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Productivity metrics

At a glance

- Productivity metrics have been developed to complement conventional CBA.
- They provide a valuable focus on the productivity impact of transport initiatives.
- However, they omit benefits not directly related to productivity (e.g. benefits of improved private travel) that are included in conventional CBA and are important to society.
- Guidance is provided for practitioners on the use of productivity metric tools and their potential application in option selection, prioritisation of initiatives and business cases.
1. Context and introduction

The issue of productivity is a major focus in discussions about short and long term outlooks for the Australian economy. Transport infrastructure is seen as being an important contributor to national productivity.

In 2012, the NSW Government proposed the concept of ‘productivity metrics’ as a tool for measuring the productivity impacts of individual transport initiatives. This section of the ATAP Guidelines explains the concept, discusses its role in the assessment and appraisal process, and proposes some specific metrics practitioners can use.

It is critical to observe from the outset that the merits of a transport initiative are fully captured by a good assessment and appraisal process, with a cost-benefit analysis (CBA) (including non-monetised benefits and costs) as the centrepiece, all presented in a sound business case. The ATAP Framework is underpinned by this philosophy, and provides guidance on the various steps and techniques.

In this context, productivity metrics can be seen as:

- An additional layer of information in the business case to aid decision makers, complementing the core CBA results, but sharpening the focus on the productivity effects of transport initiatives
- Providing a robust and systematic methodology for considering the potential productivity gains associated with initiatives, and
- Enabling decision makers to understand and compare the productivity benefits of alternative options and initiatives.
2. What are productivity metrics?

Productivity metrics are quantitative measures that indicate the extent to which an initiative contributes to national productivity and the proportion of an initiative’s benefits that are productivity related.

In exploring productivity metrics, the broad range of benefits arising from transport initiatives have been grouped into the following three categories:

1. Benefits that have a clear and significant productivity impact (by reducing the costs of production or improving the productivity of inputs) and that can be readily estimated using accepted appraisal methodologies.
2. Benefits that also have a productivity impact but are difficult to measure and assess and are less significant, and
3. Benefits that do not have an impact of any significance on productivity.

In the productivity metrics proposed here, only category 1 benefits are included. Categories 2 and 3 are excluded.

Table 1 groups benefits typically included in conventional transport CBAs against these three categories, and forms the proposed guide for practice.

<table>
<thead>
<tr>
<th>Benefits that can be included in productivity metrics</th>
<th>For business travellers(^{(1)}) and freight:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Travel time savings</td>
<td>• Travel time savings</td>
</tr>
<tr>
<td>• Vehicle operating cost savings</td>
<td>• Vehicle operating cost savings</td>
</tr>
<tr>
<td>• Reliability improvements (if available)</td>
<td>• Reliability improvements (if available)</td>
</tr>
<tr>
<td>• Wider economic benefits (WEBs) (if they exist for initiative and are available) – agglomeration benefits being the main one (see T3)</td>
<td>• Wider economic benefits (WEBs) (if they exist for initiative and are available) – agglomeration benefits being the main one (see T3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits that should not currently be included in productivity metrics(^{(2)})</th>
<th>The productivity elements of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Safety benefits (valued using the human capital approach)</td>
<td>• Safety benefits (valued using the human capital approach)</td>
</tr>
<tr>
<td>• Environmental health benefits</td>
<td>• Environmental health benefits</td>
</tr>
<tr>
<td>• Health benefits from active travel</td>
<td>• Health benefits from active travel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits that should not be included in productivity metrics</th>
<th>Non-business (i.e. private) travel benefits, including for journey to work</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Travel time savings</td>
<td>• Travel time savings</td>
</tr>
<tr>
<td>• Vehicle operating cost savings</td>
<td>• Vehicle operating cost savings</td>
</tr>
<tr>
<td>• Reliability improvements (if available)</td>
<td>• Reliability improvements (if available)</td>
</tr>
</tbody>
</table>

Notes to Table 1:

\(^{(1)}\) Most would be by car, but there would be some business travel by public transport and active travel modes. Business-to-business walking trips within a locality could be an important source of knowledge transfer benefits, a component of agglomeration economies.

\(^{(2)}\) Further work on these issues may enable future updates of the Guidelines to revisit these exclusions.
3. Proposed productivity metrics

After considering a number of measures, the most useful productivity metrics were considered to be (see further discussion in Appendix A):

- The present value of productivity benefits
- The productivity benefit intensity, which is present value of productivity benefits as a percentage of the present value of total benefits including WEBs
- The productivity benefit cost ratio (BCR), which is the present value productivity benefits divided by the present value of investment costs.

Table 2 shows a simple worked example of how to obtain the three productivity metrics from the main benefits and costs of a typical road transport initiative.

Table 2  Productivity metrics: simple worked example

<table>
<thead>
<tr>
<th>Benefits and costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a  Private car travel time vehicle operating cost savings</td>
<td>12*</td>
</tr>
<tr>
<td>b  Business car and truck travel time vehicle operating cost savings</td>
<td>5</td>
</tr>
<tr>
<td>c  Safety benefits</td>
<td>2</td>
</tr>
<tr>
<td>d  Environmental benefits</td>
<td>1</td>
</tr>
<tr>
<td>e  Wider economic benefits</td>
<td>4</td>
</tr>
<tr>
<td>f  Investment cost</td>
<td>12</td>
</tr>
</tbody>
</table>

CBA measures without WEBs

| g  Total benefits (a + b + c + d) | 20 |
| NPV (g - f) | 8 |
| BCR (g / f) | 1.7 |

CBA measures with WEBs

| h  Total benefits (g + e) | 24 |
| NPV (h - f) | 12 |
| BCR (h / f) | 2.0 |

Productivity metrics

| i  Present value of productivity benefits (b + e) | 9 |
| Productivity benefit intensity % (i / h *100) | 38% |
| Productivity BCR (i / f) | 0.8 |

* All values are $'000 million present values

The fact that the inputs for productivity metrics calculation can readily be extracted from CBAs makes the task of compiling these metrics straightforward once a CBA is done.
4. Using productivity metrics to complement cost-benefit analysis

It is important to recognise that cost benefit analysis (CBA) is the only way to estimate the net benefits (benefits minus costs) of an initiative, and therefore will remain the primary tool to appraise and prioritise initiatives (see T2).

However, productivity metrics can complement the CBA results by providing an additional layer of information to aid decision-makers. Ways in which the concept can be used include:

- Information on productivity impacts can simply be highlighted to reveal the value of individual initiatives or entire programs.
- Productivity metrics may be included in the Strategic Merit Test (see F3) where improving productivity is a program objective.
- Productivity metrics can be presented in the Appraisal Summary Table (see F3) for decision-makers to consider alongside information on the initiative’s impacts and full CBA results.
- Productivity metrics could prove valuable in cases of major investment decisions where the initiative proponent has decided to undertake economy-wide modelling (using a computable general equilibrium, CGE model) since the productivity benefits are required as inputs in the CGE model.
- For major initiatives, productivity metrics can be used for estimating changes in future tax revenues associated with productivity improvements.
5. Role in prioritisation of initiatives

When it comes to prioritising across a list of initiatives, CBA is also the primary tool to use (see F5). Indeed, prioritising initiatives by a productivity metric such as ‘productivity BCR’ instead of the conventional benefit cost ratio (BCR) could result in significant losses of other benefits. The losses are mainly savings in travel time for non-business car and public transport users, because a pure productivity metrics approach attaches zero weight to all non-productivity benefits. Sole reliance on productivity metrics to make decisions is to be avoided.

A compromise approach to prioritisation is to use the adjusted CBA technique in Part T2 (Chapter 14) with productivity benefits given a weight greater than one. Initiatives would be prioritised using the ‘adjusted BCR’ obtained from the weighted sum of initiative benefits (including WEBs). The size of the weight represents the value decision-makers place on additional productivity benefits relative to non-productivity benefits.

Starting with the priority order of projects from unadjusted descending BCRs, as the weight for productivity benefits is progressively increased, pairs of initiatives swap places in the priority order. The first swap to occur is the cheapest in terms of non-productivity benefits forgone to gain additional productivity benefits. Say the weight was set at two, swaps in the priority order would only occur where the additional dollar of productivity benefit gained from the swap came at a sacrifice of less than two dollars of non-productivity benefit. More expensive reorderings of priorities in terms of non-productivity benefits forgone in order to gain additional productivity benefits would not occur.

The weighting approach offers a simple and transparent approach to reconcile decision-making using conventional BCRs and productivity BCRs while controlling the potential economic efficiency losses in terms of foregone non-productivity benefits.

5.1 Next Steps

The next step is to receive feedback from stakeholders about the merit of using productivity metrics to aid decision-makers.

An important barrier limiting application of productivity metrics is the poor quality of estimates for Australian WEBs parameter values (see T3). An important step forward is the improvement of those estimates, which will in turn improve the quality of productivity metrics estimates. As indicated in T3, work planned for 2015 should lead to a significant improvement in the quality of WEBs estimates.
Appendix A  Supporting discussion

A.1 How transport initiatives raise productivity

Productivity benefits directly affect Gross Domestic Product (GDP), a key indicator of economic activity in the economy. They lead to higher wages for workers, higher profits for businesses, lower prices for consumers and higher tax receipts for governments. Where they improve international competitiveness, they lead to a higher exchange rate, which improves the purchasing power of Australians to buy foreign goods and services.

In contrast, non-productivity benefits recognised in CBAs (principally savings in non-work travel time and improvements in environmental or urban amenity) accrue directly to individuals without being recorded in the national accounts (through which GDP is measured).

Productivity is the efficiency with which inputs (labour, capital, raw materials, intermediate goods and services) are transformed into outputs (goods and services) (BITRE, 2014). An increase in productivity is said to occur when the same output can be produced from less inputs or greater output can be produced from the same inputs. Productivity improvements are a source of economic growth and higher per capita income.

NCHRP (2014) lists three dominant ways in which transport improvements raise productivity.

- Efficiency (cost reduction) effects: Shorter distances, faster speeds and reduced incident delays for travel by workers and freight transport directly lower the prices of inputs to production and costs of distributing outputs.
- Agglomeration/access benefits: see T3 on wider economic benefits for a discussion of agglomeration benefits.
- Technology adoption effects: Faster and more reliable trip times can enable adoption of new business operating processes and technologies (just-in-time manufacturing and lean supply chain processing) with more centralised manufacturing and distribution locations, and reduced inventory levels, safety stocks, back up delivery vehicles and loading dock workers.

All three are legitimate in-principle benefits. However:

- Techniques to measure agglomeration benefits and the value of reliability improvements for road transport are still evolving.
- With respect to technology adoption benefits, no accepted methods yet exist for measuring them. It is also not clear that their size is significant compared to the cost reduction effects. In addition, they may already be included in estimated benefits where the unit values for time savings and reliability improvements for freight are willingness-to-pay values. When freight consignors are surveyed to estimate their willingness to pay for shorter and more reliable trip times, they would be expected to take into account the value to them of any changes to processes and technologies they could adopt as a result of the transport service improvements.
Consumers’ surplus gains associated with induced travel should be included because they represent gains to businesses.¹

### A.2 Rationale for excluding safety, health, environmental and non-business benefits

Table 1 listed the benefits recommended for exclusion from productivity metrics. In each case, there are associated productivity aspects:

- Forgone income due to injuries and deaths caused by crashes represents lost economic output. This would have to be measured using the human capital approach, not the willingness-to-pay approach. Other costs of crashes (property damage, traffic delays, emergency services, legal costs, correctional services) divert resources from alternative uses, some of which would be production rather than direct consumption.

- NCHRP (2014, p.22) considers as productivity benefits only the components that directly affect businesses’ costs such as fleet vehicle repairs and insurance costs for personal injury. Reductions in traffic delays associated with crashes would be counted with reliability benefits. From a general equilibrium point of view, a reduction in crashes frees resources for other uses, leading to lower input costs for businesses.

- Environmental and active travel benefits relating to human health would contribute to productivity — directly by reducing absences from work due to sickness, loss of experience from shortened working lives and improving employee morale, and indirectly by freeing up resources required for medical and hospital expenses.

- For CBA purposes, commuting is considered to be non-work travel. NCHRP (2014, pp.22 and 45-6) suggests that some commuting costs enter into business costs where employers are paying a wage premium or direct subsidies to compensate workers for excess travel time and expenses. This applies typically for travel to and from large urban centres with congested access and high parking costs, or locations at the fringe of a labour market area.

The above points are noted; however, these benefits are excluded from the calculation of productivity metrics because of the:

- Difficulty in separating out the productivity components, and
- Likelihood that they will be quantitatively small compared to the other productivity benefits for most large infrastructure initiatives.

### A.3 Warning: non-productivity benefits still matter

The fact that non-productivity benefits do not increase productivity does not mean they are not important. They are important, and this is reflected in their inclusion in the CBA, which remains the most comprehensive and rigorous tool for assessing initiative impacts.

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¹ This is contrary to the advice in NCHRP (2014, p. 45), but NCHRP (2014) takes account of induced travel in another way.
If decision-makers choose to select options or prioritise initiatives on the basis of productivity metrics, rather than the ‘full BCR’, they are implicitly inferring that non-productivity benefits are less important than productivity benefits. They are essentially trading off some non-productivity benefits in order to gain greater productivity benefits, and it is important that they are aware of the trade-offs.

A.4 Productivity metric measures

Present value of productivity benefits ($)

The present value of productivity benefits by itself is one piece of information about productivity benefits. It is also a prerequisite for calculating the other metrics.

Productivity benefit intensity (%)

The productivity benefit intensity is the most informative metric for an initiative considered by itself (not compared with other initiatives) showing the proportion of total benefits that contribute to national productivity. Where improving productivity is a stated objective, the productivity intensity benefit percentage can be helpful as an indicator of the extent to which an initiative is expected to contribute to the productivity objective. This is important for strategic merit tests where alignment between objectives of an initiative and planning objectives is being assessed.

When governments want to explain the value of individual initiatives or entire programs, they could make a statement along the lines of ‘x per cent of initiative benefits will contribute directly to increasing national productivity’.

Productivity benefit intensity should not be used to rank options or initiatives or even make a pairwise comparison. The option with the higher productivity benefit intensity might have the lower absolute value of productivity benefits. The initiative with the higher productivity intensity could have lower productivity benefits per dollar of investment cost.

Productivity BCR

By itself, an initiative’s productivity BCR is not a very useful number. The productivity BCR will always be less than the full BCR counting WEBs, and can be less than one even when the full BCR is above one. It can be used to assess how the ranking of options might change if the decision-maker placed a greater importance on productivity benefits than non-productivity benefits.

The full BCR is used to compare options or initiatives in terms of economic merit. Prioritising initiatives solely by productivity BCR will completely ignore non-productivity benefits and can result in a very different ranking of initiatives.
References

