the car and public transport to the bicycle. We assumed that the Second Avenue cycle path would attract 100 new cyclists, 20% of which were previously travelling by public transport, 60% of which were travelling by car and 20% of which were previously "sitting on the couch". This last group are people who didn't travel before and now start to cycle because of the new safe cycle path. The average trip length was given by the 2012 Center City Commuter Mode Split Survey (page 16).[3] Besides these changes we used all assumption from the 'middle' scenario.

Figure 2 Assumptions in the sensitivity analysis including modal shift to bicycle



This modal shift results in some other effects we didn't see in the CBA above (see table 3). Besides safety benefits the shift from car, public transport and 'couch' to the bicycle results in:

- **Travel time and reliability gains for car drivers**: a reduction of cars on the road results in less delay for the remaining cars on the road.
- **Less productivity loss**: because people get healthier due to their physical activity they will be less absent from work because of illness. Besides that healthier people are more productive and deliver better quality.

[3] The Gilmore Research Group (2012)

- **Health effects**: again, people get healthier due to the extra physical activity. This results in less hospitalizations and other health care costs.
- **Excises car transport**[4]: because some people leave their car in this analysis to start cycling, they will obviously buy less fuel for their car. And on every litre of car fuel an excise is paid to the government. Therefore, less excises means a negative public effect.
- **Public transport subsidies**: some of the new cyclists were previously travelling by public transport. With every person switching from bus to bike the chance of needing an extra bus lines in the near future decreases. Implementing extra buses would cost the public more subsidies (in the Netherlands public transport systems are quite heavily subsidized). A modal shift from bus to bike therefore results in a positive effect for society.

Table 3 Results from the CBA including a modal shift to the bicycle

	Costs	Benefits
Investment costs	-$1.200.000	
Maintenance costs	-$434.000	
Travel time and reliability gains car drivers		$115.600
Less productivity loss		$331.100
Health effects		$6.514.700
Excises car transport	-$187.400	
Public transport subsidies		$329.400
Environmental effects		$333.600
Total effects (excluding safety)	-$1.821.400	$7.624.500
Balance (excluding safety)		**$5.803.000**
Safety		$95.297.100
Total	**-$1.821.400**	**$102.921.600**
Balance		**$101.100.200**
Cost/benefit ratio		**57**

This analysis shows that the safety effects are by far the largest benefits in this project. The projects seems to be effective; the whole idea behind the project was to create a safer traffic environment for cyclists. The sensitivity analysis shows that a growth of **only 100 cyclists in Seattle ensures an extra $7,3 million of societal gains**. The health effects draw most attention here. More than $6,5 million on **health effects** due to these 100 cyclists; that equals **$65.000 per cyclist**. The other effects are marginal compared to health and safety effects, but still quite substantial when viewed on their own.

The travel time and reliability gains for those car drivers that stay on the road accounts for roughly $100.000 of the benefits. This figure has been calculated using Value of Time (VoT) indicators and the economic value of being more certain to arrive on time. As explained above the excises from car

[4] This number is based on the Dutch situation; in reality this effect will be less negative using U.S. excises.

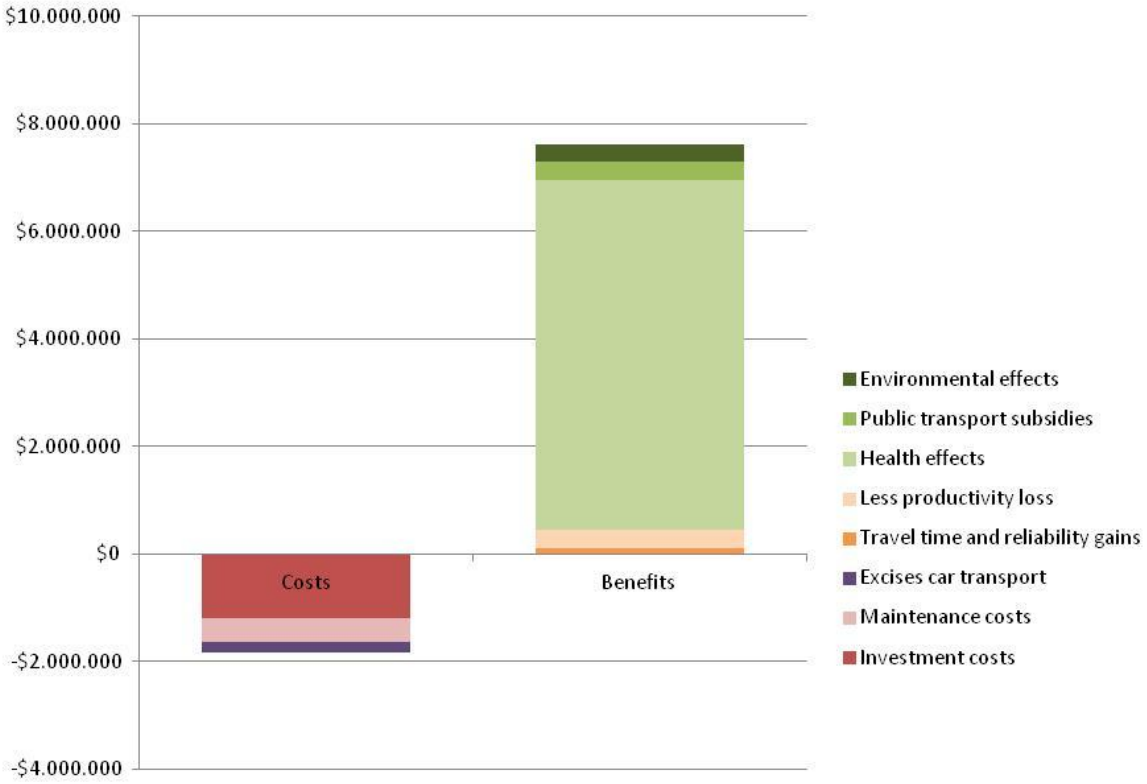
fuel drops down because some car drivers transfer to the bicycle. U.S. figures would be needed to calculate this effect more accurately.

The saved losses in productivity are roughly $300.000, which means that an average person who starts to cycle saves his employer some $3000. We must notice here that we used Dutch indicators to calculate this effect. **Using U.S. indicators would result in higher benefits**; because rates of physical activity are already quite high in the Netherlands the increase in cycling has only marginal effect.

Another positive effect of cycling that is often brought up is **the environmental effect**. The Dutch indicator that is used here includes a benefit per kilometre for the reduction in greenhouse gas emissions and the reduction of noise due to less cars (and buses) on the road. This brings another $333 thousand of societal benefits.

The same applies to the effect of public transport subsidies; Dutch indicators are used here. Using U.S. indicators would result in a different number. Notice that this analysis gives an indication of the set-up of societal benefits through different effects – some further research would be needed to find U.S. indicators for all effects.

Figure 3 Results of the modal shift from car, public transport and couch to bicycle, excluding safety effects (Net Present Values).



Conclusion: 2nd Avenue is a goldmine to Seattle!

Even though this social cost benefit analysis on the Second Avenue project was only a quick scan, we can conclude that the project is **very favourable to society**. Even in the most negative scenario the benefits from increased safety outweigh the investment and maintenance costs by far.

The sensitivity analysis gives some insight in other potential effects from cycling investments. The outcomes show that social cost benefit analysis can be a very effective tool to help mobility and city planners in making the right choices.

> **If cycling is good to society will not even be the question in most cases** (see the enormous safety effects in this project) - **which alternative will be most beneficial and why** will be the most interesting question.

Social cost benefit analysis is a very effective tool for this; by expressing all costs and benefits in Net Present Values costs and effects at different points in time become comparable. Performing a thorough CBA for U.S. projects however would ask for some further research on country or city specific indicators. But the information is out there: searching for the relevant indicators should take no more than one or two days.

Source: Seattle Bike Blog (2014): "The new 2nd Ave bike lane revolutionizes biking downtown".

Indicators used

- Safety effects:
  - Value of statistical life (= value for one fatal accident): $9.200.000
  - Average value for one injury: $336.628
  - Calculated as follows:

AIS level	Severity	Fraction of Value of Statistical Life	Amount ($)		Fraction of non-fatal accidents	
AIS 1	Minor	0,003	27.600	*	0,7	
AIS 2	Moderate	0,047	432.400	*	0,2	
AIS 3	Serious	0,105	966.000	*	0,05	
AIS 4	Severe	0,266	2.447.200	*	0,03	
AIS 5	Critical	0,593	5.455.600	*	0,02	+
					$336.628	

Source: U.S. department of transportation (2014); Guidance on treatment of the economic Value of a Statistical Life (VSL) in U.S. Department of Transportation Analyses. - 2014 adjustments

- Health effects: €0,81 per kilometre cycled in 2008 – equals €0,91 in today's prices (using Dutch consumer price indices).

  Source: WHO (2008); Health Economic Assessment Tool for Cycling. User Guide.

- When needed transformed to dollar prices using exchange rates of September 19, 2014 (1 euro = 1,288 dollar)

  Source: http://www.wisselkoers.nl/

- Travel time and reliability gains car transport:
  - Dutch indicator of 'network effect' for every kilometre not driven by car: -€0,025

- Less productivity losses:
  - Dutch indicator for every kilometre cycled: €0,046

- Excises car transport:
  - Dutch indicator for every kilometre not driven by car: -€0,0316

- Public transport subsidies
  - Dutch indicator for every kilometre less travelled by bus: €0,286

  Sources Dutch indicators: CE (2008).

Contact

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