Benefits and costs of walking and cycling projects

Canberra Pedestrian Forum, July 2011

Table of Contents

Background

Members of the ACT Trunk Walking and Cycling Infrastructure Working Group have been asked to provide advice on the benefits of walking and cycling, to assist in the development of a new method for prioritising walking and cycling infrastructure projects.

The principal benefits of a walking and cycling project arise from improved access and health, and reduced road congestion. The principal costs are the capital and maintenance cost of the project.

The benefits of a project are broadly proportional to the number and distance of walking and cycling trips that they attract, and the extent to which they attract trips that would otherwise be undertaken by car or public transport.

A short literature review

Davis (2010)[1] reported that "almost all of the studies … report economic benefits of walking and cycling interventions which are highly significant, and these average 13:1."

Ker and Sidebottom (2006)[2] reviewed a range of analysis methods, and concluded that "*most jurisdictions use both simplistic and mechanistic multi-*

1 Davis, Dr A., 2010, *Value for Money: An Economic Assessment of Investment in Walking and Cycling*, Research Report 5, Bristol City Council and NHS Bristol.

2 Ian Ker and Adam Sidebottom, (2006), *Prioritisation of Bicycle Infrastructure Proposals*, Australian Bicycle Council. http://www.austroads.com.au/documents/Bicycle_Infrastructure_Prioritisation.pdf

criteria analyses, inappropriate benefit cost approaches or simply rely on opaque judgemental process."

The Canberra Pedestrian Forum comments on the draft Australian Road Safety Strategy 2011-2020[3] identify and reference a range of benefits that are attributable to walking, relative to driving.

Methodologies for cost benefit analysis of walking and cycling projects.

Predicting the costs and benefits of walking and cycling projects is a matter of making the best use of the available but imperfect data. We cannot know in advance exactly how many people will use a cycling or walking facility, how they will use it, or its ultimate value to the community.

The Multi-Criteria Analysis that was used in the ACT in 2005 and 2007 was crude and simple, but it assessed verifiable information in a transparent way. It was not difficult to understand its shortcomings, verify its results, or convert its scores into cost-benefit rankings or Net Present Values.

A more complex analysis may rely more heavily on stated or unstated assumptions, may be less transparent, and may be more difficult to understand or to verify.

Cost benefit analysis normally has one of two purposes:

1. Identifying whether or not a project is worthwhile (i.e. whether its benefits outweigh its costs).
2. Prioritising projects.

Net Present Value and Cost-Benefit Ratio

The standard economic measure for identifying whether or not a project is worthwhile is Net Present Value. A Net Present Value of less than zero means that the costs of a project outweigh its benefits and hence it is cost-effective.

The standard economic measure for prioritising projects is Cost-Benefit Ratio. A lower cost-benefit ratio means a more cost-effective project.

Multi Criteria Analysis

From 2005 to 2011, ACT cycling and walking projects were prioritised using a Multi Criteria Analysis (MCA). This MCA is a variation of Net Present Value Analysis. It represents benefits as a point score that combines safety with the factors that influence the degree of cycling and walking that the project will attract. Rather than deriving a net present value by subtracting the costs from the benefits, it calculates a cost score (that varies inversely with cost) and then adds the cost score to the benefit score. Because of this, it is not possible for a project to obtain a score of less than zero. Hence, an MCA score cannot clearly identify whether or not a project is cost-effective.

The 2011 version of the MCA uses some economic terms in non-standard ways. It uses "cost-effectiveness" to describe "*cost of the link divided by the*

3 Canberra Pedestrian Forum comments on the draft NationalRoad Safety Strategy 2011-2020. http://grapevine.net.au/~mccluskeyarundell/NationalRoadSafetyStrategyComments.pdf

population it serves." This does not include other measures of economic effectiveness, such as safety and the factors that influence the population's decisions on whether or not to use the link.

It also uses "economic benefits" to describe the "*economic benefits of combining projects and activities*." This does not including other economic benefits such as those that are intrinsic to the project/s.

The 2011 report is also unclear as to how some factors are quantified in the MCA score. For example, "number of attractors" is variously described as:

- "***number of potential key destinations*** *which fall within 500m of the proposed project alignment*" (Sec. 5.1.1)
- "*number of attractors served along a route* ***divided by the kms.***" (Table 5.1)
- "***Normalised score*** *= (project score minus minimum score of all projects)/(maximum score of all projects minus minimum score of all projects)*" (Table 5.2)
- "*high priority attractors: employment areas … are awarded a* ***score of 3*** *… medium priority attractors: retail areas … are awarded a* ***score of 2*** *… low priority attractors: local parks/recreational nodes … are awarded a* ***score of 1*** *… For projects less than 1 km in length … these projects have been given a* ***standard length of 1km***." (Section 5.1.5).

Other analysis methods

Ker and Sidebottom (2006)[4] reviewed a range of analysis methods, and concluded that:

> *"The New Approach to Appraisal offers an opportunity to transform the prioritisation of cycling infrastructure funding into a transparent, efficient and accountable process.*
>
> *"The New Approach to Appraisal (NATA) approach was developed in the United Kingdom and hence the prioritisation of transport infrastructure is undertaken using this method. … The same process is used for all transport infrastructure projects, including cycling. This is done through the Transport Analysis Guide[5]. Although the evaluation (and associated application) process is only relevant for National Government funding it is advised that the model be used by all jurisdictions as an example of best practice.*
>
> *"The Appraisal Summary Table in the New Approach to Appraisal is essentially a Planning Balance Sheet within a Goals Achievement Matrix framework, with one set of goals being economic ones, largely measured using Benefit-Cost Analysis techniques"*

Cost-benefit analysis of the existing data

The benefits of a cycling or walking project include safety, and are largely

4 Ian Ker and Adam Sidebottom, (2006), *Prioritisation of Bicycle Infrastructure Proposals*, Australian Bicycle Council. http://www.austroads.com.au/documents/Bicycle_Infrastructure_Prioritisation.pdf

5 See: http://www.webtag.org.uk/

proportional to the amount of cycling and walking that it generates. The 2005, 2007 and 2011 MCA reports measure the benefits of projects in terms of their safety and of the factors that influence the amount of cycling and walking that they will generate.

Re-analysis of the 2005 and 2007 cycling and walking infrastructure reports, using the assumptions implicit in those reports indicates that, with the possible exception of the Hindmarsh Drive projects, all of those projects have positive Net Present Values.

It will be a trivial matter to recalculate the current MCA data to provide a cost-benefit ranking of the 200-odd projects, and a slightly less trivial matter to recalculate it to estimate Net Present Values.

Access and mobility

The most important economic benefit of a walking or cycling project is that it provides improved access to destinations such as shops, schools, employment or recreation.

A walking or cycling project has a very high economic value if it provides people with their **only** safe access to a destination. This can be the case for the 40% of Canberrans who don't own their own car[6], including the 15% of Canberrans who don't have a driving licence[7].

A new trip, that would not otherwise have occurred, represents an absolute increase in access and mobility.

A trip represents an improvement in access, if it is undertaken using the walking or cycling project in preference to the other trip options.

Project costs

The principal costs of a project are its (present) capital and (future) maintenance costs.

Travel cost

The cost of operating a car includes loan repayments, depreciation, insurance, maintenance and fuel. Much of this information is readily available from the NRMA. The Centre for International Economics (2005)[8] estimates the social costs of congestion, emissions, accidents, air pollution and subsidies for road traffic authorities to be over 40 cents per vehicle km.

The Canberra Pedestrian Forum has not been able to find an estimate of the cost per kilometre of walking.

Car and bicycle operating costs are dominated by standing costs which include loan repayments, depreciation and insurance. Car operating costs are typically

---

6 ABS 9309.0 Motor Vehicle Census, 31 March 2010

7 Derived from ABS 1307.8: *Australian Capital Territory in Focus*, 2007 and 3218.0 - *Regional Population Growth, Australia*, 2008-09

8 Centre for International Economics (2005) Sydney's Transport Infrastructure - the Real Economics; September 2005: http://www.thecie.com.au/publication.asp?pID=94

based on a driving distance of 15,000 km per year.

The average cost of operating a bicycle in Australia has been estimated at 53 cents per km (Arundell, 2007)[9]. This figure is based on an average weekly cycling distance of 37 km.

The average Canberra cycle commuter commutes three and a half 20 km bicycle round trips (70 km) per week. At this weekly distance the average cost per kilometre falls to about 22 cents/km and the weekly cost is around $20.

If a small car travels only 70 km per week, its weekly operating cost is about $120.

Parking is an additional cost that affects car drivers, but does not usually affect pedestrians or cyclists.

Time cost

This is discussed by Gheorghe Camelia Monica and Firoiu Daniela of the Romanian-American University School of Internal and International Economy of Tourism, a paper entitled "Perspectives of travel time costs."

Another perspective is provided by Canberra's Paul Tranter and Murray May, in their paper "*The hidden benefits of walking: is speed stealing our time and money*?" presented at the 7th International Conference on Walking and Liveable Communities, October 23-25 2006, Melbourne, Australia.

In peak Canberra traffic, it can be faster to walk a 500 metre trip or cycle a 5 km trip, than to do the same trip by car.

Fast cyclists may experience a time penalty, if their exertions mean that they must shower and change at the end of their trip.

Distance

A longer walking trip means more exercise and greater pollution reductions.

But a longer trip is also more likely to be taken by car, as shown in Table 1.

	<2km	**2-4.9km**	**5-9.9km**	**10-14.9km**	**>15km**	**Total**
Walk	43%	6%	0%	0%	0%	8%
Bicycle	50%	64%	44%	18%	1%	35%
Car	4%	17%	28%	47%	58%	32%
Bus	1%	9%	14%	6%	1%	6%
Train	1%	4%	13%	27%	37%	17%
Other	0%	0%	1%	2%	3%	1%
Total	100%	100%	100%	100%	100%	100%

Table 1: mode share by trip distance, Copenhagen[10].

In the Netherlands 27% of trips under 7.5 km are walked, but the number of longer walking trips is negligible. 34% of trips under 7.5 km are cycled, but this drops to 15% for trips between 7.5 and 15 km, and 2% for trips over 15 km[11].

A walking or cycling route will attract greater use if its residential trip origins

9 Arundell, L, 2007, The Cost of Cycling, Thinking on 2 Wheels Conference. http://grapevine.net.au/~mccluskeyarundell/leon_pubs.html

10 City of Copenhagen, Copenhagen City of Cyclists Bicycle Account 2010.

11 Ministerie van Verkeer en Waterstaat, 2009, "Cycling in the Netherlands"

and its “attractors” are spread along its length, rather than concentrated at each end.

Recreation and amenity

A person will choose a specific route because it offers greater amenity than other routes. Amenity includes time, safety, convenience, and simple enjoyment.

A recreational trip is taken for its own sake, because the amenity of the trip outweighs its costs.

Amenity is also a factor in the economic value of a non-recreational trip, though in that case amenity need not in itself outweigh the costs of the trip.

As examples on a progressively increasing scale of enjoyment during peak hour commuting, consider:

1. Riding a bicycle in a heavy high-speed traffic, on a road with no verge or bicycle lane.
2. Walking on a footpath beside congested car traffic.
3. Riding a bicycle on the scenic Sullivan's Creek cycle path.
4. Walking along a quiet street, where complete strangers greet you simply because you are sharing their street.

Health

Walking and cycling projects produce two main types of health benefits - reduced pollution and increased exercise.

Reduced pollution

A walking or cycling trip reduces vehicle exhaust pollution if it replaces a trip by car or public transport. The Bureau of Transport and Regional Economics[12] estimates that in the year 2000 motor vehicle-related ambient air pollution accounted for between 900 and 4,500 cases of cardiovascular and respiratory diseases and bronchitis, and between 900 and 2,000 early deaths. The economic cost was estimated to be in the range $1.5 billion to $3.8 billion.

Increased exercise

Exercise reduces the prevalence and/or severity of cardiovascular diseases, colon and breast cancer, diabetes and depression. 23,665 Australians died from ischaemic heart disease, 18,704 from other cardiovascular diseases, 4,191 from diabetes, 4,120 from colon and rectum cancer, 2,788 from breast cancer and 2,190 from suicide in 2008-9[13].

The general recommendation for reducing the risk of cardiovascular disease is

12 Bureau of Transport and Regional Economics, 2005, Health impacts of transport emissions in Australia: Economic costs, BTRE Working Paper 63.

13 Canberra Pedestrian Forum comments on the draft NationalRoad Safety Strategy 2011-2020. http://grapevine.net.au/~mccluskeyarundell/NationalRoadSafetyStrategyComments.pdf

at least 30 minutes of exercise per day on most days of the week. For a given trip, walking tends to be done for a longer duration but at lower intensity than cycling.

A walking or cycling trip provides additional exercise if it is an additional trip, or if it replaces a trip by car or public transport. The exercise benefit is greater if the exercise is of moderate (rather than low) intensity and if the person would not otherwise obtain sufficient exercise.

A 2009 Ride to Work survey[14] indicated that 9% of cycle-commuters would not obtain the recommended level of exercise if they did not commute by bicycle, and 30% of non-cycle-commuters do not obtain the recommended level of exercise. If they did not cycle, 56% of the people surveyed would travel to work by car, 26% would travel by bus, and 13% would walk.

Road Safety

For each kilometre travelled, walking and cycling cause less injury to other road users but suffer more injury from other road users. For more information, see the Canberra Pedestrian Forum comments on the draft National Road Safety Strategy 2011-2020. http://grapevine.net.au/~mccluskeyarundell/NationalRoadSafetyStrategyComments.pdf.

14 What people want from Ride to Work: http://ridetowork.pedalpower.org.au/category.php?id=62

Road congestion

A walking or cycling trip reduces road congestion if it replaces a peak hour car trip and does not occupy motor vehicle space on congested streets.

Greenhouse emissions

We cause greenhouse emissions when we travel on foot, by bicycle, by car or by bus.

These include emissions from tailpipes, from expired carbon dioxide, from fuel refining, from lubricants, from producing the food that is metabolised during travel, from the production and maintenance of paths, roads and vehicles, and from the operation of the transport agencies that administer roads and public transport.

Some of these emissions are summarised below in Table 2.

---

15 Australia's 2009 emissions from petroleum refining and lubricants were 5.2 and 0.5 MT CO2-e (Department of Climate Change and Energy Efficiency, April 2011, Australian national greenhouse accounts - National Greenhouse Gas inventory December Quarter 2010), which is 6.82 per cent of direct transport emissions.

16 Based on travel time and metabolic rate, derived inter alia from Rockwell fitness, http://rockwellfitness.com/?page_id=1153, accessed 30 May 2011; Dr. Andreacci, 2006, Bloomsburg University of Pennsylvania: Assessment of Anaerobic & Aerobic Power, http://facstaff.bloomu.edu/jandreac/Downloads/class_notes/Exercise_Physiology/Lab2b-Maximal_WAnT-VO2maxPower.pdf, accessed 30 May 2011; ABS 7106.0 - Australian Farming in Brief, 2010; Department of Climate Change and Energy Efficiency 2010, Australia's emissions projections 2010; ABS 5368 and 5349; American College of Sports Medicine, American Dietetic Association and Dietitians of Canada, 2000, Nutrition and Athletic Performance, Joint position Statement, (http://www.acsm.org/AM/TemplateRedirect.cfm?Template=/CM/ContentDisplay.cfm&ContentID=8811&Section=Media_Referral_Network)

17 Walking to and from bus stops

18 Based on a carbon price of $23 per tonne CO_2-e

19 Derived from SKM MMA (2011), Australian Transport Emissions Projections to 2050, Version 1, 9 February 2011, http://www.climatechange.gov.au/publications/projections/~/media/publications/projections/skmmma-transport-modelling-pdf.pdf, accessed 20 May 2011.

20 Derived from ACT Department of Territory and Municipal Services Annual Report 2010, and SKM MMA (2011), Australian Transport Emissions Projections to 2050, Version 1, 9 February 2011, http://www.climatechange.gov.au/publications/projections/~/media/publications/projections/skmmma-transport-modelling-pdf.pdf, accessed 20 May 2011.

21 Derived from SKM MMA (2011), Australian Transport Emissions Projections to 2050, Version 1, 9 February 2011, http://www.climatechange.gov.au/publications/projections/~/media/publications/projections/skmmma-transport-modelling-pdf.pdf, accessed 20 May 2011.