Transport Research Foundation

# In Search of Sustainable Urban Transport Strategies

**Professor Tony May, FREng**

**Institute for Transport Studies**

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**The Fellowship Chairman, Professor R M Kimber, in the chair**

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## Professor Anthony May, FREng

Following early work with the Greater London Council, three decades ago, Tony May moved to the ITS, Leeds, as Professor in 1977, a post which he has held ever since in conjunction with a great number of other very distinguished posts at various times throughout. He served as Head of the Department of Civil Engineering, Dean of the Faculty of Engineering and Pro-Vice Chancellor for Research, and for a sustained period, between the mid-1980s and 2001, Tony was also Director of Transport Policy in the consultants MVA. He thus brought together the academic and professional experience to form a very powerful combination.

Tony has been responsible for a large number of research contracts and grants and the list of these is wide-ranging and extensive. They include the Research Councils, the Department for Transport, the European Community, the Rees Jeffreys Fund and, at various times in the past, TRL. He has also acted as a specialist advisor to the Commons' and Lord's Select Committees over quite a substantial period in Science and Technology, and as a consultant to many world-wide organisations.

# In Search of Sustainable Urban Transport Strategies


## Professor Tony May, FREeng

Institute for Transport Studies
ITS, Leeds


### Introduction

During this lecture, I want to talk about sustainable transport in urban areas (Figure 1). This has always been my interest and I wanted to look in particular at two of the most over-used words in the subject area—sustainability and integration (Figure 2).

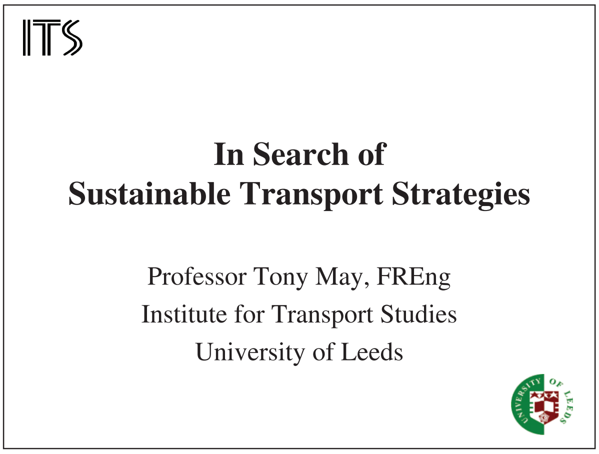


*Figure 1*


*Figure 2*

What I am going to talk about first of all is what sustainability is, and how it links back to the underlying objectives of transport policy. I want to look at the range of transport policy instruments and, in particular, a development that we have been pursuing over the last couple of years called 'KonSULT'. I then want to spend the largest section of the lecture looking at some work we have been doing on how best to integrate policy instruments in an urban area to get more benefits from the sum of the parts. This was actually prompted by my work with MVA, a decade ago, when we were developing sustainable transport strategies for Edinburgh, Birmingham, Liverpool and so on. Then, towards the end I want to look at barriers to implementation.

### A sustainable transport strategy

What is a sustainable transport strategy? There are all sorts of definitions. I've taken this one from the European Ministers of Transport statement of 2001 (Figure 3). It is rather lengthy but it is interesting because it flags virtually every objective the transport planners have been thinking about for years: efficiency, safety, health, equity and so on. It is, in some ways, helpful because it actually reminds us that to achieve a sustainable system, we have to try to pursue all of those objectives together.


*Figure 3*

In work we have recently finished for the European Commission on a project called *PROSPECTS*, we devised a checklist of what we saw as seven key policy objectives. They are all in effect in that earlier statement of sustainability: economic efficiency, protecting the environment, liveable streets and neighbourhoods; safety; equity and social inclusion; economic growth; and, one which everybody seems to forget at the moment in transport planning because it is too long term, inter-generational equity. That is, providing for future generations (or not making it worse for them). A number of our European colleagues interpreted the liveable streets and neighbourhoods objective slightly differently from classical environmental concerns over noise and pollution, and as much more to do with the quality of the urban environment and encouraging people to live in cities rather than move away.

Figure 4 highlights those objectives that were mentioned explicitly in the 1998 UK White Paper. It did not say much about liveability, and, interestingly, it did not say much about equity—that has really come later, through the work, for example, of the Social Exclusion Unit. And it said virtually nothing about inter-generational concerns.

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**What are the related objectives?**

- Economic efficiency*
- Protection of the environment*
- Liveable streets and neighbourhoods
- Safety*
- Equity and social inclusion
- Contribution to economic growth*
- Intergenerational equity

Source: PROSPECTS, 2003
* Mentioned explicitly in 1998 UK White Paper

*Figure 4*

Part of what we did in *PROSPECTS* was to ask cities, and we had a survey of 60 of them, which of these objectives were important for them (Figure 5). We gave them the standard set of options of 'very important' down to 'not at all important'. The results were quite interesting. Initially, the majority were saying that all of them were important. However, there is a stronger concern for economic growth, and somewhat less for equity and, interestingly, environmental protection. There is an important conflict that all cities experience: between what they do for improving the economy and what they do for protecting the worse-off in the community, and for protecting the environment.

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**Importance of objectives to European cities**

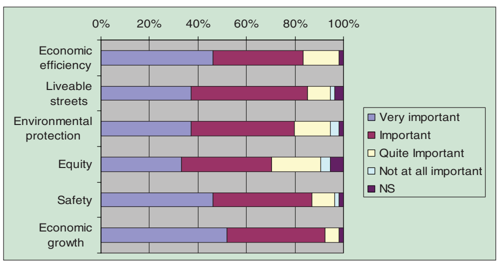


*Figure 5*

## Policy instruments and means of intervention

Keeping those objectives in mind and moving on to what we can do and how we can change things to help achieve those objectives, we actually have a very wide range of possible interventions (Figure 6). This is one of the interesting opportunities and challenges in transport policy.

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**Types of policy instrument**

- Land use measures
- Infrastructure provision
- Management of the infrastructure
  - – Including service provision
- Information provision
- Awareness and behavioural measures
- Pricing

*Figure 6*

I start with land use. (I know it is not transport but actually a lot of the transport problems are to do with the way land use develops and is used. Therefore, a significant part of what we do has to do with planning land use and the way it is used effectively.) Then, there are the interventions of providing new infrastructure and managing that infrastructure. The latter may be through regulation, traffic management, provision of effective transport services, providing better information, using information to make people more aware of the impact of their travel and the ways in which they can improve things, and then last, but certainly by no means least, pricing.

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**The range of policy instruments**


*Figure 7*

Figure 7 shows a few slides of some of those in operation in different parts of the world—the middle pair are Travelsmart in Perth and congestion charging in London.

As we did our work in PROSPECTS, we estimated that there are probably about 60 or so different types of policy instrument available. All of them will be more successful in some contexts than others and what works well in one location may well not transfer effectively to another. One of the real difficulties is the relatively little documented evidence.

I remember back in the 1970s, NATO, of all organisations, doing a review of bus priorities all around the world. Quite why bus priorities were important to the North Atlantic Treaty Organisation is difficult to remember but they were and it was actually a very useful document. But many cities do things and it either works and they breathe a sigh of relief and go on and do something else, or it does not work and the last thing they want to do is to tell anybody. Therefore, it is actually quite difficult to collect experience, and much of that experience is hidden away in consultancy reports and committee reports, and sometimes in individual journal articles (Figure 8). Even the good summaries, for example the 1976 review of bus priorities, get out of date very rapidly.


*Figure 8*

One in the middle of this slide, which a number of you working in public transport will recognise, dates back to the 1980s. Some of my colleagues here and some of my TRL colleagues are working hard at the moment on an update of that.

Another way of looking at this is some work that was done three years ago, by David Simmonds, John Bates and myself, for the Department for Transport. The project looked at multi-modal modelling, and what was needed to improve our ability to model urban systems.

Figure 9 says 'How important is it, given the emphasis on these policy instruments, that we should be able to model them?'. Not surprisingly, and the scale here is the number of land use instruments, for example, which, given the concerns of the moment, it is important to model and those which are of relatively low importance. Not surprisingly from most of these types of policy instrument, there is a majority for which there is a significant need to model. But when you move on to a similar assessment of our ability to model them, the situation is pretty appalling (Figure 10).

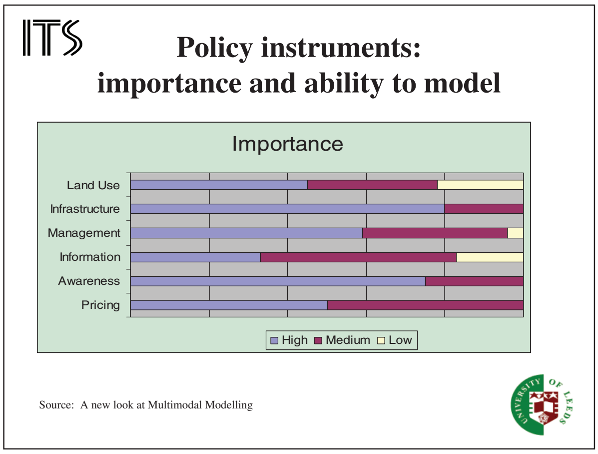


*Figure 9*

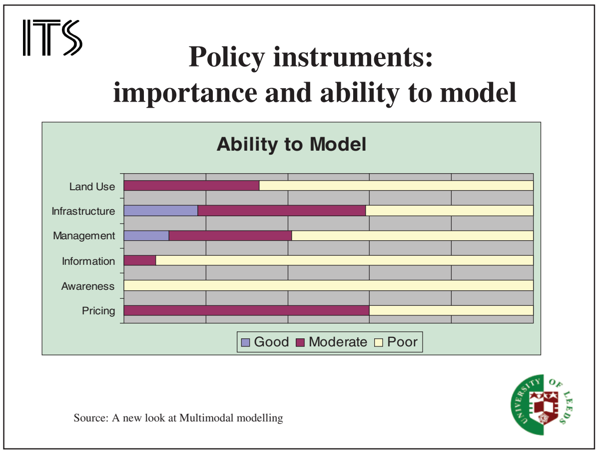


*Figure 10*

Firstly, infrastructure projects—we can model a significant minority of these pretty well, new roads being an obvious example. But if you look at awareness schemes, for example, at the other end of spectrum, we really do not know, at the moment, how to reflect the effects of an individualised marketing campaign or a travel planning system in our urban models. There is a distinct dearth of information on the way in which people respond, and on how the systems respond to these interventions; there is a dearth of ways of predicting what will happen if you do something.

## KonSULT

That is what KonSULT is all about (Figure 11). We are not trying to build new models, we are trying to provide background information which will allow practitioners to decide whether something would be useful in their circumstances, and for modellers to go the next step of incorporating some of these policy instruments into their models. We have designed this to get away from some of the problems of a paper

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**KonSULT**

**Knowledgebase on Sustainable Urban Land use and Transport**

- Web-based information source
- Up to date understanding of performance
  - of urban land use and transport instruments
- Consistent treatment of all instruments
- Flexible navigation and use
- Readily updated, with user input

*Figure 11*

based time-limited information source. It is web-based. It is designed to:

- provide an up-to-date understanding of the performance of policy instruments across that range that I have looked at;
- consider the instruments consistently, so that the same questions are asked of each, in order that one can compare one with another;
- be flexible in use; and
- be readily updated.

What we hope to do, and this is still in a developmental stage, is to get to the state where users can say 'I have actually got an example of this policy instrument working in my circumstances and here is some data you might like to incorporate in the website' (Figure 12).

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**KonSULT Development**

- Developed by ITS, University of Leeds
- Supported by EPSRC, DfT, Rees Jeffreys, EC, Japan Institute for Transport Policy
- Stage 1 prototype: July 2001
- Stage 2 first full version: January 2003
- Stage 3 complete coverage: April 2004
- Stage 4 regular quarterly updates

*Figure 12*

In this area we have had support from EPSRC, The Department for Transport, and the Rees Jeffreys Road Fund. Some of our European Community commissioned work has gone into this, and interestingly, this is the first Japanese research grant I have had. We have been working quite closely with the Japan Institute of Transport Policy Strategies in part of this. We have started with a prototype, we produced a first full version at a launch in Vienna in January of this year, and the aim is to have completed the coverage of fifty of the sixty policy instruments by January of next year. We then aim to move on to a process where we are regularly updating it, quarterly we hope.

It is structured as shown in Figure 13, and the main element I want to look at is the third level, the one that deals specifically with instruments and transport policy. You will see some references to charging and not being charged. (We have a debate at the moment with the Department for Transport as to whether people should buy a licence to use the more detailed parts of the database. We may move away from that but we are only going to move away from that if the Department finds some way of providing continuing funding for it.) In that third level, looking at each individual policy instrument, this is the standard structure:

- A description—what it is about
- A first principles assessment which considers:
  - How people might respond to it?
  - How the system might respond?
  - How might it change demand?
  - How might it change the supply of transport?
  - How might it change the costs of the transport system?
  - How might it affect that set of objectives?
- Case studies.
- A summary of these case studies, in terms of the extent to which this particular policy instrument in different circumstances helps achieve objectives, helps overcome problems. (The objectives, not surprisingly, are the list I showed you earlier, without, interestingly, inter-generational equity, which I still have to add to the database.)
- Complementary instruments—Instruments which may help overcome some of the weaknesses of this particular measure.

The first principles assessment looks at demand, it looks at supply, it looks at costs and revenues and then it says, 'Given all of those, how might it contribute to that set of objectives (Figure 15), and who might gain from it and who might lose?' This


*Figure 13*

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**Coverage of each Instrument**

- Taxonomy and description
- First principles assessment
  - demand effects, supply effects, costs
- Evidence on performance
- Contribution to objectives and alleviation of problems
  - efficiency, environment, liveable streets, safety, equity, economic growth
- Complementary instruments

*Figure 14*

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**First Principles Assessment**

- Demand effects
  - Types of user response (set categories)
  - Scale of user response (standard scores)
  - Variations over time (standard scores)
- Supply effects
  - Types of response (set categories)
- Costs and revenues
- Implications for objectives (PROSPECTS list)
- Gainers and losers (set categories, scores)

*Figure 15*

helps bring in some of the equity considerations. The evidence on performance looks at a set of case studies and this is the area that we will expand as more information becomes available. It assesses each of them in a consistent way using a scoring system. There is inevitably a certain amount of professional judgement in this and one of the great debates we have had in formulating it asks if two different people can ask the same question and get the same answer. There is still a debate to be had on that.

When summarising the overall contribution of the instrument we, crucially, at the end of that ask what we do not know. That is the flag which we hope will prompt users to say, 'I can fill a gap in your evidence—here's some information that you might like to consider including.'

We have set up, and this is fairly recent, three different ways of searching it (Figure 16).


*Figure 16*

1 There is a standard taxonomy, and I can show you that briefly in a moment.

2 We have a key word search.

3 We have what we call a filter selection, where one can say, for example, 'I am a government official, I am concerned about the environment, I am looking after a city centre, I have this particular strategy I want to test—what will work for me?'. If one ticks any of those (see screenshot) and it then flags the policy instruments within the system that appear to work best in those circumstances

## Screenshots of this in action

The site map looks like this:

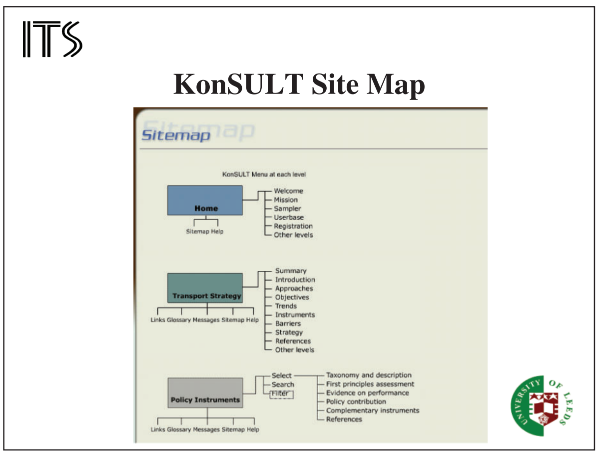


*Figure 17*

In the ordinary selection it gives each of these main headings: Land use measures; attitudinal and behavioural; infrastructure and so on. Looking in 'Pricing': similarly, a list (Figure 18).

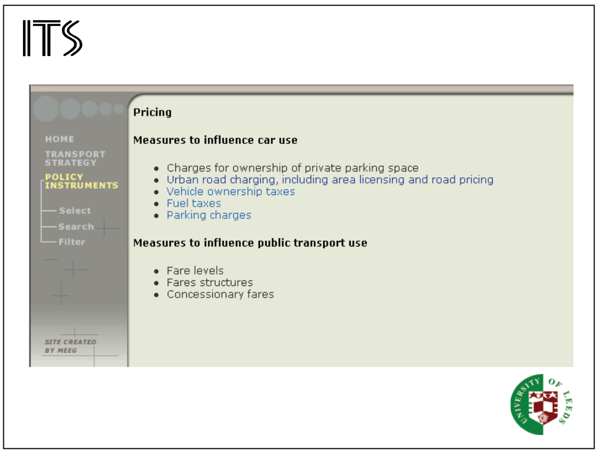


*Figure 18*

Incidentally, we are going to incorporate all those to do with public transport when the update of the 1980 'Review of Public Transport Demand Management Measures' is published.

Looking in 'Urban Road Charging', for example, there is a summary page and a description (Figure 19). The description provides a bit of terminology, describes different types of charging method, and has a little description, courtesy of the Singapore authorities, on how the Singapore charging system operates. At any stage, one can go back to the top. One can go into, for example, the evidence on performance. We ought, of course, to have congestion charging in London in here, but that is not yet there, it is on the list of things to do. However, we have incorporated Singapore's area licensing scheme, the original one; and the Singapore electronic road-pricing scheme and the toll rings in Bergen; as well as value pricing in San Diego; and the London modelling test. One can look at any of these.

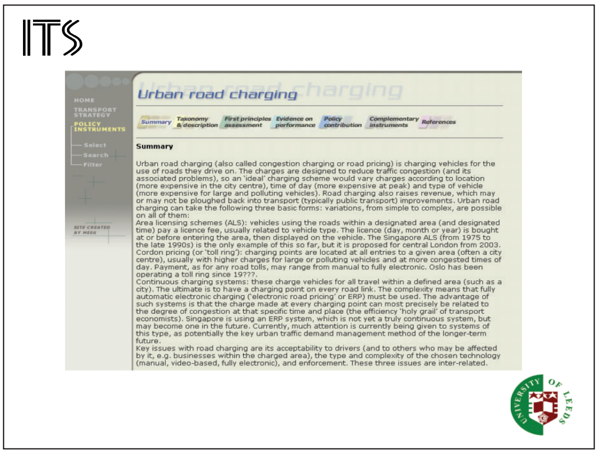


*Figure 19*

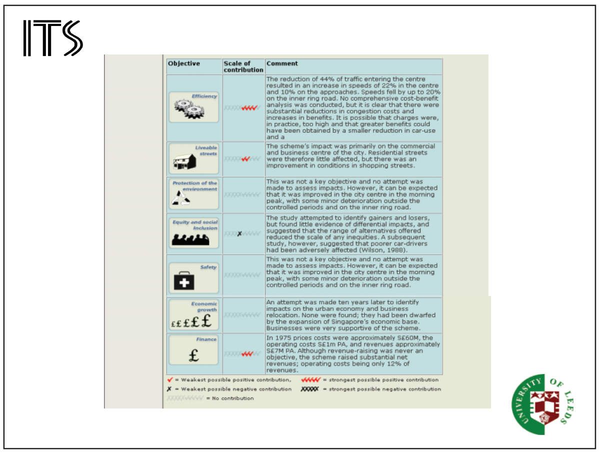


*Figure 20*

Taking the Singaporean area licence, for example, it looks at what has happened to demand, provides an assessment in terms of the key objectives on a simple plus/minus five scale (using ticks and crosses), and gives a brief description of each.

All of the information is brought together into a series of summary assessments of performance for these individual case studies (Figure 21). Some commentary is given on the contexts in which the policy instrument might be appropriate. There is also a description of some of the adverse side effects and where we have particular gaps in information.

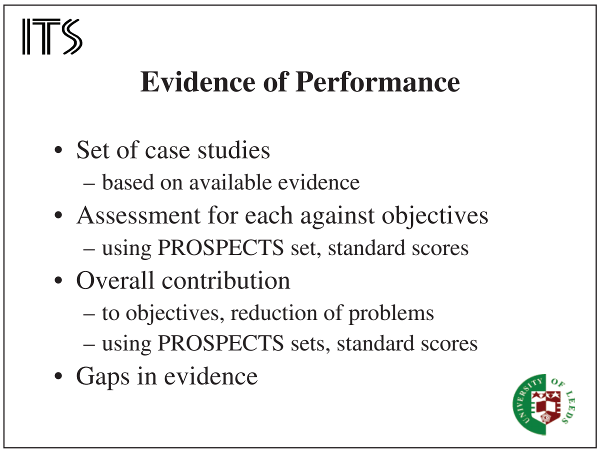


*Figure 21*

We have managed to form an arrangement with Elsevier, and they are hosting this on Transport Connect. We have a working version in the University which we are working on all of the time. Every quarter or so, we pass on the information we have gathered to Elsevier and that is mounted on their Transport Connect website. We have incorporated 26 policy instruments at the moment. We are going to be complete at around 50 by next January. There are ten or so that are relatively less important and we can work on those later. This is available free at the moment and we are already getting some very useful feedback on it (Figure 22).

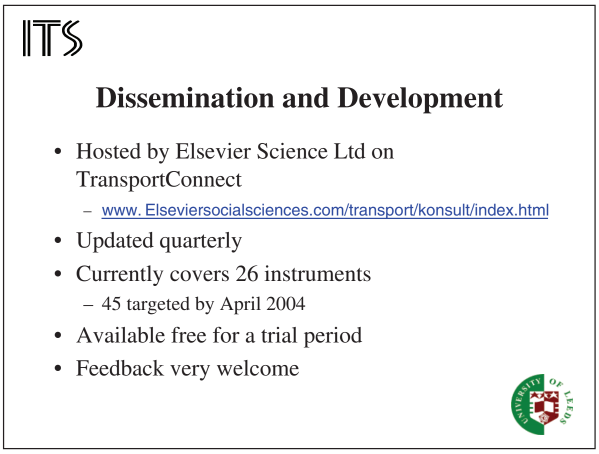


*Figure 22*

## Integration

Now let's move on to the second topic and look at the whole question of integration of policy instruments (Figure 23). If we know more about individual policy instruments, the next question we have to consider is how we can combine them to be more effective in an urban area. Rather bizarrely, in the White Paper, integration actually appears as an objective rather than a strategy and has never been properly defined. There are lots of different definitions of integration, almost as many as there are for sustainability.

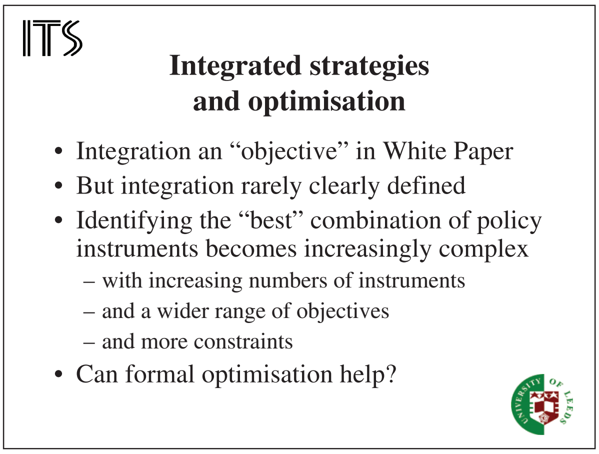


*Figure 23*

As we see it, what we have been doing is to look for the best combination of policy instruments to meet a given set of objectives. That task itself becomes more difficult as one moves away from a basic list of around ten things one might want to do, to perhaps fifty or sixty. One typically has a wider set of objectives, some of them in conflict with one another, as well as constraints on public acceptability, finance, institutional responsibilities and so on.

One of the ideas that emerged from the work that I was doing with MVA in Edinburgh in the early 1990s was that it should be possible to find some formalised method for examining combinations and from that identifying the 'best combinations' (Figure 24).

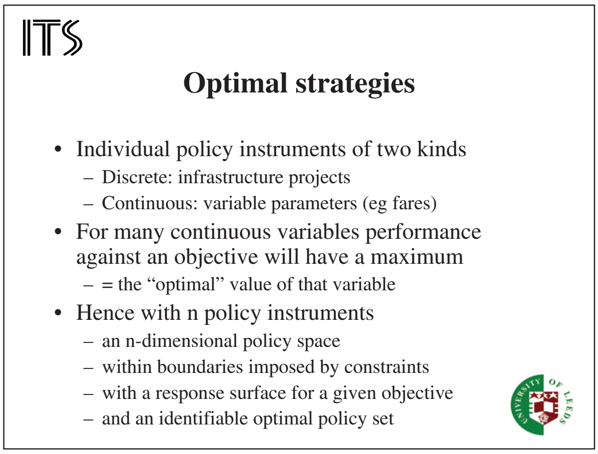


*Figure 24*

In a simplistic way, we said that there are two sorts of policies:

1 Discrete policies where either they are implemented or not, at each of a number of places. For example one might have a road scheme or a light rail project—eg Super-tram in Leeds—or you could have larger or smaller discrete projects of that kind.

2 Then there are other policies that are continuous. A fares policy, for example, is a continuous variable: one can raise or reduce the fare by any amount

For the set of continuous variables, what we found the hard way in the Edinburgh study was that as the level varied, not surprisingly, the performance against the objective varied: and in most cases, somewhere in the policy space was a maximum level for performance. If one broadens that to a number of policy instruments, this moves to a multi-dimensional policy space, which, of course, then becomes that number of times more difficult to visualise. But somewhere in that multi-dimensional policy space will again be a combination of policy instruments which performs best against whatever objective you have set or whatever set of objectives you put into an objective function.

That is the concept. After some development work here, funded by EPSRC, we tried it for real for the first time in a big European project called FATIMA (Figure 25). There were nine cities and one of the weaknesses of the project was that each city had its own model, so we really never knew whether the differences were:

- differences in the cities;
- differences in the models; or
- differences in the nature of the cities.

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**Application in FATIMA (EC FP4 1996-9)**

- Nine cities, each with its own transport model
- Two objective functions
  - Benchmark: efficiency, environment, safety, sustainability, finance
  - Deregulated: as Benchmark but with public transport in private sector (15% return)
- Seven policy instruments

*Figure 25*

We also had two different objective functions. It is the first one that is most interesting because that was what we now call a sustainability objective function. This was a combination of efficiency, environment and safety, together with a concern over the financial costs or indeed the potential for making money out of the strategy. We also looked at one in which, in good old UK fashion, the private sector ran public transport and had their own objectives, and the city had to do battle to try and get the best strategy despite this.

We tested a set of seven policy instruments (Figure 26): two discrete ones: a high level of public transport investment, which the city defined, and which was either in or was not in, and a medium level. The high levels were usually big rail projects, and the medium ones were generally bus improvement projects.

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**FATIMA: instruments tested**

| Instrument | Minimum Value | Maximum Value |
|---|---|---|
| High public transport infrastructure investment | 0 | 1 (dummy) |
| Medium public transport infrastructure investment | 0 | 1 (dummy) |
| Increasing/decreasing of road capacity (whole city) | -20% | +20% |
| Increasing/decreasing public transport frequency (whole city) | -50% | +100% |
| Increasing/decreasing public transport fares (whole city) | -100% | +100% |
| Road pricing (city centre) | 0 | 10.0 Euro |
| Increasing/decreasing parking charges (city centre) | -100% | +500% |

*Figure 26*

We did not test road building at all because none of the cities wanted to. However, we did look at changing the capacity of the road network, either downwards, through traffic calming or pedestrianisation or some other similar measure, or upwards, through traffic management. We were probably rather over-optimistic in saying that we could potentially get a 20% increase in capacity in the latter case. We could certainly get a 20% reduction in the case where we lowered capacity.

We also looked at:

- changing public transport frequency;
- changing public transport fares;
- introducing road pricing in the city centre; and
- increasing and decreasing parking charges.

Our cities were a little alarmed when we tried a 500% increase in parking charges—but that was the upper end of the range we tested.

The detailed results are written up elsewhere but the interesting conclusions that we drew (Figure 27)—which were reasonably consistent across the nine cities despite the different models and different environments were that:

- Public transport fares and frequencies and charging for car use in some combination or another were the elements that contributed most to a successful strategy.

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**Policy recommendations from FATIMA**

- The principal elements of an integrated strategy should be:
  - public transport fares, frequencies
  - charging for car use
- Given these, low cost improvements in road capacity are worthwhile
- Major new infrastructure projects may well not be justified
- Such strategies can potentially be self-financing

*Figure 27*

- Once one had those in place it was actually worth investing in capacity increases at low cost because those who were still prepared to travel then got the efficiency benefits from being able to travel more effectively.
- Very rarely did the major infrastructure projects appear anywhere in the optimal strategy. We were never really sure whether this was because the cities had over-embellished them and said that they were going to cost too much, or whether, given other options, it was actually more effective to go for low cost measures. This is a question for Supertram although I'm sure it's too late to ask it!
- Interestingly, particularly if one leaves the infrastructure projects out, those strategies are quite often self-financing over a 30-year horizon. The

income from users is more than enough to pay for the costs of operation and costs of enhancement.

Since then we have been doing two things, first of all incorporating these optimisation ideas and testing them further in the PROSPECT project, in which we have been providing guidance to cities on how they might use these techniques. Then there is the project I want to talk about now which we are working on with TRL (Figure 28).

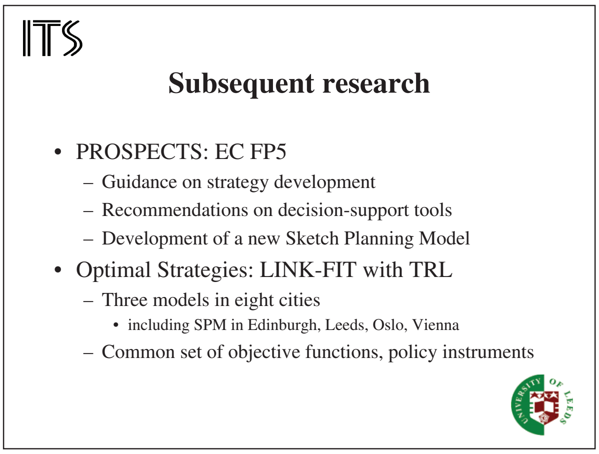



*Figure 28*

## Using three models across eight cities

In this project, we are using the same three models throughout the project. We are using them in eight cities. We are not using all three in all eight, because we would rapidly run out of resources doing that, but the one I want to look at is the middle of the three models. TRL's Transport Policy Model (TPM) is being used in all eight, and there is the Sketch Planning Model (SPM), which our colleagues in Vienna developed. This is being used in Edinburgh, Leeds, Oslo and Vienna and we have been using these with a common set of objective functions and common policy instruments.

Figure 29 shows the approach that we are adopting: we identify a policy package having specified the instruments we are going to use. Then, we put it into the SPM, in this case, using an objective function we have defined and then we produce an appraisal. We may want to impose some constraints; for example, we may want to say that only a certain amount can be spent on the strategy, or that we want to keep carbon dioxide emissions to within a given level. We can then test to see whether we have reached an optimum, and if so, then that is the optimal strategy; if not, one then goes round the loop again.

That is—simplistically—how it works, but I just want to look at each of those elements in turn. The SPM (Figure 30) is a very fast land-use and transport

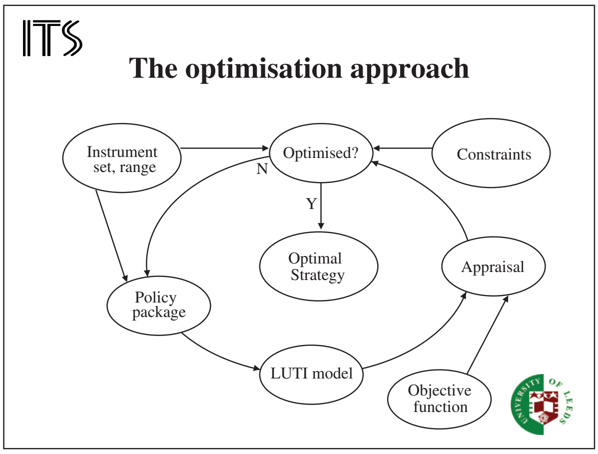



*Figure 29*

interaction model. It has a high level of spatial aggregation and inevitably that has some weaknesses. It deals with three modes and two time-periods and it has feedback between transport and land use. It is not an equilibrium model, it operates in what we call time marching mode so that it moves on from year 1 to year 2 to year 3 with transport changes affecting land use and the land use changes then affecting transport. A single 30-year test can be completed in one to two minutes but full optimisation might take 4-8 hours. A full run is actually done overnight. No doubt that this will change in the next 5 years, and we shall be able to do a full run in an hour, as well.

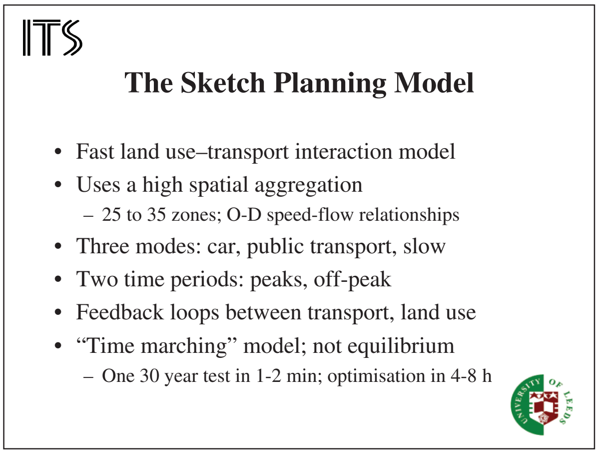



*Figure 30*

Looking at objective functions was rather more challenging than building the model, in some ways because for our cities we asked what objectives we should set, or what appraisal methods we should use, thinking they would all go back to the White Paper and NATA (New Approach to Appraisal) and so on (Figure 31). We did, for good measure, include an expanded cost benefit analysis, to reflect a NATA type appraisal—rather similarly to the objective function that we had used in FATIMA earlier. But that was not their preferred choice at all. Not surprisingly, looking back on it, they all said, 'We set ourselves targets, or we are told to set ourselves targets by the DfT, and

### Possible objective functions

- How do local authorities assess performance?
  - Cost benefit analysis, (Objective Function 1)
  - Outcome targets (Objective Function 2)
    - e.g. accessibility, accidents, carbon dioxide
  - Process targets (Objective Function 3)
    - e.g. car mode share
- Targets have come to dominate thinking
  - But are they consistent with conventional appraisal?

*Figure 31*

that is what we have to do. This is how we decide whether we are doing the right thing or not.’ We therefore set up another objective function which is based on what are called ‘outcome targets’: changes in performance against objectives, improvements and accessibility, reductions in carbon dioxide emissions, and reductions in accidents, for example.

We also set a third objective function which asked straightforward questions like ‘How far can one go to reduce car use?’. That actually came up with some rather simple answers—one just went for that set of policy instruments which was as anti-car as possible. This did not work very well against most of the objectives, but it got one’s car use reduction targets up and running nicely.

Interestingly, targets have come to dominate thinking in policy formulation. But some of the work we have been doing is suggesting that they can actually send one off in rather counter-intuitive directions. We have looked at the idea of incorporating barriers (Figure 32)—we can set a constraint on an outcome target, for example carbon dioxide emissions. We can reflect public acceptability simply by limiting the range. For example, one might say that, in Leeds, if we are going to get away with congestion charging, the most one might be able to charge is a couple of Euros, and we can see what then happens.

Financial constraints were, for us, the most difficult to reflect because they actually appear in all sorts of different guises. One gets money to do one thing but not another; one can get capital but not revenue, one can get finance in five years time but not now—and so on.

We actually focussed in on three tests:

1 Straightforwardly using the shadow price on public funds to reflect the opportunity costs of investment.

2 Putting a constraint on what we call the present value of finance. That is the discounted current value of the stream of costs and revenues.

3 Applying a long-term constraint on what the thirtieth year costs—that is thinking about future generations.

Figure 33 shows the policy instruments that we can test in SPM and there is an indication as to whether they are discrete or continuous and what they affect in terms of the way the model operates. We can, of course, given the 30-year model, change the policy instruments each year. But that was going to be an horrendous optimisation problem, and so we stepped back from that. Instead we said that—since local authorities are actually interested, given their five-year plans, in doing something in five-year jumps—that one can do something in 2006, and one can do something in 2016. We then interpolated between those and assumed that there is a linear change. These assumptions can be varied if one wants to, but beyond 2016 nothing else is assumed to happen (Figure 34).

Figure 35 shows a plot of the optimisation process at work. There are iterations and the objective function goes all over the place at first, and then gradually improves to a maximum value. Of the individual policy instruments, some settle down quite early on and some

### Treatment of barriers and constraints

- Target-based constraints (eg $CO_2$)
  - constrained optimisation of Objective Function 1
- Public, political acceptability
  - limiting range for specific policy instruments
- Finance
  - shadow price of public funds
  - constraint on present value of finance
  - constraint on net cost in year 30

*Figure 32*

### Policy instruments

| | | Affects | Type |
|---|---|---|---|
| Slow modes | Pedestrianisation | Travel time | discrete |
| Public Transport | New PT-Infrastructure<br>Fares<br>Frequency | Travel time<br>Cost<br>Travel time | discrete<br>continuous<br>continuous |
| Private Car | New Roads<br>Road Pricing<br>Parking charges<br>Road capacity increase/decrease<br>Fuel price | Travel time<br>Cost<br>Cost<br>Travel time<br>Cost | discrete<br>continuous<br>continuous<br>continuous<br>continuous |
| Land use measures | Controls on development<br>Land use charges | Cost<br>Cost | discrete<br>continuous |

*Figure 33*

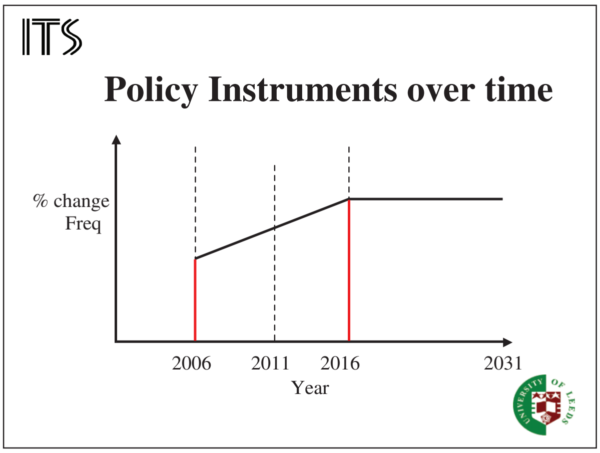



*Figure 34*

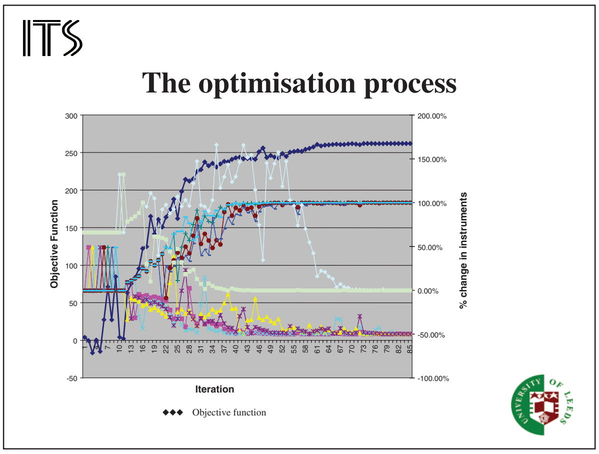



*Figure 35*

yo-yo around and never really settle down. This is quite informative because the ones that settle down quickly are the ones that the strategy is particularly sensitive to; the ones that yo-yo around do not affect performance very much at all. So one learns something from that about the contribution of the individual policy instruments.

Figure 36 illustrates a nice simple two-dimensional response surface, which is in fact plotted for Edinburgh and it shows what happens to the objective function, if

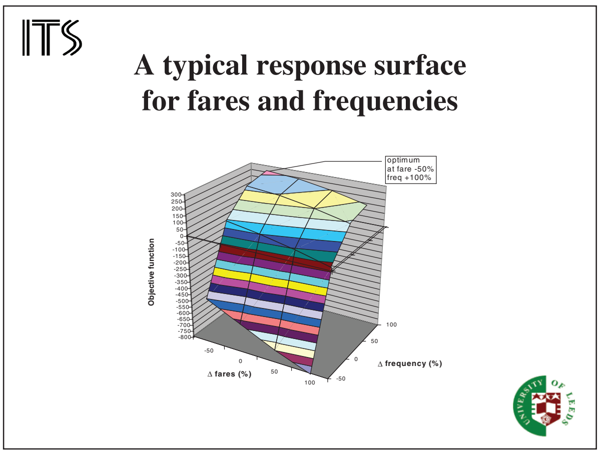



*Figure 36*

fares and frequency are changed. What this says is that in this particular model, performance is particularly sensitive to frequency and rather less sensitive to fares, but the best performance is at the highest frequency improvement and the highest fares reduction.

Figure 37 is a plot of a run, this time for Vienna, where we imposed a carbon dioxide target. This was the 'do minimum' strategy and we were intervening in year five and then year fifteen in such a way that carbon dioxide emissions would stay below the specified target. You can compare how that performs with a non-constrained strategy.

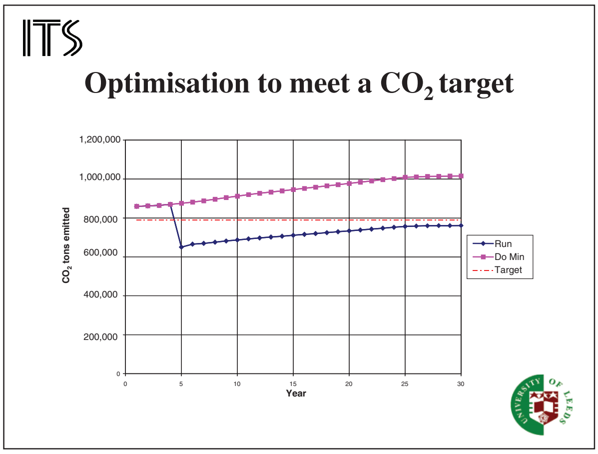



*Figure 37*

Figure 38 show the things that we have tested so far but the next set of results are for just these three. There are results for others as well, but we haven't the time this evening to go into them.

ITS

**Tests conducted to date**

| Instrument | Minimum | Maximum |
|---|---|---|
| Fares | - 50% | +100% |
| Frequency | - 50% | +200% |
| Road pricing (city centre only) | € 0 | €10 |
| Fuel tax | 0% | +200% |
| Parking charge (city centre, all parking) | -100% | +300% |
| Road capacity | - 10% | + 10% |

*Figure 38*

## Commonalities across cities and across models

There are four cities, the cost-benefit style objective function, and the target based objective function. What this recommends for fares is that in all cases fares are reduced: it is worthwhile, even in somewhere like Vienna where fares are relatively low, to reduce them further (Figure 39).

**Optimal strategies: four cities**
**peak fares: % change from dm**

| | 2006 OF1 | 2016 OF1 | 2006 OF2 | 2016 OF2 |
|---|---|---|---|---|
| Oslo | -29 | -32 | +14 | -10 |
| Vienna | -35 | -44 | +60 | +62 |
| Leeds | -45 | -49 | +2 | +66 |
| Edinbgh | -50 | -50 | -50 | -50 |

*Figure 39*

When one starts setting targets one gets a much more confused picture. In three of the four cities it is worth increasing the public transport frequency (Figure 40). (Remember there are no external financial constraints on this at the moment and that is obviously an important consideration.) In Vienna, they have to get the frequency levels pretty well spot on, as we might have expected, but again if one starts setting targets they go all over the place.

**Optimal strategies: four cities**
**peak freq: % change from dm**

| | 2006 OF1 | 2016 OF1 | 2006 OF2 | 2016 OF2 |
|---|---|---|---|---|
| Oslo | +76 | +93 | -39 | +91 |
| Vienna | -3 | -5 | +84 | +71 |
| Leeds | +190 | +199 | +8 | +49 |
| Edinbgh | +64 | +33 | -33 | +133 |

*Figure 40*

Figure 41 shows it is worth introducing road pricing everywhere. The levels actually differ from one city to another and there are some bizarre effects that we have not yet got to grips with. These are very recent results and we are still racking our brains trying to understand them. For example, we have got Oslo putting in a high level of road pricing charges to start with and then reducing it over time. We do not quite understand that yet, so I'd welcome ideas.

Here we have different levels in different cities, perhaps not surprisingly, but again a rather more confused message in this case (Figure 42). For example: what happens to peak car load share in year 30, the end of the modelling period. For the 'do minimum', this is what happens with the cost/benefits based objective function and that is what happens with the targets.

**Optimal strategies: four cities**
**peak road pricing €**

| | 2006 OF1 | 2016 OF1 | 2006 OF2 | 2016 OF2 |
|---|---|---|---|---|
| Oslo | 4.64 | 2.24 | 0.42 | 4.67 |
| Vienna | 1.89 | 0.95 | 1.86 | 1.12 |
| Leeds | 3.31 | 5.20 | 0.54 | 0.02 |
| Edinbgh | 2.88 | 2.46 | 9.87 | 9.97 |

*Figure 41*

**Optimal strategies: four cities**
**peak car mode share year 30 (%)**

| | Do min | OF1 | OF2 |
|---|---|---|---|
| Oslo | 46.6 | 42.3 | 41.5 |
| Vienna | 43.4 | 37.6 | 42.7 |
| Leeds | 58.5 | 48.4 | 56.7 |
| Edinbgh | 49.6 | 44.4 | 41.1 |

*Figure 42*

Interestingly all of these reductions are about 10-15%. It looks as though a 10-15% reduction in car use is about the optimal if we assume a combination of concern over efficiency, environment and so on.

In one or two cases, there is a further reduction in car use. In the case of Vienna and Leeds, given the targets that we have set, it does not seem to be worth reducing car use at all.

**Comparison between cities**

- To satisfy OF1 (CBA)
  - All reduce fares substantially
  - All except Vienna raise frequency
    - but levels vary depending on current provision
  - All introduce road pricing
    - but levels vary, and often lower in 2016
  - All except Oslo have substantial net cost
  - All reduce car use by 10% to 15%

*Figure 43*

So in summary, to satisfy a NATA style, cost/benefit style objective function: it is worth reducing fares; it is worth raising frequency; and it is worth introducing road pricing. But all of those, with the exception of the Oslo strategy, have a substantial net cost, and we have done some further tests which I will not show now, which suppose that one constrains the funding available, and ask what then happens. What goes out is some of the frequency increases and what comes in is further increases in road pricing; but the fare reductions are pretty robust whether you have public funds or not.

## Target setting

When one starts setting targets the impacts are much more variable and crucially, if one compares the performance with the best NATA style appraisal, typically about 50% of the benefits are lost (Figure 44). What seems to be happening is that the safety target, in particular, is causing problems because, to some extent, as traffic levels are reduced and speeds increased. Drawing on the useful TRL research on the links between speed and accident severity one can see that there are actually some increases in the safety cost. We are not yet absolutely certain whether that is appropriately reflected in the model. That is a test we still have to do, but I think that similar results are coming out of the TPM tests as well.

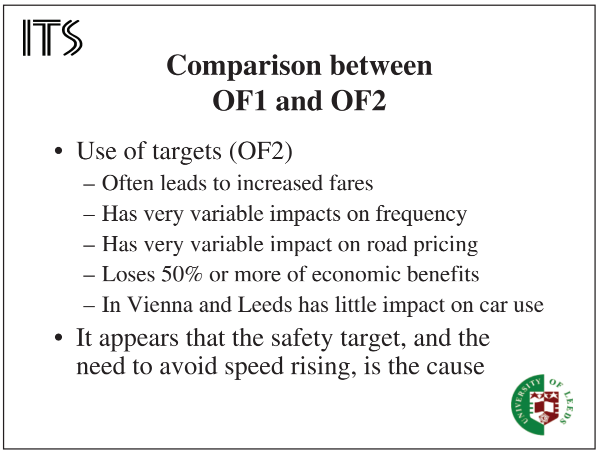



*Figure 44*

So there is some evidence here that fares reductions appear to be pretty important and therefore that local authorities need to be able to influence fares in a way that in the UK at the moment they cannot at all (Figure 45). Frequency increases are worthwhile, but are sensitive to financial constraints. Road pricing is justified and the increased charges help overcome the financial constraints. This is one of the main sources of revenue for paying for other parts of the strategy.

We have done some tests also with road capacity increases, and again we have got some indication that they are worth pursuing but we are not sure that we

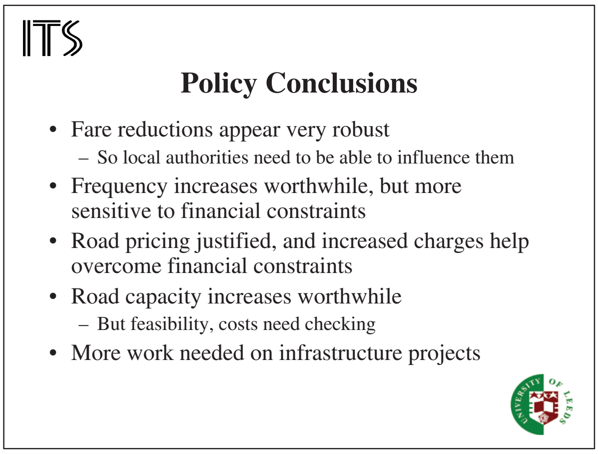



*Figure 45*

have got the costs right at the moment and we are not sure we have got the maximum levels of feasibility right. Tim Parry, in some comments on the work that we have been doing with the Leeds authority on this, has come up with some interesting ideas that we want to test further. We have not yet, this time round, tested infrastructure projects. As I have said, target-based planning can lead to some quite significantly different policies and we think that one of the key problems is that targets are being set at the moment in different ways for different objectives, and that they in turn are in effect not consistent (Figure 46).

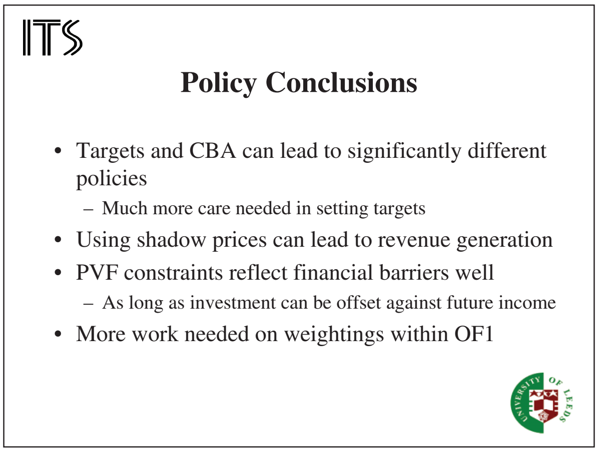



*Figure 46*

The use of shadow prices on public funds has the interesting side effect of developing a transport strategy that raises revenue for other purposes. This might be a good thing to do in the wider interest, but was not quite what we set out to do. But our constrained financial optimisation seems to be producing some quite sensible results.

## Barriers to progress

Let's now move on from an understanding of policy instruments and some of the ways one might integrate them, to some of the barriers to progress (Figure 47). A very important report came out from the ECMT

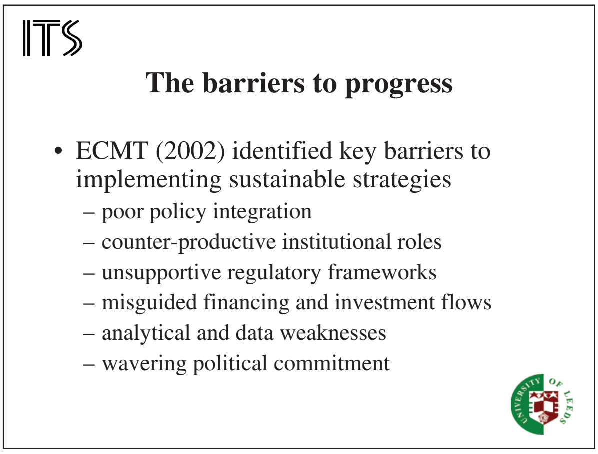



*Figure 47*

last year on urban transport, and on why cities were not able to implement the recommendations that they made in 1995 on sustainable urban transport. Here are their key barriers:

- poor policy integration;
- counter-productive institutional roles;
- unsupported regulatory frameworks;
- misguided financing and investment flows;
- analytical data weaknesses; and
- wavering political commitment.

There is not much in there for the transport engineer and planner—except perhaps some of the comments on analysis and data. But crucially, of course, as transport planners, these are the sorts of issues that we have to get to grips with. We have been doing that to some extent in our work in PROSPECTS where we have been providing guidance for cities on how, in their own circumstances, to develop optimal strategies: and based initially on a survey of 60 cities in 17 countries (Figure 48). We have seen one or two results from that already and we have developed three key guidebooks. The first is to a large extent a layman's guide as to what transport strategy formulation is all about; there is a methodological guide book which is looking more specifically at the use of models, appraisal techniques, optimisation and so on; and there is a policy guidebook which is based straightforwardly on KonSULT (Figure 49).

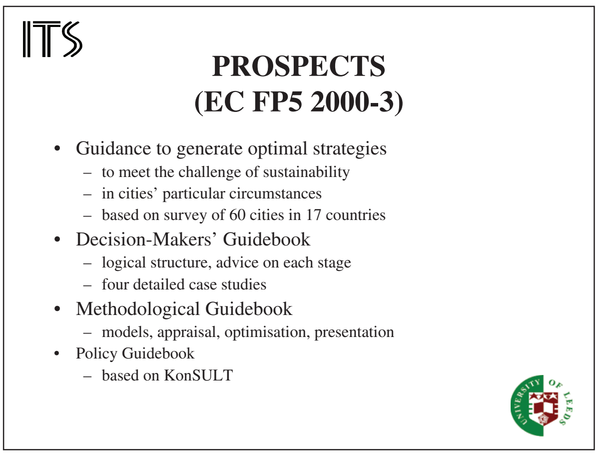



*Figure 48*

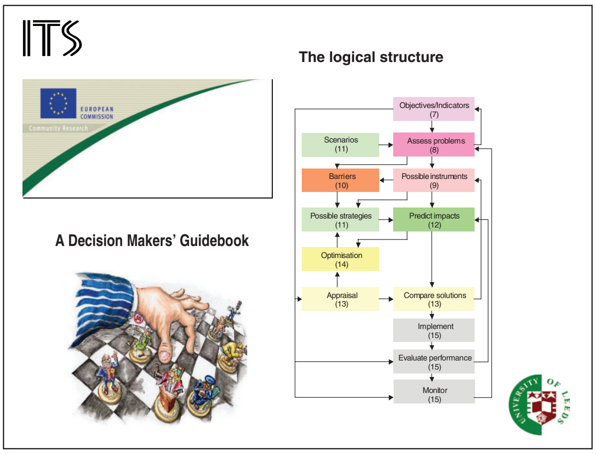



*Figure 49*

The right hand side is the logical structure that we have suggested for formulation strategies and around which each of the sections in the guidebook, colour-coded, is based.

Let me note one or two things from the survey. First of all, most cities do not have direct responsibility for the majority of policy instruments (Figure 50). Only the percentage denoted [in red] are solely responsible for road building, pricing, or bus and rail operation. In the majority of cases, with the exception of land use and traffic management, they are reliant on others, whether it is other authorities, other levels of government or the private sector. They are to a large extent dependent on adjacent authorities. For example, in an area like West Yorkshire, very clearly there are strong interfaces at the district boundaries and one cannot simply plan one's own system as if on an island. To some extent, less so here at the moment—but it is coming—there is a reliance or dependence on regional authorities (Figure 51).

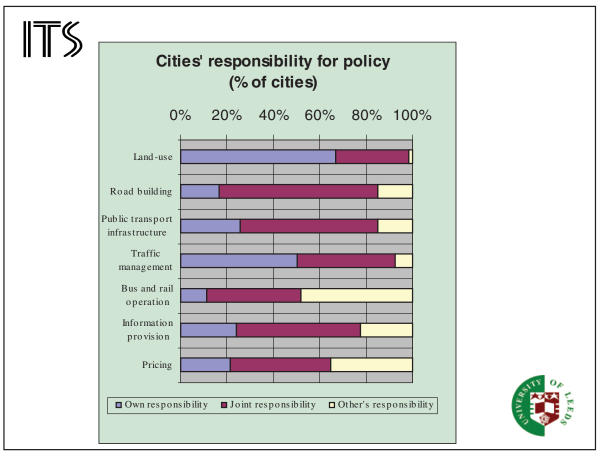



*Figure 50*

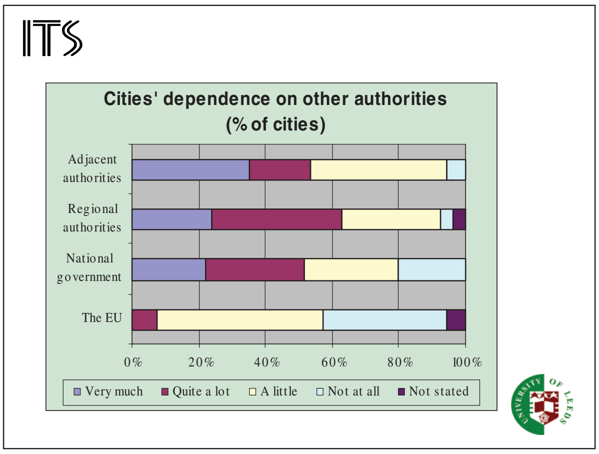



*Figure 51*

There is a strong influence from national government, but at the moment there is very little dependence on what Brussels is telling us though maybe that will come too.

For some policy instruments, not surprisingly, financial barriers are severe (Figure 52). Political barriers are a serious impact for many of the policy instruments and particularly pricing but also for road building and infrastructure projects generally and, to some extent land use, cities are saying that there are political barriers on progress (Figure 53).

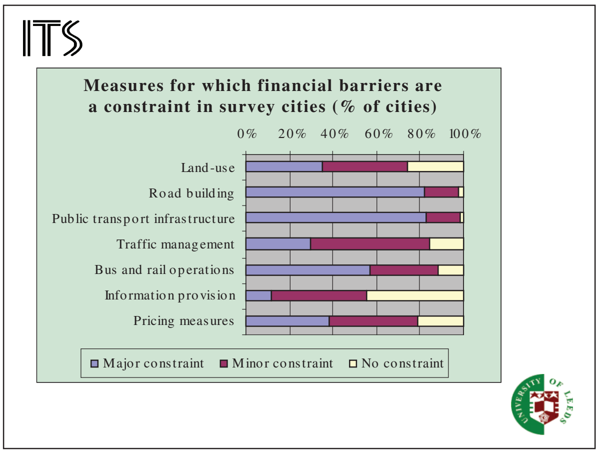



*Figure 52*

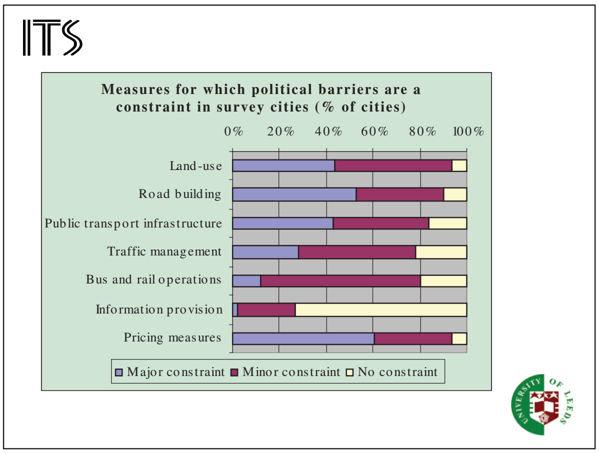
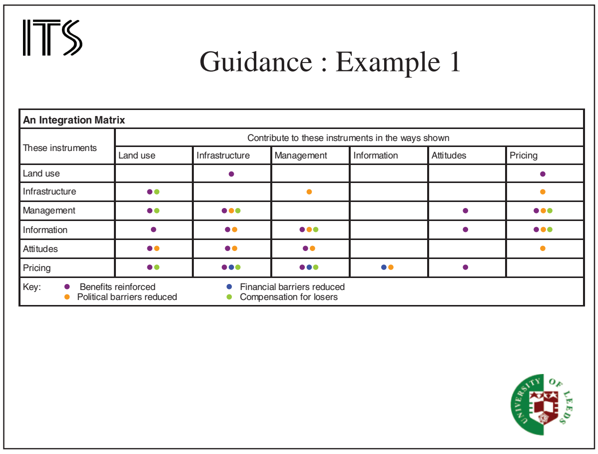



*Figure 53*

Figures 54 and 55 whow a couple of examples from the guidebook of simple summary tables for guidance. This one looks at the way in which policy instruments on the left hand side might reinforce ones across the columns by reinforcing benefits, by helping overcome political barriers, by helping reduce financial constraints, and by helping overcome disbenefits for particular groups of user. The second one looks at the contribution different policy instruments make for different types of strategy, reducing the need to travel, reducing car use, improving public transport and the road network. As I said, in the guidebook, we have looked at a series of case studies and there are some interesting messages that emerge. In all four of our case studies the decision-making context is extremely complex. It is complex in different ways in different cities. There is no standard model that says 'This is how you can simplify things' or 'This is how you have to deal with the different factors'.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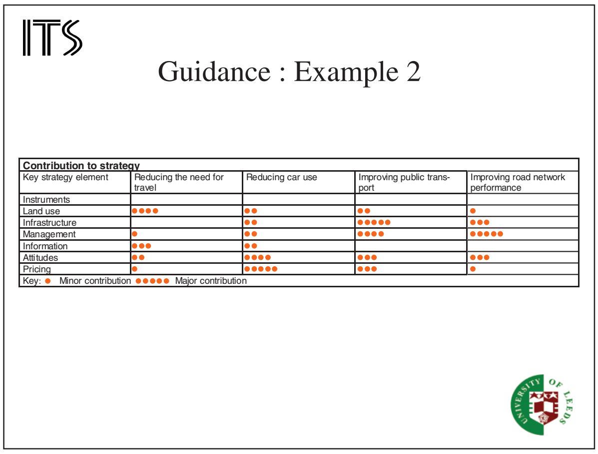
Guidance : Example 1

**An Integration Matrix**

| These instruments | Contribute to these instruments in the ways shown | | | | | |
|---|---|---|---|---|---|---|
| | Land use | Infrastructure | Management | Information | Attitudes | Pricing |
| Land use | | ● | | | | ● |
| Infrastructure | ●● | | ● | | | ● |
| Management | ●● | ●●● | | | ● | ●●● |
| Information | ● | ●● | ●●● | | ● | ●●● |
| Attitudes | ●● | ●● | ●● | | | ● |
| Pricing | ●● | ●●● | ●●● | ●● | ● | |

Key: ● Benefits reinforced ● Political barriers reduced ● Financial barriers reduced ● Compensation for losers

*Figure 54*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Guidance : Example 2

**Contribution to strategy**

| Key strategy element | Reducing the need for travel | Reducing car use | Improving public transport | Improving road network performance |
|---|---|---|---|---|
| Instruments | | | | |
| Land use | ●●●● | ●● | ●● | ● |
| Infrastructure | | ●● | ●●●●● | ●●● |
| Management | ● | ●● | ●●●● | ●●●●● |
| Information | ●●● | ●● | | |
| Attitudes | ●● | ●●●● | ●●● | ●●● |
| Pricing | ● | ●●●●● | ●●● | ● |

Key: ● Minor contribution ●●●●● Major contribution

*Figure 55*

With the one exception of Edinburgh which was the local case study, most of the cities did not have integration between transport and land use (Figure 56). We saw that as a particularly serious barrier to progress. Very few of the cities were actually thinking long term. They were setting themselves five or ten-year objectives but they were not really addressing

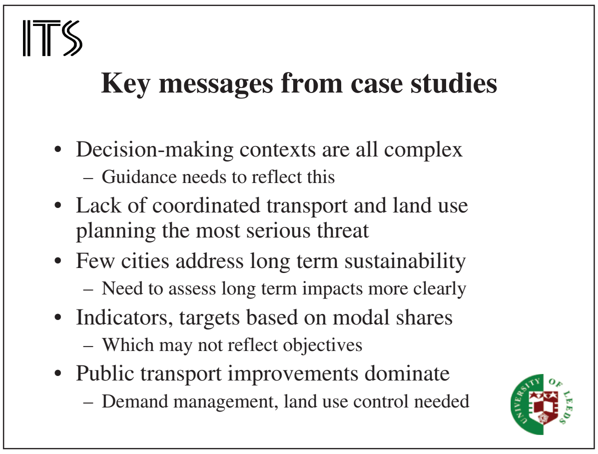


*Figure 56*

long term sustainability, the impacts on future generations, at all well. Most of these were targets and most of them were using targets based on modal shares which, as I say, we are pretty certain do not necessarily lead to the best strategy. It is interesting when they are asked what they want to do to improve their problems. Public transport improvements dominate the scene in all of them. There is very little emphasis, in much of their thinking, either on demand management or land use planning.

## The future

Finally, looking ahead, what we are working on at the moment is a scoping study in EPSRC's sustainable urban environment programme project, (and I'm very proud of this acronym!), DISTILLATE—Design and Implementation Support Tools for Integrated Local Land Use, Transport and Environment. We are working together with TRL on this as well. Although this is an Engineering and Physical Science Research Council funded project, we see a very strong social science element in this because we are looking at ways in which we can help cities and local authorities achieve a step change in how they develop and deliver strategies. We are hoping to look at ways of overcoming the barriers, and particularly those barriers that ECMT identified (Figures 57 and 58).


*Figure 57*


*Figure 58*

We are also trying to understand policy interventions better and their integration so the two areas of research I have talked about will feed in there (Figure 59). Also, we are examining improved methods for project planning and design and implementation. This, as we see it, is a very under-researched area—there is much more work on strategy formulation than how actually to turn that strategy into practice. Also, we are looking at decision making processes and particularly their complexities and how to tackle them: involving stakeholders more fully and then supporting them through improved decision support tools. Figures 60 and 61 show the way in which the various work packages fit together.

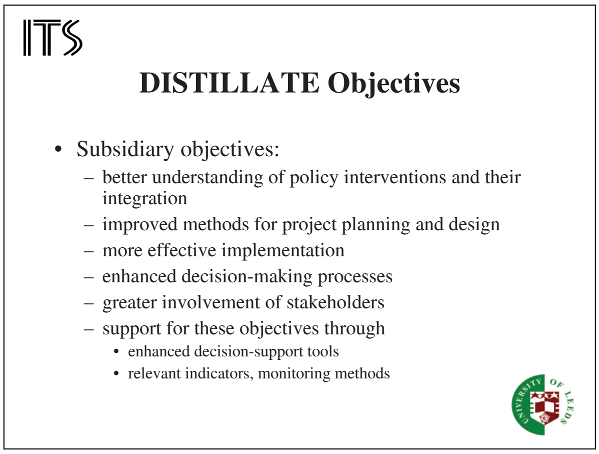


*Figure 59*

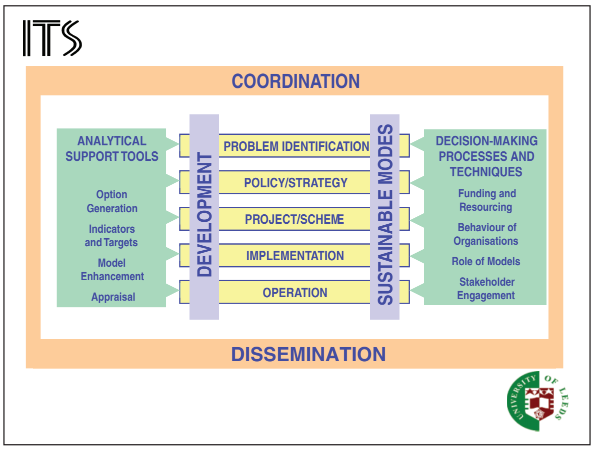


*Figure 60*

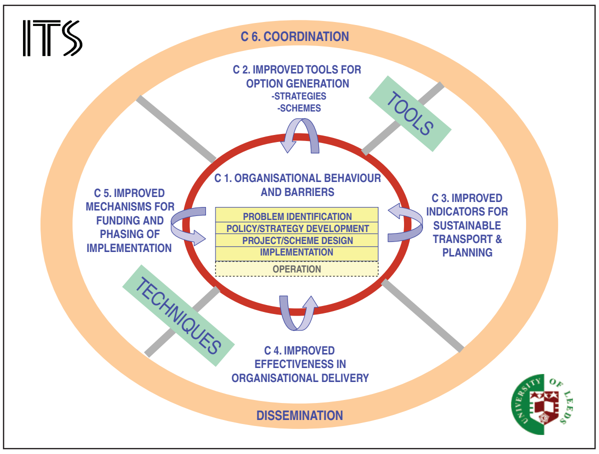


*Figure 61*

## Conclusions

Drawing the strands together, there is absolutely no shortage of things we can do (Figure 62). I have identified something of the order of 60 different policy instruments, but a serious lack of information on how well they work: this is what KonSULT was set up to help overcome. There is still a lack of clarity and an uncertainty about what we mean by integration and how integration works. But our optimisation methods, whether they come up with the 'right' strategy or not, are proving to be very interesting in exploring the problem and understanding the interactions and the way in which constraints apply. What they are already telling us is that local authorities need to be much better able to influence fares and service levels, particularly in the UK, and to be able to plan land use and transport together.

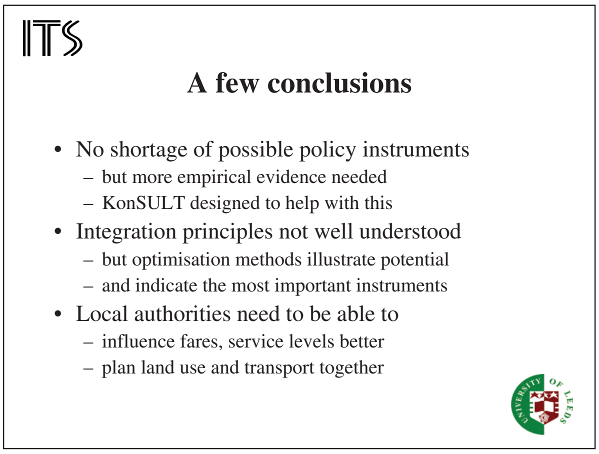


*Figure 62*

We are seeing from *PROSPECTS* a general message that cities are not as concerned as perhaps they should be with equity, both current equity considerations and even more so the longer term inter-generational equity (Figure 63). There is too much emphasis on target setting, at least target setting without ensuring consistency and logical approaches. The financial barriers—and this is a note for us in our further work—are important, but need to be better understood: what is the best way of allocating finance? And what is the best way of planning against an uncertain financial future? But it is the institutional barriers that are proving to be the most serious. The decision-making process and environment are more complicated and we need to help local authorities understand how best to make decisions, when dealing with multiple actors, the private sector as well as the public sector, and how better to involve stakeholders across the range in their decision making processes. That, in closing, is where our new strands of research are just starting.

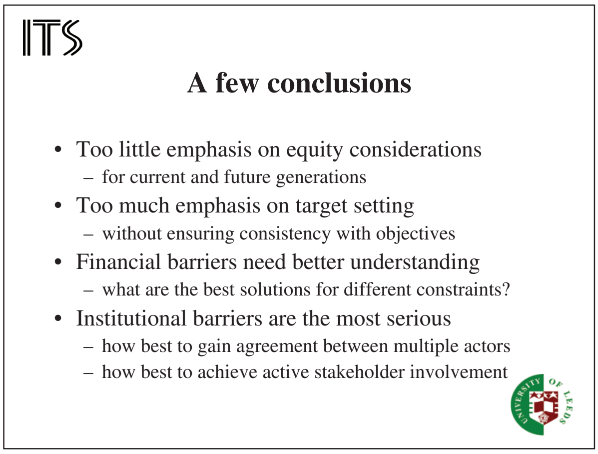


*Figure 63*

## DISCUSSION

**Rod Kimber**

Thank you Tony for a splendid lecture. You have moved from what are normally abstract nouns and difficult phrases—sustainability, strategy and so on—to a very tangible and wide-ranging analysis. In short you have made the concepts manifest in clear terms, relating to real decision making. It is very stimulating, and I am quite looking forward to the debate.

**Question**

Some of your conclusions are music to our ears. A number of questions come out. But, first of all an observation: a lot of emerging messages, as you said, are that there is relatively Iittle coming through to the planner or engineer, but a lot coming out for the decision makers, whether they be political, organisational or individual. We really do need to educate our public to get them to appreciate, in lay terms, many of the concepts that we are grappling with.

That brings me to one of my questions because necessarily, in terms of a complex objective function, there will be decision makers running systems that are in fact being asked to run sub-optimally. One very good example: if one has a congested city centre, and one wants a higher frequency of buses, a good scheduler will be wanting to minimise the standing times of buses so as to provide sufficient frequency with the minimum number of vehicles. But if there is any propensity for perturbations, disturbances causing serious impact on the number of vehicles the public sees, (ie the actual frequency, as opposed to the theoretical frequency) then one needs sub-optimal operation. That is a message that is very often not fully appreciated.

My second question is this. I noticed with interest that you have got Vienna as one of the four cities. I think I am right in saying that Vienna, since about 1990, has actually been fairly good, at least in public transport terms (I cannot speak for what they are doing on the highways side), in documenting the decisions that they have been taking, and in documenting the targets that they have been setting. I wonder if you have had the opportunity to apply the model in reverse? In other words, here is a set of historical results, how well would the model have predicted if you had started in 1990, rather than 2000 or whatever you are starting at?

**Tony May**

The questioner was alluding to a meeting we were both at last night in the Institute. This was the inaugural meeting of the Yorkshire branch of the Transport Planning Society. We got very much into this discussion. We were ably stimulated by a new colleague in Transport Planning who declared himself a policeman and philosopher, and who said that he did not really understand what we transport planners were talking about at all. We generally accepted that there is a role in enlightening public awareness and public understanding; but there is a role within the broader planning professions in understanding some of these issues, as well as with our political decision makers.

The issue of sub-optimal operation is an interesting one and there are a number of caveats to be sounded on the optimisation work we are doing. Partly, there are all sorts of policy instruments that we cannot model. We know this at the moment and we know we cannot build it into the optimisation process at all. But also, we have a deterministic model rather than a stochastic model, so we cannot at the moment reflect the effects of uncertainty and variability as you get closer to capacity, in these models at least, except in an average way. We cannot, at the moment, actually address the sort of issue that you are outlining, except indirectly by saying that if one gets to a higher level of utilisation of vehicles then there is a greater propensity for increased waiting time and increased variability and so on. That is an interesting challenge for the future; I don't think we are up to it at the moment.

As regards Vienna, the scope of the planning model was actually developed and calibrated for Vienna, and an element of what you are suggesting has been done, but a conventional backwards projection over a longer period has not been done as yet. It would be an interesting issue to test. You are absolutely right that Vienna has been pursuing a very effective public transport strategy and a fairly effective traffic management and demand management strategy. It has set itself targets, but interestingly it gets nowhere near to the clarity and specification of objectives that we do here. It has targets that are much more related to modal shares than anything to do with the environment or safety or efficiency. Its major weakness, which the Viennese themselves accept, is that the transport planners are totally separate from the land-use planners, and indeed that land-use planning is done at a lower level of government. They are very concerned now about the extent to which land use planning decisions are de-railing, if you like, their transport strategy.

**Question**

Thank you very much for that excellent talk—I really enjoyed it. One area that particularly interested me is in setting targets and the relationship of that to the bigger policy. We have heard this week about the health service, and although I do not think this is an exact parallel, people are complaining that there are too many targets, and that that is affecting the implementation of policy (rather than the actual setting of policy). On your suggestion, I understand here that it is the inconsistency of the targets that is affecting the quality. So is the answer to somehow prioritise the targets, to simplify, to have fewer of them? What is the way forward on it?

**Tony May**

We discussed this to some extent in the publication. As I see it, the problem is manifold. To start off, many targets that are set are actually targets on input, so they are things like building so many kilometres of cycle lanes or providing so many kilometres of light-rail (or whatever it is) without necessarily saying that that is the most effective input to the strategy. A lot of the targets are what we call process targets so they have to do with the way the system works and particularly with modal shares. You'll remember the debate about Road Traffic Reduction Act and the levels and targets that need to be set there. There was never any reference back to whether it made sense in terms of the underlying objectives. There is an interesting aside, from the tables I was showing that suggest that actually if you set yourself a 10% reduction over a 30 year period against the 'do minimum', you would probably be about right.

Even where there are what we call outcome targets, ones that are related to performance against objectives like levels of reductions in accidents or reductions in carbon dioxide emissions, or avoiding particular levels of air pollution, they are done without necessarily thinking about the costs of achieving them or the impacts on other policy objectives. So there is this internal inconsistency in the way that they are set. There will be some objectives for which no targets are set at all, putting to one side the Department's congestion target, and they are certainly rueing the day it was ever set). Other than that there is no real efficiency target that anybody sets at all. There is not much in the way of accessibility targets—I'm thinking in respect of equity considerations.

So if the strategy is dominated by some safety targets and some carbon dioxide targets, not surprisingly one will end up with a rather unbalanced strategy. Our recommendations are that targets are actually quite useful because they are simple concepts to get to grips with, and politicians and members of the public can understand them. However, what one ought to do is work out the strategy first, make sure that the strategy is best designed to achieve the objectives and ask what the targets would be that are consistent with that strategy. Then they should be used as the indicators of performance. I know more than a few local authorities that are beginning to realise that it would have been rather good to have done that back in 2000 when they developed their local transport plans. Now they are finding that the funding they are getting is to some extent determined by their performance in achieving those rather ill thought out targets.

**Question**

One of the most interesting parts of your talk is the way that you can integrate policy. Economists generally tend to look at everything else being equal and concentrate on a single policy instrument. What I wonder is whether the deregulation of buses has been just such an instrument? It is being carried out all over Europe, putting public operators at arm's length moving them towards the private sector. But when you push these companies into the private sector, it seems unreasonable for the local authorities to have control of their fares. You can see where the question is coming to. So what do you suggest?

**Tony May**

We were addressing precisely that in the FATIMA project I touched on briefly. Again, we started off with a conventional cost/benefit style objective function, and, as we talked to city authorities, they said that they do not have direct control over public transport—so how can they achieve that? It turned out in practice that in most of the cities we talked about in continental Europe, although public transport was under private control, it was franchised in the London model. The public body was saying 'These are the service levels we want and these are the fares we want, let us have the best provision of service within those constraints'. One can represent that in more or less the same way, except that one has to be able to say something about whether the costs of running the service are less as a result of involving the private sector or not. In the UK de-regulated environment, this comes back in our current study where cities are saying that there is no point in putting in variation in fares in the scenario because they cannot do anything about it. If one has got a private operator who is determining fares and frequencies and doing so against a profit maximising objective, while bearing in mind the competition in the market place, then one has to reflect it in a totally different way.

What we did, in fact, and this was the de-regulated objective function, was to say fares and frequencies are determined by the operator on the basis that the operators might expect to achieve a 15% internal return. That figure, back in 1996, was taken from one of my economist colleagues who was studying it at the time. It is too high a figure now certainly, but it was an appropriate one then; and then the assumption was that the local authority was optimising everything else, given what the operator was doing to fares and frequencies. What we found was, first of all, that the local authority had to impose higher levels of road pricing charges, and it adopted different policies on road capacity. Almost inevitably, it ended up with a strategy which was performing less well, and typically 15%-20% less well against the public objective function, than it would have done even if it had had some moderate control over public transport. So we could begin to assess, there, the cost to society of having the form of de-regulation that we have in the UK outside London—a bit simplistically but quite informatively.

**Rod Kimber**

At the moment the whole thing seems to turn on a problem of knowledge. The understanding that actually emerges is comprehensible in a professional sense but it is not very easy to communicate to the political stakeholders, except in the sense of saying 'Well, we think you have got this wrong a bit, and if you had have gone in this other direction it would have been better'. In principle I could see an education process emerging. The question is: how hopeful are you of a reasonable level of convergence between the real information coming from this work, and these hidden constraints and inconsistencies and targets that are being batted about politically?

**Tony May**

I find it very difficult to read at the moment. I cannot say too much about it because we are actually doing some work to look at the implications of all of this for the 10 year plan update. There is now a growing realisation that an inability to control fares and frequencies is an important constraint on local authorities' ability to achieve effective strategies. Whether that will actually find its way into changes in legislation and how soon is a big question. But, it is already clear that the emerging message is that we are actually losing benefits as a result of the way in which we have implemented that policy. This is because you can present the comparison quite straightforwardly and starkly, maybe a bit over-simplistically, but I think one has to do that. From another perspective, when looking at the level of profit which was being recorded or implicit in the returns from public transport operators/bus operators in the metropolitan counties, there was another indication that there were almost certainly inconsistencies in the transport system.

**Question**

Is it fair that the constraints are against customers by imposing parking charges, for example? Is the strategy desirable and appropriate in this respect?

**Tony May**

The question of fairness and equity is one of the really big challenges in the optimisation work I have been discussing. We have not for the moment incorporated any distributional parameter—although some of the work we were experimenting on in the PROSPECTS project did look at ways in which one might specify an equity parameter that could be optimised.

If you look at the issue of fairness in charging for road use, the messages are actually extremely complex. It is not straightforwardly that all motorists will be worse off because they are having to pay, because those with high values of time will almost certainly be better off—because although they are paying, they are experiencing reduced congestion. Those who will be most adversely affected are lower income car users, typically those who have few alternatives. If you remember, in the run up to London Congestion Charging, there was the rumour that Smithfield market traders were coming in at 3am and really had not got any other way of getting in. The question became why should they pay because they had to drive home during the working day? That is a fair point.

To some extent the answer lies in the revenue, and you may remember that table I showed you towards the end that came from PROSPECTS and was looking at the way in which you can use combinations of policy instruments to compensate the losers. This is a rather stark way of saying that there are some people with whom anything you do will make them worse off but if you bring in something else you may be able to make them better off. Crucially, with charging for road use, you have got a very substantial revenue stream that you can if you want to, focus on those who will be most adversely affected. I think Ken Livingstone did a pretty good job of this in putting most of his investment into the bus service, not just the daytime bus service, but the night time and unsociable hours bus services as well, so that there were alternatives for those who were no longer able to use their cars. There is always going to be some rough justice but equally there is a lot of rough justice with congestion as it operates at the moment. Consider somebody who has no option but to travel in congestion, and whose journey is made worse for the simple fact that other people are travelling in congested conditions when they could do something different.

In a very interesting development of that, back in the 1970s when I was in London working on a pre-cursor to congestion charging as a policy option, and an earlier version of Ken Livingstone, the then Leader of Transport Committee of Nottingham City Council, came up with the scheme called Zones and Collar. His was a simple approach. There was a very good TRL review of this. The principle was pricing is unfair, but everybody has got the same number of hours in the day: we will therefore use a time penalty instead and we will impose a ten-minute penalty on everybody driving into Nottingham; and will give the buses priority. It resulted in people spending far more time in the system, and as a result of this, they could not use that time for anything else. There was no revenue as a result, and on balance people were worse off as a result. In contrast if you adopt a pricing mechanism, people have to pay, but at least there is income that you can use on other policy measures. This is not a black and white answer, but charging is not quite as unattractive as perhaps it appears at first sight.

**Question (follow-up):**

But do you not think that we will be worse off if some people can pay, and other people cannot afford to pay? These people will be forced to use public transport—and that is another social, ethical issue. Do you not think that we should extend this strategy to create empty city centres [empty of cars], so that all people are forced to use public transport? Imposing a congestion charge will create a social difference.

**Tony May**

At a low level, introducing a pedestrian street does this: that nobody can use their cars there and they have to take them somewhere else. It is possible to do that over a significantly wider area, either absolutely, or by the Italian approach which uses a permit system. If you can manage to get a permit then you can bring your car in, and if not, you cannot. There is still rough justice. But I think it's worth just bearing in mind the figures I have shown in that what is needed is not a 100% reduction in cars. What you need is about a 10-15% reduction, and it is actually quite difficult to achieve that by a regulatory mechanism that is fair to the 10-15% who can no longer use their cars, and, at the same time, to the 85% or so who can. However it is adopted or approached there will be rough justice. The crucial questions in each situation are: who are the gainers and losers; and, in each situation, have you got some means of compensating the losers. It seems to me that one of the great advantages of raising revenue is that you have got a revenue stream to use for that compensation purpose.

**Question**

I have two comments and two questions. Firstly, going back to the very beginning of your presentation, you questioned the definition of sustainability. That is something that I am very familiar with in the safety context. You may be well aware that the Dutch safety policy is built round what they call sustainable safety, but if you ask them what it means they willingly admit that is simply a 'hooking onto' word because it is politically acceptable. There is a lot benefit of doing that if you are trying to raise profiles and get people interested. But what constitutes sustainability in safety terms is more difficult to define. It is very easy to set targets in safety because one is simply trying to reduce casualties. In a sense sustainability becomes a matter of inter-generational equity. In a way one can argue that things are only made better by achieving a continuing decrease in casualties over time.

My second comment is to agree with your earlier point on targets and integration. Safety entered very much earlier into the process because of the simplicity of setting targets. But safety targets are set in isolation, and to aid understanding. There is interaction with traffic and traffic management because of the safety objective, but I think that you are absolutely right that there is very little integration with the broader transport strategy. That raises questions like: where is equity in that process? How much does one trade off? What could be potential safety gains from broader transport decisions. There needs to be more work in trying to understand how these are addressed together. But I find it difficult to understand how one can actually create an over-arching target, if you like, from which the strategy can then develop individual targets.

Now let me come on to my two questions. The first is to do with the KonSULT database. One thing that struck me when I was looking at it was that there is a lot of good material on what the outcomes are. For example, you showed the Singapore pricing. Are some of the things that have come through in the discussion so far already deployed in the model or do they come in the next stage? I mean what are the actual circumstances that make it work in a particular situation. Can the effects of particular factors be isolated, and can one see whether those factors are available in other areas? Otherwise, Town A may simply say, 'Superficially, I look like Town B, therefore it should work' when, in fact, it does not have many of the levers needed. Your own sort of analysis of the factors that are relevant showed that a lot of them are very difficult to influence. In many cases one cannot influence them at the moment.

The second question harks back to when I worked in this area. How does the capability of the models now, compare and improve on those of thirty years ago? Where are the areas of improvement from what we were doing in the 1970s, when you were dealing with the supplementary licensing study? I can remember some results that were similar—the road pricing and the fares policy came out well in those. Interestingly, the order mattered. For instance, fares did very well if there already was pricing. Reduced fares on their own were far more difficult to justify, though they gave some benefit. Is the main improvement in understanding the mechanisms, and if so have they changed the conclusions?

**Tony May**

Let me go back for a moment before tackling the questions. I was not in fact suggesting some sort of overall target. I was suggesting an approach that said, if you know what you want to achieve and you know the constraints you are working under then you can identify a best combination of policy instruments. That becomes your strategy, and when you know what that is, you know how much you can achieve in accident reduction, in pollution reduction, in congestion reduction and so on. Then you can use those as your targets, knowing that they are consistent with one another and that they are achievable if you do all the right things.

**Comment (follow-on)**

The difficulty is knowing what you can actually set as your overall strategy itself implies making the trade-offs.

**Tony May**

Yes it does, of course, and our combined objective function has a lot of weights in it. We can quite readily vary those weights and see how robust the strategy is with respect to them. That is a further, really quite informative, part of the process. One of the things we are wanting to do in this sort of project if we get the full funding for it, is to turn this into an interactive strategy formulation approach. We can then sit down with decision-makers who do not believe in safety at all and who may want to have a look at a strategy that does not do anything for safety. We could then see whether we end up with something different or with something that takes much more account of equity considerations, for example. That is potentially possible and really quite challenging in terms of the sorts of messages it might develop.

Going on now to your two questions, KonSULT certainly has an element of why it works, or at least it has an element of how it works, by looking at what happens to demand and what happens to supply. It attempts say in which contexts these will be most important. But that is one of the areas I feel least confident in at the moment, largely because there is very little evidence around at all on transferability of performance. I have just been putting together a special issue of *Transport Policy* on behalf of the new special interest group on urban transport. There is a paper by Mike Taylor and Liz Ampt from Australia, describing the very impressive work they have been doing there on awareness campaigns and individualised marketing. They have had similar sorts of successes in Adelaide, Perth and Brisbane. We do not even know whether we could transfer that to Sydney because Sydney has a higher level of congestion than these other cities, and it may be that people have responded already. Generally when one thinks about transferring experience not just to a city with different congestion but with a different culture, it can be very difficult to know the degree of transferability. There is a totally unploughed furrow there, which will be there for years, of really important comparative research to be done.

To the modelling question: shortly after congestion charging was introduced in London recently, two or three of my colleagues from the supplementary licensing study of 1974, the one that used Crystal, claimed that we had done pretty well then because we were then recommending a scheme virtually identical with what has now been introduced in London. I think we predicted a 25% reduction in car use. It was 20%. So Crystal, I think, did pretty well as a very early multi-modal model. In some ways it would be difficult to say we have improved on that a great deal. Areas where, I think, there have been improvements, are:

- in the demand/supply interaction;
- the feedback from congestion onto public transport performance;
- the feedback on parking utilisation on capacity and searching traffic in road systems;
- the feedback that is required in our de-regulated environment; and
- the feedback between levels of patronage and the service levels that operators will provide.

Things like that are new. Probably, if I had put those slides up 30 year ago, we would have had slightly more policy instruments that we could not model well. We have not actually made much progress in modelling a wider range on instruments, but I think we have made some progress: but nowhere near as much as should have been made.

**Comment (follow-on)**

I sense, from what you are saying, that the outputs in very global terms are not too dissimilar; but the actual mechanisms, particularly the operability, is much more understood.

**Tony May**

Just to interpolate a bit, the work that we did in the mid-1990s on congestion charging in London, using the APRIL model, and using SATURN and SATEASY as a local model, came up with totally different answers as between the two models. In both cases we had totally different answers from either what we were saying in the supplementary licensing study or what has happened now. So I think it actually got worse before it got better.

**Question**

Can we go back to the discussion about the conclusions emerging about, particularly, the work with FATIMA and the planning people, the important variables of public transport fares and frequencies, and some of the variables that are not important—the infrastructure measures. How does this relate to the current UK policy thrust which is all about delivering major projects—tram schemes in every city, the list of projects in the 10 year plan etc?

**Tony May**

Well you have almost answered the question for me. I have hinted when I mentioned those results that there is a tantalising set of questions behind them. What we know, and all we know, from those FATIMA results, is that the infrastructure projects that the cities gave us, at the costs which they said would be incurred in implementing them, were not worth building. At least, there would be better things to do with the money if one wanted to achieve the best benefits. That is certainly not to say that infrastructure is never worth investing in. One of the interesting asides is that the two cities where it was worth investing were the two UK ones, which says something about the pattern of past investment. I think there is quite an interesting reverse application of this model and I have been talking a bit with colleagues in the DfT about the possibility of pursuing this further. We are asking 'Given this city and the way we are projecting it, and knowing something about the relationship, if we could formulate it, between the cost of investment and the performance of the improved infrastructure, what then are the best infrastructure projects and how much is it worth spending on them?' Or turning the whole thing round to asking 'What are the corridors where investment would be most worthwhile?' And 'How much would it be worth spending to get to a given level of improvement?' Then, you should be able actually to formulate an infrastructure project that is affordable within that budget; if you cannot, then it is not worth pursuing. I suspect, and this is the engineer coming out in me, that with that sort of challenge you could also certainly find a simpler form of infrastructure which was more affordable. We only have to look at the way in which, as ever, we have over-engineered our light-rail projects in the UK to realise that actually we could get a lot more for our money if only we were prepared to simplify the requirements on the design.

**Comment**

One of the problems that we have in the UK is designing down to a price, rather than designing to a rational objective.

**Tony May**

Yes. You have put that far more simply than I did. They are the exact words I was looking for.

**Comment**

I wanted to comment about the idea of banning traffic from an area that was raised earlier. In a recent edition of Question Time, prior to congestion charging came in, Jeremy Clarkson agreed with the congestion charge idea, and said it should be a lot higher, because of the effect on the rich poor divide. Ken Livingstone's response was that that is all well and good as an ideal, but that there is a political barrier. Having said that, I have heard that the costs involved in running and maintaining the congestion charge form a very high proportion of the revenue that is generated.

**Tony May**

The figures I have seen suggest that the running costs are getting on for half of the revenue which is ridiculous and that certainly should not have been one of the outcomes. I do not know the figures with the current electronic system in Singapore, but in the original area licensing scheme, albeit with lots of probably rather lowly paid policemen in booths checking licences, the operating costs were about 15% of the revenues. It seems absurd that London seems to be operating at three times that level.

**Rod Kimber**

The argument they make is that they had to gold plate the system to remove all of the possibilities of catastrophic failure; but I agree entirely that it comes close to the real difficulty of not covering itself; and in that sense it raises real questions of financial efficiency.

**Tony May**

I should say that that is something we got wrong in the supplementary licensing studies because we were predicting a figure of about 15% too.

**Question**

The 10% reduction over 30 years: was that an aim or was that what could be achieved? I am a little unclear.

**Tony May**

What we were saying then was, by comparison with the 'do minimum' levels of car use 30 years hence, the optimum level of car use was about 10-15% lower—no less than that. Now we have to be a little careful in interpreting that because there are limitations in the way that the sketch-planning model predicts the growth in car ownership over time. Having said that, that sort of figure is quite consistent with results we have had from other studies—it is not inconsistent with what was coming out of the London congestion charging study either.

**Question**

You alluded a little to the role of regulation. It did not seem to come through quite fully in the factors you were looking at in terms of policy. I wondered whether that was partly because regulation was predominantly a national government policy area. I was thinking of examples, like the growth in the SUV market in the United States, which is fundamentally a result of the regulation they have had on the fuel economy, in that certain classes of vehicle are exempt from fuel economy regulations.

A counterpart of that is that if one has very strict regulations on fuel economy, things like carbon emissions, or, as an analogy in safety, on the pedestrian protection offered by vehicles, the city would then be freed up in a way from the sort of constraints that they are under at the moment. I wondered if there is a way in there, a scheme to look at these kinds of issues, turning the whole thing on its head, which you alluded to, saying what are the optimum national policies, in order to make things happen at the local level?

**Tony May**

I have two or three thoughts on that. First of all on KonSULT, which was designed specifically as an urban information tool, but for which there has been quite a lot of interest, and indeed interest coming out of some of the European work we are doing at the moment, in broadening it to cover national policies. When we do that, things like taxation, vehicle regulations and the regulation of public transport operation, need to be in it, and we will have to change its structure somewhat to facilitate that. We cannot ask the same set of questions in the same logical way, so that is going to be an interesting challenge for us in the next year or two if we go that route. Secondly, we have in our optimisation work, and in some of the work we have been doing with the Department for Transport recently, been looking at ways in which we could change the national policy which would make it easier for the local policy to work well. So it is possible to set that up as a context—as a scenario if you like—and it is possible to say that one could optimise that as part of the optimisation for the city. To take a simple example, one could certainly deal with fuel tax in that way and indeed we have. But of course, what we are not doing is looking at the effects of that policy outside that particular urban context. I think it is perfectly possible, if one wants to, to use these sorts of techniques at a national level as well, albeit one has to have a fairly simplistic national model. The greater difficulty I think in responding to the question is how best regulatory instruments are modelled, in which people can either use a particular type of vehicle or not, as opposed to the fiscal and management instruments. I am sure it can be done, though, given time.

**Rod Kimber**

It is a measure of how interesting and wide-ranging Tony's talk was that we have had so much stimulating debate from it. There is still much discussion we could pursue and quite obviously we could go on for some time! This is a challenging area at the forefront of the policy possibilities, and the work Tony has described is providing tangible argumentation and understanding which I think bodes well for the future. So let me thank you, Tony, on behalf of all of us for giving us a superb lecture and stimulating an extremely impressive debate.

**Tony May**

Thank you all very much for being with us this evening. I should in closing do what I ought to have done at the outset, particularly with Bryan in the audience [and Nagata as well], and thank a number of my colleagues in the Institute who have worked with me on this range of programmes, and indeed colleagues in the School of the Environment who worked with us on the KonSULT databases—it is very much a team effort and a stimulating one at that so thank you very much indeed.