Australian Government

Department of Infrastructure, Transport, Cities and Regional Development

BCA Tool Guidance

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Great Cities. Strong Regions. Connecting Australians.

Introduction

The Notes on Administration require proponents to provide the Benefit Cost Ratio (BCR) for projects seeking Commonwealth funding.

The Department recognises that the expense and time required to commission a detailed benefit cost analysis may place a disproportional and excessive burden on non-state delivery agencies such as local governments for low value projects.

The Department has developed an Excel-based tool to assist proponents to complete tables D2 and D4 of the Project Proposal Report template. At this stage the tool is applicable to road projects only.

State delivery agencies should continue to use their own existing tools and processes rather than this tool, where they are likely to achieve more accurate outcomes.

Each individual transport problem and associated solution will be unique. As such, developing a generic tool which easily captures all relevant benefits with only a small number of required inputs will inevitably mean the output is not as accurate as a detailed analysis and certain benefit categories may be missed altogether. Modifications should be made as necessary to meet the specific needs of the initiative being analysed.

Two versions have been developed: version 1 for uninterrupted (free-flow) traffic and version 2 for interrupted (stop-start) traffic based on the following assumptions and benefit drivers:

- Uninterrupted flow is applicable to speeds typically above 60km/h and applies to projects such as sealing/resealing rural or remote roads which enable faster travel time and reduction in vehicle operating costs due to significant reduction in roughness. Avoided maintenance and avoided diversions may also be major benefit drivers.
- Interrupted flow is applicable to speeds below 60km/h and applies to projects such as intersection upgrades (traffic lights, roundabouts, slip lanes), grade separations, etc where travel time savings accrue through reduced waiting times. Accident reductions may also be a major benefit driver.

Defaults and Limitations

The model and parameter values are based on current ATAP guidance, simplified as much as possible. The model is not intended to replace a rigorous benefit cost analysis. It aims to capture the majority of conventional benefits so as to derive an estimate of the benefit cost ratio of a relatively low-value generic road project.

In order to make the model and the process of inputting data as simple as possible, a number of defaults have been chosen. For example, it is assumed that vehicles are either heavy or light. Operating cost parameters for heavy vehicles are based on a 6-axle articulated truck and a medium car for light vehicles. Other simplifications are explained at each section as appropriate.

Interface and data entry

The tool contains several tabs. Only the first tab – "Input sheet" requires data entry (see figure below). All cells highlighted require data entry. Summarised instructions for each required input are contained within Column C.

The discount rate (4% or 7%) should be selected from the drop down in Cell E6.

For many fields such as traffic volumes, heavy vehicle/light vehicle split, road roughness, crash statistics, etc. accurate or up to date data may not be available. In all such instances an estimate should be made.

The "Summary sheet" tab displays summary results, while the tab "Table D4 PPR template" allows the user to copy and paste the data required to fill in Tab D4 of the PPR template.

The "Model" tab is where calculations are performed in the background but it should not be altered. All formula are intact for transparency and traceability.

Several tabs are hidden which contain information such as default parameter values and references. They should also not be altered.

Instructions	Category	Value	
Project Discount Rate Data	**Project Discount Rate Data**		
Select 4% or 7%	Discount Rate (%)	7%	
Project Cost Data	**Project Cost Data**		
Enter unescalated project capital cost including contingency (P50 or P90)	Capital Costs ($)	10,000,000	
Residual/Salvage Value Data	**Residual/Salvage Value Data**		
Enter salvage value (if applicable)	Residual/Salvage Value ($)	1,000,000	
General Project Data	**Traffic Data**		
Enter actual or estimated AADT	Average Annual Daily Traffic (AADT, number)	1,000	
Select percentage of heavy vehicles	Heavy Vehicles (HV, %)	20%	
Estimate long term traffic growth	Annual Traffic Growth (%)	2%	
Estimate average speed under the base case	Base Case - Average Speed (km/hr)	60	
Estimate average speed under the project case	Project Case - Average Speed (km/hr)	80	
Enter project length	Project Length (km)	5	
Estimate the average level of roughness under the base case	Base Case - Roughness (IRI)	6	
Estimate the average level of roughness under the project case	Project Case - Roughness (IRI)	2	
Other Travel Time Savings Data (if applicable)	**Intersection Data**	**Number**	**Average Delay (Seconds)**
Enter number of roundabouts and associated delay	Roundabouts	3	15
Enter number of signalised intersections and associated delay	Signalised	4	30
Enter number of unsignalised intersections and associated delay	Unsignalised	1	60
Enter number of other intersections and associated delay	Other Intersection (Level Crossings etc)	1	30
Estimate the reduction in delays under the project case as a whole	Project Case - Estimated Reduction in Delays (%)	50%	
Crash Savings	**Crash Cost Data**		
Enter number of fatalities experienced over the last 15 years	Fatalities (Actual or Estimated Number)	1	
Enter number of serious injuries experienced over the last 15 years	Serious Injuries (Actual or Estimated Number)	2	
Enter number of injuries experienced over the last 15 years	Injuries (Actual or Estimated Number)	3	
Estimate the reduction in crashes under the project case as a whole	Project Case - Estimated Reduction (%)	80%	
Diversion and Avoided Waiting Time Savings	**Diversion & Waiting Time Data**		
Estimate proportion of vehicles diverting due to road closure	Base case - Proportion of Vehicles Diverting (%)	20%	
Estimate proportion of vehicles waiting due to road closure	Base Case - Proporiton of Vehicles Waiting (%)	10%	
Enter length of diversionary route	Distance Travelled on Alternative Route (km)	10	
Estimate the average number of days the road is closed per year	Duration of Road Closures (Days/Year)	20	
Enter average speed on diversionary route	Average speed on diversionary route (km/h)	60	

Project Costs

Enter the unescalated capital cost including contingency at Cell E10. The capital cost must include contingency (P50 and P90).

The estimated maintenance costs for the project case (in today's dollars) should be entered in the years they are anticipated to be incurred in column J.

Benefits

1.1.1 Avoided Cost of Maintenance

This benefit refers to maintenance expenditure that would have occurred under the base case (note: would have occurred, not should have occurred!) but will not be required under the project case. For example, a remote unsealed road may require re-sheeting/regrading every 12 months after the wet season. Providing an all-weather surface would generally be expected to eliminate that requirement and hence it becomes a benefit. Enter the avoided cost of maintenance in each of the years it would have occurred in column N.

1.1.2 Residual value

Ideally this is determined as the difference in cost between a rehabilitation (or reconstruction) using the existing pavement, and the cost of construction of a new pavement as if the old pavement did not exist.

The salvage value of unbound granular and bitumen materials is generally high because they can be built on, while the residual value of cracked or otherwise distress asphalt and cemented materials will be relatively low unless they can be easily recycled.

In an urban situation where levels are a constraint, an old pavement has to be excavated (milled) and either spoiled or recycled. In such cases the residual value should be considered to be zero.

Enter the salvage value in whole dollars at Cell E13.

1.1.3 Traffic data

Estimated or known average annual daily traffic (AADT) should be entered at Cell E16. Because traffic volumes are likely to heavily influence total overall benefits, this value should be as accurate as possible.

There are significant differences in vehicle operating costs across the 20 vehicle types recognised in the ATAP guidance. Base vehicle operating costs range from 21 cents per km for a small car to 190 cents for a Double B-Double. To make it as easy as possible this model assumes only 2 vehicle types – light vehicles or heavy vehicles.

Enter percentage of heavy vehicles at cell E17. For simplicity it is assumed that all heavy vehicles are 6-axle articulated with a GCM of 42.5 tonnes.

Percentage of light vehicles will automatically populate based on HV percentage. It is assumed that all light vehicles are a medium car with a GCM of 1.4 tonnes.

Annual traffic growth is set at a default of 2% per year (linear rather than cumulative). The growth rate can be adjusted at cell E18.

Vehicle speed

In some cases project speeds may increase significantly as a result of an initiative, resulting in large travel time savings. Estimates of average travel speed under the base case and project case should be made at cells E19and E20 respectively.

1.1.4 Vehicle operating cost (VOC) savings – free flow

For uninterrupted flow VOC savings are primarily a function of roughness and speed. VOC savings as a result of reduced roughness are partly offset by higher fuel costs if the project enables higher travel speeds.

ATAP prescribes using either the ARRB aggregate model or the Alternative aggregate model to calculate VOC.

Because the ARRB aggregate model requires roughness, gradient, curvature and vehicle payload as inputs, the simpler Alternative aggregate model has been used for this tool which only requires speed and roughness.

Users should enter the known or estimated value of roughness (in IRI) under the base case (or current condition) at Cell E22 and under the project case at Cell E23.

NRM can be converted to IRI using the following formula:

$$NRM = 26.49IRI - 1.27$$

Enter project length in km at Cell E21.

VOC savings for each year will automatically calculate based on AADT, traffic growth rate, split between heavy and light vehicles, roughness, speed and project length.

Notes on road deterioration

The rate with which a road deteriorates (measured as roughness) is dynamic and complex to model. It is affected by factors such as initial strength (and how well the pavement was constructed), traffic volumes and loadings, and moisture regime. Deterioration rate can be expected to follow a sigmoidal function over the design life of the pavement. However, there will be significant variances between segments. Complicating efforts to derive a "typical" rate of deterioration is the fact that design lives may also vary.

For simplicity, this model assumes an exponential (rather than linear or sigmoidal) rate of deterioration, beginning slowly before accelerating towards the end of the 30-year appraisal period. As such, deterioration may be slightly understated. Conversely, it does not take into account intervention treatments over the appraisal period (noting that sprayed seal treatments do not reduce roughness) that may reduce roughness. The two simplifications are expected to more or less balance themselves out.

As a very rough guide, one may assume that the sealing of an unsealed road results in an initial roughness of 2, deteriorating to 6 by year 30.

1.1.5 Vehicle operating costs savings - interrupted flow

Interrupted flow may be experienced on urban and sub-urban arterials and freeways depending on factors such as time of day and traffic capacity. Rather than road roughness, costs tend to be driven by consumption of fuel, oil, tyres, brakes and vehicle wear.

For interrupted flow users should use version B of the tool which uses the Stop-Start model for VOC.

The Stop-Start (interrupted) model and aggregate (free flow) model for VOC cross over at approximately 60km/h – for travel speeds above 60km/h use the free flow version, for speeds under 60km/h use the interrupted version.

For the interrupted flow model, users only need enter average travel speeds under the base case and project case at cells E19 and E20 respectively.

1.1.6 Travel Time Savings

Travel Time Savings (TTS) may arise in many different ways depending upon the problem to be solved. Examples include:

- Sealing or resealing a remote road enabling faster journey time;
- Flood mitigation works resulting in avoided waiting time or requirement to divert to a longer route; and
- Grade separation which eliminates waiting time at an intersection.

Time savings resulting from higher journey speed will already have been accounted for by entering travels speeds under the base case and project case at cells E19 and E20.

To account for traffic-related time savings, users should enter the number of intersections (signalised, unsignalised, roundabouts, etc) at rows 26-29 and the estimated delays (in seconds) currently experienced at each one.

For simplicity, rather than attempting to determine the time savings achieved at each individual delay point, an estimate should be made of the reduction in waiting time overall as a result of the project. Enter the estimated reduction in waiting time, as a percentage, at Cell E30.

TTS will be automatically calculated based on HV/LV split, number of vehicles, and the value of time associated with each vehicle type.

1.1.7 Crash reductions

Step 1. From either crash data or estimates, enter the number the fatalities, serious injuries, and injuries that have occurred over the past 15 years at rows 33-35.

Step 2. As a percentage, estimate the reduction in crashes as a result of the initiative at cell E36.

Benefits as a result of crash reductions will be automatically averaged across the appraisal period.

1.1.8 Diversion and avoided waiting time – road closures

Road users may be faced with situations where roads are regularly closed due to flooding, periodic maintenance, or other factors (excluding congestion or delays from accidents) making a road impassable. This necessitates either waiting or using an alternative longer route. This benefit refers to avoided waiting time or avoided additional travel time/distance if an initiative mitigates such a transportation problem.

Proportion of vehicles diverting

The following options exist for motorists affected by closed roads:

- Do not travel;
- Divert (use an alternate route); or
- Wait.

Under many circumstances, due to flood warnings, advance notices of road works, etc., most motorists may choose not to travel. During periods of extended closure (more than 1 day), most motorists will elect to either divert or return to their place of origin rather than wait (few motorists will have sufficient provisions or patience to wait several days for flood water to recede if an alternate route is available).

Step 1. At cell E39 enter the proportion of vehicles diverting under the base case.

Step 2. At cell E40 enter the number of vehicles waiting under the base case.

Step 3. At Cell E41 enter length of diversionary/alternative route.

Step 4. At Cell E42 enter number of days the road is expected to be closed each year (on average) under the base case.

Step 5. At Cell E43 enter the estimated average speed of vehicles using the diversionary route.

The model will automatically calculate time and vehicle operating cost savings achieved based on the number of vehicles that will no longer need to divert under the project case, as well as the time savings achieved by the number of vehicles no longer needing to wait under the project case.

1.1.9 Externalities

Externalities are primarily related to diversions. If part of a road is closed and a diversionary (longer) route is required, this results in externalities such as additional greenhouse gas emissions. A default value for externalities expressed as cents per kilometre is embedded within the model.

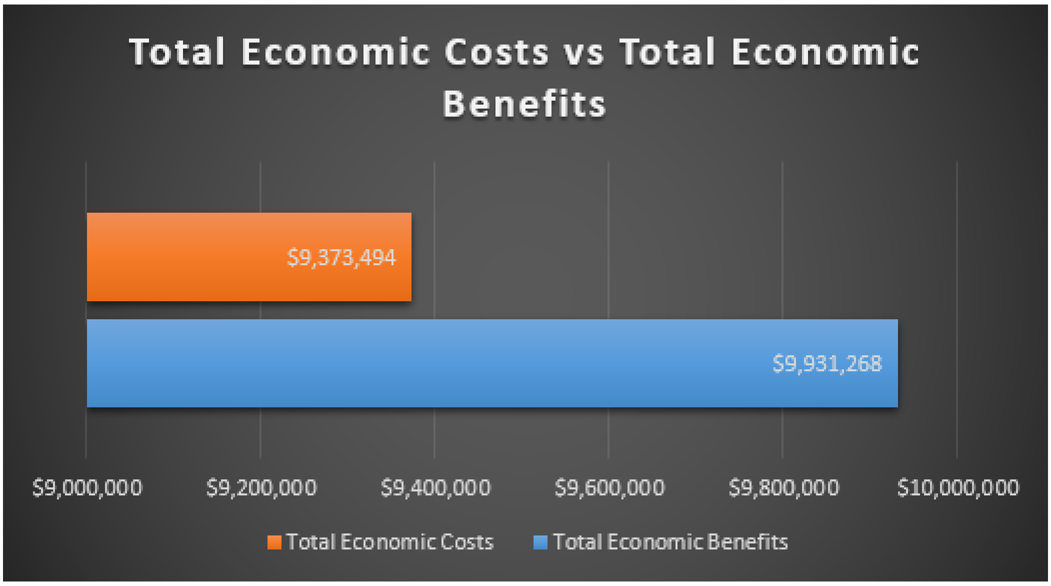
Externality benefits will automatically generate based on diversion data previously entered at rows 39-43.

Outputs

The tab "Summary sheet" provides a snapshot of the standard economic benefits for a range of categories, the net present value and the benefit cost ratio.

Economic Costs	Value
Capital Costs	$9,373,494
Maintenance Costs	$0
Total Economic Costs	$9,373,494

Economic Benefits	Value
Avoided Cost of Maintenance	$0
Travel Time Savings	$195,364
Delay Reduction Savings	$0
Vehicle Operating Cost Savings	$1,043,483
Crash Cost Savings	$8,349,905
Avoided Costs of Diversion (including Externalities)	$342,515
Residual/Salvage Value	$0
Total Economic Benefits	$9,931,268
Net Present Value	$557,774
Benefit Cost Ratio (BCR)	1.06



The tab "NPV table" populates the data required to fill in table D4 of the Project Proposal Report Template.

Benefit Component		Present Value of all Benefits ($m)	Year 10 Only	
			Year 10 Benefits in $m (10 years after construction complete)	Year 10 Benefits as a percentage of total benefits
Travel Time Savings	Passenger (existing/ new users)	0.11	0.00	0.04%
	Business (existing/ new users)	0.03	0.00	0.01%
	Freight (existing/ new users)	0.06	0.00	0.03%
	Total Travel Time Savings	0.20	0.01	0.08%
Reduced Vehicle Operating Costs (resource costs)	Passenger (existing/ new users)	0.27	0.01	0.11%
	Business (existing/ new users)	0.06	0.00	0.03%
	Freight (existing/ new users)	0.71	0.03	0.30%
	Total Reduced Operating Costs	1.04	0.04	0.43%
Accident Reduction	Passenger (existing/ new users)	5.41	0.22	2.17%
	Business (existing/ new users)	1.27	0.05	0.51%
	Freight (existing/ new users)	1.67	0.07	0.67%
	Total Accident Reduction	8.35	0.33	3.35%
Environmental Benefits	Reduced Greenhouse Emissions			
	Reduced Local Pollution			
	Reduced Noise			
	Other (i.e. Biodiversity)			
	Total Environmental Benefits	0.01	0.00	0.01%
Reduced Maintenance Costs	Routine (annual)			
	Periodic			
	Rehabilitation			
	Total Reduced Maintenance Costs	-	-	
Other standard benefits (reliability, crowding, tolls/fare box)				
TOTAL STANDARD BENEFITS*		**9.93**	**0.40**	**4.00%**
Wider Economic Benefits	Agglomeration Benefits			
	Other Wider Economic Benefits			
	Total Wider Economic Benefits			
Other Benefits (i.e. City shaping)	(add category as required: such as heavy vehicle productivity)			
	(add category as required)			
	Total Other Benefits			