Edinburgh Napier UNIVERSITY

# School of Engineering & the Built Environment

# CTR Postgraduate Programmes

## CTR11116

## Transport Economics and Appraisal

# Study Guide 2 – Transport Appraisal

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# Introduction to appraisal: the purpose of appraisal

## Introduction to the module

Welcome to the second part of the Transport Economics and Appraisal module. This is the seventh of thirteen units, which will provide an introduction to the topic of appraisal in transport. This, and the subsequent 6 units, concern the use of appraisal in transport today. They are:

7. Introduction: the purpose of appraisal.
8. Different types of appraisal.
9. The use of cost benefit analysis in appraisal.
10. New Transport Appraisal in England
11. New Transport Appraisal in Scotland.
12. Transport Economic Efficiency.
13. Transport and Economic Development.

In addition to these units themselves, there is a continuous self-assessment exercise to refer to throughout these seven units, which is designed to let you put into practice some of the skills and knowledge that you will be developing. In addition, there are a number of self-assessment exercises that you can go through. If at anytime you have problems with or questions about these exercises or any other part of the module, you can contact the module leader Tom Rye at Napier University on 0131 455 2477, or by email at t.rye@napier.ac.uk.

## Reading

There are a number of publications that are of particular use for this part of the module. These may be available in your local university library. With the exception of the core text, do not make a special effort to buy these books and articles; key reading is included with the module.

Napier University Library Services subscribe to a number of on-line academic periodical indexes. For more recent journal editions, it is often possible to download entire articles in Acrobat format. One such index is www.sciencedirect.com. If you contact the University Learning and Information Service (details available on University website) they will be able to explain to you how to access these sites from home.

You will find throughout the Module references to a materials on the CD ROM and/or webserver. These terms are in fact synonymous and you should be able to download all this material from the student webserver, where it is organised in Unit order. The web address is as follows (ensure to paste the entire address into your browser otherwise it will not work). You need the username sbe and password student. http://sbe.napier.ac.uk/resource_centre/downloads/browser.jsp?file=%2Fhome%2Fwebsites%2Fsbe%2Fwebapps%2Fresource_centre%2Fdownloads%2Fbe71007%2Fdl+tea

### Books and articles

There is no core text for this module. However, P.J. Mackie and J. Nellthorp, "Transport Appraisal in a Policy Context". 2000, you may find this of use. During the module it will be complemented by a lot of reading on practical issues and techniques which is right up

to date, including some based on current research. Other potentially useful sources for background reading are listed below.

HM Treasury, The Green Book http://www.hm-treasury.gov.uk/data_greenbook_index.htm.

David Pearce, Cost-Benefit Analysis. Macmillan, 1983. Chapters 1-3.

D.W. Pearce and C.A, Nash, The Social Appraisal of Projects. Macmillan, 1981. Chapter 2.

R. Sugden and A. Williams, The Principles of Practical Cost-Benefit Analysis. Oxford University Press, 1978.

P.J. Mackie and J. Nellthorp, "Cost-Benefit Analysis in Transport". 2000. Nathan Bodington site.

Price, A., "A New Approach to the Appraisal of Road Projects in England" in Journal of Transport Economics and Policy, May 1999, p 221-226 and S. Glaister in the same volume. (Available on www.sciencedirect.com)

J. Nellthorp and P.J. Mackie, "The UK Roads Review: A hedonic model of decision-making" in Transport Policy 7(2), November 2000. (Available on www.sciencedirect.com. )

International Comparison of Evaluation Process of Transport Projects (sic) Whole volume of Transport Policy Journal, Volume 7 Number 1, January 2000. (Strongly recommended; available on www.sciencedirect.com. )

Dodgson J., Spackman M., Pearman A. and Phillips, L. (1999) DTLR multi-criteria analysis manual. DTLR, London. Available at www.communities.gov.uk/documents/corporate/pdf/146868.pdf

EVATREN (2008) *Improved Decision-Aid Methods and Tools to Support Evaluation of Investment for Transport and Energy Networks in Europe.* European Commission funded Framework 6 Research Project 2006-2008. Results available at http://www.eva-tren.eu/home.htm

Foster C.D. and Beesley M.E., (1963) Estimating the social benefit of constructing an underground railway in London. Journal of the Royal Statistical Society

HEATCO (2005) Developing Harmonised European Approaches for Transport Costing and Project Assessment. European Commission funded Framework 6 Research Project 2003-2005. Results available at http://heatco.ier.uni-stuttgart.de/

HM Treasury (2003) Supplementary Green Book Guidance on Optimism Bias. HM Treasury, London. http://www.hm-treasury.gov.uk/data_greenbook_supguidance.htm#Optimism_bias_OB

Mann, C. Bailey G., Bowler K., and Stucky M. (1996). *The Victoria Line 30 Years On.* Proceedings of 23rd Annual Summer Meeting of PTRC, Warwick.

P. J. Mackie, S. Jara-Díaz, A. S. Fowkes The value of travel time savings in evaluation *Transportation Research Part E: Logistics and Transportation Review, Volume 37, Issues 2-3, April-July 2001, Pages 91-106* available with Athens password on www.sciencedirect.com

Mott MacDonald, 2002 Review of Large Public Procurement in the UK. HM Treasury, London.

**Websites**

Transport appraisal is, believe it or not, a fast moving subject. Much recent material that is of direct relevance to the module is now available on the web. Specific websites are listed below, but it is also useful to search under "cost benefit analysis transport UK" and "transport appraisal UK" in a search engine such as www.google.co.uk. I also recommend that you keep an eye on the publication *Local Transport Today* (available from Landor Publishing; student subscription £28 for 12 months – see http://www.landor.co.uk/subs/ltt_sub.htm ). This often features short but useful articles, and links to further information, on recent developments in transport appraisal.

Particularly recommended is the compendium of web resources published by the Department for Transport *Useful Links on Appraisal and Valuation* - http://www.communities.gov.uk/archived/general-content/corporate/usefullinks/.

Another extremely useful source of very well-written and referenced material, much of it web-based, is www.vtpi.org. Although working out of the back room of a house in

Victoria, Canada, and with a definite sustainable transport agenda, Todd Litman – or, as he refers to himself, the Victoria Transport Policy Institute – much of the material on this vast website will be of great assistance to you in your studies and will give you a different viewpoint on some of the issues that we will be covering.

Specific web publications are as follows. Many of them are downloadable in Acrobat format.

All DfT guidance and related material on appraisal is now available at www.webtag.org.uk – it is an ever-expanding feast of information about transport appraisal. Further details and links are provided in relevant units of this module. The Scottish equivalent is at www.scot-tag.org.uk

Department for Transport (DfT) *Design Manual for Roads and Bridges* – this is an important document for both CTR11116 Transport Economics and Appraisal; and for CTR11114, Highway Design. It sets out appraisal practice for main road schemes in the UK. http://www.standardsforhighways.co.uk/dmrb/index.htm. Various chapters deal with various issues. Volume 13, the Economic Assessment of Road Schemes, is most relevant to this Module. Volume 11 is most relevant to the Environmental Assessment elements in BE71008.

J. Dodgson, M. Spackman, A. Pearman and L Phillips, Multi-Criteria Analysis: A Manual. Department of the Environment, Transport and the Regions, 2001. Now available on the Department's website at: http://www.dtlr.gov.uk/about/multicriteria/index.htm

Department for Transport (DfT) *Valuation of Accidents 2000* – see website http://www.roads.dft.gov.uk/roadsafety/hen2000/index.htm

The following EU research projects *may* be of use, particularly in finding out about practice in other countries. Be prepared to look through much irrelevant information to find what you are looking for, though.

ASTRA (Assessment of Transport Strategies) http://www.iww.uni-karlsruhe.de/ASTRA/. (Deliverable 1, the Final Report and the conference papers are most relevant.)

IASON (Integrated Assessment of Spatial Economic and Network Effects of Transport Investments and Policies (!)) - http://www.inro.tno.nl/iason/

TRANSECON – Urban Transport and Local Socio-Economic Development - http://www.boku.ac.at/verkehr/transecon.html (especially relevant to Unit 13).

PORTAL – this project provides learning materials on a number of different topics in transport, including transport economics, and modelling, both of which are relevant to this module. See www.eu-portal.net/ - in "Study Material" section, username is Portal and password Alexandria, to browse and download materials. The Economics and Pricing module may be of greatest use for our module, but there are other materials of relevance to other parts of the Napier M.Sc.

# Unit Seven

## Learning outcomes

Once you have worked your way through this unit you should:

- Understand why appraisal is carried out in transport.
- Have an appreciation of the principles of appraisal.
- Be able to distinguish between external costs and internal costs in appraisal.

## Introduction to appraisal

**ACTIVITY**

Before you start the Unit, think about the problem that transport planners and government have: many projects that require funding, but not enough money to fund them all. Think about the kind of mechanism that we might need to help us to decide which projects to fund. You might be able to relate this to some of your own spending decisions – you only have a limited amount of money, so how do you decide what to spend it on?

Transport involves the expenditure of resources on a combination of investment in capital items (e.g. stations, track, roads) and/or in operations (e.g. subsidy). Society, and private investors, have limited amounts of resources. Therefore, both seek to maximise the return that they get from the investment of those resources. The best way to do this is to ensure that they choose to spend their resources on those projects that maximise their return. Economists call this **maximizing utility**.

Utility is the usefulness or enjoyment that you as an individual get from expending a resource. For example, for many people who like to drink, then the first drink of the day is particularly useful or enjoyable. The next drink is perhaps a little more or a little less so; the next drink, probably less so again. At some point the enjoyment or usefulness that the person gets out of their next drink is worth less to them than the money that they are using to buy it; at this point, the rational person would stop drinking: it is the point at which they have **maximised their utility**. The economist argues that you would adjust the amount of money that you spent on different items such that you could not derive any more utility from that expenditure. Economists also argue that organizations, and the whole of society, can and should do the same thing.

Looking at the same issue in a more informal way, you can imagine that you yourself may go through a similar process when trying to decide on large purchases. Think about the following, for example:

- What are the advantages and disadvantages of different models of car? This information is an appraisal which may guide your purchase decision.
- With a limited budget (and your own house or flat), you may not be able to immediately afford all the home improvements you would like. You may think about those which provide the maximum return on your investment. However, this can become quite complicated as you start to think about long term *versus* short-term benefits, and things which add value to the house but also have benefits or costs which you cannot put a money value on.

Appraisal, therefore, is a way of **predicting** how much utility we as a society will derive from the expenditure of resources on one thing, compared to another, by predicting the utility

that will arise from each – how much utility would we get from spending £20 million on a new motorway compared to a new railway, for example. In theory we are aiming to expend our societal resources in such a way as to maximise our utility right across society.

It is fundamental to realize that, inherent in appraisal, there is some kind of prediction or forecasting required. Because we have not built a project yet but are only considering whether or not it will be worthwhile, we have to try to forecast the future – sometimes quite far into the future. This is of course a very uncertain process, yet it is fundamental to the results of the appraisal. In transport, two main techniques can be used to forecast the effects of future projects:

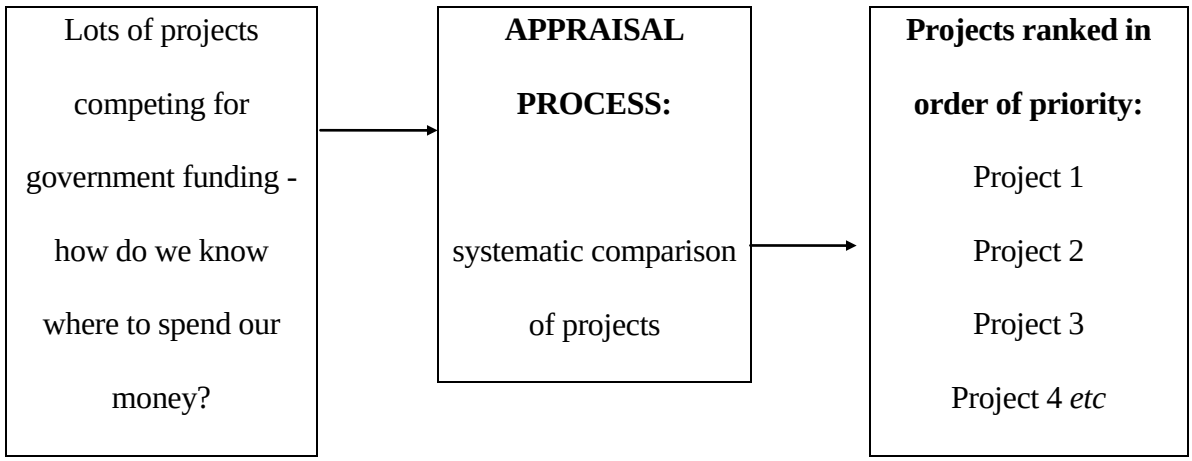
- Looking at the performance of similar, existing projects.
- Using predictive models (which you will deal with, or have already covered, in other modules).

Both options have major drawbacks – principally, the uncertainty that surrounds their results. Predictive models can also be very costly to construct and so are only really justified where the investment that is being appraised is a relatively large one – over £1 million or so. In spite of these uncertainties, appraisal is problematic if we do not predict the future in some way, and so these methods are used. In your professional life, you should always be circumspect about the results of future predictions, whatever the method used, and consequently circumspect about the results of appraisals.

It is also important to realize that, in transport investment in Britain, resources have traditionally come from Government; government and society are virtually synonymous in this context. Increasingly, however, investment in transport projects involves the private sector as well. This can complicate matters, as utility is perceived differently by society and

by private sector companies. The former are driven largely by a need to maximise profits: that is their utility. Society's utility is more widely defined; it may wish to maximise revenue, or environmental benefits, or the number of people who are employed, or increase road safety, or any combination of these and many other factors. This focus on factors other than profit may lead to difficulties when public and private sector try to use the results of appraisals.

**TO SUMMARISE: Appraisal is a way of thinking about all the costs and benefits of different spending projects in a *systematic manner* so that, in theory at least, we can *compare* the different projects and spend our money on those which are going to provide the maximum possible return on our investment.** This process is illustrated below:




We have therefore to consider which costs and benefits we will include in our appraisal, and how we can compare them - for example, we may lose 100 mature trees if a new bypass is built. Should we include the loss of the trees in our appraisal and, if we do, how do we know that these trees are "worth" less to society than the reduction in journey times and accidents

which are predicted to result from the construction of the bypass? This and the following units will show you how these decisions and calculations are made.

**Self assessment exercise: different kinds of costs and benefits**

The purpose of this exercise is to make you start to think about the problems which we face when trying to decide how and where to spend (public) money.

Choose one of the following examples of investment (or more, if you like):

- A new bus lane.
- A new bypass around a congested town.
- A new railway line between London and Scotland.
- A new rural motorway.
- A new ferry link to a remote Scottish island.

Now take your chosen investment and consider the following questions. There may or not be right answers; the purpose of the exercise is to start you thinking about how things might be appraised and about some of the problems that this might bring about.

- What are the costs and benefits of the project?
- Are there any costs and benefits that are difficult to allocate directly to particular individuals, but which are a cost or benefit for society?
- Could you buy and sell all of the costs and benefits?
- Would you include all of these costs and benefits in a your appraisal? Why, or why not?
- What kind of surveys would have to be carried out to count all these costs and benefits?

- How can these costs and benefits be expressed in a way which makes them easy to add up and compare with each other?

Try to answer all questions but don't worry if you can only come up with a one or two sentence answer. The answers to the questions are discussed in the Study Guide.

**Theory and practice**

The economic theory of appraisal is outlined above – you can read more about it in any number of books on appraisal, including the Treasury Green Book. However, there are reasons that you have probably already started to realise why the theory of appraisal is slightly different from the reality.

Firstly, the theory of maximising society's utility is one that would be very hard to put into practice since we do not have complete ("perfect") knowledge of all the benefits or costs that could accrue as a result of every single possible project.

Secondly, in the public sector at least, money to invest in projects is not allocated in a theoretically perfect manner. Rather than all projects – from a new hospital to a new jet fighter – being compared together, money tends to be controlled by different government departments. Appraisal is carried out *within* departments, but much less between them (although in the UK large projects are reviewed at a governmental level by the Treasury). Thus, from the point of view of theoretical economics, utility may be maximised within departments, but not between them.

Thirdly, it is extremely difficult – as you may have found out in the self assessment exercise – to find a common unit in which to measure and express all costs and benefits.

Thus each appraisal will have uncertainties and imperfections within it, making it more difficult to compare with the results of appraisals of other projects.

Finally, and perhaps most importantly, appraisal is not the only basis on which projects are selected for funding: politics often does play a role. Politicians may have "non-rational" reasons for wanting, or not wanting projects, and these may have little to do with the results of appraisals. A good example is the Jubilee Line Extension on the London Underground, which ultimately cost £3.5 billion. Even on initial cost estimates, the ratio of benefits to costs was very small, and other schemes were judged to have greater potential to deliver benefits. Nonetheless, the scheme went ahead because the Minister of the Environment, Michael Heseltine, wanted it to open up the London Docklands. It is now quite difficult to imagine London, and especially Docklands, without the JLE – yet its results in appraisal terms before it was built were questionable to say the least.

**Conclusion**

This Unit has reviewed the basis of appraisal in transport. It has summarised why we carry out appraisal in theory and in practice, and hinted at some of the problems that appraisal of projects can encounter. Now we go on to consider different forms of appraisal in a little more detail.

## Self-assessment exercise – appraisal of station improvements

As explained above, this exercise is designed to be carried out as you work your way through the module. It is based on a piece of consultancy work that I carried out for a Scottish Council, which was submitted to the Scottish Executive as a bid for Public Transport Fund monies. It is possible that you too may have to carry out similar work in your professional lives.

The assignment is to carry out an appraisal of proposals to install a footbridge suitable for mobility impaired people, improved bus interchange facilities, and more car and cycle parking at two stations in Scotland. Some of the terms in this assignment summary will not be familiar at the present, but you will learn them as you go through the module. You are aiming to produce a series of structured notes and calculations.

As closely as possible you should aim to follow the appraisal methodology set out in WebTAG or STAG, although not in great detail. You should produce the following:

- a summary of the problems that the improvements will address
- a cost-benefit analysis of the improvements,
- a TEE table
- an Environmental Assessment based on the methodology in STAG (you may find that this is extremely brief)
- an appraisal summary table

You will be supplied with the following:

- Summary and costs of proposed improvements;
- Ridership (you have to estimate revenue);

- Social and socio-economic background information;
- Local transport policy information;
- Local bus service information is available at

http://www.angus.gov.uk/transport/maps/default.htm ;

- Environmental background;
- Any relevant safety information.
- A map and photos.

As you work your way through this second half of the module, after completing each unit, you should return to this assessment exercise and consider whether there are any further tasks that you are able to carry out from the list above. By the end of the module you should have completed a form of appraisal of the improvements, but you should also have an appreciation of the constraints under which you must work when carrying out such a job.

# Unit Eight

# Different types of appraisal in transport

## Introduction

In the previous unit, we considered the basic aim of appraisal: that is, to be able to compare investments with one another to decide which provides the most return for the available resources (or which maximises our utility). In this unit, we go on to look at practical approaches to this problem in more detail, as a way of explaining how and why UK transport appraisal practice has evolved over the past few years.

## Learning outcomes

When you have completed this unit, you should be able to:

- Have an appreciation of the reasons why UK transport appraisal practice has changed over the past few years.
- Distinguish between financial and social cost benefit analysis.
- Distinguish between cost-benefit approaches to appraisal, objectives-based appraisal and multi-criteria analysis.
- Understand and summarise the main advantages and disadvantages of these different approaches.

### Cost-benefit analysis appraisal methodology

Cost-Benefit Analysis ( CBA) estimates and totals up the equivalent money value of the benefits and costs to the community of projects to establish whether they are worthwhile.

These projects may be dams and highways or can be training programs and health care systems.

The economic appraisal provides a financial justification for a transport scheme where:

- Resources are limited
- Schemes may compete for construction

Construction and scheme costs are compared on a financial basis, best value seen as an important factor.

The result of a cost-benefit analysis is a number: this shows the ratio of benefits to costs for the scheme. If it is less than 1 (i.e. costs exceed benefits) then the rational government or organisation would be expected to be unlikely to fund the scheme. The higher the ratio, the more likely that the scheme would be funded in preference to other schemes.

In the previous unit you should have done an exercise where you tried to come up with the costs and benefits of a chosen transport improvement. It is likely that you decided that the easiest way to be able to add up all the costs and benefits – and so to compare projects - would be to express them in monetary terms. However, you probably found that there were some costs and benefits that could be easily expressed in money terms (e.g. the price of tickets, the cost of building roads or operating trains); some that could probably be expressed in some kind of money terms (e.g. accidents); some that could be quantified but not monetised (e.g. noise); and some that it was extremely difficult to quantify at all (e.g. change in the quality of the landscape). This is a fundamental difficulty with cost benefit analysis approaches with which economists have grappled since the approach was first developed, in the late 1950s.

For the private sector organisation that is conducting a cost-benefit analysis, the problem is relatively straightforward: these organisations are interested mainly in the costs and benefits that can be bought and sold in a market – for example, fare revenue, maintenance or construction costs. Since they can be bought and sold, they have a direct monetary value and are therefore easily added up to derive the overall ratio of benefit to cost for a project. This is called **financial cost-benefit analysis.**

In the public sector, cost-benefit analysis considers a wider range of costs and benefits. Ideally, it should include them all. In practice, it does not, due to the difficulty and uncertainty of expressing some costs and benefits in monetary terms. The challenge for the appraiser is therefore to decide which costs and benefits to include and which to exclude.

In UK practice, public sector cost benefit analysis in transport typically includes:

- **Costs:** capital and operating costs (e.g. maintenance, electricity for trams, bus drivers' wages).
- **Benefits:** time savings, accident reductions, revenues and reductions in operating costs (e.g. decreased petrol costs for drivers who switch to a new tram).

You will note from this list that there are some factors – particularly time and accident savings – that you cannot buy on the open market. You cannot go into shop and ask to buy an hour's worth of time, nor can you pay directly for a reduction in accident (risk). Nonetheless, public sector cost benefit analysis normally includes time (indeed, for many transport projects, the largest benefit is often the time saving, as we will see in the next

Unit and in Unit 12). Because this type of cost-benefit analysis includes factors without a direct market value, it is known as **social cost-benefit analysis (SCBA).**

There is no fixed rule as to which factors should be monetised and included in SCBA and which not. In the UK we do not include changes in air quality or noise in cost-benefit analysis, whereas in many other northern European countries, these factors *are* included. The English Department for Transport (DfT) is currently (July 2002) considering whether or not to change our cost-benefit analysis procedure to include these environmental factors.

It is a reasonable assumption that, whichever factors are included in a monetised cost-benefit analysis, there will always be some that are left out. Yet there are strong arguments for including them, somehow, in the appraisal of your project(s). The main question is: how to do this? There is a subsidiary issue, which is that those factors that are left out of the cost-benefit analysis may be viewed as being less important than those that are included.

**ACTIVITY**

**SKIM READ** HEATCO Deliverable 3.1 http://www.eva-tren.eu/Documenti/D1.pdf which compares transport assessment techniques across the EU. Read only the information about transport, not energy, between pages 35 and 101.

Categories of impacts of a transport project, and how they have traditionally been dealt with in UK transport appraisal practice, are listed in Table 8.1, below.

***Table 8.1 – Different categories of impact for appraisal***

| **Category 1 – monetised impacts included in SCBA in UK practice** | |
|---|---|
| Journey time | Fuel |
| Costs/fares | Construction materials |
| Accidents | Maintenance costs |
| Land | Vehicle components |
| Noise (added in 2006) | Change in noise levels, number of people affected |
| Greenhouse gases (added in 2008) | Tonnes of additional CO2 generated |
| | |
| **Category 2 – quantifiable but non-monetised impacts** | ***Criteria*** |
| Severance caused by route | Distance of diversion required, number of people affected |
| Air pollution | Chemical composition, quantity in relation to thresholds, number of people affected |
| Watercourses | Composition of pollution, number and quality of watercourses affected |
| Habitats | Number and quality of habitats affected; severity of effect |
| Flora and fauna | Number and quality of flora and fauna affected; severity of effect |
| Agriculture | Amount and quality of land taken |
| Buildings | Quality and number affected; severity of effect |
| Geology | Number and quality of geologically important areas affected; severity of effect |
| | |
| **Category 3 – difficult to quantify impacts** | |
| Policies and plans | Qualitative |
| Heritage | Qualitative |
| Rural landscape | Qualitative |
| Urban landscape | Qualitative |

In traditional UK transport appraisal, there has been something of a dichotomy between the environmental and other non-monetised impacts (Categories 2 and 3 in Table 7.1), and the monetised impacts (Category 1). The latter constitutes the SCBA whilst the former together constitute the Environmental (Impact) Assessment (E(I)A), which is required by law in all EU member states under Directive EU 85/337. (You will learn more about EA if you study Module CTR11114, Highway Planning and Design.)

Whilst nominally presented together in a summary table, for road schemes at least, the EIA and the SCBA always remained relatively separate. There was no easy way to weigh

economic benefits against environmental disbenefits, or vice versa. Hence transport appraisal methodology was often criticised for putting too much weight on the monetised benefits to the detriment of other impacts. Furthermore, up until 1998, different appraisal mechanisms were used for different modes of transport, leading to further criticisms that a "level playing field" did not apply to transport investment. At the same time, a number of high profile roads schemes, such as the Newbury bypass and the Winchester Bypass (M3 through Twyford Down) were built with what appeared to be scant regard for environmental concerns, further adding pressure for appraisal procedures to be modified.

These criticisms of SCBA and EA are entirely valid. They could however be answered, at least in theory, by monetising all impacts and incorporating them all into a SCBA. Even if this were possible, however, a further, more fundamental issue, would remain. To think about this, answer the following question, without looking at the footnote (which contains the answer!).

**ACTIVITY**

What result do we get from a cost benefit analysis and what does it tell us? What does it **not** tell us about the benefits that we get from the scheme that is appraised?[1]

Up until recently (about 1998), transport schemes in the UK were appraised using different methods. Larger public transport schemes used a "Section 56 Appraisal", which did not value user time savings on the grounds that these could be recouped through higher fares. Urban road schemes used a programme called URECA. And trunk road schemes used a cost benefit analysis package called COBA, in parallel with which environmental costs and benefits were assessed using an Environmental Assessment (EA) methodology set out in the fun-packed Volume 11 of the Design Manual for Roads and Bridges (DMRB) (see reading list in Unit 7).

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[1] SCBA shows the value of the scheme in monetary terms or as a ratio of benefits to costs. It does not tell us whether the benefits of the scheme are benefits that we actually want. A good example is in modern transport policy where, for a variety of reasons, we may actually be trying to slow traffic down (to bring about modal shift), or to shift travellers from cars to other slower modes. In a conventional SCBA such measures will perform very badly, because journey time savings will be negative.

There is also a lack of output from SCBA to indicate who would benefit and who would lose as a result of the scheme. From an economist's point of view, a scheme that saves one person £60 is just as good as a scheme that saves 60 people £1 each, yet from a societal point of view this is clearly no acceptable. Further, in the UK's privatised environment, it is now quite possible that a public investment - in a bus lane, for example - will end up producing benefits for a private company - for example, increased fare revenues and hence profit. A simple SCBA does not calculate any such distributional outputs.

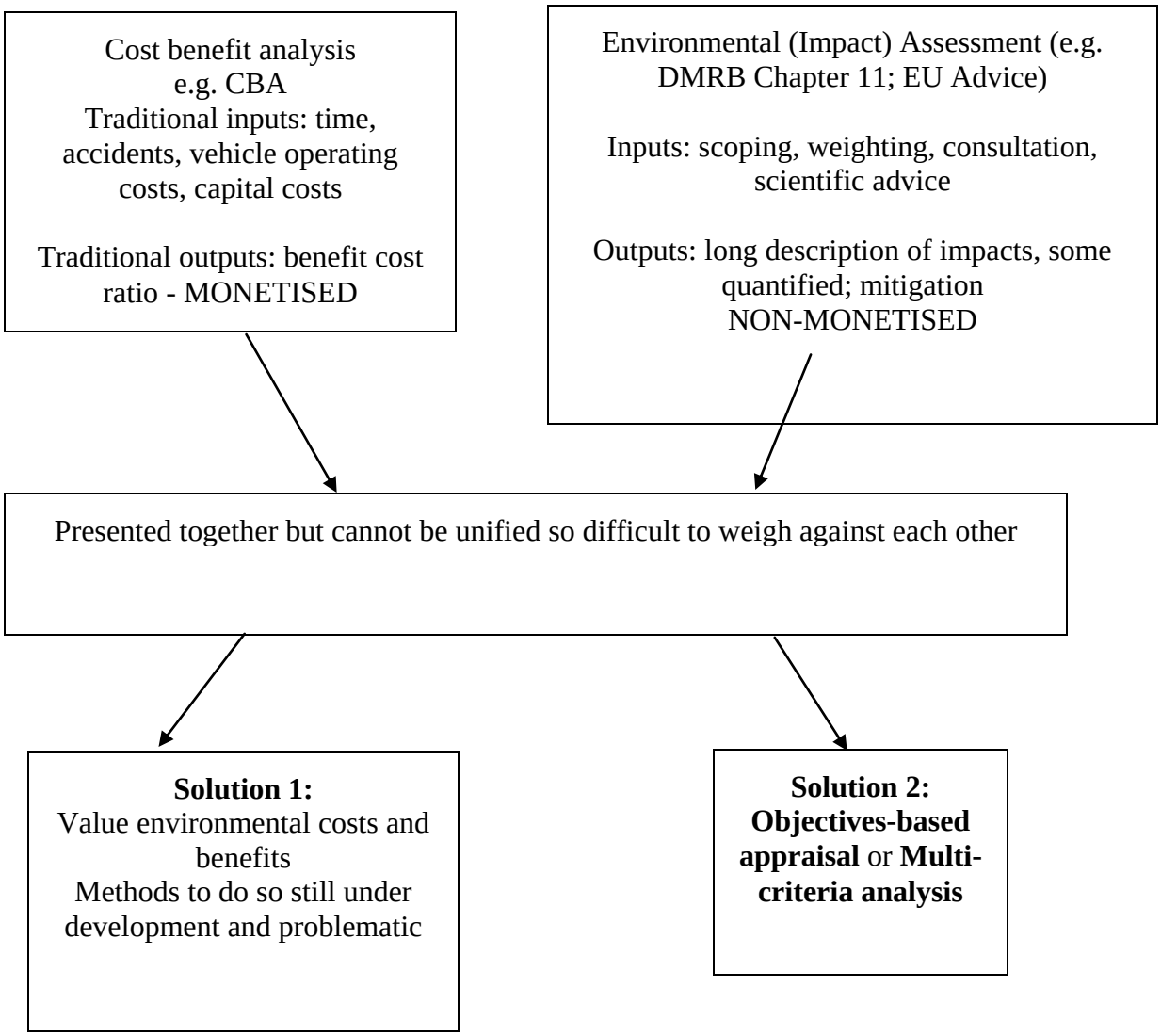
The lack of relationship between outputs and objectives is perhaps the key reason why transport appraisal in the UK has changed recently, from one dominated by SCBA to one that considers transport schemes in relation to transport policy objectives. This is called **objectives based appraisal** although it is very similar to another technique called **multi-criteria analysis.** This change is summarised in Figure 8.1.

**Objectives-based appraisal (or multi-criteria analysis)**

There is a strong argument for setting the appraisal of schemes within the following planning framework:

1. Identify problems with transport.
2. Set objectives for improvement.
3. Identify schemes to achieve objectives.
4. Implement schemes that best achieve objectives.
5. Monitor implementation.
6. Modify schemes to ensure that they achieve objectives as predicted.

## Figure 8.1 - Comparison of appraisal methodologies: a summary



As noted above, an appraisal schema based on SCBA and EA did not necessarily fit into this planning framework, since it was not always obvious how or if objectives were being achieved. Therefore, the Governments in the UK (as well as other organisations, for example the former Strategic Rail Authority (SRA)) have decided to move to appraisal methodologies that have at their centre a number of objectives, and to assess schemes according to how well they achieve these objectives.

Good objectives-based appraisal needs clear *objectives*. These should be specific, measurable, agreed, realistic and time-dependent. It is sometimes useful to classify objectives according to their level. For example, the Treasury Green Book distinguishes between ultimate, intermediate and immediate objectives, but it is particularly useful to distinguish between ultimate and immediate ones.

- Ultimate objectives are usually framed in terms of strategic or higher-level variables, such as the level of economic growth, social cohesion or sustainable development. These objectives may be stated in White Papers, or in Departmental or Agency plans or in annual reports.
- Immediate objectives are those which can be directly linked with the outputs of the policy, programme, or project. Consideration of a proposed option needs to concentrate on those criteria which contribute to the immediate, and hence to the ultimate objectives.

In the UK, central Governments have chosen five key objectives against which to assess transport projects. These are:

- Economy
- Environment

- Safety
- Integration
- Accessibility

Whilst economy, environment and safety have equivalents in the former assessment methodology, integration and accessibility are not as transparent. Their origin is very much in "New Labour" policy – to implement an "integrated transport system" and to reduce social exclusion (part of the accessibility objective) – but their precise meaning is less easy to explain.

Suffice it to say that this choice is not necessarily ideal and that there is some overlap in definitions between them, leading to loss of clarity in the appraisal process, and to the risk of double counting of benefits and costs as they are assessed against various objectives. This risk may be compounded by the addition of local transport objectives as additional elements of the appraisal process. It is also worth remembering that one person's top priority transport policy objective may be at the bottom of someone else's list. Why not spend 5 minutes coming up with your own list of objectives for transport policy and appraisal? Then think who might not be in support of your objectives. This element of political controversy in objectives-based appraisal can be reduced by consulting carefully on possible objectives before using them; however, SCBA approaches avoid this problem altogether – it is very difficult to argue against a project that appears to be good value for money, whereas it is quite easy to argue against a project that performs well against an objective with which you do not agree.

The ways in which these objectives are defined and projects measured against them is described in detail in Units 10 and 11.

**Quantification or not?**

The difference between objectives based appraisal and multi-criteria analysis is that the latter will normally attach numerical weightings to the achievement of objectives, allowing a score for each scheme to be derived and compared with other schemes. Objectives-based appraisal does not: the achievement of each objective may be assessed in money terms, quantitative terms or qualitatively, making it impossible to "score" the scheme or investment overall.

The example below is taken from Dodgson, Spackman, Pearman and Phillips' *Multi-Criteria Analysis: A Manual* (see reading list in Unit 7). As you will see, it has nothing to do with transport! Nonetheless, the matrix conforms to the basic principles of objectives-based appraisal: the objectives are listed across the top and the "schemes" or options listed down the left hand side.

***Table 8.1 – Objectives-based appraisal matrix – toasters***

| **Options** | **Price** | **Reheat setting** | **Warming rack** | **Adjustable slot width** | **Evenness of toasting** | **Number of drawbacks** |
|---|---|---|---|---|---|---|
| Boots 2-slice | £18 | | | | ☆ | 3 |
| Kenwood TT350 | £27 | ✓ | ✓ | ✓ | ☆ | 3 |
| Marks & Spencer 2235 | £25 | ✓ | ✓ | | ★ | 3 |
| Morphy Richards Coolstyle | £22 | | | | ☆ | 2 |
| Philips HD4807 | £22 | ✓ | | | ★ | 2 |
| Kenwood TT825 | £30 | | | | ☆ | 2 |
| Tefal Thick'n'Thin 8780 | £20 | ✓ | | ✓ | ★ | 5 |
| A tick indicates the presence of a feature. Evenness of toasting is shown in ***Which?*** on a five-point scale, with a solid star representing the best toaster, and an open star the next best. The family eliminated from consideration all the toasters that scored less than best or next best. | | | | | | |

**ACTIVITY**

**Firstly**, consider the matrix in Table 8.1 and, on the basis of the information presented, try to decide which toaster you would buy. Does this cause you any difficulties? Would it be more difficult if there were more objectives and they were more different from one another? What you are working with here is a form of objectives-based appraisal.

**Secondly**, try to develop a methodology so that you can derive an overall score for each toaster. To do this, obviously you will need to score each toaster's performance against each objective, and then add the scores together. But you may think that certain features – or objectives – are less important than others (after all, what is a warming rack? And just how vital is "adjustable slot width"?). How would you take that into account in your appraisal? What you eventually develop will be multi-criteria analysis.

**Thirdly**, make a reasoned case for the addition of any further objectives to the matrix – or, if you think that Which? Magazine got it right, explain why.

**More complex multi-criteria analysis**

On the CD ROM supplied with this Module/on the webserver, you will find a spreadsheet called "Swiss spreadsheet model". This was developed by a consultant from Switzerland and, although hypothetical, is based loosely on multi-criteria analysis methods used by some Swiss Local Authorities for the appraisal of transport projects.

The Swiss example assigns weights to various objectives against which the transport project is appraised. In the example given, a bus priority scheme is assessed against a new road scheme, and both are assessed against a do-nothing option.

On the first sheet in the workbook, "Eval. criteria", the objectives and sub-objectives for appraisal are set out, together with indicators. The assessor assigns a number of points to the project depending on how it performs against each indicator. For example, under the Economy objective, if a project leads to a reduction of 100% in traffic volume compared to traffic volumes today, it is assigned a score of 70 points; 35 points if there is no change; and no points if traffic volumes are forecast to increase as a result of the project. (There would also be scope for interpolating between the 70, 35 and zero point markers depending on how precise were the predictions of change in traffic volumes.)

On the worksheet "Basic", weightings are assigned to each objective and sub-objective. The indicators are then scored for the bus option, new road option, and do-nothing option. These base scores – assigned by the assessor - are shown in columns I, K and M in the spreadsheet. The scores are then multiplied by the weightings in columns B and D to give a final weighted score, shown in columns J, L and N. These then give a score out of 100 for each of the three options – in the worksheet "Basic", the bus network is very marginally better than the new road option, with do nothing a poor third.

In the sheets “Traffic part.”, “Society” and “Environment”, the weightings are changed to reflect the priorities of particular groups or objectives. This obviously changes the results of the appraisal of each option. A comparison of the scores for each option under each weighting system is shown in the final sheet, “Comparison”. You can change the weightings and the scores in this spreadsheet yourself to see how the evaluations change.

Whilst obviously quite subjective in the assignment of scores to each option, this form of multi-criteria analysis has the advantage of making both scoring and weighting of objectives transparent, and so is of greater use to the decision maker than the simple presentation of results such as those for the toasters, shown in Table 7.1.

**Conclusion**

In this Unit we have looked at the differences between a SCBA centred approach to appraisal, and objectives-based appraisal. You have found out, in principle, how and why UK appraisal practice has changed over the past few years. Now the Module goes on to consider the operation of SCBA in much more detail, as it remains a key input to objectives-based appraisal in transport in the UK today, and you are very likely to come across it in your working life. But before you go on to the next Unit, don’t forget to do the self-assessment exercise for this Unit, and look at the exercise in Unit 7 to see if you are now able to do any more with that.

**SELF-ASSESSMENT EXERCISE**

**Answer the following questions**

1. What are the costs and benefits that are valued in a typical social cost-benefit analysis (SCBA) package?
2. How (in what units) are they valued?
3. How is the answer expressed?
4. What costs and benefits are not normally taken into account in a CBA and why not?
5. What process is used instead?
6. How is this process and CBA used together to assess a project?
7. Why is this joint use of the two processes not ideal?
8. How could SCBA procedure be expanded as an alternative or addition to EA?
9. What methodology would have to be used to do this?
10. What are the problems with this methodology?
11. In view of all the uncertainties and problems that you have read about already, do you think appraisal of transport schemes is worth bothering with? Why, or why not?

# Unit Nine

# The Use of Cost Benefit Analysis in Appraisal

## Introduction

Having briefly compared the principles of social cost benefit analysis, financial analysis and multi-criteria (or objectives-based) appraisal in the previous Unit, we will now go on in this Unit to consider the operation of social cost-benefit analysis (SCBA) in much greater detail.

It is very important that you do understand the principles on which SCBA is based. This is because, even though many countries have adopted a multi-criteria based approach to the appraisal of transport projects, SCBA still forms a fundamental part of such appraisals – it remains one of the key criteria on which transport projects are assessed. It is very likely that, at some point in your career in transport, you will have to deal with some form of SCBA and so it is very important that you understand how it works.

### Learning Outcomes

After completing this Unit, you should:

1. Understand the operation of basic SCBA.
2. Be able to carry out a simple SCBA.
3. Understand in detail the principles on which SCBA is based, and to be able to critique these principles.
4. Have knowledge of some of the SCBA packages that are used in transport appraisal today.

## Origins of cost benefit analysis

Cost benefit analysis originated in the USA in work immediately before and after WW2. Initially it was applied to flood prevention schemes and to military investment and was concerned with injecting some intellectual rigour into the informal objective of "getting most bang for a buck".

The first use of SCBA in the UK was in its application to the assessment of the M1 motorway, in 1960; and, as we shall see later, to the Victoria Line on London's underground, in 1967. At this time, SCBA also became more widely accepted – or required – in Government, initially in the nationalised industries, where it became possible to appraise projects, not only against the financial income that they generated, but also in relation to the non-market benefits that they might also realise. As you will find from reading the UK Treasury's Green Book (supplied on the CD ROM with the module), since 1967, SCBA has become a key aspect of UK appraisal techniques.

## How does SCBA work?

The purpose of cost benefit analysis (CBA) is to weigh up the costs and benefits of a project to see whether the benefits are greater than the costs and, if so, by how much. For example, in Gothenburg, Sweden, the local traffic authority is currently constructing a bypass. This is a rather unusual bypass, because it is for trams: the tram network has become congested in the city centre, so a bypass is being built around it in order to provide faster journey times across town, and to provide new journey opportunities.

In order to assess whether or not this scheme was worth building, the traffic authority is likely to have gone through some of the following steps:

- Chosen one or more alternative options against which to assess the tram bypass scheme. The base option (let's call it Option B) would have been to build nothing, or make only minor improvements to the existing network. We can call the tram bypass Option A.
- Choose a length of time – probably several decades – over which to assess the costs and benefits of the scheme.
- Use a predictive model to calculate the likely ridership during the whole evaluation period on the tram network in Options A, B and any other possible options that were subject to evaluation. From this, calculate likely revenue.
- Use the same predictive model to calculate total journey times on the different options over the whole evaluation period.
- For Option A, calculate the **journey time savings** likely to result from the project by taking away the total journey time for all passengers on Option A from the total journey time for all passengers on Option B (or possibly restricting this part of the analysis to total journey time to those passengers who would use Option A *or* Option B, and not to include the passengers who are attracted to the tram because the network is improved).
- In a similar way, calculate journey time savings on the road network resulting from the tram bypass, if people are predicted to transfer from car and/or bus to tram.
- Calculate construction, maintenance and operating costs of the different options.

- Take away the benefits (revenue plus journey time savings) from the costs for Option A to find out whether benefits exceed costs and, if so, by how much.

This is all summarised in the diagram, below.

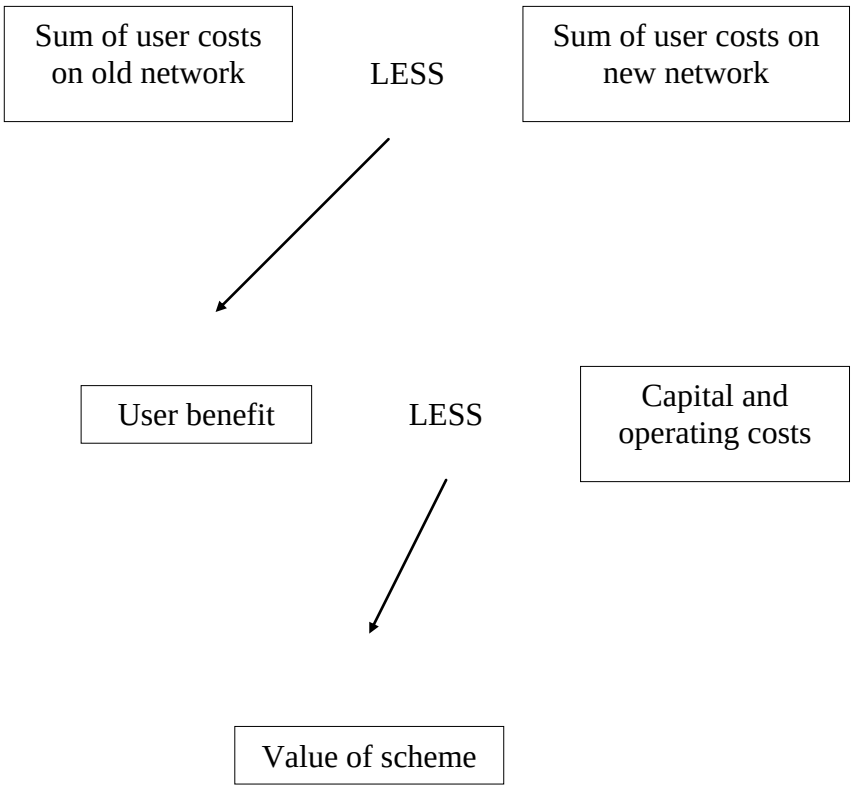



***Figure 9.1 - Principles of SCBA***

It follows from the discussion above that are some key elements to any SCBA. These include:

***Project appraisal period***

A transport project such as a new road produces benefits in the year that it is built and over the years into the future. The SCBA must decide how many of these future years

will be taken into account; currently in the UK, projects are assessed over a 60 year period but this is quite an arbitrary number, related to accounting conventions and to the accuracy of predictive modelling. As we will see in later parts of this unit and module, however, the length of time chosen for the SCBA can have a critical impact on the end result.

***The benefits that are assessed.***

These normally include changes in the costs to users of the transport network as a result of a new project. For example, a new road or rail line can often be expected to relieve congestion on existing routes. This is a change in user costs – the journey time (a user cost) would normally be expected to fall, at least in the short to medium term.

The user costs that are most typically included in SCBA are:

- travel time (and variants of it e.g. parking search time);
- revenues (e.g. fares, parking charges, road user charges);
- vehicle operating costs (e.g. fuel); and
- accident costs.

All these costs are expressed in monetary values e.g. £, Euros, $. In countries other than the UK, some other impacts are included, such as the value of changes in local air pollution.

The presumption of a SCBA is that user costs on the transport network as a whole will fall as a result of the investment. **Thus the user costs on the new network (e.g. the network that includes the new investment) must be compared to those on the old network (that without the new investment).** This reduction in user costs on the new network

compared to the old is the benefit measured by the SCBA. The capital (e.g. construction) and revenue (e.g. operating, maintenance) costs must be weighed against the measured benefit.

**Do something and do-minimum**

From the discussion above, it should hopefully be reasonably clear that SCBA involves the comparison of at least two options: that which includes the investment that is being appraised, and that without. These are conventionally referred to in appraisal as the **do-something** and the **do-minimum.**

Both the do-something and the do-minimum consider the "whole" transport network, not just that part that is subject to improvement. The definition of the network that would be considered "in scope" for the appraisal will depend on the scale of the project that is being appraised. For example, where the investment under consideration is in a tram line that will primarily serve one corridor radiating out from a city centre, then it is likely that the network considered would include bus, car and cycling options along that corridor and along parallel corridors out from the city – but not in other areas of the city. On the other hand, a tram network for the whole city would be assessed in the context of the entire transport network for that city.

The **do-something** network is the chosen transport network, including the investment option under consideration.

The **do-minimum** network is the network without the chosen investment option, but it may include minor improvements that are already programmed to occur. For example,

the existing network may have a particularly congested junction where minor widening and re-signalling is programmed to deliver some reduction in congestion; such improvements would be included in the do-minimum.

**Forecasting and modelling**

It is clear that a pre-requisite for a SCBA is a model that will predict travel on the transport network - and hence user costs - for the life of the scheme. Modelling is covered in other modules but you should not underestimate its importance to SCBA. Modelling may not always be up to the demands placed upon it, especially when the new transport scheme may lead to very great changes in demand, or where there is a need to model interactions between different modes of transport. If you are carrying out an appraisal, or review results of one, be very careful to check all the assumptions that are made in the model, and to ask for justifications for these. If the model is wrong then the appraisal will also be completely wrong.

The most significant example of forecasting assumptions affecting the outcome of appraisals is that which existed in UK trunk road assessment up until 1994. Prior to this time, it was assumed that the amount of traffic that would use do-something road network would be the same as that which would use the do-minimum network; that is, no account was taken of what is known as *induced traffic*. It is possible that an appraisal that does not take account of induced traffic may *overestimate* the benefits of a new road – since the induced traffic can increase congestion, thus increasing network travel time and total user costs to a greater degree than was predicted by the modelling. On the other hand, if the amount of induced traffic is less than that which would cause congestion, but more than

that which would be predicted by a fixed trip matrix approach, then the benefits of the road will be *underestimated* by the latter approach. Unfortunately, the prediction of the amount of induced traffic remains an extremely difficult science, and one that lies outwith the scope of this module.

### *Present value*

If the project is assessed over a number of years, then the predictive model used will normally calculate the benefits and costs for each year of the project. However, consider the following situation: your model gives a predicted benefit for the year 2010 of £25,000 and for 2015, also of £25,000. *Disregarding any inflation that might exist,* can you simply add these, and the other benefits for all the other years of the appraisal, together, to derive a total benefit? The answer is **no**. This is because – even if you could buy the same amount of goods with £25,000 in 2015 as in 2010 – the two sums would be worth different amounts to you *now*, because you would have to wait longer before you would enjoy the benefit arising from the investment in 2015. Don't worry if you do not entirely grasp this idea now, as we will return to it later in this Unit, but take it as read for now that before costs and benefits that are predicted to arise in different years are added together, they must be subject to a process that converts them to a common unit known in SCBA as their **(Net) Present Value (NPV).** Benefits will sometimes be expressed as Net Present Benefit (NPB) and costs as Net Present Cost (NPC).

### Values of time

Time savings are normally the most significant benefit in SCBA of transport schemes, and so the value of time used is absolutely critical to the final outcome of the evaluation. The

normal procedure used is to take the total time saving predicted for each group of users (e.g. car drivers travelling on works' business; pedestrians going shopping) for each year of the evaluation. This is then multiplied by the relevant value of time for that user group to derive an overall value of time for the scheme.

You should be aware that sometimes the total time saving for the scheme is the result of multiplying very small individual journey time savings by a very large number of users over a long period. Think, for example, of a short section of bypass of an historic town; the average time saving per vehicle may be of the order of only two or three minutes, but with much traffic on the road, these small time savings multiplied many times aggregate to one large – and valuable – time saving.

The values of time that are used in SCBA are standard for the UK. These values are derived from stated preference surveys and also from observing people's actual behaviour where they can choose between paying for a shorter journey or taking a longer route to avoid a toll (for example, the Kincardine Bridge across the Forth has no toll, whereas there is a toll on the Forth Bridge, so studying driver route choice can help us to understand how drivers trade off cost against time, and hence to derive values of time. Similar studies have been undertaken of crossings of the Severn from Bristol to Wales).

Different values of time apply to those people deemed to be travelling in working time and in non-working time. Examples of trips that are made in working time include lorry drivers at work; bus drivers at work; and people who are travelling to meetings, or sales representatives, who are travelling in time during which they are being paid by their

employer. All other trips – *including trips made to and from work, where the traveller is not being paid by their employer* – are deemed to be made in non-work time.

The value of trips made in non-work time is less than those made in work time. This is because there is no market for work time – it cannot be bought and sold. Values of non-work time represent the *opportunity cost* of the time involved, meaning the value that people attach to time because of what they could do with it instead of travelling. (This of course is related, indirectly, to wage rates and to the proportion of people who are employed.) In contrast, there is a market for working time – employers buy it and employees sell it all the time – and so the values used for people travelling in working time approximate to average wage rates paid to these groups of people. Data from the rolling National Travel Survey (NTS – see http://www.dft.gov.uk/pgr/statistics/datatablespublications/personal/mainresults/nts2006/) are used to derive the average pay rates of the average person making the average trip on works business by car, bus and other modes. You can see the effect of this in Table 2/1 of the DfT's *Transport Economics Note* (see below).

**ACTIVITY**

Read Section 1.2 of the Department for Transport publication WebTAG Chapter 3.5.6 on values of time and operating costs, available at *http://www.dft.gov.uk/webtag/documents/expert/unit3.5.6.php* Decide which values of time you should use for a person who is travelling by underground train on works' business; and for a person who is travelling to work by bus. Why do you think that

values of time when travelling in working time are highest for travellers on the underground and lowest for those on the bus?

A number of assumptions normally support the use of standard values of working time in SCBA of transport schemes. Without these assumptions it becomes more difficult to justify the use of averaged wage rates as proxies for the value of working time, for appraisal purposes. These assumptions are:

- That time spent travelling cannot be used for working and, therefore, that time saved thanks to investment in a transport scheme therefore increases the amount of productive work that a person can do and, consequently, increases output per employee and/or saves the employer money. With the advent of laptop computers and mobile phones this assumption is increasingly open to challenge but for the moment it remains in place.
- That time saved due to the investment in a transport scheme is used by an employee to do more productive work – not to, for example, have a longer lunch break or to get home earlier because you can fit in all your business meetings in a shorter time!

Given that there is a relationship, either direct or indirect, between values of time and wage rates, you may be asking yourself why UK transport appraisal practice currently uses standard values of time right across the country, when wage rates differ markedly on a regional basis. From the point of view of economic theory, it is actually nonsensical to use averaged values of time: theory dictates that the value of time savings is greater in those areas where values of time are higher, and therefore investment in a scheme with

similar time savings would be of greater value in an area of high wage rates than lower wage rates.

**ACTIVITY**

Take five minutes to think: why has the decision been taken up to now in UK transport appraisal practice to use standard national values of time? If we used regional values of time, where would transport investment in the UK tend to be concentrated? By using higher values of time for certain groups of users than others, how might this influence the performance of different types of schemes in appraisal at the current time (e.g. how might a bus scheme perform compared to a road scheme compared to an underground scheme)?

Other countries have less standardised values of time than we use in the UK – in Sweden, for example, different values of time are used for rail passengers travelling first class and standard class. If you wish, you can read more about this topic in Bristow and Nellthorp in Transport Policy Journal, Volume 7 Number 1, January 2000.

Valuation of time savings in SCBA also requires a knowledge of the proportion of total trips on the network that are made in working time and non-working time, by mode. For example, your predictive model for a large scheme is likely to provide sufficient detail for you to know that, between 1100 and 1115 on a weekday there will be 100 cars on the network with 120 occupants. You need to know the proportion of these people that will be travelling in work time and in non-work time. Again, the NTS is used to derive these data.

**ACTIVITY**

You might also want to think about the times of day and times of the week that there are likely to be lots of people travelling on the network in working time, and days and times of the week when the proportion is low. Write down your justification for your decisions. Then refer to Table 4 in WebTAG Chapter 3.5.6 on values of time and operating costs, available at *http://www.dft.gov.uk/webtag/documents/expert/unit3.5.6.php*, to see whether you were thinking along the same lines as the DfT's economists.

**Accident valuation**

The costs of an accident are several:

- The costs of policing the accident and clearing up the mess.
- The loss of economic production from the victims who are injured or killed.
- The costs of medical treatment.
- The pain and suffering inflicted on the victim and those close to them.
- The general feeling of a less safe travel environment for all those who travel by the mode of transport in general (and therefore people's willingness to pay for safety improvements).

In the UK, all these various factors are taken into account in deriving values of a standard life used for calculating the cost of road accidents. This means that the UK has one of the highest values for accident savings used in Europe. Spain, Portugal and Greece have very low rates, reflecting in part their lower rates of pay and hence lower willingness to pay for safety improvements, but mostly because their accident valuations are based largely on

insurance costs. These countries also have some of the highest rates of traffic accidents in the European Union.

In the UK, different valuations are used for accidents on railways and the underground. This is justified on the basis of willingness to pay studies, which have discovered that, because people feel less in control while travelling on these modes of transport compared to driving, they are willing to pay more for safety improvements. Recent research has cast doubt on the higher accident values used on the railways but, up to now they have been used to justify greater spending on safety measures per passenger km than on the roads.

As part of a SCBA it is necessary to predict the number of accidents that will occur on the new network. On road schemes, this is largely a function of traffic speed, road type and junction layout. There is a massive amount of historic data about actual accidents that has been collected in the UK over the years. Using regression techniques, engineers are able to fairly confidently predict the number of accidents that will take place on new roads into the future, and to input this to SCBA appraisal. For other modes, predictions of future accidents must be made on a more ad-hoc basis.

**ACTIVITY**

Download the section of the COBA11 Manual that deals with accident valuations. (See http://www.dft.gov.uk/pgr/economics/software/coba11usermanual/part2thevalofcostsandb3154.pdf, part 4). Consider two sections of two roads – one a D2 motorway, the other a modern S2 road - both carrying 3 million vehicle km per year. Using the combined link and junction rates from Tables 4/1 and 4/2, calculate the number of accidents that would have occurred on each road in 2000, and the average number of casualties in each.

**Tax**

When considering the results of an appraisal, you should be aware of how tax has been dealt with – if it is not clear, ask your tutor by email or phone.

There are two types of tax:

- direct – for example, income or capital gains taxes which come directly from your income or wealth; and
- indirect – sales taxes, which you pay only if you buy things. VAT is the principal indirect tax, but there are others, such as fuel duty.

Previously in UK transport appraisal, indirect tax was excluded. This was because it was regarded merely as a transfer from one section of society to another, rather than a saving in resources, and there was a danger that including taxes could exaggerate benefits. For example, consider the situation where a new road permits car drivers to make a 5 mile journey at a more constant speed, thus saving them fuel costs. For each litre of fuel saved as a result of the road, users benefit by about £0.76 (at current fuel prices). However, 80% of this £0.76 is tax, so if the users are not buying the petrol, Government loses about 60 pence per litre that is not sold. If Government were to include this loss of tax as a benefit, it would in effect be advocating the use of taxpayers' money to build a road that then reduced income from taxpayers – to paraphrase a market trader, it would be "robbing itself". Therefore, SCBA in the past in the UK excluded indirect tax by simply measuring the benefit to the user whose petrol consumption is reduced by using the cost of the petrol after tax – about 15 pence per litre. This is also known as the *resource cost*.

Government has now decided, however, that transport appraisal should make clear the flows of tax that are affected or changed by a new transport scheme. This does not affect the overall NPV of the scheme, but it does allow Government to see flows of money from private sector to public sector and vice versa – extremely important in a climate where, increasingly, schemes are being financed by public private partnership, and also where the investment of public money can realise significant financial gains for private sector organisations. You can read more about this issue in Unit 12.

**Operating costs**

Operating cost savings are likely to accrue from investment in a transport scheme. For example, if a bus lane increases average bus speeds then the bus company will be able to operate more service with a given number of buses and drivers, or the same service with fewer, and hence save money. By raising average speeds and reducing congestion, a new road is likely to reduce operating costs for all road users.

Many transport schemes may also lead to an increase in operating costs. For example, running additional buses or new trams will have an operating cost associated with it. A new road will have operating (i.e. maintenance) costs. Remember that at all times the operating costs that are included in the appraisal must be *net* – for example, the new tram scheme will lead to an increase in operating costs, but these may in part be offset by a reduction in bus operating costs if the tram substitutes for some bus services.

Standard vehicle operating costs (VOCs) for road schemes can be derived using DfT formulae, which are based on vehicle performance data collated by the Vehicle Standards

Agency. Operating costs for public transport vehicles are often more difficult to collect as they are increasingly regarded as "commercially confidential", as most public transport services in the UK are operated by the private sector. Rail operating costs in particular are very difficult to calculate as they are a combination of:

- track access charges paid by the train operating company to Railtrack, the infrastructure destroyer;
- charges paid by the train operating company to the train leasing company for the actual vehicles; and
- the wage and day to day maintenance and fuel costs incurred by the train operating company for running the trains.

This can lead to under priced projects or, as it has also recently been termed, "optimism pricing bias" which of course can make a project seem much more attractive than it in fact is (see discussion of this issue, below).

**Revenue**

In simplistic terms, the **net** effect of revenue in a SCBA is neutral, since it is a cost to users (fares or parking charges) but it reduces the operating costs of the scheme. However, it is increasingly useful to set out this flow of money in a SCBA because it may be from one sector of society – normally consumers – to another, perhaps government, or private companies.

In more complex terms, the benefits of the scheme to users may exceed the revenue that is generated, since some are prepared to pay more than they are actually charged, so they are effectively in a "surplus" situation. This fact is taken into account in appraisal practice by

something called The Rule of the Half. You can read more about this rule at http://www.dft.gov.uk/webtag/documents/expert/unit3.5.3.php but do not be concerned if you do not fully understand this, as you will not be directly tested on it in an exam situation (although if you are able to explain it in a relevant answer, then you will gain additional marks).

**Discounting**

A SCBA calculates benefits and costs for each year of the life of the scheme. However, these cannot simply be added up to give the total costs and benefits of the scheme, since a benefit of £1 is worth less to us if we have to wait ten years before we receive it. Put another way, if you took £10 now and invested it in a savings account at 6% interest, in 10 years it would be worth £17.90 (i.e. £10 $x$ $1.06^{10}$). Therefore, if you had £10 to invest in a project that realised benefits in year 10, you would want to know that the predicted benefit in year 10 would be more than £17.90, otherwise there would be no point in you putting the money into the project and having to wait ten years to realise the benefit.

Furthermore, there is risk attached to investing in a project that will realise benefits in the future: it may not realise the predicted benefits. The discount rate is also an attempt to take this into account.

In SCBA, therefore, a process called discounting is used to transform all costs and benefits to a common value - that is, their value in a common year, known as the **price base year**. A standard discount rate is also used, and is related to the general rate of return on money invested in banks and government bonds. **At the current time in the UK the discount rate is 3.5% and the price base year is 2002.** As you will understand when you do the

activity below, it is important that all projects are appraised using a common discount rate and price base year, as well as a common length of time over which they are appraised.

The formula for discounting a benefit received in year *n* (B*n*) to its value in the price base year 2002 ($B_{2002}$) is as follows:

$$B_{2002} = Bn/(1+r)^n$$

In using this equation you should remember that for 2002 $n = 0$ and $r = 0.035$.

To calculate the total benefits from a project, the predicted benefit for each year is discounted and then added together. Costs are also not always incurred in year one of a project – indeed, operating costs occur throughout a project's life – and so these too must be discounted.

**The total summed discounted costs and benefits are called Net Present Cost (NPC) and Net Present Benefit (NPB) because they give the *current* value of the total costs and benefits from the project. Subtracting the NPC from the NPB gives the Net Present Value (NPV) of the scheme, which will normally be positive. NPC, NPB and NPV are key terms with which you should be familiar.**

**ACTIVITY**

First, discount the following stream of benefits from a project and derive a NPB for price base year 2002. Use a discount rate of 3.5%.

| Year | Benefit (£) |
|---|---|
| 2002 | 25,000 |

| | |
|---|---|
| 2005 | 35,000 |
| 2006 | 40,000 |
| 2007 | 60,000 |
| 2008 | 70,000 |
| 2009 | 100,000 |

Secondly, do the exercise again but use a discount rate of 2%. What effect does this have on the NPB?

Thirdly, if the majority of a project's costs were incurred in its first few years, but benefits continued to accrue for many years afterwards, over how many years would you wish to appraise the project if you were trying to get it approved for funding? Can you think of any reasons why we currently appraise a transport project over 60 years (as one clue – discount a £25,000 benefit received in year 70 of a project's lifetime)?

The price base year currently changes approximately once every 4-5 years. The previous price base year used in UK transport appraisal was 1998. The Treasury sets the discount rate for public sector SCBA project appraisal, and they have recently lowered it from 6%, in order to encourage investment in projects that realise benefits over a long timescale. (See the Treasury Green Book, available at www.treasury.gov.uk/greenbook). Their argument is also that the "risk" element of the discount rate should be dealt with much more systematically by sensitivity testing and other techniques (see Unit 12) and so they have removed this element from the discount rate – the 3.5% is supposed only to reflect the fact that future benefits are lower because we have to wait for them.

It is important not to confuse inflation with discounting. The streams of costs and benefits in appraisal are measured in real £, that is, £s with the same buying power regardless of the year that the cost or benefit occurs. However, after the NPB, NPC and NPV are calculated for price base year, it is possible to adjust these figures for the effects of inflation – that is, to express them in today's money – by carrying out the simple multiplication set out below:

$$\text{NPV (or NPB or NPC)}_{2008} = \text{NPV}_{2002} \times \text{(Retail price index 2010/Retail price index 2002)}$$

The Retail price index (RPI) is readily available in Government statistical publications.

**Criticisms of and problems with SCBA**

There are several criticisms that can be levelled at SCBA and it is these that have in part led to the UK Government nominally reducing its overall importance in transport project appraisal – although it still retains a key role.

**ACTIVITY**

Before you start reading the rest of this section, why not take a few minutes to write down any criticisms of or problems with SCBA that may have occurred to you while you have been reading the previous parts of this Unit. Then read the next section and compare your thoughts with mine.

***Valuing time savings***

In the section of this Unit that discusses values of time in SCBA we have already discussed the theoretical problems with using average values of time right across the country when in fact values of time vary. However, there are other difficulties with the assumptions that underlie the valuation of time savings in SCBA.

The first is that very small time savings are valued proportionally the same as large time savings: the value of an hour in standard SCBA is simply 120 times the value of 30 seconds. You may wish to test the validity of this assumption yourself. Think about the way that you normally get to work or to go shopping: how large a time saving would have to be delivered by a new project before you would notice the time saving as part of that regular journey? Fifteen seconds? Thirty seconds? Probably not. For most of us, a saving of at least three to five minutes would be needed before we would even start to register it. Yet for SCBA, there is, proportionally, no difference, and as long as the total of all the fifteen second time savings is enough to outweigh the costs of the project over the life of the appraisal, then the project is deemed worthwhile. There are, however, immense difficulties in trying to decide on a "cut-off" time saving, less than which would not be included in a SCBA.

Recognising this problem, the DfT has recently undertaken research that supports our intuitive feeling that small time savings are not valued. (See article from LTT included on the webserver.) This has yet to work its way through into appraisal practice as it fundamentally affects the justification for many projects across all modes of transport.

The second key difficulty with the valuation of time savings in SCBA in transport appraisal is what we actually do with the time saved. Since there has been a lot of money invested in transport projects in the UK over the past 30 years, and given that the justification for many of these projects is that they reduced journey times, one might expect that people would now be spending less time travelling than they did 30 years ago. In fact, the opposite is the case: we spend about 25% more time travelling, and we travel twice as far per person per year (see the National Travel Survey, available on the web). Thus the effect of reducing travel times appears to be that, in the medium to long term at least, we change our behaviour and re-invest travel time saved from new transport schemes into travelling longer distances.

A typical example of this might be an improved road from Edinburgh to the East Lothian town of Dunbar. (For those of you not from the East of Scotland, you might have to consult a road map – but the road in question is the A1, which is currently being upgraded between the two places.) Initially, for all those people who used to travel on the old slow road, the new road provides a time saving. But because it is now quicker to travel from Edinburgh to Dunbar and vice versa, some of those people may make the journey more often than they used to. Some other people, who spend half an hour travelling to and from work by bus within Edinburgh may realise that the new road would allow them to live in Dunbar and spend 35 minutes travelling by car to and from work every day. And thus, in the longer term, the road leads to people travelling further and perhaps spending a little more time travelling than they did before. This is not to say that there is no benefit to the person who decides to move to Dunbar, nor to the person who can travel more often between Dunbar and Edinburgh; but it may not be valid to measure this benefit in terms of

the net journey time saving delivered by the new road compared to the old – change in property values might be a more appropriate proxy, but this is not yet accepted practice in SCBA.

***What to value?***

Many costs and benefits of transport investment are currently left out of SCBA, largely because it is methodologically too difficult to derive monetary values for many impacts of a scheme. Theoretical economists advocate further work on valuation in order to get round this problem; pragmatists prefer multi-criteria analysis.

***Discount rate and length of time of project appraisal***

From the activity about discounting, you will hopefully have worked out that a lower discount rate makes a project seem more attractive, because future benefits have a higher present value than if a higher discount rate is used. Thus choice of discount rate can be critical to a project's feasibility when assessed using SCBA. Similarly, a longer appraisal period will generally make a project appear more attractive, especially where the bulk of the costs are expended early in the project's life time.

The choice of discount rate and appraisal period is to an extent arbitrary, yet can spell the difference between negative and positive NPV. The key thing for you to do if you are appraising different projects, or if you are asked to choose between projects on the basis of appraisals that have been carried out for you, is to ensure that discount rates and appraisal periods are the same for all the projects, so that you can be assured that they have been assessed on a "level playing field".

***What does NPV show us?***

This point was discussed in the previous Unit, but is worth reiterating here. Simply because a project or scheme has a high NPV when assessed using SCBA, this does not necessarily mean that it will help us to achieve transport objectives. For example, one of our objectives may be to enhance road safety, so we may decide to have a blanket 20 mph speed limit. Another might be to bring about mode shift from car to bus for congestion reduction and environmental reasons. If assessed using a SCBA, such schemes would be likely to have a poor NPV because they involve increasing some people's travel time. This would remain a problem for SCBA even if it included all possible costs and benefits.

***Equity and distributional effects***

From the point of view of economic theory, aggregate increases in utility represent a benefit, regardless of how many people, or to whom, they accrue. Consider the following examples: each pair would be considered to have equal value in a SCBA:

- Sixty people each saving one minute's travel time, or one person saving 60 minutes' travel time.
- Vehicle operating cost savings arising from a new road scheme built in a wealthy area, or equal vehicle operating cost savings arising from a road scheme built in a poor area.
- A scheme that increased total travel car drivers' journey costs by £900 but reduced bus users' journey costs by £1000 would have equal benefit to one which increased bus users' costs by £900 and reduced car drivers' costs by £1000.

It is obvious, however, that some of these options would be more *politically* acceptable than others, or might accord more with policy objectives than others. At the present time,

for example, nominal Government policy is to assist bus users, particularly those from poor ("socially excluded") areas. Also, few nominally democratic Governments would often choose the scheme that benefited one person rather than sixty, unless there were other important reasons for choosing that scheme. (For example, in Scotland or Norway, transport schemes in small island communities are funded because there is a general presumption that to support such communities is a desirable societal objective – even though very few people will benefit from the investment.) But the SCBA would have provided the decision maker with no guidance on any of these choices; it would classify all pairs as equal. This can be summarised by saying that SCBA does not take into account **equity** or **distributional effects**; this is an important criticism.

***Project pricing – optimism and inaccuracy***

This is a problem that is not unique to appraisal using SCBA, but it is well illustrated in this Unit. For many large transport projects, forecast NPV is not high, and the ratio of benefits to costs is normally in the range 1.2:1 to 4:1 for large schemes. Thus the appraisal is highly sensitive to increases in project construction and operating costs.

It has become increasingly obvious to the UK Treasury that there is what as known as "optimism pricing bias" in transport scheme appraisal – that is, construction and operating cost estimates are priced optimistically in order to make the scheme look more appealing than it is. This deliberate underpricing is compounded by a simple lack of knowledge about the true costs, due to engineering uncertainties and because modern transport investment involves many different parties, each of whom has their own pricing structure and need to make profit. Thus costs escalate massively; recent research by the Treasury

indicates that for transport projects, actual outturn costs are on average 44% greater than the costs included in appraisals, and sometimes much higher. This issue is dealt with at greater length in Unit 12.

**Examples of SCBA programmes**

Having reviewed the principles of SCBA in principle, the remainder of the Unit is devoted to considering actual computer packages used for SCBA in transport. These are very minimal descriptions of these packages and, certainly for COBA and TUBA, you should try to find out more about them. User manuals for both packages are available on the web. Also, a TUBA "test" package is included on the CD ROM for the module.

The first example that we will consider is PRIDE, which was designed to calculate the costs and benefits of new park and ride schemes. Sample input and output files from PRIDE are provided on the CD ROM with this module. You should note that PRIDE incorporates a modal choice model that predicts how many drivers will switch to park and ride. This modal choice model includes the number of travellers who wish to travel from certain parts of the city and outlying areas into town, and it also includes journey times and costs by different modes for the journey. Using the mode choice model, it predicts the numbers of people that will switch from car to park and ride. It then calculates the savings in parking costs and journey time that will accrue to all travellers as a result of some of them switching to park and ride, and compares these to the operating costs of the park and ride and any reduction in on-street parking revenue, in order to derive the overall NPV of the scheme.

The second example is COBA, a cost benefit analysis package for the evaluation of inter-urban trunk road schemes. If you wish, you can read the manual for COBA at http://www.standardsforhighways.co.uk/dmrb/index.htm – download Volume 13, Economic Analysis of Road Schemes, part of the Design Manual for Roads and Bridges. A skim of the document is certainly recommended. COBA was the standard appraisal package for trunk roads from its inception in the early 1970s through to 2000. It is still recommended for inter-urban road scheme evaluation (in England – the Scottish equivalent is a package called NESA) but has been somewhat overtaken by the necessity for multi-modal evaluation tools (see below).

The latest version of COBA is COBA11. The chief inputs to COBA11 are the numbers of vehicles predicted to on the old and new network (from the National Road Traffic Forecasts (see http://www.dft.gov.uk/pgr/economics/ntm/ntmdatasources/nrtf1997/), and a network specification (in terms of the types of roads, numbers of junctions and link lengths). Using default national values and speed flow relationships rather than assignment modelling, COBA calculates user costs on the old and new networks: these are composed of journey times, vehicle operating costs and accident costs. These are then discounted and compared to the construction and maintenance costs to derive the NPV of the scheme. COBA11 is still not well adapted for modelling situations where a new road induces additional traffic, and so other appraisal tools are recommended.

The final example of an appraisal package is TUBA (transport user benefit appraisal). This was commissioned by DfT and was first released in summer 2001. It was produced because there was a need for a package that could appraise multi-modal schemes (those

including new roads and public transport schemes together) and to produce results that are disaggregated according to their impact on government and private sector service providers, as well as on users. (More explanation of these terms, and of TUBA itself, is provided in Unit 12.)

**Summary of this Unit**

Don't forget to look at the ongoing Activity about the appraisal of station improvements at two stations in Scotland. You should be able to do a few more of the tasks in the Activity, now that you have completed this Unit.

In this Unit, we have looked in more detail at how a social cost benefit analysis works. In particular we have covered the important concept of comparing the do-something scheme to the do-minimum, and we have looked at the need to discount benefits to provide costs and benefits in current ("Net Present") terms. We looked at some of the key criticisms of SCBA as a technique. These are important and you should make sure that you are aware of them. Finally, the Unit briefly considered some of the computer packages that have been developed that are available to carry out different kinds of appraisal in transport.

To fully acquaint yourself with the material in the Unit, you will probably find it useful to go through the questions on the next page - these are the final Activity in this Unit.

## Questions on Appraisal and Social Cost Benefit Analysis (SCBA)

1. What is the difference between social cost benefit analysis and financial analysis?
2. Explain in outline – preferably with a flow chart - how social cost benefit analysis works.
3. What is the output of a SCBA? What does this show us? What does it not show us?
4. Which costs and benefits are typically included in a transport SCBA?
5. Which costs and benefits are typically **not** included in a transport SCBA, and why not?
6. Define user benefit in a typical transport SCBA.
7. What predictive tools are required to be able to show future user benefits in a SCBA? What are the major problems with the use of these predictive tools?
8. Comment on the assumption implicit in a typical SCBA that the value of time savings per unit of time is constant regardless of the length of the time saving; and that a 60 minute time saving for one person is of equal value to 60 people saving one minute each.
9. Why and how do we discount costs and benefits in SCBA?
10. How is the discount rate set and how does it affect the outcome of the SCBA?
11. Over how many years are transport schemes typically appraised, and why?
12. What happens to the result of the appraisal if you assess the scheme over a longer period; and a shorter period?
13. Name 3 SCBA packages and briefly explain what they do and what they are for.
14. What in your view are the main disadvantages of SCBA in the appraisal of transport projects?

# Unit Ten

# New Transport Appraisal

## Learning Objectives

By the time that you have finished this Unit you will:

- Understand how and why objectives-based appraisal has been put into practice in Britain.
- Have an appreciation of the basic operation of the appraisal methodology used in England and Scotland
- Understand how public transport scheme appraisal methodology has developed.
- Be able to critique the appraisal methodology.
- Be able to carry out an outline scheme appraisal in keeping with the principles of English transport appraisal practice.

## Introduction

In the previous Unit, we looked at the operation of SCBA. However, in that and the Unit before, we gained some understanding of why SCBA does not fulfil all requirements for appraisal in transport, and consequently why practice in the UK and elsewhere has been moving towards some form of objectives-based appraisal (or multi-criteria analysis).

This need was met by the development of GOMMMS (Guidance on the Methodology for Multi-Modal Studies) in England and STAG (Scottish Transport Appraisal Guidance) in Scotland. They were intended to provide a methodology for appraising multi-modal

studies and projects – that is, those that include more than one mode of transport. Several of these studies were commissioned by the DfT in the early 2000s for different areas in England, possibly as an alternative to any concrete action! (Read Local Transport Today for the most up-to-date situation with regard to the results of many of the MMSs. Most of them also have websites, which are worth a look.) GOMMMS was developed to assist in the appraisal of MMSs but its applicability is supposedly much wider, to transport investment projects in the public and public/private (PFI/PPP) spheres in general. For example, another fine DfT publication, *Major Scheme Appraisal in Local Transport Plans Part 1 Detailed Guidance on Public Transport and Highways Schemes* (http://www.webtag.org.uk/webdocuments/3_Expert/9_Major_Scheme_Appraisal_in_LTPs/index.htm ) takes as its basis the appraisal structure set out in GOMMMS.

**GOMMMS and much connected material is now available on the internet in an easily accessible format, called WebTAG (www.webtag.org.uk). These notes were written before the advent of WebTAG but make reference to relevant parts of the guidance. It is worth your while browsing the pages of WebTAG. If these notes contain a reference to a certain part of GOMMMS, look for it on WebTAG before contacting your tutor.** Most of all, it is also very much worth your while to look at the final reports of multi-modal studies and other appraisals carried out in the GOMMMS/WebTAG framework, and draw your own conclusions about the extent to which they really meet the spirit of the guidance.

Because GOMMMS and then WebTAG was designed primarily for the appraisal of multi-modal studies it is, as you will see, relatively prescriptive in the appraisal methodology

that it specifies. As you will also see, in the following Unit, STAG is less prescriptive and more flexible because it was designed for the appraisal of a much wider range of schemes. Both STAG and GOMMMS are both, however, quite lengthy and complex documents and so in most cases they are likely to be used only for the appraisal of projects for which central government funding is sought – if a project is to be funded from a local authority's internal resources, it is likely to use a much less rigorous and time-consuming appraisal process.

WebTAG in England and Wales, and STAG in Scotland, replaced earlier forms of transport appraisal based around the Design Manual for Roads and Bridges (DMRB). If you work for a consultancy or local authority, it is likely that you will have a copy of this document. If not, it is available on the web. The two volumes that most closely relate to the material dealt with in this module are Volume 11, Environmental Appraisal; and Volume 13, Economic Appraisal. As its name suggests, DMRB is intended for use by those transport planners and engineers designing and appraising highway schemes. As noted in Unit 8, there were also a number of other methodologies for appraising other types of transport investment – although a standard format for the appraisal of small public transport schemes was noticeably lacking. Thus WebTAG and STAG have been developed to replace all these different appraisal methodologies with one "level playing field", whereby all transport schemes can – ostensibly – be appraised against one another on an equal basis.

This Unit will describes WebTAG and how it works, and highlights the important similarities that STAG shares with it. The following Unit provides more detailed information on how STAG differs from WebTAG; and Unit 12 and 13 provide much more

detail on the way that the two methodologies analyse the economic impacts of transport schemes.

You should read at the very least **WebTAG Unit 2.1 and 2.5 available at www.webtag.org.uk** and also to the completed copies of different ASTs (from the South and West Yorkshire Multi-Modal Studies – but you may wish to download others from the web) that are on the School of the Built Environment Webserver (see Unit 7 for details of how to access this) and others that are on WebCT for this module.

## What WebTAG does

Figure 1.1 in WebTAG Unit 2.5 shows the overall strategy for a multi-modal project. This covers all aspects, including public consultation, option generation and option testing. A typical multi-modal study is for the A1 between Newcastle and Berwick. Here, the consultants will consider all the transport problems along this **corridor** (i.e. not just the road) and then generate options for solving these problems. These options may include some road improvements, improvements to local public transport/cycling/walking and to long distance public transport (the railway line from Newcastle to Berwick). They may also include changes in land use patterns in an attempt to change travel patterns. The appraisal strategy will then be used to assess these different alternatives. A single mode appraisal mechanism – like the Design Manual for Roads and Bridges – would not have been able to assess all these different types of measure.

WebTAG and STAG operate on the general and very important principle that the scale of the appraisal should be related to the scale of the problem and the solutions proposed –

there is no need to produce a 500 page appraisal document for the appraisal of a bus lane, for example.

## Problem appraisal

WebTAG and STAG are based around the Government's five key objectives for transport:

- Economy
- Safety
- Environment
- Accessibility
- Integration

They essentially assess projects'/strategies'/options' performance against these objectives.

However, they also assess **problems** since these are what people actually worry about and hope that transport investment will alleviate. Thus part of a WebTAG/STAG based appraisal includes a systematic identification of all the problems related to transport in an area and then an analysis of how much these problems would be reduced if different transport options were introduced. These problem analyses are sometimes presented on a map base.

### *Option Appraisal*

Consider WebTAG Unit 2.5 Figure 1.1. Of particular interest to you as a student of appraisal are boxes 6, 7 and 8 which provide details of the appraisal framework, appraisal procedures, and types of cost. Box 6, the appraisal framework, is essentially based on the appraisal summary table. In this sense it is **an objectives-based** form of appraisal.

You will also note that in Box 7 there are four main ways to work out how the project performs against the objectives. Two of these at least – (social) cost benefit analysis, and environmental impact assessment – should be familiar to you. The transport model also mentioned is essential if the cost benefit analysis is to work, since the model will provide the inputs – in terms of predicting numbers of users, user costs and (where appropriate) fare revenue in the future – that are then used to predict future costs and benefits in the cost benefit analysis. GIS is also mentioned as a way of presenting more than analysing data, and demonstrating graphically the outcomes of different options.

Both WebTAG and STAG are based around appraisal summary tables (ASTs). However, WebTAG has a single stage AST whilst STAG has a 2 stage AST, and the ways in which inputs are derived differ in some cases. Firstly, a description of the English methodology is provided. Further details in Unit 11 then highlight the key differences in the Scottish approach. Perhaps most important is the much greater consideration given in Scotland to the economic development effects of a new transport scheme (i.e. does it create new jobs). This will be dealt with in detail in Unit 13.

## The Appraisal Summary Table in WebTAG

You should read these notes in conjunction with the examples of Appraisal Summary Tables (ASTs) that you have been given. It is also recommended that you search on the internet for examples of ASTs from recent projects in England. The most up-to-date (2009) version of a blank AST is on WebCT, but see also WebTAG Unit 3.2.

The AST was developed to bring together all impacts of a scheme in one easily digested framework so that they can be compared to each other, and so that schemes can also easily be compared. Critically, it is objectives-based – the impacts of a scheme are assessed against the Government's key transport objectives

You may wonder how these objectives were derived. This is not made clear in the guidance. You could argue that there are some important elements that these objectives do not consider, or consider only obliquely; for example, social inclusion is a key Government objective at the time of writing, yet it is nominally covered here by one of the other WebTAG objectives, accessibility, rather than meriting the status of objective in itself. Similarly, equity considerations – one of the key criticisms of the SCBA approach – are not considered here, and neither is the affordability or financial viability of the project. Finally, the key objectives do not directly consider how the public might react to a certain scheme – a new airport runway, for example, might be predicted to deliver enormous benefits but on the other hand would attract so much public opposition that it would simply not be viable to try to build it. These issues are covered in other parts of GOMMMS but they are not related directly to the five key objectives, and nor are they presented on the AST. More details of the way in which they are considered are presented in later sections of this Unit.

A WebTAG or a STAG analysis is also supposed to consider regional and local objectives. There is an expectation that many these would be subsumed ("nested") within the central government objective to which they are most closely related but, where there are significantly additional local or regional objectives for transport, then the project or strategy's performance against these should be assessed and listed on a separate sheet.

## Who uses the AST?

The AST is aimed at three groups of people:

- Those carrying out the study for the new transport infrastructure; it guides them as to the information that they should collect and the way in which they should collect it.
- Everyone who takes part in the consultation process for the new scheme; it presents the information about the scheme, and invites input, in a structured manner.
- The decision maker(s) – a "Steering Group" in some cases, or a single decision maker such as a senior Civil Servant or Minister; these people use the AST to help them to decide which option(s) to approve for construction or funding.

## When do you use an AST?

It is appropriate to use an AST for the assessment of many types of transport project, and for transport strategies (groups of policies, services and schemes); for groups of schemes; and for single schemes. Also, it can be filled in at different levels of detail so for a small scheme it can still be used, but you would not have to gather large amounts of data to support your analysis. For large schemes, in contrast, it would be worth your while to gather much data and to make the AST-based analysis highly sophisticated.

You would use an AST, filled in with varying levels of detail, at the following levels, therefore:

- Assessing strategies for an area (e.g. different versions of Edinburgh's Local Transport Strategy)
- Assessing options for a corridor e.g. should the M8 be widened to 8 lanes or only to 6 lanes and the rest of the money spent on improving the railway line from Edinburgh to Glasgow via Shotts?
- Assessing groups of schemes within strategies e.g. should we spend money first on transport schemes in the Marchmont area of Edinburgh, or in neighbouring Bruntsfield?
- Assessing different schemes within an area e.g. is a parking management scheme a better use of our money than a cycle lane scheme?

## How do you fill in an AST?

For much of an AST, you would use the results of an environmental impact assessment (EIA) and cost benefit analysis to fill in the various rows. Each main objective is divided into sub-objectives, and these are as you can see quite similar to the outputs of COBA and EIA (see also module CTR11114, Highway Planning and Design). However, for environmental impacts in particular, they are assessed in a much more structured way than in DMRB. There are however some new ones when compared to COBA and DMRB Chapter 11 – these are highlighted below. There are also some where DfT has decided that they should be in the AST but is still unsure as to how to measure them. You can see that some of these objectives are important to include but very difficult to measure in any

meaningful way (see if you can work out which ones). The full list of sub-objectives is as follows (there is a full breakdown on the WebTAG site map):

**Environment** ***(to protect the built and natural environment)***

- To reduce noise - EIA
- To improve local air quality - EIA
- To reduce greenhouse gases - EIA
- To protect and enhance the landscape - EIA
- To protect and enhance the townscape - EIA
- To protect the heritage of historic resources - EIA
- To support biodiversity - EIA
- To protect the water environment - EIA
- To encourage physical fitness - NEW
- To improve journey ambience - EIA

**Safety** ***(to improve safety)***

- To reduce accidents - COBA
- To improve security - NEW

**Economy** ***(to support sustainable economic activity and get good value for money)***

The outputs of SCBA are used to inform *part* of the economy objective of the AST, but there are other important parts as well. As you can see, some of the terms are familiar from Unit 9, but the costs and benefits are more disaggregated to show their *distribution* – who wins, who loses, and how much government is expected to pay to realise the benefit.

*Public Accounts* – Present Value of Costs to Central Govt and Local Govt (£), NEW

*Transport Economic Efficiency:* Present Value of Benefits to Business Users & Transport Providers **(£),** NEW

*Transport Economic Efficiency:* Present Value of Benefits to Consumers **(£),** NEW

*Reliability* **–** How much more reliable the transport system becomes as a result of the scheme, measured qualitatively as a score - NEW

*Wider Economic Impacts* **(**see Unit 13) - NEW

**Accessibility** ***(to improve access to facilities for those without a car and to reduce severance)***

- To improve access to the transport system - NEW
- To increase option values – this is the idea that people benefit from the option of having a scheme available to them even if they never use it - NEW
- To reduce severance (i.e. the degree to which a scheme requires pedestrians, cyclists and equestrians to divert around it to find a crossing point) - DMRB

**Integration** ***(to ensure that all decisions are taken in the context of the Government's integrated transport policy)***

- Access to the transport system, especially for those with no car - NEW
- To improve transport interchange
- To integrate transport policy with land-use policy
- To integrate transport policy with other Government policies

While the DfT Guidance indicates that it is very important to keep the AST itself to one easily-digested A4 page, there is obviously much more data gathering and analysis that

underlies this; these are presented in a series of worksheets, all of which are available on the website.

## Measuring the effect of the scheme or strategy on the sub-objectives

The different impacts are measured in different ways, some of them very similar to those in the Design Manual for Roads and Bridges. However, in the AST the effect of mitigation is taken into account in measuring, or assessing, the different impacts. The ways to assess the different impacts are as follows:

- **Noise** – areas affected by noise increases and decreases above and below certain thresholds.
- **Air pollution** (PM10 and NOx) – changes in levels of these pollutants within 0-200 metres of the scheme.
- **Greenhouse gases** – total change in tonnes of CO2 as a result of the scheme, noting whether rail emissions have been taken into account
- **Landscape** – describe the landscape through which the scheme will pass, noting in particular any culturally/historically important aspects, then appraise the scheme's impact on these and give it an overall assessment score on a 1 to 7 scale (large beneficial to very large adverse). (Note – this is a much more developed methodology than that set out in DMRB Chapter 11.)
- The methodology for **environment, heritage** and **townscape** are similar to that for landscape. The key aspect here is that criteria and thresholds are used to indicate the severity of the impact in a much more systematic way than in DMRB Volume 11. A working sheet is used to summarise the effects on each of these potential impacts of the scheme.

- **Fitness** essentially evaluates the increase in the number of 30 minute long walking and cycling trips that may result from a scheme, as these are considered to be a benefit in raising physical activity and hence reducing health care costs. The scale used is again 1 to 7.
- **Journey ambience** is a combination of the view from the transport scheme, the improvements in quality of public transport vehicles and information, changes in the quality of road signs and other traveller information, and the provision of rest facilities for road travellers. The scale used is again 1 to 7.
- **Safety** – in the case of accidents, the DMRB methodology is used for road schemes. For other modes, there are reliable methods of predicting accident numbers. **Security** is a very important attribute of all journeys that has not previously been considered in assessment methodologies. Table 1 in WebTAG Unit 3.4.2 shows how these changes are assessed; again, the scale used is 1 to 7.
- **Economy.** There is a key difference here with COBA, in that the AST breaks down the changes in economic costs/benefits in terms of their impact on different types of consumer, and private sector operators, as well as the Government. It DOES NOT ignore indirect tax changes, but rather calculates these separately. The idea of this development of conventional COBA is to show who pays and who benefits from a scheme – very important in our privatised/deregulated environment. Costs and benefits in this section need to be discounted over the life of the scheme – at a rate of 3.5% - and presented in £. Under economy, there is also an attempt to value (but as a score) the impacts of the scheme on **reliability** – i.e. the degree to which the time taken for the same journey varies from day to day – and also the impact of the scheme

on **economic regeneration**. The latter issue is considered in much more detail in Unit 13.

- **Integration. Option values** are the usefulness of the existence of a transport service to someone who hardly ever uses the service. They are assessed in the AST on a scale of strong adverse to strong beneficial, depending on the level of the population affected and the degree to which the service is altered. However, it is theoretically possible to put a value on them – WebTAG provides one example of this. **Severance** is the degree to which cyclists, pedestrians and horse riders are forced to change their travel patterns because a new piece of transport infrastructure cuts across existing routes. It is again measured on a scale of large negative to large positive, depending on the degree of change from the do-nothing to the do-something situation. (e.g. if there was previously no severance but the scheme causes severe severance, this is a large negative effect.) **Accessibility** is calculated by considering the proportion of the local population *without cars* that currently have access to an hourly or better bus service, and then considering how the scheme will change this situation. If the accessible population increases by more than 21%, this is considered a large beneficial change; incremental steps lead to a 21% decrease, considered to be a large adverse change. More details on the methodology are to be found in WebTAG Unit 3.6.3.

## Completing the AST

Before each row of the AST is completed, it is very important to complete the assessment tables for environmental and economic benefits and costs.

## Supporting analyses

Although the AST is the "front" of the WebTAG (and STAG) appraisal, and is supposed to be the key aid to decision making, as stated in WebTAG, the decision maker will ultimately be presented with the following:

- an annotated map describing the strategy or plan option;
- possibly a separate sheet listing the alternatives considered and their reasons for rejection;
- an AST;
- an analysis of the Value for Money of the scheme;
- a summary showing the strategy or scheme's contribution to the achievement of regional and local objectives;
- a map showing the changes in do-minimum problems which would be brought about by the strategy or plan option; and
- a summary of the main points from the Supporting Analyses.

In addition, the decision maker could request access to the many worksheets that are used to derive the scores for the different sub-objectives. They will certainly wish to know something about the supporting analyses, details of which are provided in the following sections.

### *Distribution and equity supporting analysis*

This analysis is intended to show who gains and who loses from the project that is being appraised, and thus to highlight whether the project's positive and negative impacts are equitably distributed. WebTAG limits this analysis to certain objectives and sub-objectives, as follows:

- Noise and local air quality – spatial distribution;
- Landscape, townscape, bio-diversity, heritage and water resources – spatial distribution;
- Accidents – changes according to accident severity and road type, and spatial distribution;
- Transport economic efficiency – distribution by travellers by mode, by time of travel; and by type of transport operator;
- Access to the transport system – these are shown spatially and related to car ownership.

**ACTIVITY**

In view of some of the Government's key priorities, can you think of any other level of disaggregation against which the criteria listed above might be considered?

***Affordability and Financial Sustainability; and Value for Money***

In Unit 12 we will consider the Transport Economic Efficiency Table, which is at the heart of the economic analysis in WebTAG. This is based on social cost benefit analysis and so includes monetised benefits such as time and accident savings that cannot be bought and sold in the market. However, some consideration of the *financial* viability of the project is also required – that is, the actual flows of investment and operational monies, and any revenue from tolls or fares. This is considered in terms of the predicted financial situation for each element of the project (e.g. each bus corridor) for years 1, 5 and 10 of the project, broken down by the impact on each actor in the private and public sector. Costs are set down in money terms, undiscounted, not in present values. The main

purpose is to understand whether the project makes significant calls on public resources; and whether operating costs will be covered by revenues. There is no explicit guidance that states that projects whose revenue stream does not cover their operating costs should not be funded; but there is a general presumption that, if there is a choice between a project that does cover its operating costs and one that does not, then the former should be funded first.

In 2005, the Department for Transport in England introduced a new element into appraisal: Value for Money analysis. Some observers have commented that this marks something of a move away from giving supposedly equal weight to all objectives in the AST within a WebTAG-based appraisal, since it gives renewed importance to the results of the SCBA and thus the Economy objective. In summary, the guidance states the following, for spending proposals on which government ministers make the final decision (this is a direct quote from Page 2 of the Guidance on Value for Money, DfT, 2005):

"This section on value for money should:

- Set out the estimated Benefit Cost Ratio (BCR) of the project
- Assess whether it has any significant benefits or costs which cannot be put in money terms ("non-monetised impacts") and
- On the basis of this analysis, describe the project as "poor", "low", "medium" or "high" value for money.

A project will generally be:

- Poor value for money if its BCR is less than 1
- Low value for money if its BCR is between 1 and 1.5
- Medium value for money if its BCR is between 1.5 and 2

- High value for money if its BCR is over 2

unless the non-monetised impacts are sufficiently significant relative to the costs to shift the value for money categorisation.

Advice to Ministers should reflect the presumption that, purely on grounds of value for money, we should generally fund:

- No projects with poor VfM
- Very few projects with low VfM
- Some, but by no means all, projects with medium VfM
- Most, if not all, projects with high VfM

No submission should recommend agreement to a project with low value for money without the agreement of the relevant Director General [of the DfT]. No project with poor value for money should be recommended without the agreement of the Accounting Officer [of the DfT].”

The Guidance is included on the student webserver for this module, but is also available on WebTAG. You will note that poor VFM projects will only be funded where “the non-monetised impacts [i.e. Accessibility, Environment and Integration] are sufficiently significant relative to the costs to shift the value for money categorization”. The Guidance argues (p 5) that very few projects typically have non-monetised impacts sufficient to shift a project into a different VFM category, giving the example of new infrastructure being built through an environmentally sensitive area as a case where they might be large enough.

***Practicality and public acceptability supporting analysis***

Although not included in the AST, WebTAG suggests that an analysis of the practicality and public acceptability of a scheme should be undertaken: previously, schemes which perform well in appraisal terms have met significant but un-expected public opposition. There is also the possibility that schemes may not be as easy to implement as was envisaged; some assessment of the probability of this, and of the scope for alternative paths of action, should be undertaken as part of the overall appraisal. WebTAG suggests that the following checklist of factors to take into account. (You will read the full text relating to each bullet point in the next Activity.)

- Feasibility.
- Enforcement.
- Area of interest.
- Complexity of the decision.
- Timescale.
- Phasing.
- Partitioning.
- Complementarity.
- Conflicts.
- Politics.

This checklist relates to feasibility; the planner should also consider whether there is considerable public opposition to the plan which cannot be overcome by modifications to that plan; and similarly, any opposition from "stakeholder groups" (e.g. local butchers, businesses etc.). While, as you will see from your own reading of the chapter, the advice on this issue is not 100% clear, it is the first time that feasibility and acceptability have

been explicitly required in transport appraisals in Britain, and this "new pragmatism" is undoubtedly a positive step forward.

**ACTIVITY**

Download and read Units 2.1 and 2.5 in WebTAG. Do you think that the process it describes is a straightforward one – why, or why not? How confident are you that two different groups of transport planners, conducting this process to appraise the same scheme(s), would come up with the same conclusions? How would you know from the result of a WebTAG appraisal whether a project was worth building, or not?

## Do the AST and WebTAG represent an improvement compared to the appraisal methodology in DMRB (COBA, and EIA)?

The AST has the fundamental drawback common to DMRB that it is still not possible to add up all the costs and benefits of a scheme or strategy and come up with one figure that shows what the scheme is "worth". In addition, and very importantly, the weightings put on the different policy objectives by decision makers remain unclear in the AST – the Guidance specifically states that explicit weightings should not be used, yet there must be implicit weightings, otherwise the decision maker would be unable to use the information in the AST to reach a decision about the scheme. However, the AST nonetheless represents a major improvement on DMRB for the following reasons:

- It clearly relates the planned transport investment to problems in the local and national context.
- It clearly relates the thing that is being appraised to transport policy objectives.

- It includes new impacts which are very important, such as greenhouse gases, interchange, physical fitness, security, equity and social inclusion considerations, and value for money.
- In assessing environmental impacts it uses a much more sophisticated methodology than does DMRB. It does not place monetary values on environmental impacts, but it uses a systematic approach and sets out criteria to assess the scale of environmental damage (or benefit) that results from a scheme.

## Appraisal of Public Transport projects.

The appraisal of public transport projects in the UK has changed considerably in the past 10 years. This is because the policy climate has become more favourable towards public transport and so appraisal mechanisms have been modified either (depending on your viewpoint) to make it easier for these projects to be justified, or to make the appraisal of road and public transport projects more equal (this second argument is often referred to as "the level playing field"). Appraisal has moved from being dominated by cost-benefit analysis where the project with the highest NPV would be built first, to one that is based much more on how the project will help to achieve transport policy objectives (objectives-based appraisal, also sometimes known as multi-criteria appraisal (MCA)).

This section of the Unit explains, briefly, how appraisal of public transport has changed and then provide examples from Scotland of public transport projects in Scotland that have been funded recently.

***Older appraisal mechanisms: Section 56 appraisal for large public transport projects***

Prior to about 1993 the main source of Government funding for large public transport projects (other than those directly funded by British Rail) was a grant available under Section 56 of the 1968 Transport Act – hence Section 56. This was to fund projects such as busways, locally-funded rail and tram schemes. The key element of the appraisal procedure for a Section 56 project was a cost-benefit analysis. The key inputs to this cost-benefit analysis were:

- Discounted capital cost
- Annual operating cost
- Revenue from fares
- Non-user benefits – time, accident and vehicle operating cost savings on the parallel road network that would result from some people switching from car to the new tram or bus. (In order to predict these numbers it is necessary to build a complex multi-modal network model and carry out stated preference surveys; in spite of such complexity, predictions are often in error.)

You will note that in comparison to a COBA for a road, there is a key element missing from this list of inputs: **user benefits**, or the time, accident and VOC savings for people using the new tram, train or bus route. This is because the Treasury at the time argued that such benefits could be recouped directly from the users, by charging higher fares. Obviously therefore a new public transport scheme would have to perform extremely well in terms of predicted modal shift before it could justify S56 funding.

An example of a scheme that was justified under S56 was Manchester Metrolink. However, not all of its funding was received this way: some came from the European

Union, and some from the private sector who are now recouping their investment from the fare revenue that the tram generates. However, Metrolink is a rarity; there were very few schemes that did succeed in gaining S56 funding. An example of one that failed is a light rapid transit scheme in the City of Cambridge, where S56 funding of only half the required amount could be justified. Hence the scheme was not built. Under current appraisal procedures, it stands a much greater chance of gaining funding since it could be demonstrated to meet other policy objectives.

***Smaller (< £1m) public transport schemes***

A typical example of such a scheme is bus priority. You have covered the appraisal of bus priority using a cost benefit analysis approach in Public Transport. This approach was required in early (1991) DETR guidance on bus priority and the implication was very much that if the scheme did not show a positive NPV using a cost benefit analysis methodology, then it would not gain grant funding from the DETR or Scottish Executive. Later (1997) Guidance indicated that a positive NPV, whilst still important, was not always necessary to guarantee funding of the scheme, as long as the scheme *could be shown to contribute to local transport policy objectives*. This was a clear move towards the objective-based appraisal methodology that we have today in NATA and GOMMS.

***Current national rail appraisal methods***

Rail appraisal continues to develop. The essential justification of any rail scheme that improves service levels and journey times, is that it should increase passenger numbers or freight flows by making travel by rail more attractive. This will then increase revenue, which will help to pay back the investment made.

Whilst Network Rail and the Train Operating Companies are, as you know, private firms whose main interest is profitability and for whom therefore a financial appraisal – showing annualised capital and operating costs compared to projected revenue streams - will suffice, there is still an enormous amount of public money in the rail system and a wider, more socially-based appraisal framework, is required to appraise how this is spent.

The Strategic Rail Authority was in charge of the distribution of public subsidy for TOCs and for specific infrastructure grants such as Rail Partnership Fund and Freight Facilities Grants. They therefore used a multi criteria approach to appraise rail schemes and franchise bids. This includes the following criteria:

- Financial costs and revenue, including requirement for subsidy
- Fares, journey times, frequencies and reliability
- Interchange
- Crowding
- Rolling stock quality
- Station facilities
- Information facilities
- Ticketing facilities
- Time of first and last services
- Passenger security
- Disabled access
- On-train cycle facilities
- Safety

- Congestion, crowding and safety on other modes affected by the rail scheme
- Local and regional environmental impacts
- Option values
- Accessibility

**ACTIVITY**

Read the SRA's Appraisal Criteria (2003), available on the student webserver (pages 27 to 38 only). What are the main differences in the SRA's appraisal criteria for awarding Rail Passenger Partnership funding compared to the criteria in WebTAG?

***Scottish Public Transport Fund bids***

The Scottish Government (formerly the Scottish Executive) previously provided money for public transport projects throughout Scotland. Up until 2002, Local Authorities had to bid for money by demonstrating, in a document that they submitted to the Executive, that the project is worthwhile. Therefore there was a need to carry out an appraisal of each project for which money is sought. This appraisal was structured around the five key objectives of Government transport policy with which you are already familiar: economy, environment, integration, safety and accessibility. Guidance from the Scottish Executive on the appraisal of bids also suggested that social exclusion was an important criterion. However, it did not suggest what weights should be put on each element in the appraisal, and indeed the projects that have been awarded funding over the five years that the Fund was in existence indicated that implicit weights obviously varies from project to project in each case. Unquestionably there was also a strong political element in the decisions that were made as to which PTF projects to fund.

An important requirement of the PTF Fund Bids was that they should include three distinct forms of cost-benefit analysis. This helped to distinguish to whom the financial benefits of a project are accruing, and to what extent the justification of a project is dependent on social relative to financial benefits. The forms of cost-benefit analysis and their inputs are as follows. It is important to be familiar with these.

*Full social cost benefit analysis*

This is similar to SCBA and includes the following elements:

- Discounted capital cost
- Annual operating costs
- Revenue from fares
- User benefits – time, accident and vehicle operating cost savings for the people who use the new service (this would be the net impact, since a new public transport service can abstract users from existing services)
- Non-user benefits – time, accident and vehicle operating cost savings on the parallel road network that would result from some people switching from car to the new tram or bus.

*Restricted social cost benefit analysis*

This is the same as the S56 appraisal and includes the following elements:

- Discounted capital cost
- Annual operating costs
- Revenue from fares

- Non-user benefits – time, accident and vehicle operating cost savings on the parallel road network that would result from some people switching from car to the new tram or bus.

*Financial analysis*

This is what any private sector investor in the scheme would want to know. This excludes any social benefits at all.

- Discounted capital cost
- Annual operating costs
- Revenue from fares

It is to be expected that for any scheme these cost benefit analyses would become progressively less favourable. By disaggregating them in this fashion, it is possible for the Executive to see how dependent a project is on social as opposed to financial benefits, and who is enjoying those benefits. However, even if a scheme has a negative NPV under all three cost benefit analyses, this does not necessarily mean that it would not be funded if it could be demonstrated to have other benefits that accord with the local authority's transport policy objectives.

*Conclusion*

In the past ten years, the appraisal of public transport projects in the UK has developed considerably and with the advent of WebTAG and STAG they are now nominally at least on a "level playing field" with roads projects. The appraisal of Scottish Public Transport Fund bids was carried out using a combination of objectives-based and cost benefit analysis for the five years of its existence. The wide range of projects that has been funded is testimony to the continuing political nature of appraisal. The bid documents are,

curiously, not made public. However, projects that have recently been funded under the last round of PTF (2002) comprised the following.

**Argyll and Bute** - £1.65 million for upgrading to the ferry service for Luing and Seil.

**Dundee** - £6.769 million for extensive, citywide renewal of bus stop facilities, extension of real time information and improved security measures for bus travellers.

**East Ayrshire** – £2.1 million for the development of quality bus corridors.

**East Dunbartonshire** - £0.05 million to identify linking land use planning with transport in the Bearsden and Milngavie area and £4.098 million for a package of measures to create and maintain high quality walking and cycling amenities in Bishopbriggs, Bearsden and Milngavie.

**Eilean Siar** - £0.410 million for measures to provide overnight berth at Leverburgh for the Sound of Harris vehicle ferry service.

**Edinburgh** - £10.5 million for improving access to South Gyle/Edinburgh Park, North Edinburgh and the New Edinburgh Royal Infirmary and Fort Kinnaird.

**Falkirk** - £0.4 million for a feasibility study into rail development work on the rail line serving Cumbernauld and Falkirk Grahamston.

**Fife** - £3.997 million for measures to deliver a high quality bus based transport system for Fife.

**Glasgow** - £2.715 million for expansion of Park and Ride facilities at Shields Road Underground station car park.

**Highland** - £1.450 million for the pedestrianisation of Inverness city centre and improved rail services.

**Highlands and Islands** - £2.015 million to build on last year's successful bid to provide public transport information and interchanges.

**Moray** - £0.924 million for measures to improve access to public transport in Buckie and Forres and encourage cycling and walking around Forres.

**Northeast Scotland** – £0.115 million for a study of transport needs in the Dyce area and £0.318 million for a range of measures to improve access to Aberdeen airport such as traffic signal priorities for buses, bus and train 'real time' information and new pedestrian and cycle routes.

**North Ayrshire** - £3.302m for the provision of a quality public transport corridor between Ardrossan, Saltcoats, Stevenston, Kilwinning, Irvine and Kilmarnock.

North Lanarkshire - £1.107 million for provision of Park and Ride facilities at Greenfaulds railway station and related access link to A73.

**Southeast Scotland** - £11.396 million for improved park & ride in South East Scotland including enlarged railway station car park and expansion of the Park and Ride at the Ferrytoll and £0.479 million for a number of transport corridor studies.

**South Lanarkshire** - £1.061 million to help with Park and Ride and improvements on the Hamilton Circle.

**Stirling** - £2.555 million for the completion of the Stirling City East West public transport corridor

**West Dunbartonshire** - £0.214 million for a study into travel patterns in the Clydebank area from direct and indirect sources

**Strathclyde Passenger Transport** - £1.350 million to deliver the infrastructure for modern bus stop information at a minimum of 3,200 of the most heavily used stops and information points across the SPT area.

**ACTIVITY**

What is there to suggest that NPV was not the most important criterion in the Scottish Executive's decision to fund the projects listed above? Think about the information that you need to calculate NPV; and the relative numbers of people who stand to benefit from the projects above.

## Summary

In this Unit, you will have gained some understanding of the process of a modern-day transport appraisal in the UK. You will now know that the two documents for appraisal are WebTAG in England, and STAG in Scotland. You should understand why they were introduced, why they are structured as they are and, in outline, how they are used. By reading this Unit and parts of WebTAG you should also have some understanding of the drawbacks that remain with in their use. The following Unit goes on to consider STAG in a little more detail.

**ACTIVITY**

**A multi-modal assessment: a congested orbital route**

Consider a *congested orbital* road route with which you are reasonably familiar (the more familiar the better!). Then work through the following questions and issues. It will not be possible for you to appraise problems or options for this corridor with any accuracy or detail, but that is not the purpose of this exercise. Rather, the purpose is for you to think in a structured way about the corridor and options for it, and to identify the information

you would need to gather if you were to carry out a full multi-modal study for the corridor.

***Problems***

First, list the problems along the corridor and try to assess their magnitude (are they slight, severe, moderate etc; and do the problems vary in time or space (e.g. is there more congestion at one end of the bypass than another?; if so, when?) Use the key objectives of the AST as a structure for assessing the problems. Also consider which different groups of people are affected. Finally, decide what studies you would carry out to gather more information on the problems, if you were carrying out this study for real.

***Option generation***

Next, generate some options for reducing the problems that you have identified. Some might include:

- road pricing on the route
- another lane on the route

But there will be others – have a think!

***Assessing the options and how they solve the problems***

Choose two of the options that you have generated. Use a blank AST (electronic version is included on the webserver or downloadable from WebTAG or ScotTAG) and carry out an appraisal based purely on your judgement as to how this option will perform against the various criteria in the AST. These are (don't forget the extra ones):

- Accessibility
- Integration

- Safety
- Environment
- Economy
- Distribution/equity/social inclusion
- Financial feasibility and value for money, including possible private finance
- Public acceptability

You will obviously not be able to put a figure on any of these, and some you will have to assess as "good, poor, moderate" or "slight, severe, moderate". In each case make a note as to how you would gather more accurate information.

Finally, go through the list of problems you identified earlier, and decide how these would be improved by the option that you have assessed.

If you wish, you can contact your tutor by email who will contact other students on the module so that you can compare notes on your ASTs.

# Unit Eleven

# New Transport Appraisal in Scotland

## Learning outcomes

When you have completed this short Unit you should be able to:

- Specify the differences between a Stage 1 and Stage 2 AST.
- Specify the key differences between STAG and GOMMMS.
- Critically evaluate STAG as a transport appraisal tool.

## Introduction

Transport planners in Scotland do not have to use WebTAG to appraise their projects: the Scottish equivalent is STAG (Scottish Transport Appraisal Guidance), available at www.scot-tag.org.uk

As noted in the previous Unit, WebTAG was primarily designed for the appraisal of large multi-modal studies, although the principle of objectives-based appraisal now runs right through English appraisal practice. However, the Scottish Executive (now the Scottish Government) felt that a more general and less prescriptive appraisal methodology was required north of the border – something that could be adapted in scope to suit most projects (not only those for which local authorities are applying for funding from the Executive!). Hence STAG was born in 2001, and updated in 2008.

## Key differences between STAG and WebTAG

As note above, perhaps the key difference between STAG and WebTAG is that the former is less prescriptive and more flexible. However, another way of describing flexibility is "vagueness"; you should read Chapter 1 of STAG and compare it to WebTAG Unit 1.1. (http://www.webtag.org.uk/webdocuments/1_Overview/1_Introduction_to_Transport_analysis/index.htm), and see which you would feel more comfortable using. Perhaps the most important aspect of this flexibility is the ability in STAG, at least its first part, to appraise projects against local "planning objectives" more than against central government's five key objectives.

The second difference between STAG and WebTAG is that the former includes two Appraisal Summary Tables (ASTs). The purpose of this two stage appraisal process is to allow testing of a wide range of options and schemes in the first stage; and only subjecting those schemes that have performed well in the first stage to much more detailed appraisal. The Part 1 appraisal concentrates on the following areas:

- The proposal's likely impact against the planning objectives (as opposed to Government's five objectives);
- The rationale for the proposal, including an explanation of the options that were considered and why they were included/discarded;
- An initial check of the proposal's fit with relevant established transport, land-use planning and other policies;
- An investigation of the proposal's feasibility, affordability and likely public acceptability (its "implementability").

In addition, an initial view of the impacts of the proposal against the Government's five objectives is required. You can look at a blank Stage 1 AST if you go to http://www.transportscotland.gov.uk/stag/td/downloads; one that has been completed is at http://www.aberdeencity.gov.uk/nmsruntime/saveasdialog.asp?lID=5365&sID=2952.

As you can see from this, the Part 1 AST helps the planner to describe the scheme and its context in a systematic way, for easy comparison with other projects that may be seeking funding. It does not necessarily require an enormous amount of data gathering or analysis in order to complete it. If you then look at a Stage 2 AST, you will see that this bears much greater similarity to its English counterpart. (See for example (current in Dec 2008) the ASTs A to G of the Elgin STAG Study available at the bottom of the page http://www.moray.gov.uk/moray_standard/page_52145.html.)

## Important objectives and sub-objectives in STAG

In the part 2 STAG appraisal, the majority of the objectives and sub-objectives are similar to those in WebTAG; indeed, at many points in the document, there are direct references to relevant parts of WebTAG for more detailed instructions on how to assess a particular sub-objective. However, there are some sub-objectives that were developed in a different or more detailed way in the Scottish document. These are detailed below.

### *Accessibility and social inclusion*

WebTAG essentially defines changes in accessibility as the change in access to public transport services for those without access to a car. STAG goes slightly further. The first main difference is that the objective itself is called Accessibility and Social Inclusion.

Accessibility in STAG is then divided into two types: community accessibility and comparative accessibility. The first covers access to basic services and to work, particularly by modes other than the car. It is subdivided into two parts: public transport network coverage and how this influences access to work, training, major shopping and healthcare opportunities; and local accessibility on foot and by bike to key local services such as a corner shop, health centre and post office. The second main category, comparative accessibility, covers the distribution of accessibility benefits – who is benefiting from enhanced accessibility and who is not, and where the benefits are distributed spatially. As ever in appraisal, the results should be presented in terms of a *change* in accessibility compared with the do-minimum situation.

For more than the most simple calculations of accessibility, it is likely that access to GIS and not inconsiderable data will be required. Some time-consuming analyses are required, as you will see if you look at http://www.moray.gov.uk/downloads/file55327.pdf, Chapter 5.15, p85 (link current November 2009).

Accessibility is an important concept that is used increasingly in different parts of transport planning, and if you wish to read more about it, you should start with the Scottish Executive publication *Guidance on Accessibility Measurement Techniques and their Application* (2000), available at http://www.scotland.gov.uk/Publications/2000/10/fb9e5e3e-f5ca-4e97-832e-7762cbff6234.

ACTIVITY

Read Chapter 4.6 of STAG and also the Accessibility Objective, Unit 3.6 in WebTAG at http://www.webtag.org.uk/webdocuments/3_Expert/6_Accessibility_Objective/index.htm.

In your view, which takes the most comprehensive approach and why?

***Economic Activity and Location Impacts (EALIs)***

Frequently, the justification for a new piece of transport infrastructure is based not so much on its direct transport benefits as its economic development impacts: local pressure groups and decision makers may feel that inward investment is deterred, and economic activity reduced, by congested or poor quality road and rail links. A current example of a scheme whose benefits are seen largely in economic development terms is the proposed re-opening of the Waverley rail line from Edinburgh to Galashiels, in the Scottish Borders. Many "stakeholders" and even some vegetarians in the area feel that the Borders are perceived as "isolated"; this isolation is seen to reduce economic development; and they believe very strongly that the rail re-opening would reduce the sense of isolation and stimulate economic development. There are many parts of Scotland where economic development is a key priority, and so attempts to justification transport schemes wholly or in part on economic development grounds are very common.

However, in a developed economy like Scotland's, it is difficult to argue that there are many areas from which goods cannot be exported, or raw materials imported, due to lack of transport infrastructure. (One of the few examples might be an island without a vehicle ferry link.) Transport infrastructure investment can speed up the movement of goods, but

it is unlikely to make it possible where it was impossible before. Also, changes in accessibility in one area of Scotland (due to transport investment) may simply re-distribute economic activity rather than increase its aggregate level. Thus the Scottish Government has placed considerable emphasis in STAG on a systematic and in-depth analysis of the economic development benefits of the scheme that is under appraisal – it is no longer sufficient to state that "the scheme will stimulate local economic development" – and the outcome of this is the Economic Activity and Location Impacts (EALIs) sub-objective within the economy objective. (WebTAG does deal with this issue but still not in as much detail as STAG. See Unit 13 for more details.)

To quote STAG directly:

> "Decision makers are interested in how a transport proposal might affect economic performance - income and employment - at national and/or regional or local level. Decision makers are also interested in how particular groups and/or areas might be affected, again in terms of levels of income and access to new or existing employment. This applies particularly in areas where there are issues of social inclusion to be addressed, where a transport proposal could help to enhance social inclusion, or might enable other measures to be more effective in tackling exclusion."

The process for assessing EALIs in STAG is to use increase in GDP and increase in the number of jobs resulting from the transport investment as measures, and to assess their changes at the local and national level, and to identify who loses and who wins in economic development terms, as a result of the investment. STAG notes that it is expected that in the case of most schemes, the net impact at the Scotland level is likely to

be zero; although, rather paradoxically, it also notes that this is the impact that is of most interest to the Scottish Government.

At its root, the analysis of the economic development impacts of a transport investment centre on how people's economic activity responds to a change in accessibility and travel cost. The example of a ferry service used in STAG is an instructive one. If an island receives a public ferry service where there was none before, the following impacts are possible:

- Visitors who previously came to the island can travel further afield when on the island because it takes them less time to get there. Their total spending will not increase, but it takes place at different places on the island (a re-distributive effect – the "winners" are those places where the people now travel; the "losers" are those areas of the island to which they used to travel).
- People who previously came to the island spend more time on the island and spend more there because it takes them less time to get there (at the island level, an increase in economic activity; at the Scotland level, probably no net change because previously these people were spending their money somewhere else in Scotland).
- People who previously came to the island do not come so often because they now perceive it to be more "spoiled". At the island level, this leads to a decrease in economic activity but this then simply takes place somewhere else in Scotland.
- People who are attracted to the island from other destinations in Scotland. This is a net benefit to the island, but there is no net change in Scotland.

- Possibly, a few people come to Scotland to visit the island who would not previously have come to the country at all. This represents a net increase in economic activity.
- Companies on the island may be able to export their goods more easily, or obtain raw materials more easily, both allowing them to compete more effectively with companies elsewhere. If this is at the expense of other companies in Scotland, it represents no net change to the Scottish economy.

At the Stage 2 level, STAG recommends analysing these possible responses, mainly through survey work, at an economic sector level. Sectors include:

- existing manufacturing and process industries, which produce physical products: this may usefully be segmented by sector/industry, and/or by size;
- service businesses, which may be sub-segmented into those serving the local area and those which export services outwith that area; and/or by whether a physical product is produced;
- mobile/inward/foreign direct investment, which may be capable of being attracted to the area;
- tourists, who may be considered as a specific market served primarily by local
- service industries;
- day visitors including shoppers, also a specific service sector market;
- working residents, who may migrate from or to the area and who may have jobs in or outwith the area.

For each sector, a summary sheet such as that seen on page http://www.transportscotland.gov.uk/stag/td/Part2/Economy/9.4.4.1. These are then combined to form the overall EALI report.

**ACTIVITY**

Read the STAG sections on EALIs, starting at http://www.transportscotland.gov.uk/stag/td/Part2/Economy/9.4. Do you feel confident after reading this that, if you were in the position of being the client for the appraisal of a particular scheme, you would understand how estimates of its impacts on economic activity were derived?

## Changes to STAG

STAG was first published as a consultation draft in 2000 and as such was used to appraise many projects since then (including the proposals for road user charging and associated transport improvements in Edinburgh) but, at the same time, the Scottish Executive were inviting comments from users, some of which they took into the final version that was published in September 2003, and updated in 2005 and 2008. Some of the main changes that they included in the final version are:

- There is much greater emphasis throughout the document on "distributional impacts" – that is, who benefits and who loses as a result of a project.
- The accessibility objective was expanded to become an "accessibility and social inclusion" objective.
- There was in the consultation version some overlap between the integration and the accessibility objectives. This duplication was removed.
- Given that many projects have seen considerable cost over-runs when actually built, a new section was added to STAG on "optimism bias" (see Unit 12) and

sensitivity testing, to ensure that, even if costs do over-run, the project is still likely to be worth the investment.

- Real examples of STAG appraisals, suitably anonymised, were unfortunately not included in the revised version; however, they are discussed in the STAG user group, convened by the Scottish Government, that anyone can join.

## Summary

In this Unit we have reviewed the operation of Scottish Transport Appraisal Guidance (STAG) and how it differs from its English equivalent. In particular you should have gained a detailed knowledge of the derivation of the accessibility and EALI measures. We have read parts of STAG and considered a critique of it. The Module now goes on to look in more detail at the derivation of economic costs and benefits in STAG and WebTAG. However, don't forget to do the first activity below; and the second activity, whilst optional, may help you to think some more about STAG and its usefulness.

**ACTIVITY**

**Appraisal Summary Table – North Edinburgh Tram exercise – please note the data presented here are entirely hypothetical and bear no resemblance to any real tram schemes**

Line 1 of the Edinburgh Tram Network is due to open sometime between now and 2200. It will run between the city centre and Granton via Haymarket, the Western General Hospital and Muirhouse, making use for much of its length of a disused rail line. (See map on CD ROM.) It will reduce current peak hour journey times by public transport from Granton to the city centre from 25 minutes to 15 and from the Western General from

15 to 8 minutes. The Tram is expected to carry 10 million passengers per year compared to the 6.5 million currently carried by bus; some 35% of this increased patronage is expected to transfer from car. Fares are expected to be slightly more than existing bus fares (80 pence or £1 single, dependent on distance travelled), and it is anticipated that the tram will cover its operating costs and be able to cover about half of the interest on capital from its revenue, if it were to receive no grant funding.

The Tram system would be designed to be fully accessible to the mobility impaired, and high quality interchange would be designed in, particularly at Haymarket and in the city centre. The Tram would accept smartcards compatible with those used by local bus operators. Per passenger trip the risk of injury accidents can be expected to be about 20% lower than by bus.

The capital cost of the Tram would be about £125 million of which about half would be met by the private sector. Operating costs of about £5 million per year would, as noted above, be covered by fare revenues.

Granton and Muirhouse, with a combined population of 25,000 people, are both deprived areas with unemployment rates of about 25% of the economically active population and with only 30% of households owning at least one car. It is estimated that there is sufficient derelict land in the area to support more than 5,000 new housing units and approximately 140,000 square metres of office and light industrial development, but poor transport links have been recognised as a barrier to its further development.

Produce a Stage 1 AST for the tram – your base case is the existing public transport network. List the information you would need to be able to fully complete your AST.

**OPTIONAL FURTHER ACTIVITY ON STAG**

Consider the following questions:

1. Is the move to an objectives-based framework a good one when compared to previous appraisal methodologies?
2. Do you feel confident that two different staff members putting together a STAG appraisal for the same project would produce broadly similar appraisals?
3. Do you feel assured that two different Scottish Executive appraisers reading the same STAG output about the same scheme would come to the same decision as to whether it was worth funding?
4. Is there a need for separate Scottish Appraisal Guidance – what's wrong with GOMMMS?
5. Does it address the correct objectives?
6. Are the objectives and subobjectives clearly defined?
7. Are there any sub-objectives that you don't understand (e.g. accessibility)?
8. Is there overlap between objectives and subobjectives?
9. Should objectives (and sub-objectives?) be weighted? If so, how should weightings be derived?
10. Is there clear guidance on the level of consultation and appraisal required for different sizes of schemes and, if not, is that an important omission? E.g the COBA manual said COBA is for schemes > £1 million; is such clear cut guidance required in STAG as well?
11. Would you feel competent as a large authority in that you have the in-house expertise necessary to derive the measurements for certain sub-objectives, or would you feel it necessary to get a consultant to help, and is that a good or a bad thing?
12. Do certain consultancies benefit from their knowledge of STAG and is that a good or a bad thing?

13. Is the 2-stage appraisal process a useful one?
14. How does STAG help you to appraise packages of projects against one another as opposed to individual projects?
15. Should there be one CBA package recommended to derive the Transport Economic Efficiency results for a STAG appraisal, or is it correct to suggest a range of packages?

# Unit Twelve

# The Transport Economic Efficiency Table and how it is derived

## Learning Objectives

Once you have completed this Unit you should:

- Understand why the TEE table has been introduced.
- Be able to find your way around a TEE table.
- Appreciate the concepts of sensitivity testing and optimism bias, and how appraisal is modified to take them into account.
- Be aware of the main inputs to the TUBA model, and be able to critique it.

## Introduction

The Economy objective within WebTAG and STAG is divided into a number of sub-objectives, arguably the most important of which is Transport Economy Efficiency. (The fact that the Treasury's Green Book, which is primarily about SCBA, is binding on all public sector project appraisals in the UK, implies that SCBA and hence NPV is a very important criterion in appraisal.)

Previously in transport appraisal the primary measure of economic efficiency was simply Net Present Value (NPV). In a simple road scheme, where public sector expenditure reduces user costs (time, accidents and vehicle operating costs) to users, this approach may be sufficient. However, many transport projects in the UK are now much more complex: they include a wide range of actors spending both private and public sector

monies to realise benefits for private companies as well as for society as a whole, and they can in some cases include user charges (tolls, and road pricing, as well as more conventional charges such as public transport fares and parking costs). Therefore, a much more detailed analysis of economic impacts is now required: these are summarised in the Transport Economic Efficiency Table.

The TEE table shows net effects; but it also shows gross impacts on different user groups. For example, in simplified terms, public transport fares are a benefit (income) to transport operators, but a cost to passengers. Thus they will be entered twice in the TEE table, as a user cost and an operator benefit, the first with as a negative number (a disbenefits) and the second with a positive sign (a benefit). The net effect, in the most simple terms, will be zero and so does not affect the NPV of the scheme, but the TEE analysis – in contrast to a simple SCBA – shows *who gains and who loses* (a recurring theme in GOMMMS and STAG).

## Interpreting the Transport Economic Efficiency Table

WebTAG Units 3.5.2 and 3.5.9 explain the components of the TEE table. It is worth your while reading one of these two sources. Perhaps the most useful element of the ten pages is Table 1 in WebTAG 3.5.9, which summarises the different types of transport costs in appraisal. You should note that fuel costs, for example, is described as a "user benefit". The TEE table, as with standard SCBA, shows the net impact of a project – the difference between the do-something and do-minimum cases. The user *benefit* arises if there is a saving in fuel costs between the do-something and do-minimum cases.

The best way to get an appreciation of the TEE table is to look at one that has been completed. On the CD ROM with this module you will find a copy of Chapter 8 of the final report of the South and West Yorkshire Multi-Modal study (the full report is available at http://www.swymms.org/). This considered options to reduce congestion and improve transport choices in the area around and between Sheffield and Leeds, including the M62 and M1 motorways and the A1 trunk road. Three options were evaluated in detail:

- selective widening of the motorways plus ramp metering and other non-priced management techniques (Plan Version 1);
- selective widening plus road user charging on the widened sections (Plan Version 2);
- selective widening plus area-wide road user charging (Plan Version 3).

All included significant improvements to public transport in the area.

Tables 8.11, 8.13 and 8.14 in SWYMMS Chapter 8 show the transport economic efficiency results from Plan Versions 1, 2 and 3 – with and without motorway charging. Print these out, together with a copy of the blank TEE table also provided on the CD ROM. The first thing that you will notice is that this supposedly multi-modal study output includes no TEE results for walking or cycling. This is because the models used were not "fine-grained" (disaggregate) enough to quantify user benefits for the so-called slow modes. This should then be entered in the Net Impact cell (row 5) under the "Other" column in the TEE table (but is not in the SWYMMS results).

The column headed "TOTAL" present value in tables 8.11 and 8.12 is the sum of the columns to the right. All values are in net present terms. In plan version 1 (no user charging), under User Benefits, it is clear that there are travel time savings accruing to car

drivers and freight operators of £955 million and £255 million respectively, due to the motorway widening. However, increased congestion increases vehicle operating costs. There are no user charges, because there is no tolling. The Private Sector providers are bus and rail operators, who spend £64 million on providing extra services, but get this all back as subsidy. There are no Public Sector providers (Highways Agency or local authority) impacts in current terms, but the Government is expected to invest some £400 million in additional road infrastructure. Other Government impacts include a loss of £64 million (the subsidy to bus and rail operators) and a gain of indirect tax revenue – fuel duty, something specifically excluded from earlier transport appraisals such as COBA9.

In Plan Version 2, the effects of road user charging come into play. Hence congestion is reduced significantly compared to the do-nothing situation, so both time savings and vehicle operating cost savings are significantly higher than in the previous version. However, car drivers pay out £362 million in user charges to offset these savings. Public transport is in a much healthier position due to modal shift caused in part by road user charging. Thus the demand for subsidy from the public sector is much lower (£15 million). In spite of the road user charging revenues, the cost of setting up and operating the charging scheme, plus the cost of the new road infrastructure, means that there is a cost to the public sector of £339 million in this option. The benefit to cost ratio is *lower* than in Plan Version 1, due to the user charges; but, for the same reason, the value/cost to Government ratio is higher. Looking briefly at Table 3.14, we see that, in Plan Version 3, area-wide user charging actually nets the Government some £9.8 billion over the planning period! Thus, although there are very large travel time and vehicle operating cost savings due to reduced congestion, users pay more (and in money, not time) in Plan Version 3.

The present value of cost to Government is actually positive (i.e. in spite of major road investment the Government makes money) and so this has the perverse effect of making the Value/Cost to Government Ratio negative. The overall benefit to cost ratio for this option is slightly higher than in Plan Version 2 but lower than in Plan Version 1. If you don't know already, how do you think local and national government reacted to the consultants' recommendation to adopt Plan Version 3?!

## Using TUBA to derive the TEE table

The numbers in the TEE table are not easy to derive. Special software was developed for the Department for Transport, in order to help. This is called TUBA (Transport User Benefit Appraisal). The CD ROM for the module includes selected input files to and outputs from TUBA, as well as the TUBA user guidance notes. The *.021 file is an example of a matrix in TUBA; the *.DAT file is the inputs; and *.OUT an example of an output. It is also worth looking at the DfT's TUBA Demo 1.3, also on the CD ROM.

TUBA does not include within it any type of mode choice model. Therefore, a separate zone-based model is required to predict the effects on people's travel patterns of the new transport scheme(s) that are being appraised. The outputs from this model are then input to TUBA as matrices. The matrices show the numbers of trips, journey time, journey cost, user charges and distance between each of the zones in the transport model, for each of the time periods modelled, for the do-minimum and the do-something cases. TUBA takes these data along with user input data on values of time for different groups of travellers, tax rates, construction and maintenance costs, and then calculates the costs and benefits to

different groups. Many of the other inputs to TUBA are included as defaults, but are capable of being over-written with more local data, if these are available to the modeller.

For the same reason that user benefits for cyclists and pedestrians are not shown in the SWYMMS TEE tables, TUBA cannot predict these costs and benefits unless a transport model is used to produce matrices at a very fine level of detail. Its earlier versions were also not well-suited to modelling the introduction of entirely new modes of transport (e.g. an LRT), due to difficulties in calculating the benefit for new users, where there are not already some existing users. However, these problems are being addressed in continuing upgrades to the software and it remains the only programme currently (late 2009) capable of directly producing a TEE table.

## Optimism bias

In recent years, the Treasury has become concerned about cost escalation between the time of project appraisal and the actual implementation of the project. Examples from transport include the Jubilee Line underground extension, forecast to cost £1.9 billion when the project was approved, but with an actual final bill of £2.75 billion when the line was opened 5 years later. Another is the West Coast Main Line upgrade, originally (in 1998) envisaged to cost £2 billion, with estimates now currently running at £8 billion. Obviously such cost escalations can massively affect the transport economic efficiency of the project appraisal and hence, in the Treasury's eyes at least, the justification – or not – for building it.

The Green Book (2003) therefore includes specific advice on how to take into account optimism bias. This consists of a range percentages by which the estimated costs and duration of the project should be uplifted to make them more realistic, based on a wide-

ranging study of projects across Government. (A longer duration will obviously delay the time at which benefits will start to be delivered by the project.) These percentages are shown below, for projects related to transport:

***Table 12.1 – Optimism bias adjustment factors***

| | **Optimism bias (%)** | | | |
|---|---|---|---|---|
| | **Works duration** | | **Capital expenditure** | |
| | **Upper** | **Lower** | **Upper** | **Lower** |
| Standard Civil Engineering | 20 | 1 | 44 | 3 |
| Non-standard Civil Engineering | 25 | 3 | 66 | 6 |
| Outsourcing (e.g. Tube PPP) | n/a | n/a | 41 | 0 |
| Equipment development | 54 | 10 | 200 | 10 |

Source – *Supplementary Green Book Guidance – Optimism Bias.* HM Treasury, 2003. Available on your Module CD ROM.

Non-standard civil engineering refers to projects with a significant innovative element, such as the "moving block" signalling first proposed on the Jubilee Line Extension. The optimism bias adjustment uplift should use, as a default, the higher factor, unless a sound case can be made that the major contributors to optimism bias will be addressed. These include poor project intelligence; political and economic factors; a poor project business case (which, one would expect, might be resolved by adjusting for optimism bias); and design complexity and innovativeness.

Many large transport investments have benefit to cost ratios (BCRs) of between 1 and 3. Therefore, uplifting costs by up to 66% may render the BCR negative for many of them. It is worth keeping an eye out in Local Transport Today and other professional publications to keep up-to-date on the impacts of optimism bias in transport. For two high-profile projects in Scotland under construction in 2009 (Edinburgh tram and the M74 extension – you can find details of both on the internet), both were subject to optimism bias adjustment in their costings, but both have nonetheless significantly exceeded this

adjusted costing. A systematic review to see whether optimism bias has led to more projects being delivered on time and on budget is still awaited (winter 2009).

## Sensitivity testing

Compared to the assessment of optimism bias, the use of sensitivity testing in appraisal has a long and proud history, and is good practice in any appraisal. Sensitivity analysis, as its name suggests, tests the sensitivity of the appraisal results to changes in key inputs, in particular showing how much a variable would have to fall (if it is a benefit or contributor to benefits) or rise (if it is a cost) before the project becomes unviable in NPV terms. Particularly important variables usually include wages, revenues, demand, prices and assumptions about the transfer of risk. The Treasury Green Book gives the following example:

> A new IT system costs £1 million and is expected to yield staff savings of £150,000 per year over a period of 10 years. Discounting at 3.5% the NPV of these costs and benefits is £247,000 over that period. Suppose that the estimates of staff savings assumed that 15 staff would be replaced, each with an annual cost of £10,000. A typical sensitivity test would consider the outcome of the appraisal if in fact only 10 staff were replaced: here, staff savings would fall to £100,000 per year and the NPV would then be negative.

Sensitivity testing is neither conceptually nor practically complex and is extremely valuable in demonstrating the ease with which a project appraisal can cross the line between positive and negative NPV, or vice versa.

**ACTIVITY**

Whilst not directly related to the TEE table and TUBA, there are two articles that have been supplied in your study pack for this module that are a good summary to all the material that you have covered since Unit 7. You should now read these and answer the following questions:

**Mann *et al* on the Victoria Line**

1. Why could LT not justify the Victoria Line on the fares revenue that it would generate, alone?

2. What additional benefits was it thought that the line would bring, that could not be captured through fares?

3. Why are the benefits mentioned in Question 2 important to the public sector in deciding how government money should be spent, but not important to the private sector when it makes its investment decisions?

4. On page 131, first paragraph, what do you think the phrase "the 1994 modelled demand validated well against observed demand in the Victoria Line corridor" means, and why is it important that the validation should be good?

5. Also on page 131, can you find any references to simple assumptions that are made as part of the modelling process? Why is it so important to be aware of such assumptions in appraisal?

6. On page 134 there is a long list of assumptions made in the original 1960s appraisal. Why did they have to make so many assumptions? Reading on to page 135, which assumption does it seem was most "wrong" and why?

7. Of the differences between current and 1960s appraisal practice listed on page 136, which do you think would have the most impact on the results, and why (see also pages 137 and 138)?

8. If you used the current appraisal methodology, what effect would this have had on the decision in the 1960s?

9. The 1960s appraisal methodology produced a cost benefit ratio of _____? How much higher would this be if you had the benefit of historical data on actual ridership, and modern modelling techniques?

**Bristow and Nellthorp - Transport Project Appraisal in the EU**

1. On page 52 there are definitions of multi-criteria analysis and of cost-benefit analysis. Describe the difference in your own words, and cite at least one example of each with which you are familiar.

2. How many member states use CBA alone and how many use MCA combined with CBA?

3. What is included and left out of CBA in member states, in general?

4. Why is there such a wide range of values of time shown in Figure 1 on page 55?

5. In Table 3 (values of fatalities), what do you think influences the very high values shown for some countries?

6. Looking at paragraph 3.3, how many countries use money values for global air pollution, and noise pollution; and how do you think that they derive such values?

7. Looking at paragraph 4, why are projects in France likely to seem less good value than their equivalents in Germany?

8. What do the writers mean in paragraph 4 by “equity” and “distributional issues”?

## Summary

In this Unit you have looked in detail at the Transport Economic Efficiency table, one of the key inputs to WebTAG and STAG appraisals. You should appreciate that the main reason for producing such a table is to show the flows of benefits between different user and other groups who may lose or gain as a result of a project; in the world of private finance, this analysis is now essential. You should understand in outline how TUBA works and some of its drawbacks.

The final Unit in this module now looks at the evidence that transport projects deliver economic development benefits, and the wider role of transport in economic development.

# Unit Thirteen

# Economic Development and Transport Investment

## Learning outcomes

When you have completed this Unit you should be able to:

- Appreciate the links between transport investment and economic development.
- Be able to critically assess appraisals of transport schemes of which economic development is a major element.
- Understand the methodological difficulties of demonstrating a link between transport investment and economic development.
- Demonstrate an awareness of some before and after studies of the links between transport investment and economic development.

## Introduction

In Unit 11 we looked at the Economic Activity and Location Index sub-objective in STAG. You will recall that the appraiser is required to quantify the likely economic development impacts of the transport scheme that they are proposing, in GDP and employment terms. This Unit considers how transport can contribute to economic development, the difficulties of measuring this contribution in any meaningful way, and reviews some before and after studies which have attempted to see whether the predictions of economic development impacts that were included in appraisals actually came true.

Much of the material in this Unit is closely based on that in the Victoria Transport Policy Institute's Online TDM Encyclopaedia by Todd Litman, available at

http://www.vtpi.org/tdm/tdm54.htm#_Toc28139555. This web site is commended to you, not only for your studies on this module, but on others as well, particularly Traffic Management; Public Transport and Terminal Design; and Transport Policy. Many references on the topic of transport and economic development are to be found at http://www.nottingham.ac.uk/sbe/planbiblios/bibs/sustrav/refs/ST27.html. More reading on this topic is in the new book *Economics of Transport* by J.Cowie (2009), which is recommended to you.

This whole topic is of great interest to government in the UK at present. The Department for Transport commissioned its expert committee, SACTRA, to look at the issue in 1999. You can see from looking at their summary report (available at http://www.dft.gov.uk/pgr/economics/sactra/transportandtheeconomyfullre3148) that they did not have all the answers at that time. So do not expect this Unit to provide all the answers – its purpose is to make you think about what have all too often been, up until recently, unquestioned assumptions.

WebTAG now incorporates guidance on assessing wider economic impacts i.e. the economic development impacts of a new transport investment. This guidance is the DfT's distillation of the SACTRA report. Because of the complexity of the whole issue, the DfT has decided to limit the assessment of wider economic impacts to only those transport schemes that have an impact on an officially-designated regeneration area (RA) – i.e. an area that local and/or national government have targeted specifically for economic regeneration. This decision was taken on the grounds that new economic activity in such priority areas is a good thing even if it is only the displacement of activity that would have occurred elsewhere in any case. DfT argue that the wider economic benefits brought

about by a transport scheme in any other area may well be displacement of activity from somewhere else and should (in conditions of perfect competition – a rather major assumption for a national economy!) in any case be picked up in the TEE analysis, in terms of changes in the cost of accessibility.

## How does transport contribute to economic development?

There are three main ways in which transport contributes to economic development.

***As a Factor of Production***

Transportation is a major factor in the production of most goods and services. Transportation delivers raw materials to factories and finished goods to markets. It delivers employees to worksites and meetings, and allows customers to reach markets. Even information-based businesses that distribute final products by Internet require physical mobility to obtain necessary resources including employees, equipment, office materials and, of course, a wide range of espresso-based beverages.

In general, policies and programs that reduce transport costs increase economic competitiveness and development. A new road will change patterns of accessibility and make it cheaper to access certain areas.

If two farmers have equal production costs but different transportation costs, the farmer with cheaper transportation will earn greater profits. Transportation costs vary from one industry and producer to another. It represents a significant portion of total costs in many resource-based industries, and so a modest change in transportation costs can have a major impact on their profitability. However, transport represents a much smaller portion of costs in other industries, and this portion is declining, as indicated in Table 1.

***Table 13.1 Transport Inputs and Economic Output (BTS, 1999)***

| | **Farming** | **Mining** | **Construction** | **Manuf.** | **Utilities** | **Retail** | **Service** | **Other** | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| Industry Output, 1992 | 238 | 157 | 679 | 2951 | 521 | 1092 | 2,228 | 914 | 10,434 |
| Industry Output, 1996 | 290 | 173 | 868 | 3,666 | 661 | 1,454 | 2,962 | 1,085 | 13,306 |
| *Percent Change* | *22%* | *11%* | *28%* | *24%* | *27%* | *33%* | *33%* | *19%* | *28%* |
| Transport Inputs 1992 | 19 | 6.7 | 53 | 102 | 10 | 52 | 64 | 5.2 | 322 |
| Transport Inputs, 1996 | 22 | 6.5 | 65 | 117 | 12 | 68 | 81 | 8.6 | 392 |
| *Percent Change* | *18%* | *-3%* | *24%* | *14%* | *19%* | *31%* | *27%* | *65%* | *22%* |
| **1992 Transport as % of Output** | **8.0%** | **4.3%** | **7.7%** | **3.5%** | **1.9%** | **4.7%** | **2.9%** | **0.6%** | **3.1%** |
| **1996 Transport as % of Output** | **7.6%** | **3.8%** | **7.4%** | **3.2%** | **1.8%** | **4.7%** | **2.7%** | **0.8%** | **2.9%** |

Transport as a portion of output varies significantly from one industry to another, and is declining for the economy overall.

Transportation improvements that reduce transportation costs can increase industrial productivity, competitiveness and profits. For example, if a new road or rail line reduces shipping costs from an isolated region, farmers may expand their production, hire more workers and purchase more equipment at local stores, increasing economic development in that area. This reduction in transport costs may provide enough incentive to new companies to come to locate in that area. Such changes can be modelled using a variety of techniques, including transportation-land use models, benefit-cost analysis, input-output models, economic forecasting models, econometric models, case studies, surveys, real estate market analysis and fiscal impact analysis. These techniques are not described in detail in this Unit, but they are the means by which the forecasts contained in STAG EALI analyses are derived. If you wish to know more about these techniques, the book *Transport Investment and Economic Development* by David Banister and Joseph

Berechman (UCL Press, 1999) gives a detailed technical explanation, as well as comparisons of modelled and empirical results.

Policies that reduce transportation costs by shifting them elsewhere in the economy are economic transfers rather than true efficiency gains. Unless justified on other grounds, such transfers are market distortions that reduce overall productivity (Market Principles). For example, a government may try to stimulate economic development in a particular region by subsidizing transportation for farmers there. Such subsidies require funding from other industries or regions, and the subsidy reduces the incentive to improve farming and transportation efficiency. As a result, although a certain type of farm production may increase, overall economic development declines.

***As a Consumer Good***

Transportation is a major consumer good. A typical household spends 15-20% of net income directly on transportation, plus indirect costs, such as housing expenditures for residential parking, and taxes for transportation facilities. These expenditures support transportation-related industries, which have significant economic impacts.

***As a Source of Externalities***

Transportation activities impose external costs including traffic congestion, road and parking facility costs, land requirements, uncompensated crash damages, pollution, and delay to non-motorized travel. These external costs can reduce economic productivity and development. For example, traffic congestion and parking subsidies increase business overhead costs, roadway costs increase tax costs, and pollution can reduce farming and

tourist industry productivity. Policies that reduce these external costs can increase economic development.

## Justifying transport investment on economic development grounds

If the reduced transport costs brought about by investment in new transport infrastructure and services do attract and retain economic development, then it is likely that in most cases this will be economic activity that has relocated from elsewhere in the UK, or Scotland. From the market economist's point of view, this does not represent a benefit. However, there are nonetheless arguments for trying to use transport investment to "move" economic activity from very economically buoyant areas, to those where there is currently less economic activity. These arguments include:

- Equity – the reduced likelihood of different levels of unemployment in different areas is simply more fair for all sections of society.
- Economic efficiency – there is a lower demand for public capital (e.g. hospitals) and less overall congestion if economic activity, and therefore people, remain where they are, rather than there being outmigration in search of jobs from areas of low economic activity.
- Macroeconomic benefits in achieving "stable" levels of employment across country.

These may be laudable objectives; the issue, however, is whether investment in transport is the most effective way to achieve them.

## The role of transport investment: is it enough to stimulate economic development?

The effects of improved accessibility confusing. Some areas grow when congestion levels are high and investment in transport infrastructure and services appears inadequate in

relation to the level of demand – London and Los Angeles seem good examples of this. Some areas grow without transport investment, such as Pendle (East Lancashire), which was buoyant even before it was linked to the national motorway network. Other areas receive considerable transport investment but do not grow (Humberside is an example of this). The conclusion from this brief discussion is that transport investment may allow a structurally strong economy to grow but not be enough to stimulate a weak economy. It is possible that in some cases economic activity will "spill along" transport corridors e.g. M4 from west London and Berkshire to South Wales.

## Effects of transport on production costs

It stands to reason that investments in transport and consequent reductions in transport costs will only make significant differences to firms' competitiveness if a sizeable proportion of their output is taken up by transport costs. Table 13.1 shows that, for most companies, transport is a small proportion of total costs. Furthermore, some 70% of transport costs are incurred at terminals (in handling and transhipping goods and vehicles); in the vast majority of cases, public investment in new transport infrastructure and services will not reduce these. Thus such investment can only affect some 30% of what is already normally a small proportion of a firm's total costs. Obviously this will vary greatly according to the type of company, and whether the locational decision is being made about a branch plant or a headquarters building, for example.

It is obvious that large distribution companies *are* influenced in their locational decisions by the shape of the motorway network in the UK: hence the concentrations of such companies in the Warrington (M6/M62) and Leicester/Coventry/Daventry areas (M1/M6/A14/M42) in England, and in North Lanarkshire (M8/M74/A725/M80/M73) in

Scotland. This does not of course mean that the construction of these motorways has created more jobs in distribution, since the reduced journey times offered by the motorway network may have led to companies being able to carry out the same number of activities but from a smaller number of locations. It is also the case that new transport links can increase competition from other areas – shoppers may desert their home town if they can easily drive (or take the train) to a now-nearby higher order centre.

## Transport and inward investment

"Inward investment" can be defined at different spatial levels. If a firm decides to relocate from one town to another a few miles away, from the point of view of the second town, this represents inward investment, although the net effect in the area is zero. On the other hand, at the UK level, if a Japanese car manufacturer decides to locate here instead of in Spain, this represents inward investment and hence an increase in production in the national economy. Many transport investments are made at least in part to attract inward investment.

**ACTIVITY**

Read the paper (*The influence of transport on industrial location choice*) by Leitham *et al* provided on the CD ROM for this module. The conclusions are particularly pertinent. What factors do the authors find important to the locational decisions of different kinds of firms? For which firms is the quality of road transport most important? What conclusions could we draw from this study about the effectiveness of spending money on transport to attract inward investors? Are there other things on which government money could be spent that might have more of an influence on locational decisions by investors?

We can infer from the available evidence that there are factors that have a stronger influence on most firms' locational decisions than the quality and availability of transport infrastructure. Since transport is a small proportion of costs for most companies, then even if transport links are poor, the majority will be able to continue to function. However, in industries with very low profit margins, the additional costs caused by poor road links or increasing congestion levels can make the difference between profit and loss overall. It is also the case, as found by McQuaid et al (1996) (as quoted in Leitham, 2000), that foreign inward investors look for locations close to international airports. There is little evidence that the construction of a new road or rail link will increase the number of firms founded in an area, except in the case of tourism, where new road links can significantly increase visitor numbers (at the expense of other areas) (see Prideaux, 2000 on your module CD ROM).

## Empirical analysis of transport investment and economic development

Banister and Berechman (1999) consider several empirical studies of the effect on economic development of transport investment. Excerpts from their book are included in your study pack. Some of their findings are discussed here:

### *M25 orbital motorway*

The M25 runs for 188 km around London. It was fully opened in 1986. Analysis of changes in accessibility and employment were inconclusive – there was no evidence that those areas whose accessibility increased the most experienced the largest growth in employment. There was also evidence of the "two-way road" effect – the new motorway allowed companies to expand into areas as well as out from them. It is clear that in terms of regional shopping developments, the M25 vital. Two new centres, Lakeside and Blue

Water depend on the M25 for providing sufficient catchment population to support their activities. However, the analysis also shows that these centres have gained market share at the expense of less efficient – and hence more labour intensive – shopping centres.

## Buffalo Light Rapid Transit

Buffalo in the north east of the USA is what is sometimes referred to as a "rustbelt" city – traditional industries have closed, leaving many urban areas depressed and with high levels of unemployment. Between 1979 and 1985, some $450 million (US, 1978 prices) was spent on a 6 mile LRT system from the depressed city centre (CBD) northeast into suburbs. A further $350 million private sector investment was predicted to be levered in by this investment, and enhanced accessibility was predicted to double city centre jobs, and increase city centre shopping, over a period of ten years.

In fact, the relative accessibility of the CBD by different modes and in comparison to other parts of the metropolitan area changed little. The CBD was kept attractive to cars, with plenty of free parking. Private investment went largely to suburban shopping centres not served by the CBD, and new roads were built alongside the LRT and elsewhere. New public transport interchanges were required, as buses fed into the LRT; and the operating subsidy for the LRT was funded at the expense of subsidy for buses. Overall, public transport accessibility changed little – and there was, consequently, a marginal effect on the location of economic activity. Had this been forecast at the time of the appraisal, it remains to be seen whether the project would have been funded.

**ACTIVITY**

The Skye Bridge replaced a ferry service between Kyle of Lochalsh, on the Scottish mainland, and Kyleakin on the Isle of Skye. One of its major justifications was economic development benefits for the island. Read the ex-post study available at http://www.scotland.gov.uk/library2/doc16/sbse-01.asp (do not worry that you are warned by the website that it may be out of date); and at least the Executive Summary of the 2009 report, available at http://www.hie.co.uk/skye-bridge.html and decide whether you think that these benefits were realised.

## The Economic Impact Report in WebTAG

As noted in the introduction to this unit, an Economic Impact Report is required for schemes that are forecast to have a beneficial effect on a regeneration area (in England); and for all schemes in Scotland, where the process – part of STAG - is known as EALI. Other countries (e.g. Germany) also routinely quantify the economic development benefits of transport schemes. The question is: how? This section very briefly summarises the EIR process as set out in WebTAG units 2.8, 3.5.8 and 3.5.13. But, in addition, the first of these at the very least should be included in your reading for this Unit.

The EIR process is grounded in empirical research and does not rely on economic modelling. Essentially it consists of a survey of the existing economic situation in the regeneration area (RA) in question (and the problems that it suffers), followed by a qualified estimate of the impact of the scheme on employment in the area, and a "reality-check" of the estimates derived. The two main effects of a scheme (which both stem from the changes in accessibility that it brings about) are thought to be a reduction in costs for companies in the area, leading to them providing more jobs; and an increased ability for

residents of the RA to travel to jobs elsewhere. Certain schemes that might have tourism impacts are assessed slightly differently. The key methodology is interviews with employers and other key "stakeholders" to find out how they think the proposed scheme will affect their activities and their business.

At all times the level of uncertainty associated with any predictions of increases in employment associated with changes in accessibility brought about by the scheme must be estimated. Possible job losses in the RA that might stem from industrial re-structuring brought about by the new transport scheme must be set against any estimated employment gains. The tone of the guidance is very much one of caution: that the onus is very much on the scheme promoter to show that the scheme will bring about employment benefits in the RA.

## Productivity and agglomeration economies

Work in 2006 and 2007 for DfT in the UK developed some additional aspects to the economic development value of transport investments. These boil down to two major concepts:

- That, by encouraging companies to locate in certain areas close to other companies, they all become more productive simply because they are next to each other (there is some empirical evidence that, for certain industries, this appears to be the case); and that
- New transport investment can encourage people to take higher-paid (i.e. more productive) jobs that then have benefits to the wider economy greater than the benefit to the individual.

When applied to investments such as London's Crossrail scheme, the additional benefits realised through these techniques have been impressive. The problem remains that it remains very difficult to predict just how many people will move into a new job, and how many new jobs will be created by, a new transport investment. These aspects of transport and economic development are discussed more widely in the document Transport, Wider Economic Benefits and Impacts on GDP (DfT, 2007) on WebCT for this module.

## Summary and conclusions

This Unit has demonstrated the complexity of the subject of transport and economic development. It has explained in outline how estimates of the economic development impacts of transport schemes are made; and has presented evidence from ex-post evaluations to show that, often, the actual economic development impacts are much less clear than those that were predicted. It has also shown that transport has a role in companies' locational decisions, but that the importance of transport relative to other factors will not be the same in every case, and rarely will it be the most important factor.

**ACTIVITY**

By way of summary to this Unit, consider these questions.

1. What are firms' major costs (e.g. accommodation)?

2. What are the major influences on firms' locational decisions?

3. Are there examples of areas with poor transport links and high economic development, and vice versa?

4. A new motorway is built (where none existed before) from an economically buoyant region into an economically depressed region some 50 miles distant. List some of the possible economic effects on the latter region.

# Unit Fourteen

# The External Costs of Transport and How to Value Them

## Learning outcomes

When you have completed this Unit you should be able to:

- Appreciate the links between transport appraisal and economics.
- Be able to define an externality in transport.
- Understand the methodological difficulties of measuring externalities in monetary terms.
- Demonstrate an awareness of the arguments for an against including monetised externalities within SCBA in transport appraisal.

## Introduction

In Units 7 to 9 we looked at the use of SCBA in some detail. One of the problems that you identified with the methodology as it used in the UK today was its inability to deal with costs and benefits that are not easily *monetised* (expressed in monetary terms); and, indeed, you also saw from the discussion of the problems of measuring values of time that the methods for monetising those costs and benefits that are included in SCBA are not completely foolproof.

Nonetheless, there are many costs and benefits that can result from a transport scheme, and there are strong grounds for including these in SCBA. As we have seen from previous Units, UK transport appraisal methodology has currently, nominally, moved away from an

almost complete reliance on SCBA to one where the results of the SCBA are part of a wider, objectives-based, appraisal. However, you may have reached the judgement – from reviewing the results of multi-modal and other studies, for example – that there is still a tendency to put great weight on the TEE output than on any other objective. It is also possible that, in future, a new government may decide to move back to an SCBA-based appraisal procedure. We also know that, whilst we are not very good at deriving accurate estimates of the monetary values of externalities, they definitely have a value and, therefore, there may be a case for including that value in our appraisals. Finally, whilst the Department for Transport may have adopted an objectives-based appraisal procedure, the Treasury has not (as evidenced by the latest version of the Green Book, included with your notes) and therefore, for them, the results of the SCBA for a transport scheme will be all-important. These are some of the reasons why the DfT has moved to monetise more costs in appraisal, such as noise and greenhouse gas emissions. These costs and benefits are often known as externalities, for reasons that will be explained, below.

**ACTIVITY**

First, by way of a short introduction for yourself, why not list all the externalities – both positive, and negative (benefits and costs) – that you can think of that might arise from a transport scheme. Choose one or two quite different schemes to think about. Do this before you read the next section! For help, check out www.vtpi.org

Some useful references for this Unit are as follows. Those that are included with the module are noted. The others, while not essential, will deepen your understanding of the subject. Pearce (1996) is particularly good. There is new literature coming out on this subject all the time, so it is worth searching the web as well.

Gastaldi, M. *et al* (1996) Valuation of Environmental Externalities: from Theory to Decision-Making. *Transportation Planning and Technology* **19** pp 207-219 (included with module)

Pearce D. (1993) Blueprint for a Green Economy Earthscan, London (excerpt included with module)

Pearce D. (1996) The True Costs of Road Transport CSERGE, London (pages 141-142 included with module)

Tinch, R. (1995) The Valuation of Environmental Externalities *NB check that this is not on the web.*

University of Westminster/London Transport/Local Transport Today (1997) Determining Monetary Values of Environmental Impacts Proceedings of a conference, London, Oct 1997

## What are external costs and benefits?

External costs and benefits, or **externalities**, are those for which the consumer of a good or service does not pay themselves. For example, if you have a car and are driving it, you do not pay directly for the damage that the pollution emitted by your car causes to buildings or to people's health. Also if/when you are driving, although you incur travel time costs yourself, you do not pay for the additional travel time that everyone else incurs as a result of your being on the road. This is also why it is economically sensible for bus companies to run their buses without conductors, since they do not pay for the delays that they cause to other traffic while buses are at stops boarding passengers who have to pay the driver. Were bus companies required to pay for this delay (i.e. the cost was **internalised**), the economics of the decision to run without conductors would probably, in congested urban conditions, be very different. However, at present, these costs are external to the company.

Economists argue that, because externalities are not internalised, then in some situations – such as congested urban areas – drivers, and perhaps bus companies, pay less to consume transport than it costs society to provide it. In such a situation, we tend to *overconsume* transport – i.e. we maximise private utility but not society's total utility. On the other hand, in areas where there is little congestion, but drivers still pay a great deal of petrol tax and vehicle excise duty, then they are probably *underconsuming* transport as a result and, once again, society's utility is not maximised. As you will have probably gathered by reading Units 1 to 7, economists despise such situations above all else, since they see them as economically inefficient.

So, in answer to the first activity in the introduction, above, what are the key externalities – positive and negative – caused by transport schemes? Hopefully you will have thought of most of them or, possibly, more than I have!

- Air pollution (local and global).
- Noise.
- Accidents – which, as you know, are included in SCBA in UK transport appraisal at the present time.
- Visual intrusion.
- Increased or reduced severance (where it cannot be measured through changes in journey time).
- Loss (or gain) of landscape.
- Loss of built or natural heritage.
- Environmental enhancement/degradation.

Whilst most of these are straightforward, you may be wondering about the latter. However, consider a scheme that removes through traffic from an historic street: the environmental enhancement is likely to be one of the key objectives, yet it is not very well captured through GOMMMS or STAG, and it is certainly not captured through the TEE analysis. The most significant disbenefit of such a scheme will be the increased journey time for general traffic, which clearly will be captured through the TEE table. It may assist the case for the scheme if it is possible to express the value of the environmental enhancement in monetary terms and, as we will see towards the end of this Unit, some researchers have indeed tried to do this.

Before moving on to look at the techniques used to put monetary values on externalities, it is worth considering the different types of benefit (utility) or cost (disutility or disbenefit) that are incurred by members of society. They are:

- User value/cost – the ability to use directly some environmental feature, such as walking in peaceful countryside; or the environmental disbenefits incurred from the use of a transport scheme.
- Indirect value/cost – the ability to use the products of an environmental feature, such as the drugs (some of which we may have not yet discovered) derived from plants in the rain forest.
- Option value/cost – the option of being able to use an environmental feature, even if we do not use it at present.
- Existence value/cost – the value to us that some environmental feature exists, even if we have no intention or likelihood of deriving any direct use from it. An example from another area of environmental policy is the value that most people attach to the

existence of whales; or to the knowledge that an internationally famous building (e.g. the Coloseum in Rome) is not being degraded by traffic pollution.

When considering externalities, and particularly the way that they can be valued, it is worth bearing in mind these different categories of cost/benefit to see whether or not a technique actually captures all of them, or only some.

## Using and measuring externalities

It would be easy enough to measure the monetary value of externalities, if a market existed for them. However, that is the whole point: with a few exceptions, where governments have deliberately created markets in pollution (abatement) for major industry, externalities are not bought and sold. If they were, they would be unlikely to be external.

There is also the difficulty that economists argue that the marginal consumer (e.g. the last car onto the network in the morning peak, if such a car can be identified) should pay its full marginal external costs. These would be more than the costs imposed by the previous car on the network, and much more than the first car on the network. Whilst theoretically sound, the marginal cost is in fact virtually impossible to derive as it changes constantly in time and space.

Both of these problems mean that a "true" marginal monetary value for the cost or benefit of an externality cannot be derived directly. Instead, other more imprecise methodologies have to be used, and then only to derive average as opposed to marginal values. The methodologies in question are:

- Abatement expenditure (e.g. double glazing)

- Variations in rents/house prices (hedonic pricing)
- Travel time studies.
- Dose-response studies.
- Willingness to pay studies (contingent valuation methods (CVM))

Before discussing each of these methodologies in turn in more detail, it is worth bearing in mind that each of these can yield very different values for the same externality. Consider the example of standard accident costs in some EU countries. The **average** (not marginal) value of a statistical life (VOSL) in road transport in 1995 was:

- Portugal - 78.2 kEuro.
- Greece - 80 kEuro.
- Germany - 625 kEuro.
- UK - 935 kEuro (since increased to about 1.55 kEuro)
- Finland 1414 kEuro.
- European Conference of Ministers of Transport recommended value - 2500 kEuro.

The reason for these large differences is the range of different valuation methodologies used. Portugal and Greece use only the effects of a average casualty levels on motoring insurance costs (similar to the hedonic method), whilst the UK and Finland adopt a willingness to pay approach, asking a sample of their populace how much additional tax they would be willing to pay to avoid road accident deaths and injuries.

Now, the different methodologies for assigning costs are considered in turn.

**Abatement costs**

Here, the argument is that the monetary value of the externality is simply equivalent to the cost of abating (reducing or mitigating) it. To an extent, this is valid for examples such as traffic noise, where householders nearby pay for double glazing to reduce the impact of the noise on their household. However, you can probably think of reasons why the cost of the double glazing may not equate to the full cost of the externality, and of examples of other externalities where this method does not work since it is impossible to pay to mitigate the impact of the externality. Because we do not all buy helicopters to escape traffic jams this does not mean that there is not a cost attached to congestion!

**Hedonic Price Method**

With this methodology, house prices are compared with environmental (dis)benefits – normally noise or air pollution. House price is regressed as the dependent variable against environmental amenity and a wide range of other variables. Houses in noisy and quiet areas are compared. The difference in house price due to noise (when controlling for all the other contributory variables) allows a per decibel value for traffic noise to be derived. Boxes 3.5 and 3.6 in Pearce (1993) give a range of impacts from airports, and from traffic noise. This shows you that values can indeed be derived from this method but also that – in common with other methodologies – these values are likely to lie within a range.

The Hedonic Price Method also suffers from a number of problems. Firstly, as may have occurred to you, it really only reflects user value. Secondly, it only reflects the cost of disbenefits suffered at the home (or other property whose price is under investigation), not in other places. Finally, there is danger that, if key explanatory variables are missed from the analysis, the results will be erroneous. However, of the methods for monetising

externalities, this is one that has been used for the longest and results are normally seen to be reasonably reliable.

**Travel cost studies**

This method works on the simple assumption that if more people travel to a particular area – say, a park or national park – more often then it is more valuable than one to which fewer people travel. This method lends itself to valuing the loss, or gain, of particular kinds of environmental amenity such as (the quality of) recreation areas and town centres; it is not suited to measuring the external costs of congestion. The simplicity of the approach must be tempered by noting that it is necessary to control for income and for the distance to the area. Once again, this method of valuation only captures user value. However, Box 3.8 in Pearce (1993) ostensibly shows that results derived from this method are "broadly consistent" with those derived from the most methodologically complex approach, contingent valuation.

**Dose-response**

This method is almost exclusively confined to assessing the costs of air pollution, although it could also be used for noise. It considers the effects of an increased (or decreased) prevalence of an environmental externality on the average person's quality of life and health; assesses how much the environmental externality has (or will) increase(d) or decrease(d) as a result of the new transport scheme; and then multiplies the two to assess the effect across the population. The costs of medical treatment, loss of economic activity and also compensation are used to derive the total monetary values involved. You should read GVF-Report 272 (included in the study pack) as it gives a very good explanation of how this method was used to derive the external health costs attributable to

transport in Switzerland: some £700 million per year at 1993 prices. This method is reasonably reliable and now quite commonly used across northern Europe in particular to assess the costs of air pollution from transport.

**Contingent valuation (CVM) – also known as willingness to pay (WTP)**

One means of deriving a value for a "good" for which there is no market would be to ask people what they would be willing to pay, if a market existed. This is the basis of the contingent valuation method. It has two variations: the willingness to pay method (WTP); and the willingness to accept compensation method (WTA). Both use some form of questionnaire/interview system, but in the first, people are asked what they would be willing to pay to avoid an environmental disbenefit (or to gain an environmental benefit); in the second, people are asked what minimum level of compensation they would be willing to take in exchange for the loss of an environmental benefit or for incurring some environmental disbenefit.

As you will have gathered already, no doubt, a major weakness of WTP or WTA is their entirely hypothetical nature. In order to reduce the errors that are inevitably part of these methodologies to a minimum, there are a number of key steps that must be taken when carrying out the surveys to derive environmental valuations. Essentially, there is a need to construct hypothetical market for environmental "good" in question. This is typically done as follows:

- Firstly, the scenario must be described to the respondent accurately without bias. That is, there must be a consistent and unbiased description of the changes in the environment about which the respondent is being asked to bid.

- Secondly, the respondent must understand the scenario. The ease of ensuring this pre-requisite varies with the environmental change in question. If the change relates to an area or environmental feature well known to the respondent, such as the loss of a particular local beauty spot, the respondent is likely to be able to grasp the change quite easily – especially if photographs/montages are used to show how things are likely to change. However, the changes associated with global warming might be much more difficult to describe.
- Thirdly, there is a need to avoid "starting point bias". Generally, the respondent will be asked whether they would pay £x per year to avoid the environmental disbenefit. If so, the questioner increases the "bid" bit by bit until the maximum willingness to pay is reached. In the WTA method, the questioner bids down until the minimum level of compensation is reached. However, previous studies have shown that the final result is often influenced by the point at which the bidding starts. The only way around this problem is to carry out pilot interviews at different starting points and then to choose a point roughly in the middle; but this also demonstrates the "vagueness" of the whole methodology!
- Finally, the methodology requires a proper "payment vehicle" – that is, a means by which the respondent is expected to pay. Often, some form of tax is used – but it must be a tax that the respondent either already pays, or can envisage themselves having to pay – otherwise they would not be liable for the payment and could bid unrealistically high.

The responses to the interviews or questionnaires are then weighted by household income – since, all other things being equal, we would expect wealthier people to be willing to

pay more or to accept only higher levels of compensation. Finally, and most importantly, the method produces valuations – but these are within a range, rather than being precise.

There are, as you might expect, some problems with the CVM method. It is completely hypothetical but, then, it has to be, since it is used to put prices on items for which there is no market. There is also the problem that some people may make "protest bids" – unrealistically high bids in an attempt to sabotage the process and to express their total opposition to the changes that are being explored. These bids need to be eliminated before average valuations are derived from the results.

In spite of the researcher's best efforts to explain the scenario as clearly as possible, it is still possible that respondents are not clear about what they are bidding for. Related to this is the issue of embeddedness - that is, that respondents are thinking about general environmental degradation when they are being asked to bid to prevent one specific element of that degradation. For example, when asked what they would be willing to pay to prevent a certain level of traffic noise in a street with which they are familiar, respondents may think about all the disbenefits that are associated with high traffic levels in the street – noise, air pollution, loss of space and safety problems. This would lead to an unrealistically high valuation for the noise element of environmental degradation.

So, after all this critique, do you still think that CVM is worth the bother? Write down your arguments for and against, and then read Pearce (1993) pp 70-71.

## What are the external costs of road transport?

The whole point of the methodologies discussed in the former sections is to derive monetary valuations for transport externalities that can then be incorporated into SCBA.

The case studies, below, demonstrate how this has been done in at least two project-specific studies in the UK. Gastaldi *et al* (1996) list a number of estimates of the total external costs of road transport from France and Italy. You will notice that these vary over quite a wide range; however, in general, as more work is carried out in this area over the years, the mean of these ranges is tending to creep upwards.

A comprehensive study of the external costs of road transport is contained in Pearce (1996). This considers the argument, often posited by motoring organisations, that motorists already more than cover the costs that they impose on society by paying VED and fuel duty. At the time that the book was written, Pearce found that the total external costs of road transport actually exceeded the taxes paid by drivers by about £10 billion – although this situation may have changed since, due to the real terms increases in fuel duty during the late 1990s. (On the other hand, the external costs of congestion are also likely to have increased since that time.) This does not of course imply that – from the point of view of economic theory - there should not be some re-distribution of the taxation burden on motorists, away from fixed costs and uncongested times/places towards variable costs at times/places where congestion takes place; but it does imply that the total tax burden should be increased. See Pearce (1996) pp 141-142 (as supplied with the unit).

## Case studies

Two case studies of the use of CVM are detailed, below.

**Midland Metro**

The sponsors of the Midland Metro tram scheme (which is now in place) needed to make case for funding to DoT, so they surveyed residents' WTP for environmental (dis)benefits of Metro. A stratified random sample of only 75 people was asked about:

- Noise
- Visual intrusion
- Environmental improvement
- Pedestrian conflicts

They used flash cards to describe scenario and payment cards to elicit WTP values. This found small but significant valuations of these factors, but they were insufficient to make a difference to the economic case – this was ultimately justified on other grounds.

**Oxford City Centre**

In the early 1990s, Oxfordshire County Council was proposing to close Oxford High St, the main east-west route across the city centre, to through car traffic, leading to diversions for car drivers of between 1 and 3 miles. Unsurprisingly, due to the large increases in journey times, a conventional SCBA showed net disbenefit of £4.6m. However, a key benefit of the scheme would be environmental: to reduce the impact of through traffic on one of Britain's most architecturally outstanding streets – as well as to benefit cyclists, pedestrians and bus passengers. Therefore, a study was carried out in an attempt to derive a monetary valuation of the environmental improvement resulting from a reduction in through traffic. (Interestingly, this study was carried out for an M.Sc dissertation at Oxford Brookes University. Repeating the study elsewhere could be an entirely valid topic for your M.Sc dissertation!)

The survey was of High St users, excluding through drivers, since it could be argued that their valuation was captured through conventional SCBA. Predominantly, interviewees were pedestrians. As the payment vehicle was council tax, non-UK tourists, and those too young to pay council tax, were excluded. Interviews conducted in the High St, so the

scenario was relatively obvious and, since the study was attempting to derive a valuation for the overall environmental change, embeddedness was less of a problem than it would have been had, say, air pollution alone been the object of interest.

The mean bid from those surveyed suggested that they were each willing to pay an additional £24.90 per year council tax - although the median was lower. Grossing this up, a total benefit of £2,122,370 per year was derived – not enough to outweigh the increase in journey times for drivers, but a significant benefit nonetheless. Ultimately, however, the measure was approved on the basis of an objectives-based appraisal!

## Conclusion

In this unit, we have looked at the theoretical basis for deriving monetary values for environmental costs and benefits, and how these could be included within SCBA in transport. We have also looked at the advantages and disadvantages of the different methodologies used to derive valuations, and reviewed some of the monetary values that have indeed been derived. It is obvious that the methodologies are problematic, in that they produce quite wide ranges of values, but they are improving.

**ACTIVITY**

By way of conclusion, write down the arguments for and against including monetary valuations of environmental costs and benefits, derived on the basis that we have considered in this unit, in SCBA. When thinking about this, do not rely only on this unit – it may be worth your while recapping on units 7 and 8 as well.

# Unit Seven

**ACTIVITY 1**
Before you start the Unit, think about the problem that transport planners and government have: many projects that require funding, but not enough money to fund them all. Think about the kind of mechanism that we might need to help us to decide which projects to fund. You might be able to relate this to some of your own spending decisions – you only have a limited amount of money, so how do you decide what to spend it on?

**Answer**
All that this question is driving at is the idea that there is a need for some means of weighing up the advantages and disadvantages of different spending decisions so that you can then rank them and choose those that maximize the benefit that you can gain for a given expenditure of resources.

**ACTIVITY 2**
**Self assessment exercise: different kinds of costs and benefits**
The purpose of this exercise is to make you start to think about the problems which we face when trying to decide how and where to spend (public) money.

Choose one of the following examples of investment (or more, if you like):

- A new bus lane.
- A new bypass around a congested town.
- A new railway line between London and Scotland.
- A new rural motorway.
- A new ferry link to a remote Scottish island.

Now take your chosen investment and consider the following questions. There may or not be right answers; the purpose of the exercise is to start you thinking about how things might be appraised and about some of the problems that this might bring about.

- What are the costs and benefits to private individuals from the project?
- Are there any costs and benefits that accrue to or are borne by society resulting from the project that are additional to the costs and benefits to individuals?

- Could you buy and sell all of the costs and benefits?
- Would you include all of these costs and benefits in a your appraisal? Why, or why not?
- What kind of surveys would have to be carried out to count all these costs and benefits?
- How can these costs and benefits be expressed in a way which makes them easy to add up and compare with each other?

**Answer**

In answering this, let's consider the new railway line running between England and Scotland, and assume that it is to be publicly financed. Firstly, consider the costs and benefits that accrue to private individuals (within which definition you should include private companies). In the case of a rail scheme, passengers will pay a fare to travel and this will be a cost to them, which will equate to a benefit to the private operator running the railway. In addition the following are some of the benefits to individuals (there may be more):

- Reduced journey times for people travelling on the railway.
- Reduced journey times for people travelling on parallel roads and the old railway, due to reduced congestion as some trains and people transfer to the new line.
- Increased reliability of journey time (this is very different to the actual journey time itself – think about how you value knowing that a journey will always take you precisely the same amount of time, or conversely don't like having to factor in a "safety margin" in case the train is late or there is a traffic jam).

- Reduced vehicle operating costs for drivers who decide to give up their cars and use the train instead.
- The income to companies from building the line is a benefit to them, as is the income from jobs for those who work in its operations – but this may be only a small net benefit to the economy, as people transfer from other jobs.
- Reduced stress for all users of the network as it will be less congested (road, air and rail).
- Reduced accident risk and pain and suffering for those who would have been involved in an actual accident.
- Higher property values along the line as it increases accessibility, particularly of stations.
- The option of having rail available as a possible mode of transport, even if it is not used.

Some of the costs borne directly by individuals include:

- (As noted above), fares paid by passengers.
- Reduced property values for people living adjacent to the line.

There are also further benefits and costs to society more generally, for example:

- Reduced accident costs – some of these cannot be ascribed directly to individuals, such as, for example, the general feeling that roads are safer as a result of some traffic transferring to rail.
- Further jobs created by the people who work on the line spending their money.
- Enhanced accessibility can be seen as a societal good in itself, particularly for very isolated communities.

- Changes in environmental factors (noise, air pollution, visual intrusion) – some positive, some negative.
- The actual construction costs of the line, and subsidy, if required.

Then there is the question of whether or not you could buy and sell these benefits or, put another way, whether the amount of money in people's pockets changes as a result of the project being constructed. Clearly, if you pay a fare you have less money; if the government invests in a new railway line, it has less money to spend on other things. On the other hand, if you save time (time during which you are not being paid by your employer), then you do not have more money in your pocket directly – although how much you value that time may be influenced in some way by the amount of money that you might earn if you were working instead of travelling. And a high quality environment does not have a direct market value, although there are proxies (the relative prices of houses in the Lake District compared to, say, Loughborough, may tell us something about how people value the two environments).

## On-going exercise – appraisal of station improvements

This self-assessment exercise is based on a piece of consultancy that we carried out for a Council in Scotland: they were bidding to the Scottish Executive for funding from its (now defunct) public transport fund and so had to produce an appraisal broadly in line with STAG. This is a useful exercise in that it gives you an idea of the practical difficulties of appraisal compared to how it should be carried out in theory! Often, time and data shortages mean that many "guesstimates" have to be made as part of the predictions that are an inherent part of the appraisal process.

I have enclosed with the study guide a completed appraisal summary table and cost benefit analysis. Your results will probably be somewhat different, but some of the key issues that you may have identified are as follows:

- There is likely to be some kind of revenue benefit associated with the improvements to the station. However, this is difficult to estimate. STAG's advice on the issue is largely unhelpful but, luckily, we managed to find a page from the Passenger Demand Forecasting Handbook (produced by British Rail research – a part of the nationalised company that did not survive privatisation, but whose work is still industry-standard) which dealt with the issue. This was enclosed with the module. You should have worked out from it that – ostensibly - the revenue impact of any station improvement would be 4% of total annual revenue multiplied by the relevant fares elasticity. No advice is given on how many years this effect could be assumed to last, nor whether it varies with the quality/scale of the improvement. Unfortunately you do not have total revenue figures for the two stations, nor do you know the relevant fares elasticities. We used an elasticity of less than 1 for peak passengers, and more than 1 for off-peak

passengers, and assumed a fare paid by each of the passengers who were counted boarding and alighting from trains by our manual counts. It is often necessary to use such simplifications in the privatised public transport industry as, large amounts of public subsidy notwithstanding, actual passenger count and revenue data is often "commercially confidential".

- There is also likely to be a time saving for certain passengers: more parking at Montrose will result in shorter parking search times and shorter walking times from parking places (there is evidence that, at present, on-street parking is used). The lift at Arbroath and accessible footbridge at Montrose will reduce journey times for those passengers who are mobility impaired or encumbered with luggage. As we did, you could quite legitimately assign a time saving to some assumed proportion of total passenger numbers and then assign standard TEN2000 values to this time saving. One could also argue a vehicle operating cost saving for those drivers who do not have to spend so much time looking for a parking space, but we chose to ignore this.
- There is an operating cost arising from additional car parking, which would in this case be incurred by the train operator as part of its station leasing charge from Railtrack. This is included in our cost benefit analysis – it was supplied by the train operator.
- In all cases figures should be multiplied through by a suitable annualisation factor. This takes account of the fact that not every day in the year has the same number of passengers. 250 or 300 are typical annualisation factors. You could also legitimately assume some notional annual increase in passenger numbers, as rail ridership is increasing with the general rise in incomes. This would feed through to revenue benefits and to time savings. Annual totals need to be discounted – we used 6% but

you would now use 3.5%. Also you will note that there is no optimism bias adjustment in our cost figures, but it would be prudent to include this now!

- Amongst other objectives in the AST, it is clear that the greatest benefit of the station improvements is accessibility – mobility impaired people will now be able to use Montrose station's northbound platform and gain easier access to the southbound platform at Arbroath. Improvements at Arbroath also score against the accessibility integration because of its relatively high level of social exclusion. Park and ride, kiss and ride and improved bus turning facilities (the latter only at Montrose) can be argued to boost integration. Finally, CCTV – a part of the project to be paid for by ScotRail – obviously had security benefits. However, you can see that the assessments in the AST were largely qualitative and we did not use the worksheets from GOMMMS to derive them.
- In spite of all these methodological shortcuts and simplifications (and they are not unique to Colin Buchanan and Partners, incidentally!), the project received funding from the Scottish Executive.

# Unit Eight

**ACTIVITY**

What result do we get from a cost benefit analysis and what does it tell us? What does it not tell us about the benefits that we get from the scheme that is appraised?

The result of the SCBA is net present value (NPV). This tells us whether the discounted benefits of the project over a given appraisal period outweigh the discounted costs, and by how much. It shows us only how the project performs in relation to the variables that are included in SCBA (in the UK, time, vehicle operating costs, accidents, and construction and maintenance costs) and nothing about other possible variables. Also, a high NPV does not necessarily indicate that a project is moving us towards the achievement of our transport policy objectives: see the example of Oxford High St, towards the end of Unit 14, for a case in point.

**ACTIVITY**

Toaster appraisal

There is no correct answer to this activity. However, it is intended to make you think about what qualities you want from your toaster (the objectives that you are trying to achieve by acquiring one) and how relatively important these different objectives are to you. This will obviously guide you in your choice of toaster. You may also find that it is difficult to compare toasters unless you have some kind of scoring system for each toaster's performance against the objectives, so that you can derive a total score for each.

**SELF-ASSESSMENT EXERCISE**

1. What are the costs and benefits that are valued in a typical social cost-benefit analysis (SCBA) package? In transport, they are time, accident and vehicle operating cost savings; and capital, operating and maintenance costs.
2. How (in what units) are they valued? Money.
3. How is the answer expressed? As net present value or ratio of benefits to costs.
4. What costs and benefits are not normally taken into account in a CBA and why not? Environmental and other social costs and benefits; reliability; option values. Mainly because they are too difficult to measure.
5. What process is used instead? Environmental impact assessment (EIA) has been used historically; however, since 1998 the assessment of environmental and other social impacts has been grouped in an objectives-based appraisal. The EIA procedure is still used to work out the scale of the environmental impacts, for input to the objectives-based appraisal.
6. How is this process and CBA used together to assess a project? See above.
7. Why is this joint use of the two processes not ideal? Mainly because costs and benefits are not expressed in common units so it is very difficult to see how many dead badgers – to take one rather facetious example – relate to 3 hours of drivers' time savings.
8. How could SCBA procedure be expanded as an alternative or addition to EA? By monetizing other costs and benefits.
9. What methodology would have to be used to do this? See Unit 14.
10. What are the problems with this methodology? See Unit 14.

11. In view of all the uncertainties and problems that you have read about already, do you think appraisal of transport schemes is worth bothering with? Why, or why not? **Answer.** This one is up to you! My feeling is that appraisal, though certainly not perfect, is a necessary process; however, in the UK we seem to do rather more of it than do our European counterparts. Given the uncertainty that surrounds appraisal, and also the very few studies that have actually considered projects that have been built to see how accurate their appraisals actually were, then we should not spend so much time doing appraisal.

# Unit Nine

**ACTIVITY**

**Read** the first five pages of Department for Transport *Transport Economics Note* http://www.roads.dft.gov.uk/roadnetwork/heta/highway/03.htm. Decide which values of time you should use for a person who is travelling by underground train on works' business; and for a person who is travelling to work by bus. Why do you think that values of time when travelling in working time are highest for travellers on the underground and lowest for those on the bus?

**Answer**

The values for underground travel on work's business are £21.15 per hour and for bus in non-working time £4.52 per hour (perceived cost) (Table 2/1). The values for both modes **in working time** are very different because the underground is used mainly by highly paid workers, and then in London, where wages are higher than they are anywhere else in the UK. The bus is used generally by lower paid workers.

**ACTIVITY**

Take five minutes to think: why has the decision been taken up to now in UK transport appraisal practice to use standard national values of time? If we used regional values of time, where would transport investment in the UK tend to be concentrated? By using higher values of time for certain groups of users than others, how might this influence the performance of different types of schemes in appraisal at the current time (e.g. how might a bus scheme perform compared to a road scheme compared to an underground scheme)?

**Answer**

The decision is largely a political one. Values of time are either directly (working time) or indirectly (opportunity cost) related to wages. Wages are highest in the most economically buoyant parts of the country. From an economist's point of view, it makes sense to reflect this in the values of time used in project appraisal, as this would lead to the direction of resources to projects in those part of the country where they are most valued. However, from a politician's point of view, this is obviously not acceptable. However, we do accept that certain modes tend to have – by virtue of their user profile – higher values of time than others, which makes investment in rail schemes appear to reap higher benefits than investment in bus schemes. Against this must be set the higher investment required for rail schemes, of course.

**ACTIVITY**

You might also want to think about the times of day and times of the week that there are likely to be lots of people travelling on the network in working time, and days and times of the week when the proportion is low. Write down your justification for your decisions. Then refer to Table 2/1 in *Transport Economics Note* to see whether you were thinking along the same lines as the DfT's economists.

It should be fairly obvious that the proportion of total travel that is in working time will be at its highest when most people are at work: i.e. in the middle of a weekday. This is indeed borne out by the Table 2/**6** (apologies for the typo in the question) that clearly shows, for example that the travel time value of the average car (weighted average of the perceived

cost of all car occupants) is highest in the weekday interpeak. It is lowest, not at the weekend, but on a weekday night – this is because **occupancies** are higher at weekends.

**ACTIVITY**

Download the section of the COBA11 Manual that deals with accident valuations. (See http://www.roads.dft.gov.uk/roadnetwork/heta/highway/pdfs/coba11part02.pdf). Consider two sections of two roads – one a D2 motorway, the other a modern S2 road - both carrying 3 million vehicle km per year. Using the combined link and junction rates from Tables 4/1 and 4/2 in Chapter 4 Part 2, calculate the number of accidents that would have occurred on each road in 1997, and the average number of casualties in each.

The accident average for the motorway is 0.107 per mvkm. For the road, it is 0.229 per mvkm. Multiplying by 3 in each case gives us 0.321 accidents in 1997 on the motorway, and 0.687 on the road. Once again, multiplying through by the figures in Table 4/2, for the motorway we have 0.0077 fatals, 0.0549 serious and 0.4680 slight accidents. Assuming a speed limit of more than 40 mph on the other road, we then have 0.0148 fatals, 0.1002 serious and 0.4163 slight accidents.

**ACTIVITY**

First, discount the following stream of benefits from a project and derive a NPB for price base year 1998. Use a discount rate of 3.5%.

Secondly, do the exercise again but use a discount rate of 2%. What effect does this have on the NPB?

Thirdly, if the majority of a project's costs were incurred in its first few years, but benefits continued to accrue for many years afterwards, over how many years would you wish to appraise the project if you were trying to get it approved for funding? Can you think of any reasons why we currently appraise a transport project over only 30 years (as one clue – discount a £25,000 benefit received in year 30 of a project's lifetime)?

**Answer** to parts 1 and 2 is in the table below. 1998 is year zero. The spreadsheet is on the module CD ROM and on the web site.

| Year | Benefit (£) | Year n | DR | DR |
|---|---|---|---|---|
| | | | 0.035 | 0.02 |
| 2002 | 25,000 | 4 | 21786 | 23096 |
| 2003 | 35,000 | 5 | 29469 | 31701 |
| 2004 | 40,000 | 6 | 32540 | 35519 |
| 2005 | 60,000 | 7 | 47159 | 52234 |
| 2006 | 70,000 | 8 | 53159 | 59744 |
| 2007 | 100,000 | 9 | 73373 | 83676 |
| **Total** | | | 257487 | 285969 |

The decision to appraise projects over 30 years relates to a number of points:

- The notional lifetime of assets.
- The uncertainty associated with trying to predict benefits beyond year 30.
- A shorter appraisal period would not have been long enough to demonstrate a positive NPV for many capital intensive projects.
- The low value of a benefit in year 30 when it has been discounted. For example, £25,000 benefit received in year 30 is worth slightly under £9,000 when discounted at 3.5%; less at 6%. But the move to lower discount rates has led to some discussion of a possible move to a longer appraisal period which, in the example outlined in the question, would make the project appear more positive.

**ACTIVITY**

Before you start reading the rest of this section, why not take a few minutes to write down any criticisms of or problems with SCBA that may have occurred to you while you have been reading the previous parts of this Unit. Then read the next section and compare your thoughts with mine.

**Answer:** hopefully our thoughts coincided!

**Activity: Questions on Appraisal and Social Cost Benefit Analysis (SCBA)**

1. What is the difference between social cost benefit analysis and financial analysis? Financial analysis concerns itself only with flows of actual money, such as construction costs and ticket revenue. Social cost benefit analysis includes costs on which a monetary value can be put but for which no actual market exists, such as time.
2. Explain in outline – preferably with a flow chart - how social cost benefit analysis works. The flow chart would show that user costs (time, accidents and vehicle operating costs) on the old network are calculated and then the user costs on the new network subtracted from them, for each year of the appraisal. The result is the discounted to get the net present benefit (NPB). The same process is used for construction, operating and maintenance costs, to derive the net present cost. This is then subtracted from the NPB to derive the net present value (NPV).
3. What is the output of a SCBA? What does this show us? What does it not show us? The output, as seen above, is the NPV. This shows us how the project performs in terms of the costs and benefits that are included in the SCBA. It does not however

tell us anything about the costs and benefits that are not included; nor does it tell us, directly at least, whether the project will help us to attain our transport *objectives*.

4. Which costs and benefits are typically included in a transport SCBA? Time, accidents and vehicle operating costs; maintenance, construction and operating costs.
5. Which costs and benefits are typically **not** included in a transport SCBA, and why not? Others – especially environmental – because they are too difficult to place a value upon.
6. Define user benefit in a typical transport SCBA. The costs on the old network minus those on the new network.
7. What predictive tools are required to be able to show future user benefits in a SCBA? What are the major problems with the use of these predictive tools? Models are required; but they typically operate with a great deal of uncertainty. This can completely negate the results of the appraisal.
8. Comment on the assumption implicit in a typical SCBA that the value of time savings per unit of time is constant regardless of the length of the time saving; and that a 60 minute time saving for one person is of equal value to 60 people saving one minute each. The first assumption is unlikely to be true and it follows that the second is also unlikely to be valid. SCBA makes both these assumptions. The first is a threat to most transport appraisals, since many schemes realize very small individual benefits that become huge when aggregated over many years. The second demonstrates that SCBA takes no account of equity considerations.
9. Why and how do we discount costs and benefits in SCBA? By using a discount rate (r – currently 3.5%) and the formula $SP_V = S_n/(1+r)^n$ . We do this because a benefit

that we have to wait for us is worth less to us; and benefits from a transport schemes are realized in different years, so we have to discount to get these benefits in a common unit (present, or discounted, value) before we can add them together.

10. How is the discount rate set and how does it affect the outcome of the SCBA? The discount rate is set by the Treasury and reflects prevailing long term interest rates, since the project appraiser wishes to know what rate of return they could derive from investing the money, either in the project, or on the long term money markets. It has also, until recently, been used to reflect the uncertainty of trying to predict future benefits, but this has now been taken into account by using optimism bias (see Unit 13). A higher discount rate will reduce future benefits more severely, thus making the scheme appear worse value for money; and vice versa.
11. Over how many years are transport schemes typically appraised, and why? 30; because costs are typically incurred early in a project's life but in order to recoup these, the project appraisal must be run for several decades. Also, assets do last for some considerable period. However, a higher discount rate (until 2000, it was 8% in the public sector) would reduce benefits in the $30^{th}$ year to very little, making a longer appraisal period counter-productive; and uncertainties have until recently made it difficult to predict benefits any longer than this. However, the Treasury is now, in the light of the much lower discount rate, considering extending the appraisal period for transport projects to 50 years.
12. What happens to the result of the appraisal if you assess the scheme over a longer period; and a shorter period? See above.

13. Name 3 SCBA packages and briefly explain what they do and what they are for. TUBA – the new multi-modal package; COBA – for trunk roads; and PRIDE, for park and ride schemes.

14. What in your view are the main disadvantages of SCBA in the appraisal of transport projects? It is a quite self-contained process and has the attraction of producing a single figure that makes projects easier to compare. However, the result is easily manipulated; it contains many assumptions, particularly regarding the value of time; and tells us nothing about our objectives. Subsuming it within a wider objectives-based appraisal is, therefore, a good compromise.

# Unit Ten

**ACTIVITY**

In view of some of the Government's key priorities, can you think of any other level of disaggregation against which the criteria listed above might be considered?

**Answer:** The two that I was thinking about here were an explicit consideration of the scheme on social inclusion; and on health. However, you may have thought of others.

**ACTIVITY**

Download and read Chapter 6 in Volume 1 of GOMMMS. Construct your own flow chart of the recommended appraisal process (without looking at the flow chart in Figure 2.1, which is not detailed enough to reflect the complexities of Chapter 6 Volume 1). Do you think it is a straightforward process – why, or why not? How confident are you that two different groups of transport planners, conducting this process to appraise the same scheme(s), would come up with the same conclusions? How would you know from the result of a GOMMMS appraisal whether a project was worth building, or not?

**Answer**

Hopefully you have been able to come up with your own flow chart. I personally do not think that the GOMMMS process is a straightforward one because it is lengthy and requires an input of many different skills if it is to be done properly. Furthermore, although the use of worksheets gives some consistency to the derivation of the qualitative scores, they still require considerable subjective input and hence are open to interpretation.

Furthermore, when the results of GOMMMS analyses are presented (for example, in the Final Reports of Multi Modal Studies) the worksheets are rarely included, making it difficult to check how the qualitative scores were derived. This does not give me complete confidence that two transport planners conducting a GOMMMS appraisal of the same project would indeed come up with the same answer – although it is likely that they would both identify the key benefits and disbenefits of the project. The final part of the question is to me the key drawback of any unweighted objectives-based appraisal system: how do you compare between projects that score very differently against different objectives. I have still to hear a convincing argument for UK Governments' line that objectives should not be weighted; I am of the opinion that appraisals for groups of projects, or projects that are different options to address the same problems, should have weightings attached to the objectives. When decisions are made on the basis of GOMMMS appraisals, it is obvious that an implicit weighting system has been used – otherwise, a decision could not have been made. It is therefore important to my mind that these weightings are made explicit; this is part of making the appraisal process as transparent as possible.

**ACTIVITY**

Read http://www.sra.gov.uk/sra/publications/other/1999_06_16/planning_criteria.htm#COSTS BENEFITS and http://www.sra.gov.uk/sra/publications/other/2001_12_07/bgpart1.pdf (pages 26 to 30 only). What are the main differences in the SRA's appraisal criteria for awarding Rail Passenger Partnership funding compared to the criteria in GOMMMS?

**Answer** (It should be noted that, since these questions were written, RPP funding has been abandoned and, in addition, the SRA is consulting on new appraisal criteria. You may also have picked up on the fact that the appraisal criteria referred to by this question were written when the SRA was still OPRAF!) In addition to the "normal" five main objectives, the SRA considers some variations and additions to GOMMMS' normal themes; these are:

- Value for money expressed as NPV of benefits per pound of subsidy.
- Considering the amount of value that would have to be assigned to non-monetised benefits to make the scheme perform well in NPV terms (e.g. if the scheme improves air quality, this improvement would have to be worth £x for it to make the scheme show value for money – an order of magnitude test).
- Consideration of incidence groups – this is similar to the TEE analysis in consideration the distribution of impacts, but is much wider.
- Risk allocation.
- Economic costs and benefits are required in much greater detail.
- In the PDF document, produced by the SRA as opposed to OPRAF, you will notice that there is more detail given to the deliverability of the project and to dealing with cost escalations – problems that had become more obvious in the rail industry between the publication of the two documents.

The detail required in the documents reflects the fact that, firstly, they are mode specific and can therefore be very specific about the details required in an appraisal; and, secondly, that rail projects are expensive and that detailed appraisals are therefore justified.

**ACTIVITY**

What is there to suggest that NPV was not the most important criterion in the Scottish Executive's decision to fund the projects listed above? Think about the information that you need to calculate NPV; and the relative numbers of people who stand to benefit from the projects above.

**Answer.** There are several grounds for believing that NPV was probably not the most important criterion for awarding these PTF bids. Firstly, many of the projects in the list are not amenable to appraisal using conventional SCBA; their main benefits are things that are not normally included in SCBA because we have not worked out how to do so! Consider the awards for SPT and for Moray. Secondly, think about the distribution of population in Scotland. Most people live in cities and then in the area between Glasgow and Edinburgh. Yet the list includes many large awards to Councils outwith this area. The use of public transport in these areas is likely to be so low that many of the projects almost certainly could not be justified using SCBA. Instead, they can be justified – using STAG – due to their effects on accessibility (note the Western Isles' bid); and, obviously, politics played a role as well in the allocation of funds.

**Final activity (AST) – there is no answer *per se* but, as noted in the Unit, please feel free to contact your tutor for feedback on this or any other activity.**

# Unit 11

**ACTIVITY**

Read pages 8-11 to 8-26 of Volume 1 of STAG. Do you feel confident after reading this that, if you were in the position of being the client for the appraisal of a particular scheme, you would understand how estimates of its impacts on economic activity were derived?

**Answer.** I pose this question because, as you might have guessed from the previous comments in other self-assessment exercises, I am sceptical about certain parts of STAG. It is inevitable that for a subject as specialised as calculating the economic activity impacts of a piece of transport investment, specialised consultants would have to be called in. Such consultants include MVA, Steer Davies Gleave, DTZ Pieda, and David Simmonds Consultancy. They use models such as those described by Banister and Berechman in the excerpt from their book that you have had included with the module. However, from the point of view of the client, it is very difficult to know the extent to which such models are based on un-justified assumptions. Thus I find it hard to be anything but sceptical about the estimates of job and GDP impacts that are the outputs of STAG appraisals.

**Activity on City of Edinburgh STAG Consultation Response.** As I wrote this consultation response, I find it difficult to disagree with. However, I would be interested to see if you have different views on STAG. Please contact your tutor to discuss this issue if you wish. Please do the same for the further optional questions.

**North Edinburgh Tram AST.** This example has been chosen for you to see the differences between the GOMMMS and STAG ASTs. It should be fairly obvious to you that the tram will rate highly against economic development and social inclusion related objectives. Once again, if you require feedback on your AST, please email it to your tutor.

## Unit 12

**ACTIVITY**
Whilst not directly related to the TEE table and TUBA, there are two articles that have been supplied in your study pack for this module that are a good summary to all the material that you have covered since Unit 7. You should now read these and answer the following questions:

**Mann *et al* on the Victoria Line**

1. Why could LT not justify the Victoria Line on the fares revenue that it would generate, alone?

Because many of its passengers would be diverting from other bus or tube routes so would not represent new revenue.

2. What additional benefits was it thought that the line would bring, that could not be captured through fares?

De-congestion on existing lines and above ground; also a reduction in unemployment.

3. Why are the benefits mentioned in Question 2 important to the public sector in deciding how government money should be spent, but not important to the private sector when it makes its investment decisions?

Congestion benefits and reductions in unemployment do not realize financial savings for the private sector.

4. On page 131, first paragraph, what do you think the phrase "the 1994 modelled demand validated well against observed demand in the Victoria Line corridor" means, and why is it important that the validation should be good?

This means that the model's predictions of the current situation were similar to the actual current situation. This is an indication that the model works relatively well and that its predictions of future demand can be relied upon.

5. Also on page 131, can you find any references to simple assumptions that are made as part of the modelling process? Why is it so important to be aware of such assumptions in appraisal?

There is an assumption that "decongestion benefits are halved to reflect second round re-assignment". This means that the model predicts only how many people will transfer from road to tube and the decongestion benefits of this. However, it is intuitively sensible to assume that, as road space is filled up in this way, other people react by filling it up with "new" vehicle trips. Thus the decongestion benefit is not as great as the first round of modeling would assume. Nonetheless, the second round was not modeled in this case – presumably due to methodological complexity and computing power – and, instead, the benefits are simply halved. Also, decongestion benefits on platforms are not modeled – because to do so would be too complex – and, therefore, the on-train decongestion benefits are doubled to reflect this un-modelled benefit. Such assumptions can sometimes be critical to the outcome of appraisal and so it is vital to be aware of them and, if you are the client, to ask for sensitivity tests to be run to show you the effect on the result of varying such assumptions.

6. On page 134 there is a long list of assumptions made in the original 1960s appraisal. Why did they have to make so many assumptions? Reading on to page 135, which assumption does it seem was most "wrong" and why?

These assumptions were required because computers were not very powerful in the 1960s so complex models could not be built. The most "wrong" assumption was, to my mind, the general "other savings" assumption mentioned in the last paragraph on page 135 – these could be quite significant.

7. Of the differences between current and 1960s appraisal practice listed on page 136, which do you think would have the most impact on the results, and why (see also pages 137 and 138)?

The lower discount rate and the longer appraisal period used in the 1960s were key to realizing a positive NPV for the scheme at that time.

8. If you used the current appraisal methodology, what effect would this have had on the decision in the 1960s?

The scheme would not have gone ahead.

9. The 1960s appraisal methodology produced a benefit to cost ratio of _1.03 to 1? How much higher would this be if you had the benefit of historical data on actual ridership, and modern modelling techniques? It would have been close to 2 to 1.

**Bristow and Nellthorp - Transport Project Appraisal in the EU**

1. On page 52 there are definitions of multi-criteria analysis and of cost-benefit analysis. Describe the difference in your own words, and cite at least one example of each with which you are familiar.

MCA considers the performance of schemes against objectives, and assigns scores to their performance. Cost benefit analysis adds up discounted costs and benefits in monetary terms. An example of the first is the Swiss appraisal sheet that you saw in Unit 8; the second is COBA or TUBA.

2. How many member states use CBA alone and how many use MCA combined with CBA?

Note the date of this article. At the time, Denmark, France, Spain and Germany appeared from Table 2 to use CBA alone. Finland, Ireland, Italy, Portugal, Sweden and the UK then appeared to use CBA with plus some quantification (as opposed to monetization) of other impacts, and only four states used MCA.

3. What is included and left out of CBA in member states, in general?

Time, accidents and operating costs are universally included, as are construction costs. However, some member states place monetary values on air pollution, money and output/employment impacts.

4. Why is there such a wide range of values of time shown in Figure 1 on page 55?

This is largely dependent on variations in wage levels.

5. In Table 3 (values of fatalities), what do you think influences the very high values shown for some countries?

The inclusion of willingness to pay valuations (see Unit 14).

6. Looking at paragraph 3.3, how many countries use money values for global air pollution, and noise pollution; and how do you think that they derive such values?

Six states in each case have monetary values for these factors. You can read about the methodologies used in Unit 14.

7. Looking at paragraph 4, why are projects in France likely to seem less good value than their equivalents in Germany?

Due to the much higher discount rate in France.

8. What do the writers mean in paragraph 4 by "equity" and "distributional issues"?

How appraisals analyse the way in which benefits and costs of projects are distributed across social groups, and geographically – i.e. who wins, and who loses.

# Unit 13

**ACTIVITY**
Read the paper (*The influence of transport on industrial location choice*) by Leitham *et al* provided on the CD ROM for this module. The conclusions are particularly pertinent. What factors do the authors find important to the locational decisions of different kinds of firms? For which firms is the quality of road transport most important? What conclusions could we draw from this study about the effectiveness of spending money on transport to attract inward investors? Are there other things on which government money could be spent that might have more of an influence on locational decisions by investors?

The paper concludes that transport's importance in the locational decisions of firms varies according to the type of firm. For example, UK sourced branch plants find motorway links most important amongst the three groups surveyed, whilst inward investors from overseas were much more concerned with labour and premises. Transport was also an important consideration for local relocations. This implies that only in certain circumstances will spending on transport actually make a difference to inward investment; and that, since it makes a difference only in regional or local locational decisions, the effect on the UK economy overall is neutral. To attract foreign inward investment – benefiting the UK economy at the national level – governments might better spend money on training and on preparing premises, rather than on transport. However, where regions are competing with each other for location by UK firms, then transport can be important.

**ACTIVITY**
The Skye Bridge replaced a ferry service between Kyle of Lochalsh, on the Scottish mainland, and Kyleakin on the Isle of Skye. One of its major justifications was economic development benefits for the island. Read the ex-post study available at http://www.scotland.gov.uk/library2/doc16/sbse-01.asp and decide whether you think that these benefits were realised.

**Answer.** The report appears to show that most of the predicted economic development benefits of the bridge were not in fact realised. The previous ferry was not an enormous deterrent to tourists, so tourism did not increase significantly as a result of the construction of the bridge; but the bridge did allow islanders to travel more easily to the mainland, and especially to Inverness, to shop, to the detriment of the island's economy.

**ACTIVITY**

By way of summary to this Unit, consider these questions.

1. What are firms' major costs (e.g. accommodation)?

Labour, accommodation, energy and raw materials are the key costs for companies. Transport is less than 5% of total costs for the average company and, of those costs, 90% are in terminals.

2. What are the major influences on firms' locational decisions?

Labour is a critical influence. This can relate to the education system/educational level in an area or country. The cost of labour is also a vital factor. Inward investment incentives, such as prepared sites, can be a major factor. Proximity to markets will also be important, as will proximity to other inputs, for certain industries. Transport links will be important to companies that are very transport intensive (e.g. distribution); for other companies, transport links and parking availability become important locational factors when choosing where to locate within a general region/area.

3. Are there examples of areas with poor transport links and high economic development, and vice versa?

Absolutely. Pendle in East Lancashire is an example of the former. Humberside and Ayrshire are examples of the latter. There are also many examples from countries round the world of cities and regions that are heavily congested and yet remain the economic powerhouses of their respective country (L.A., Bangkok, Tokyo, Mexico City, London). This suggests that congestion does not necessarily deter inward investment, although we do not know what level of inward investment and economic growth these cities would have enjoyed, had they not been congested.

4. A new motorway is built (where none existed before) from an economically buoyant region into an economically depressed region some 50 miles distant. List some of the possible economic effects on the latter region. The new road may attract new investment into the area, because it reduces transport costs. On the other hand, it may permit the depressed area to be served from factories and distribution centres in the buoyant area, leading to the closure of such facilities in the depressed area. It may encourage shoppers from the depressed area to shop in the buoyant area. On the other hand, it may encourage people from the buoyant area to move to live in the cheaper, depressed area, thus spreading economic development.

# Unit 14

**ACTIVITY**
By way of conclusion, write down the arguments for and against including monetary valuations of environmental costs and benefits, derived on the basis that we have considered in this unit, in SCBA. When thinking about this, do not rely only on this unit – it may be worth your while recapping on units 7 and 8 as well.

If you think that most credence in appraisal – even objectives-based appraisal – is given to the economic performance of a scheme, then the inclusion of monetized environmental costs and benefits is a good idea, since it will ensure that a wider range of costs and benefits is taken into account in this, the most important part of the appraisal. However, we have seen that there are significant methodological question marks over the derivation of monetary values for environmental costs and benefits. Finally, even if they are included in SCBA, this does not get away from its core problems: only producing an NPV that does not necessarily show us whether or not the project will help us to achieve our objectives.