

# SCENARIO MODELLING 101

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*Prepared for the Engineers Australia/UNSW joint seminar "Planning Sydney's Transport", 2 September 2003.*

## 1. Sketch modelling

Scenario modelling differs from conventional forecasting in that it is not attempting to predict the likely future, but is looking at a range of possible futures and seeking to understand the differences between them.

The question it addresses is not "what" but "what-if". This process is sometimes called sketch modelling.

The following extract from a paper presented to the Australasian Transport Research Forum in 1992 puts sketch modelling in perspective.

*"Sketch modelling" is viewed in some quarters with scepticism. The phrase itself implies something incomplete, unprofessional, inaccurate, less than serious. The sometimes-used alternative description of "cartoon strategies" is no improvement. That a sketch must have been the basis at some stage for the ceiling of the Sistine Chapel indicates the other side of the story – at the right time, and for the right purpose, sketching is an invaluable, even indispensable, technique.*

*It is essentially a modelling approach for exploring alternatives rather than for forecasting. It largely dispenses with the traditional resource-hungry network-modelling approach but it does address a wide range of policy issues and future possibilities. It is only useful in a strategic context, where broad decisions on how to proceed into the future are needed. It will take a long time for futures recognisably different from today or from each other to emerge, and so the time horizon for sketch modelling must also be long – twenty years or more.*

*Once these broad decisions are in place, the more conventional planning techniques and their associated models come into play. Conversely, in the absence of strategic planning, conventional methods will continue to deliver more of the same.*

*From Is Sketch Modelling of Any Practical Value in Transport Development? By Kilsby, Prince and Stewart, ATRF 1992.*

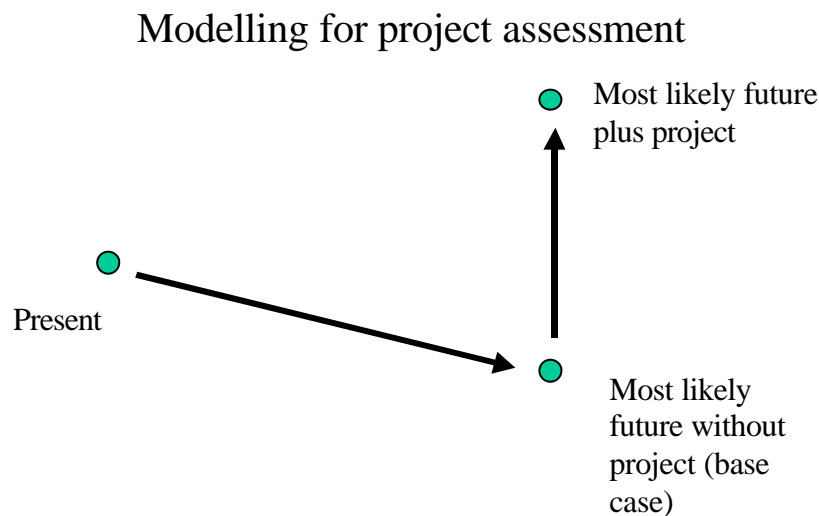
Advances in computer technology since 1992 now allow the use of more substantial models than those envisaged in the above, but still in keeping with the spirit of sketch modelling. A better description of this approach, when powerful models are used, is scenario modelling.

## 2. Conventional forecasting and scenario modelling

The difference between conventional forecasting (usually undertaken for the assessment of specific projects or for operational planning) and scenario modelling will become clear from the following two pictures.

The first shows the conventional approach.

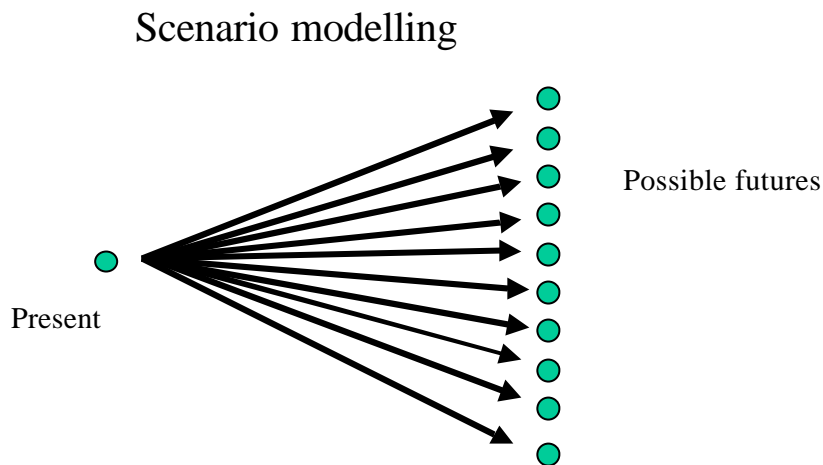
- A lot of effort is spent in making sure the model can replicate the present (or recent past) – because validation data for the future is of course not yet available.
- Also a lot of effort is put into predicting the most likely future, in detail.
- When there is confidence that the model can reproduce travel behaviour sensibly and that the description of the future is as realistic as it can be, a future “base case” is run, without the development or infrastructure or plan being assessed, and another run occurs with it.
- Since the only difference between the two sets of runs is the presence or absence of the project being assessed, the difference between the outcomes must represent the impacts of the project.
- (This is a gross over-simplification but it will suffice for now).



The second picture shows the approach for scenario modelling.

- The validation stage is still essential, but now there is no project to be assessed.
- There are many runs to estimate future outcomes, each using different assumptions about the future.
- There is no “most likely” future (though there may be a “Business As Usual” prediction – but it is most likely that business won’t be “as usual” in future!)
- There is no “best” future if a range of performance measures are used. It would be remarkable if one scenario appeared to be best unambiguously, ie producing

the most desirable performance in every aspect. That would probably indicate that the range of performance measures was too narrowly chosen.



With many alternative outcomes, the issue becomes whether the differences between them are at all important and if they are, what were the differences in the inputs that led to the different outcomes. The strategic conclusions are drawn by comparing one future scenario against others, not by considering it in isolation. This of course implies that the scenarios require some common basis which enable them to be compared directly – for instance a common level of investment or future activity.

### 3. The March of Time

The remarkable rise in the power of computers and hence models in recent years can be seen by comparing two applications which were similar in spirit but over ten years apart.

- The first was the “Road Transport – Future Directions” project, conducted for RTA in 1990. This was a statewide study, with a set of compatible models for different parts of NSW which together gave statewide performance measures.
- The second is the “Scenario Modelling Project” conducted for the (then) DoT. A first stage was carried out in the second half of 2001, and a further stage in early 2003.

The table below compares the Sydney model used in the two exercises. Both studies used a multi-modal travel model. The more recent exercise was able to use the Strategic Travel Model for Sydney, previously described in this seminar, which is several orders of magnitude more complex than the model developed for the RTA study. It also has 125 times the geographic resolution (the ratio of the squares of the zone size). Despite this, the elapsed time to run a scenario is only twice what it was in 1990 for a much simpler

modelling process – and this will continue to reduce as more powerful processors continue to be released.

Project	Road Transport Future Directions (RTA)	Scenario Modelling Project (DoT)
Duration	1990	2001 & 2003
Scope	NSW – land use, transport networks, price	Sydney – population growth, employment growth, transport investment
Model	Specially built for Sydney (EMME/2)	Sydney Travel Model (STM)
Zones	75	844
Scenarios	8	24
Processor	25 MHz 80386	2 GHz P4
Hard drive	300 Mb	80 Gb
Run time per scenario	2 hours	4 hours

A conclusion is that computational constraints are no longer the limiting factor for scenario modelling.

However the greater level of detail involved for both inputs and outputs is potentially resource-intensive if everything is to be checked carefully (as would be the case with conventional forecasting). But because the focus of interest is on the differences between outcomes rather than the individual outcomes, it is quite acceptable to use automated techniques to generate detailed inputs from relatively broad decisions (such as the percentage of new dwelling stock to be built on the fringe over the modelled period – 15%? 30%? 45%?). Systematic bias, if any, will largely cancel itself out in the comparison. Likewise the detailed outputs require aggregation to some summary indicators if different runs are to be compared quickly.

### 3. Case Study

In the presentation I will show some of the aspects of scenario modelling, using the first stage of the Sydney project (2001) as the source of the examples. These will show how:

- it is necessary to establish a common element between scenarios, so that there is some basis for comparing them. For the Sydney project, all scenarios for 2021 had the same population (and so the establishment of this control total was a key step). For the earlier NSW project, the common element was the population of the entire state, with some scenarios varying the distribution of growth between Sydney and other areas. Therefore it was not possible to compare outcomes for Sydney directly, but the Sydney performance had to be combined

with performance in other parts of the State to allow comparisons of total State performance. There were in fact complementary models for Newcastle, for Wollongong and for non-metropolitan NSW which produced outputs compatible with those of the Sydney model, so this could be done at State level.

- future land use distributions and transport networks had to be defined in sufficient detail for the model being used to function. In the case of the SMP, this meant defining population and employment totals for each of 844 zones for each scenario.
- likewise the outputs of the models, which are very detailed, must be aggregated in some way to allow for broad comparisons of scenarios. These are just the tip of the iceberg but looking at the vast amount of detail “below the surface” is a resource-intensive luxury.

Time does not permit discussion of the results in any detail. The broad conclusions that were drawn from the comparison of the scenarios covered:

- the inertia of the metropolitan area – there will be limited change at the strategic level whatever the scenario, because so much of future performance is determined by what is already there today.
- the need for transport infrastructure in growth areas – despite the first conclusion, it is clear that some severe local problems will arise if population or employment growth is allowed to happen without corresponding provision of transport infrastructure and services.
- the effects of growth scenarios on the CBD – the effects tend to manifest themselves for road planners in the growth locations themselves, but for rail planners in the CBD where trains from all areas converge.
- the effects of intervention in fringe development – either increasing or decreasing the number of new dwellings provided by half the total change to be expected under “Business As Usual”.
- the effects of greater concentration of job growth in centres and around existing railway stations – while this tends to increase rail use, it also generates greater road congestion in the vicinity of the affected centres and highlights the importance of complementary policies governing parking and local buses.
- the great variation of performance within the metropolitan area largely independent of any scenario – this provides food for thought for those concerned with equity issues.

#### **4. Conclusions**

We have seen that scenario modelling calls for a different approach from conventional forecasting, and that computational performance need not be a constraint today.

Scenario Modelling helps to develop strategy, through enhanced understanding of complex relationships and uncertainties.

Conventional forecasting then helps to implement strategy, through the process of project assessment and refinement,

The results and findings from the Scenario Modelling Project, and before that from the “Road Transport Future Directions” Study, illustrate the power of the first approach