Revised Final Report

Department of Infrastructure and Transport

An investigation of the causes of over-optimistic patronage forecasts for selected recent toll road projects

8 December 2011

Executive Summary

The Australian Government Department of Infrastructure and Transport is investigating the causes of over-optimistic patronage forecasts with the purpose of identifying potential remedies. This report contributes to that investigation via case studies of selected toll road projects to identify challenges in processes and opportunities for improvements, so that lessons from the past may guide practice in the future.

Two major cases CityLink (Melbourne) and Lane Cove Tunnel (Sydney) with two supporting cases Westlink M7 (Sydney) and the Go Between Bridge (Brisbane) were chosen for coverage of geography, timing, physical characteristic and forms of funding.

Desktop research supported by interviews with stakeholders covering the spectrum of stakeholders in the road procurement process found:

PPP bidding processes for toll roads lead to selection of the most optimistic of optimistic forecasts:

- Government forecasts, erring on the high side to avoid under-estimating environmental impacts, may set a forecast 'floor'
- Traffic modellers in bid teams produce a 'low' forecast above this floor for debt lenders and a 'high' estimate of possible returns for those taking equity
- Equity forecasts are submitted with bids and the highest forecast almost always wins.

Four-step models used in most toll road forecasts:

- Have some intrinsic positive biases when modelling toll road patronage
- More importantly they provide many opportunities for optimistic selection of parameters
- Optimism can more easily occur in the absence of data for example about values of time or traffic flow by day of week and month of year; and
- Estimates of ramp up in traffic after opening may be especially subject to optimism; and/or
- Deliberate selections to raise forecasts, such has high growth rates for population or the economy, may be applied.

Pressures for optimistic selection may occur when:

- Government proponents keen to have a road built do not make use of advice available from government sources, such as treasuries, to consider the commercial viability of the project and so seek full private sector funding for a risky project
- High private sector 'appetite' for funding road projects leads to bidding for risky projects. At the time of bidding desire for profits exceeds fear of losses
- High construction costs (as for tunnels) and fixed toll levels mean high traffic forecasts are needed to show costs can be recovered
- Financial models for optimising the bid encourage high forecasts
- High levels of competition increase the desire to produce high traffic and revenue forecasts to win (perhaps exacerbated by the high costs of bidding)
- Acceptance by the government of upfront payments as part of bid. This reduces 'costs to the public purse' for associated works, but needs to be funded by higher revenue forecasts.

Opportunities for over-optimistic forecasts can occur when:

- Bid technical reviews concentrate on forecast processes only and not on values
- Expected complementary infrastructure does not eventuate or changes to competing infrastructure changes occur; and
- Liaison between the bidding teams and the government proponent is limited.

Remedies under the control of government that can be applied in the short term are needed to ensure investor confidence:

- Major changes to traffic forecasting models are neither feasible in the short term nor usually within government control. Nor would such changes totally remedy over-optimism
- Options for reducing incentives for over-optimistic forecasts and/or reducing acceptance of over-optimistic forecasts provide more effective and more immediate solutions at all stages of the tender process.

Pre-tender:

- Inclusion of appropriately skilled Treasury officers or other Government officers in the proponent team may provide a useful complementary commercial focus to that of the project instigators
- A commercial case prepared in addition to the economic case for the project could check if full private funding was likely to be commercially viable
- Consideration of PPP models that include some government payment or early year risk sharing in commercially risky projects may reduce incentives for over-optimism, since there are significant incentives to produce early year revenue forecasts, even if optimistic, which will cover costs.

In setting tender conditions:

- Toll levels and escalation should be set by the bidder
- Bids must include one set of forecasts based on a specified Strategic Travel Model
- Government supply of traffic and travel data, with suitable indemnities, to avoid over-optimistic ‘guesses’
- A requirement that an audit report be submitted with the bid addressing set key questions about input parameter and forecasts. This process should both identify and discourage over-optimism
- Encouragement for consortia that are likely to be ‘in it for the long run’ since they might have greater incentive to produce realistic forecasts. This could perhaps be done via weighting in assessment.

In bid assessment:

- Short-listing based on consortia capacity and experience to two bidders (guidance only) would reduce bidding costs and allow the proponent to work more co-operatively with the bid teams
- More holistic technical assessment processes that consider forecast values as well as processes and may thus avoid rewarding very over-optimistic forecasts.

Importantly consortia and their modelling teams differ in both pressure applied and response to that pressure and thus not all forecasts are over-optimistic. A selection of remedial measures could reward realistic forecasts and increase confidence in both forecasts and modellers. This should mean that modelling teams will be willing to support bids when investors are willing to bid.

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1. Context

1.1 Introduction

Over-optimistic patronage forecasts have contributed to the commercial failure of a series of major toll road projects in Australia including the Sydney Cross City Tunnel, the Lane Cove Tunnel, and Brisbane's CLEM7. Overly optimistic patronage forecasts may:

- Direct scarce resources to underperforming investments, which in turn may reduce productivity;
- Make it more difficult to attract private-sector funding for future worthwhile infrastructure projects. Indeed, no Public Private Partnership (PPP) in Australia with patronage risk attached has proceeded since the Global Financial Crisis; and
- Hurt investors, possibly reducing confidence in Australia as an investment location.

International experience has shown that this problem is not confined to Australia. As Bain (2009a) has reported, in studies covering toll road projects on all continents, over-optimistic forecasts are common for toll roads built under private sector financing arrangements. However, it is possible that the problem is particularly severe in Australia. While Bain suggests actual traffic volumes are on average 23 per cent below forecasts in winning bids, a study by Li and Hensher (2010) of Australian toll roads found actual traffic volumes for five recently opened toll roads to be, on average, 45 per cent less than forecasts in the first year of operation.

Government initiatives to reduce the risk to investors of being misled by over-optimistic patronage forecasts could be an important step towards restoring confidence in the Australian PPP market. This could apply particularly for toll road projects where traffic risk is passed to the private sector. If governments are to implement practical solutions to encourage forecast improvement, they need to understand the underlying causes of the over-optimistic forecasts for recent toll road projects.

To identify practical measures to reduce over-optimistic forecasts in the future, for the benefit of investors, the Department of Infrastructure and Transport (the Department) is undertaking an investigation of the causes of over-optimistic patronage forecasts with the purpose of identifying potential remedies. The investigation began with a literature review, by Harvey and Lu (2011), of international experience in toll road forecast outcomes. This identified the trends detailed above and reported views on their causes. However, detail can be lost when project information is aggregated.

GHD in association with RBConsult, was therefore engaged to investigate selected recent toll road projects providing an in-depth study of the projects, processes, consortia involved and their contexts. This is not intended as a technical modelling review, nor is it seeking to attribute fault to any party. The aim instead is to identify challenges in processes and opportunities for improvements so that lessons from the past may guide practice in the future.

The case investigations involved examination of documentation from public, and, where available, private sources and very importantly interviews. When the landscape for the investigation changed, as when for the first time in Australia, traffic modellers faced potential legal action[1], asking people about cases in which they had been directly involved, was no longer viable. Instead a wider range of people with knowledge relevant to the case studies were interviewed and questioned about toll forecasting in general.

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[1] On April 14 2011, Maurice Blackburn Cashman and litigation funder IMF announced that information had been sent out to possible participants in a potential class action by Rivercity unit holders against the traffic modellers responsible for the Brisbane CLEM7 Tunnel forecasts.

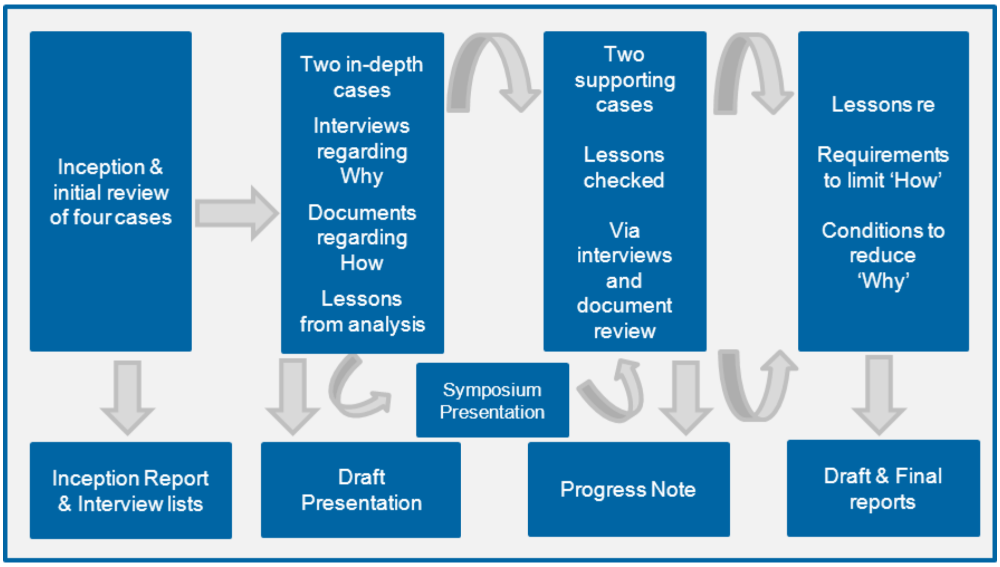
A Symposium on June 21, 2011 in Canberra brought together a wide spectrum of stakeholders with expertise in toll road projects to discuss issues related to over-optimistic forecasts. The results of the literature review and interim results from this study were reported. A report of the symposium can be found at BITRE (2011).

This document, the Final Report for this study, expands on those interim results and includes the results of further investigation, some stemming directly from suggestions made at the symposium.

The Report is structured as follows:

- Section 1.2 details the approach to the project, which, as outlined in Figure 1, balances depth and breadth of investigation;
- Sections 2 to 4 profile the case study projects, providing commentary on the forecasting outcomes;
- Section 5 then presents a series of influences identified during the course of this project that may be leading to optimistic toll road traffic and revenue forecasts in general, with over-optimistic forecasts in winning bids; and
- Section 6 completes the report with remedies suggested during this project that may both limit the scope and reduce incentives for over-optimism in forecasts
- An Appendix makes some suggestions for improving forecasting practice.

Figure 1: Integrated Investigation Framework



Source: GHD

1.2 Approach to the project

1.2.1 Evidence based lessons

The key purpose of the case studies is to provide evidence-based lessons which then might be applied in future PPPs to achieve more realistic forecasts. This requires a clear understanding of underlying causes of overestimation: **Why** did over-estimation occur? It also requires detail of the processes leading to over-estimation: **How** did over-estimation occur? Understanding both the reasons and mechanisms for over-estimation should lead to two complementary sets of recommendations for improving forecasts. The first would cover changes to conditions that encourage optimistic estimation and the second could include process checks. Much of the research effort in examining the patronage overestimates has concentrated on either establishing:

- The frequency and/or severity of over-estimates; or
- How/where the over-estimation occurred.

The reason for over-estimates has been predominantly left to anecdote such as '*it is as simple as ABC*: (*A) Higher predicted toll revenues are more attractive to investors in a proposed road project. (B) Therefore higher traffic forecasts are more attractive to proposal proponents. (C) This in turn leads to pressure on modellers to "move up" the forecasts by various means*.'[2]

However this causal relationship, even when true, is not likely to be simple. There are questions covering pressures and mechanisms for inflation at each stage of estimation. Uncovering these is the role of the case studies. The generic set of case study tasks, provided with the brief, and shown in Table 1, allowed investigation of both how, when and why conditions led to over-optimistic forecasts.

Table 1: Generic Case Study Tasks

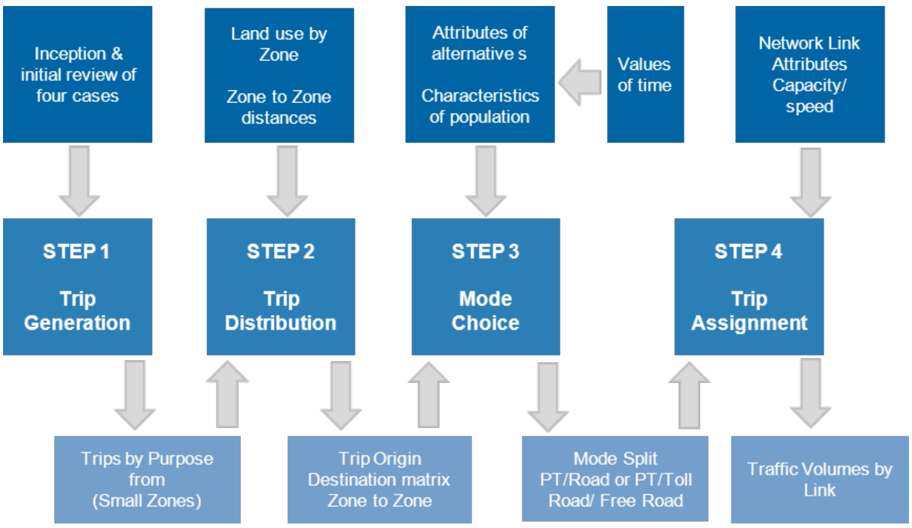
	Tasks
1	Investigate the background, sequence of events, the various forecasts made including the method, purpose and target audience, how the various forecasts compare with each other and with actual outcomes, and the roles and motives of the individuals and organisations involved
2	Attempt to identify the reasons for the differences between the various forecasts both with each other and with actual outcomes
3	Comment on whether the forecasts were reasonable at the time they were made and whether adequate provision was made for risk and uncertainty
4	Prepare a written account of the above, including a chronological relation of events

Source: Department of Infrastructure and Transport Study Brief

While in-depth investigation of modelling processes was outside the scope of the study, a broad understanding of the modelling process is needed to understand the forecasting issues raised.

The winning bids in each of the cases studied, and in most other cases mentioned, used a four-step travel modelling process. The four steps of the model together with the types of data needed at each step are shown in Figure 2 to provide context to discussion of models, data and forecasts in the cases studies presented in Sections 2 to 4. The ways in which this modelling process can influence over-optimism in forecasts is detailed in Section 5.

Figure 2: Four-step Travel Model and Required Data



Source: GHD

[2] "*Quotations in italics*" throughout this document are direct quotes from people made during the course of the study but not attributable to individuals due to confidentiality undertakings.

Note: Four-step models are “end state” or equilibrium models that estimate patronage after travellers become accustomed to the new facilities. Early traffic estimates are made by the overlay of heuristic discount curves, based on experience, to estimate growth or “ramp up” as traffic moves from old to new routes.

1.2.2 The case studies

The case studies were selected to give coverage of as full a range of project attributes as possible:

- **Geography**: to include jurisdictional and local differences in the three Australian states currently with private toll roads;
- **Timing**: from one of Australia’s first PPP toll roads to the most recently opened PPP toll road project;
- **Physical characteristics**: including a tunnel, a bridge, long roads and the shortest toll section in the country; and
- **Type of funding**: ranging from all private capital, through listing on the Australian Stock Exchange, to full government ownership.

These criteria resulted in selection of the following set of cases:

- Two major studies **CityLink** in Melbourne and the **Lane Cove Tunnel** in Sydney; with
- Two supporting studies: **Westlink M7**, also in Sydney, and the **Go Between Bridge** in Brisbane.

However, as noted in the next section, the amended interview process also provided information about projects not specifically listed above.[3]

Covering a variety of general rather than project-specific questions proved to be a benefit rather than a disadvantage. Comparisons with other projects helped set case study projects in context. The process also allowed different views to be canvassed, and, conversely, made it easier to develop some generally agreed principles and options.

1.2.3 Interviews and interviewees

Interviews covered the spectrum of stakeholders in the toll road procurement process:

- **Government** sector stakeholders included treasury officers charged with overseeing procurement, road planners, engineers and government modellers.
- **Private** enterprise covered constructors, road operators, equity investors and debt providers, plus importantly, the traffic modellers who provide the forecasts, for both bid teams and government public sector comparators.

Most people spoke on condition of not being named in the report. While some individuals were willing to have their name and even firm listed, it would be misleading to provide a partial list since views expressed by others might be wrongly attribute to those listed. However, the listing by role shown in

Table 2 indicates the knowledge and experience brought to the issues.

There are 36 roles shown for the 26 individuals interviewed as numbers of the people interviewed had served in multiple roles. It is not surprising that modellers make up the largest category of interviewees but the table also shows coverage of all stages of the proposal. Roles span activities

[3] It is noted that the sample size is modest; however, the range of features across the different cases is actually quite substantial. Furthermore, the Symposium and interview program also significantly widened the scope of data capture for the study.

from initial setting of tender conditions by government agencies, through the consortia development and bidding, to final assessment, and in some cases, update of forecasts post opening.

Table 2: Interviewees by Role in Toll Projects

From Private Firms		From Government	
Road Operators	5	Project Proponents	4
Constructors	4	Treasury	3
Debt providers	3	Government Modellers	4
Equity Holders	5		
Modellers	8		

Interviews were usually scheduled for 45 minutes and most were about this length. The shortest interview was 30 minutes and the longest over 2 hours. To make best use of this limited time interviews concentrated on the special experience and knowledge of interviewees.

People were assured they would not be questioned about individual forecasts although most did illustrate responses with project based examples. Some 'on the record' facts such as the composition of bid teams and bid timing were specifically checked if people were both willing and able to answer. This was helpful as both recollections and written sources sometimes differed on such details.

Particularly in later interviews, people were asked to comment on both suggested reasons for over-optimism and potential remedies to reduce it. This allowed us to develop a set of potential remedies which others also consider viable. These are presented in Section 6 and qualified where needed by dissenting views.

Information on issues influencing optimism divided into two types:

- Views on a range of reasons for disparities between actual and forecast traffic ranging from inherent model biases to structural issues with tender processes are presented in Section 5. While evidence was often cited in support, these views are individual opinions which are, by their nature, subjective; and
- Predominantly factual information relating to individual cases, most of which can or could be checked. This is presented, after discussion of forecast and actual traffic results for each case study, in the following Sections 2 to 4.

Key Points from Context Section

- An investigation of the causes of over-optimistic patronage forecasts with the purpose of identifying potential remedies is underway.
- This study contributes to that investigation via case studies of selected toll road projects to identify challenges in processes and opportunities for improvements, so that lessons from the past may guide practice in the future.
- Two major cases CityLink (Melbourne) and Lane Cove Tunnel (Sydney) with two supporting cases Westlink M7 (Sydney) and the Go Between Bridge (Brisbane) were chosen for coverage of geography, timing, physical characteristic and forms of funding.
- Desktop research was supported by interviews with stakeholders covering the spectrum of stakeholders in the road procurement process.

2. Case 1: CityLink (Melbourne)

2.1 Background and location

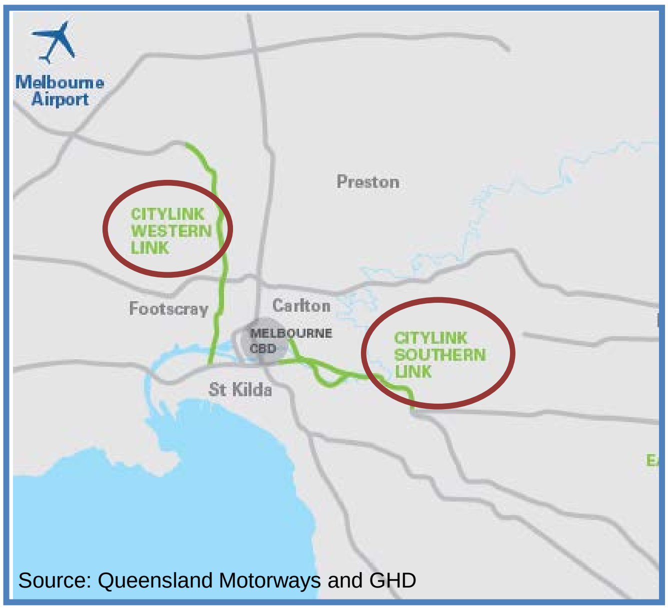


Figure 3: Location of CityLink in Melbourne Network

CityLink is a 22-kilometre automated tollway in Melbourne. It consists of two sections, the Southern and Western Links. The tollway links the major routes between Melbourne Airport, the Port of Melbourne and industrial centres in the south-east as well as the CBD with a mixture of road upgrades, elevated roadways and tunnels (Figure 3).

The project was procured under a Build, Own, Operate and Transfer (BOOT) contract and the tollway has operated since 1999/2000.

CityLink was the first fully electronic toll road in Australia. A more sophisticated charging structure than generally viable with cash based tolls could therefore be applied.

Charges vary by the class of vehicle, entry and exit locations of a trip, time of travel (peak or off-peak) with a trip cap (for holders of a CityLink account or for any e-TAG toll account issued in Australia). The tolls were to be adjusted quarterly by the greater of the quarterly increase in the Consumer Price Index (CPI) or 4.5% per annum converted to a quarterly compound rate plus one (MCLA, 1995, Schedule 1 p. 289). This escalation mechanism is in place until October 2015; thereafter, CPI escalation is to be applied. The initial toll cap for cars was $3.77 per trip in 2000 and in July 2011 was $7.04. Tolls are collected either through accounts tied to electronic toll tag recognition (e-TAG) or purchase of passes for travel checked by number plate recognition.[4]

2.2 Chronology and participants

2.2.1 Project history

Various planning studies in the 1950s and 60s proposed a network of freeways around and serving the Melbourne CBD (Muhammad and Low 2006). From 1987, Victorian Government studies highlighted the desirability of constructing two new and upgraded links, including the Metropolitan Arterial Road Access Study (1987), the National Roads Strategy Victoria (1987) and the Central Area Transport Strategy (1991) (Victorian Auditor General 1996).

The overall objectives of the CityLink project were to (GAMUT 2008, p. 15): reduce through traffic on inner city streets; improve the environment around the river, gardens and entertainment precinct; optimise economic benefits while minimising financial costs; improve access between industry and the port, rail and airport facilities; and minimise environmental and social implications along the bypasses and feeder roads.

[4] When an e-TAG is not detected and the vehicle registration number is not recognised on a CityLink account or Pass, a Late Toll invoice may be issued to the owner of the vehicle for payment of travel on CityLink

More specifically, in traffic terms, the project aimed to link the three adjoining freeways (and increase the capacity of the Tullamarine and Monash freeways) to provide western and southern by-passes of the CBD (Lay and Daley 2002).

2.2.2 Bid process, structure and participants

In May 1992 expressions of interests were called for 'to build, own and operate' the roads ultimately known as CityLink (Odgers 2002). Five proposals were received in response in July 1992, with two consortia short-listed based on predetermined selection criteria (Victorian Auditor General 1996). These consortia — Transurban and CHART Roads — were announced in September 1992 (Victorian Auditor General 1996). The Transurban consortium comprised Transfield Construction and the Obayashi Corporation, while CHART Roads comprised Clough Engineering, John Holland Construction and Engineering, Roche Brothers and Theiss Contractors (Victorian Auditor General 1996).

Over the subsequent two years, the Victorian Government considered several changes in scope, tolling technology and financing models before setting up the Melbourne CityLink Authority (MCLA) to oversee the project. The final project brief was issued to the short-listed consortia in September 1994. Both short-listed consortia responded to this brief, requiring detailed traffic forecasting by each (see section 2.3).

Importantly the tender conditions allowed "Toll price and pricing mechanisms are to be negotiated at financial close." (Transurban, 2009)

After an iterative process of tender submissions and evaluations, Transurban was ultimately selected and announced as the preferred consortium in May 1995, with CHART Roads given "active reserve" status. In July 1995, a Memorandum of Understanding was entered into by the MCLA and Transurban, which was subsequently formalised in the Concession Deed signed in October 1995 and the Melbourne City Link Act in December 1995 (Victorian Auditor General 1996). The agreements were on the basis that:

- Transurban had responsibility for the construction of the CityLink;
- Related property acquisitions, specified roads works and landscaping would be financed by the State at an estimated cost of $266 million;
- The land on which the project was to be constructed would be leased to Transurban by the State, with the State receiving additional revenue if actual cash flows exceeded the determined projected figures[5]; and
- Transurban would collect road tolls over a 34 year period (ending 14 January 2034) for public usage of the 22 kilometre length of the CityLink. At the end of this period, the ownership of the CityLink will revert to the State at no cost (Victorian Auditor General 1996, p. 117).[6]

CityLink's capital cost was estimated at around $1.8 billion for Transurban plus another $0.35 billion from the State Government (GAMUT 2008). Transurban financed upfront construction costs using a mix of debt and equity (Table 3). In 1996, a prospectus was issued to assist with raising around $0.5 billion of equity. Transfield and Obayashi provided around $0.2 billion of this total, with institutional investors contributing a further $0.25 billion and the remainder from private investors (GAMUT 2008). The remaining $1.3 billion debt finance was raised from, and underwritten by, a syndicate of banks with 17-19 year loan maturities (GAMUT 2008). These banks included each of Australia's four largest banks and several local subsidiaries of international banks (GAMUT 2008). These lenders have secured the debts through 'deeds of charge' over

[5] It is understood that additional concession fees are triggered if actual revenue exceeds are pre-determined value or actual equity return exceeds this same pre-determined value

[6] It should be noted that "early termination" provisions are in place.

Transurban's assets and obligations, and mortgages over project leases (Victorian Auditor General 1996).

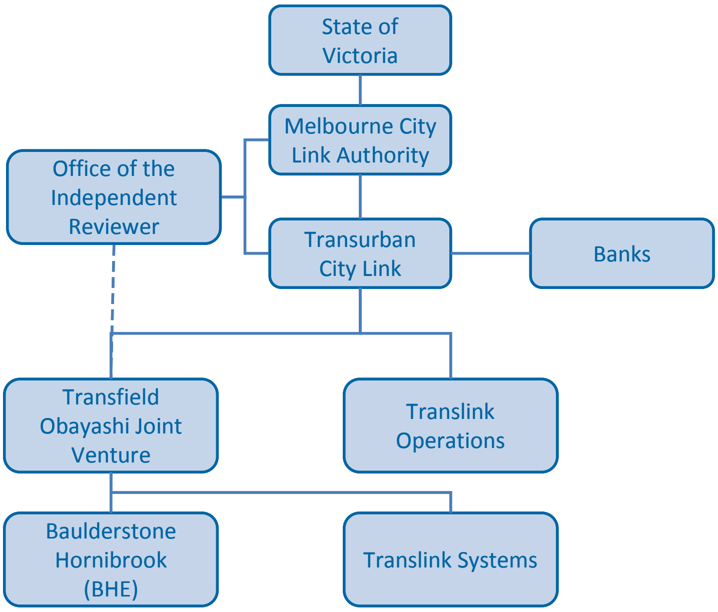
Construction commenced in May 1996, and the Western Link opened to traffic in August 1999[7] as the first toll road in Melbourne and the Southern Link fully opened in late December 2000. Tolling of all sections of CityLink began on 28 December 2000 (Odgers 2002). The overall financing and operating structure is summarised in Figure 4.

Table 3: Institutional Roles in CityLink

	Government	Constructor	Equity-holders	Debt-holders
Entities	Victorian Govt / Melbourne City Link Authority	Transfield and Obayashi plus Baulderstone Hornibrook	Transurban, Transfield, Obayashi, infrastructure financiers, institutional and private investors	NAB, CBA, Westpac, ANZ, BNP, Credit Lyonnaise, IBJ
Role in CityLink	Granted concession; administration expenses; receive minimum revenue	Construction, ownership, operation, financing	First losses if toll revenue insufficient to pay all expenses	Losses only made if equity exhausted

Source: GHD based partly on GAMUT (2008)

Figure 4: Financing and Operating Structure of CityLink



Source: Muhammad and Low (2006)

2.3 Modelling, forecasts and outcomes

2.3.1 Models and model teams

Patronage modelling — including forecasting of traffic flows on CityLink — was performed for and by a range of different participants at different stages in the process. A range of preliminary models were developed to prepare a business case for development of CityLink.

[7] The certified date of completion is understood to be 23 December 1999.

Once the decision to proceed with the project was taken there were three groups of traffic modelling teams involved:

- **Government**: Veitch Lister and Sinclair Knight Merz (SKM) both acted for the Melbourne City Link Authority (after being asked by the MCLA to stand aside from the Bid Process);
- **Transurban**: Denis Johnson and Associates/Maunsell (travel modelling) with Acer Wargon Chapman (now Hyder) for traffic estimates and Transport Research Centre (RMIT) (Tony Richardson now the Urban Institute) for travel data provision and Stated Preference studies — with R J Nairn and Partners as internal model auditors; and
- **CHART Roads** (unsuccessful bidder): Arup together with support from consortia firms.

Transurban developed a four-step model (using a TRIPS platform) adapted from the existing Country Roads Board Strategic Model for Melbourne. The model developed produced peak period, 24 hour and commercial vehicle volumes. The team imported data from VITAL, the Victorian Integrated Travel, Activities & Land-Use Toolkit, developed by RMIT. This provided land use and network data and importantly, household activity and travel survey data. The team put considerable effort into new forms of Stated Preference Surveys and modelling, attempting to establish the effect of electronic tolling (new to Australia and relatively new in the world) on patronage. Toll road patronage for alternative toll levels was estimated, as toll levels were not fixed.

As four-step models are end state models that do not include ramp up, the model team needed to develop ramp up curves on the basis of available information, which was limited at that time. Data from recently completed projects including the Western Ring Rd and the Scoresby Freeway were used for calibration with the Scoresby data particularly used for heavy vehicle forecasts.

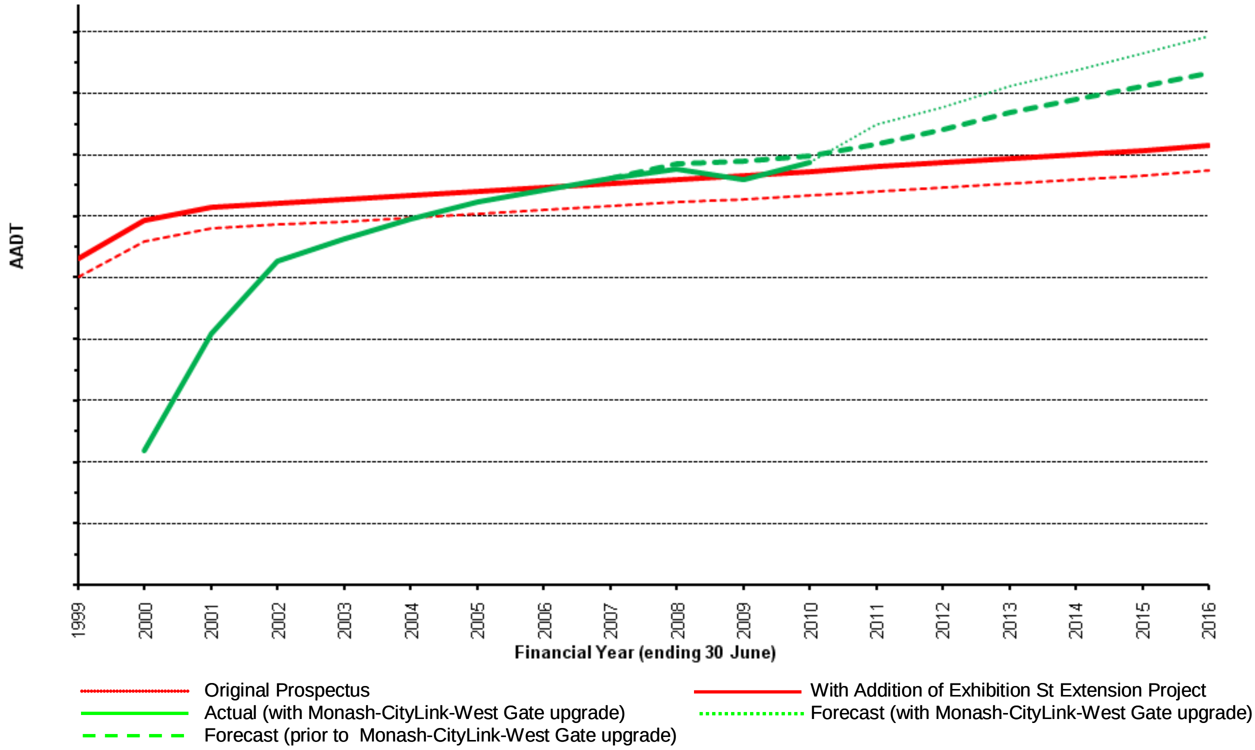
The Transurban model developed for forecasting was handed over to the Melbourne CityLink Authority for ongoing use in line with contract conditions. Veitch Lister Consulting also used their own TRANSCEND travel modelling package.

2.3.2 Forecasts compared to outcomes

Opening patronage was impacted by technical problems with the automated tolling systems which even resulted in some accounts being charged before opening. This generated considerable hostile press and very likely reduced the number of people opening toll accounts and subsequently, using the motorway.

After the initial problems were resolved the traffic improved but still tracked below forecast levels. Specifically, the average weekday traffic volume on the CityLink Western link in 2001 was approximately 15 percent below the projected 2001 volume. However, it is worth noting some sections with higher traffic levels compensated for others with lower levels, differences varied from 9% above to 39% below forecasts (Odgers, 2002). After 9 years of operation, in 2008 the gap between the projected and actual volume of traffic had closed to within 6 percent (Figure 5).

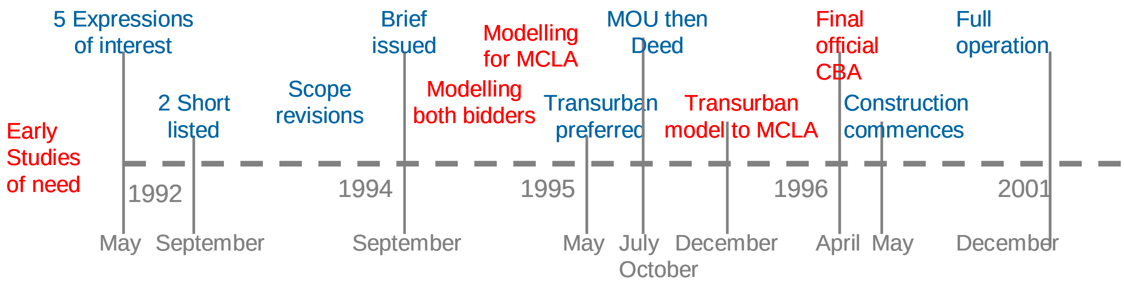
Figure 5: CityLink Forecast vs Actual



Source: Transurban prepared for this Project (AADT numbers removed to protect confidentiality)

Figure 6 shows, in red, the timing of modelling activity, within the context of the CityLink timeline, from a call for expression of interest in May 1992, to full operation to December 2001.

Figure 6: Modelling within the CityLink Timeline



2.4 Project specific views from case interviews

Interviews with stakeholders directly involved in the CityLink Project and forecasts involved more fact checking than those for other case studies since it was harder to get factual information for this older project. Most of that interview information could be cross checked and has thus been included in the project information above. The comments reported below on processes could not be checked but seem relevant to forecast issues.

Project Initiation

It was noted the original impetus for CityLink came from private sector lobbying to government regarding:

- The need for the infrastructure to avoid future damage to Melbourne's reputation as an international city; and

- An opportunity for private sector investment to speed provision of that infrastructure.

Considerable time and effort was spent deciding whether the project was needed, viable and best delivered by private investment. Several interviewees classed it as obvious “low hanging fruit” for private investment.

CityLink as an early tollway

It was suggested that early tollways were less subject to pressure for high patronage forecasts. In fact there was little pressure on forecasts either from the government or within consortia. This may have been helped by an expectation that the project was commercially viable and investment would be forthcoming. The option of negotiating toll levels prior to financial close also made traffic levels less crucial to revenue models.

There was however considerable pressure in the modelling team to get the forecasts “right”. This was particularly related to need to model the impacts, negative or positive, of electronic tolling.

Difficulties in comparing Transurban and Veitch Lister results, due to their very different modelling assumptions, from zone sizes to format of outputs, were an early example of the difficulties posed in comparing results from different models.

Bid Review Processes

There were stringent review processes and importantly the review teams liaised with the modelling teams.

Recollection suggests that the CHART roads models were less sophisticated than the Transurban models but the overall base forecast levels were not very different.

Recollection also suggests that the design requirements were specified in some detail reducing the options for large differences in the costs side of the bid.

Award of the contract was on the basis of best value for money on a range of criteria. Traffic forecasts influenced proposed tolling structures and the Transurban offer package. Plus it was suggested that higher confidence in the traffic forecasting processes in the winning bid may also have influenced the outcome. Yet forecasts were just one factor in the award decision.

It was noted that commentators at the time suggested that Transurban may have “closed the deal” with their particularly attractive design for the sculpture at the Western Gateway.

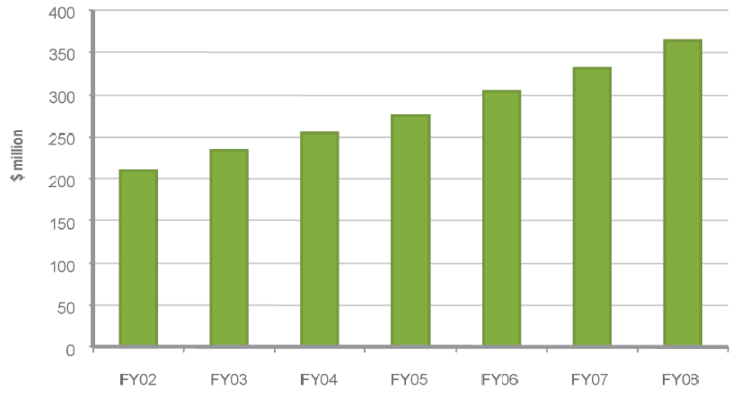
Competing Transport Infrastructure

The contract included a number of provisions covering competing and complementary transport infrastructure. The most widely reported of these was a commitment associated with an airport rail link utilised for the purpose of transporting freight. Most commitments were honoured, although Transurban initiated action to pursue compensation for diversion of patronage due to competing road improvements. The claim was referred to arbitration and in April, 2009 the claim was dismissed.

Traffic Performance

As noted there was considerable variation in performance on different sections of the tollway. There was overall better performance on the southern link through areas with a higher income profile than on the western link. It was also noted that in 2011, twelve years after opening, CityLink traffic is now tracking close to forecasts with revenues above forecast levels. As a number of interviewees noted revenues rather than traffic volumes per se are the important metrics for toll financiers. CityLink revenue grew at a faster rate than traffic in the period to 2008 due to toll rises higher numbers of commercial vehicles and trip length distributions favouring high revenue. Figure 7 shows revenue growth.

Figure 7: CityLink Toll Revenue Growth



Source: Transurban (2008)

Key Points from CityLink Case Study

- CityLink is a 22-kilometre tollway in Melbourne with western and southern sections comprised of road upgrades, elevated roadways and tunnels opened in 1999.
- It was the first fully electronic toll road in Australia and one of the first constructed by the private sector under a Build Own Operate and Transfer contract.
- Transurban and CHART ROADS, shorted listed from 5 bidding consortia, prepared full bids for the contract. These included traffic forecasts, proposed tolling charges with engineering plans tightly constrained to set design requirements.
- The traffic modelling teams did not report pressure for high forecasts. Forecasts from both teams (according to recollections) were quite similar.
- Transurban modellers were concerned about modelling (a) effects of electronic tolling (then new) and (b) ramp up (with limited experience).
- Transurban was awarded the contract on the basis of value for money assessed via multiple criteria.
- The capital cost of the project ($2.15 billion) was funded by a mix of equity (constructors/institutions and private investors via ASX), debt (banks) and a $0.35 billion government contribution
- Before and after contract award there was close co-operation between the private sector companies and the government's Melbourne CityLink Authority.
- Commitments to provide complementary transport infrastructure and to avoid building competing infrastructure such as an airport rail line transporting freight were predominantly honoured.
- Early year forecasts proved over optimistic but after 9 years of operation traffic volumes were within 6 percent of target and by 2011 had reached forecast volumes.
- The concession runs until 2034 and Transurban still operates CityLink.

3. Case 2: Lane Cove Tunnel (Sydney)

3.1 Background and location

The Lane Cove Tunnel (LCT) is a 3.6-kilometre tunnel. It links the Gore Hill Freeway with the M2 Motorway providing a key link in the Sydney Toll Road Network (Figure 8).

The LCT concession was bundled with provision and operation of the Military Rd e-ramps - two tolled north-facing ramps on the Warringah Freeway providing access to and from Military Road.

The e-ramps comprise the shortest toll road route in Australia.

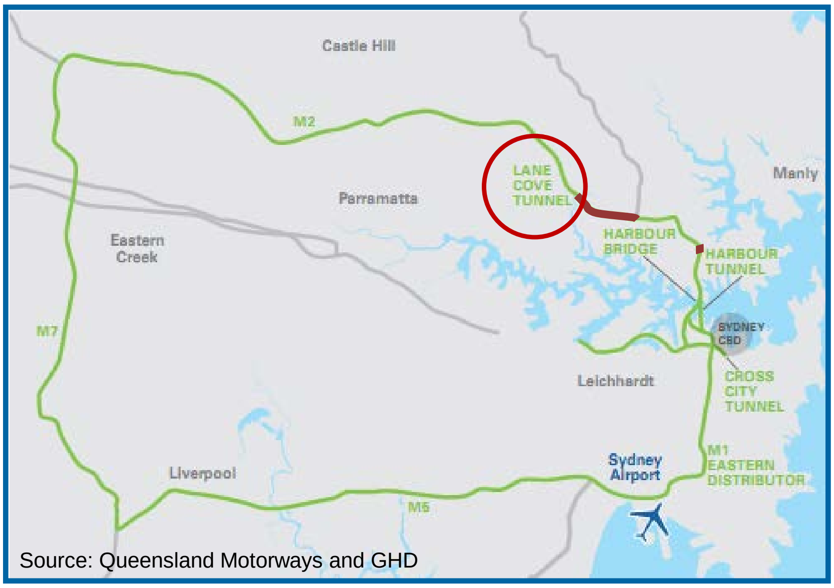


Figure 8: Location of the Lane Cove Tunnel in the Sydney Motorway Network

The Tunnel is charged in both directions and uses a free-flow fully electronic toll collection system (and accepts all e-tags and e-passes deployed in Australia). There are flat toll rates for light vehicles (cars and light commercial vehicles) or heavy commercial vehicles, with e-ramp rates set at approximately 50 percent of tunnel rates. The tunnel rates after opening in 2007 were $2.55 for light vehicles and $5.09 for heavy vehicles. Toll charges may be adjusted quarterly in line with the CPI and in July 2011 were $2.89 and $5.78 respectively.

3.2 Chronology and participants

3.2.1 Project history

The Lane Cove Tunnel (LCT) was proposed in the NSW Government's 1998 "Action for Transport 2010" report following community consideration of options under the M2–Epping Road Task Force (NSW Parliament 2006). In late 1999, the RTA's "Lane Cove Tunnel Overview Report" outlined the preferred tunnel alignment and associated works (including the Warringah Freeway ramps) for public comment. The overview report highlighted the objectives of the LCT as (RTA 1999 p. 7):

- Reduce traffic congestion along Epping Road and Mowbray Road West
- Improve travel times for freight, commercial and private vehicles
- Make traffic conditions safer for local pedestrians and cyclists
- Improve access to health and education services such as Royal North Shore Hospital, Macquarie University, Macquarie Shopping Centre and Chatswood Shopping Centre
- Improve access to jobs in business centres at North Sydney, Lower North Shore, St Leonards, Artarmon, North Ryde, Chatswood and Lane Cove
- Improve public transport links, including transit lanes on Epping Road and the Gore Hill Freeway

- Reduce through traffic in local streets
- Provide more residential parking, bus bays and landscaping
- Reduce the impact of traffic on local streets, improving air quality and reducing noise.

The “Lane Cove Tunnel Environmental Impact Assessment” (EIA) incorporated minor design changes and was released in December 2001 for public comment (NSW Parliament 2006). The scope of the LCT project was finalised in the “Lane Cove Tunnel and associated works Preferred Activity Report”, which was publicly displayed over July/August 2002 (NSW Parliament 2006).

3.2.2 Bid process, structure and participants

After the public consultation period on the EIA (in March 2002), the RTA invited the private sector to register their interest in financing, designing, constructing, operating and maintaining the LCT project. Four consortia (The Lane Cove Tunnel Consortium, Lane Cove Motorway, Lane Cove Expressway and TunnelLink) registered an interest in the project and were supplied with the full “Request for Proposals” (RFP) in late July 2002 (NSW Parliament 2006). The various consortia comprised (RTA 2007):

- Lane Cove Tunnel Consortium (ultimately Connector Motorways) — Thiess, John Holland and ABN AMRO
- Lane Cove Motorway consortium — included Leighton Contractors and Deutsche Bank
- Lane Cove Expressway consortium — included Bilfinger Berger, its Australian subsidiary Baulderstone Hornibrook, the Commonwealth Bank and Transurban Infrastructure Developments; and
- TunnelLink included Obayashi, Hills Motorway, Ferrovial Infraestructuras, Macquarie Bank and Abigroup.

The RFP included a draft Project Deed — which stipulated the level of the tolls and their method of escalation — and draft technical / legal documents (NSW Parliament 2006). The four consortia responded with full proposals to the RTA in January 2003, which were subsequently assessed by an evaluation panel (which in turn was overseen by a review panel) (RTA 2007). Award was on the basis of value for money for the community which, due to tight design criteria limiting differentiation on costs, was highly dependent on revenue forecasts. Revenue in turn depended on traffic forecasts. Thus the bid with the highest traffic forecasts, with revenues that allowed an upfront payment rather than requiring a government contribution, was selected.

Lane Cove Tunnel Consortium (which was subsequently renamed to Connector Motorways) was named as the preferred proponent, with Lane Cove Motorway the reserve proponent (NSW Parliament 2006). Following negotiations between the RTA and Lane Cove Tunnel Consortium — as well as approval for the “joint financing” arrangements — the two parties signed a contract for delivery and operation of the LCT until 2037 (NSW Parliament 2006). While the contract was amended between its initial signing in December 2003 and finalisation in March 2007, the main requirements for Lane Cove Tunnel Consortium / Connector Motorways were unchanged (RTA 2007 p. 19):

- Finance, plan, design, construct and commission all the project’s motorway, local road, property, services and temporary works by 2007/8;
- Operate, maintain and repair the motorway from the completion of works — as well as undertake specified asset renewals at specified intervals — between the completion of the works and January 2037; and
- Yield possession of the motorway to the RTA on 9 January 2037 or upon any earlier termination of the Project Deed (i.e. 30 year concession).

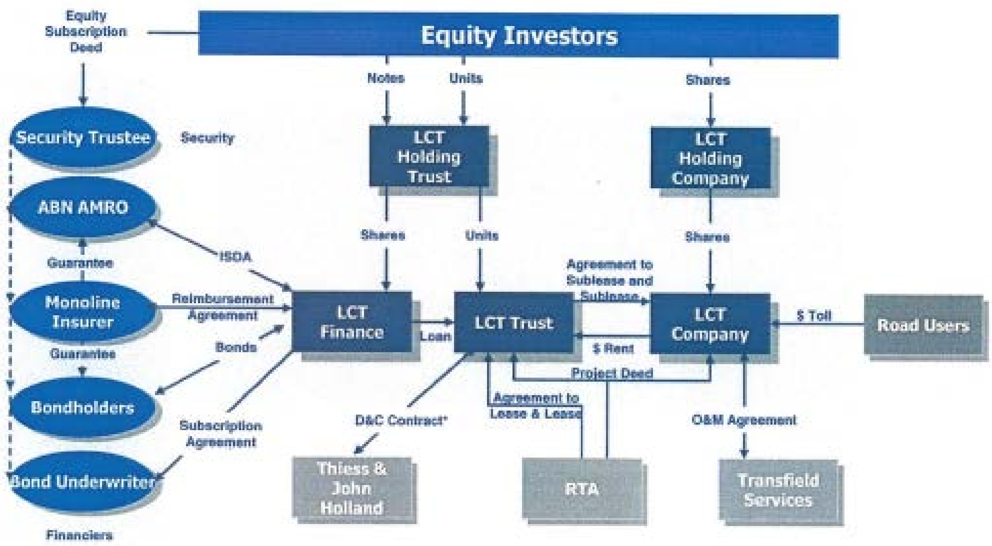
The capital cost of the Lane Cove Tunnel and E-ramps project was estimated at over $1.6 billion, which was financed with $0.54 billion equity and $1.14 billion in debt of various maturities (Traffic Technology Today, n.d.). The firms with initial equity stakes included: ABN AMRO, Thiess, John Holland, Transfield Holdings, AMP, Westscheme and Motor Trades Association of Australia Superannuation Fund (RTA 2007). The overall financing and operating structure is summarised in Figure 9.

Table 4: Institutional Roles in Lane Cove Tunnel and E-ramps

	Government	Constructor	Equity-holders	Debt-holders
Entities	NSW Government / RTA	Thiess and John Holland	ABN AMRO, Thiess, John Holland, Transfield Holdings, institutional / superannuation investors	Private bond-holders
Role in project	Granted concession; administration expenses; receive upfront fee ($79m)	Construction, ownership, operation, financing	First losses if toll revenue insufficient to pay all expenses	Protection against losses via monoline insurer MBIA

Source: GHD based on RTA (2007), Traffic Technology Today (n.d.) and NSW Parliament (2006)

Figure 9: Financing and Operating Structure of Lane Cove Tunnel and E-ramps



Source: ABN AMRO Australia (2006)

While the tunnel and ramps were successfully completed and opened to traffic in 2007, Connector Motorways went into a receivership in January 2010 after experiencing a string of losses. Transurban purchased the tunnel in May 2010 and is currently operating both tunnel and E-ramps.

3.3 Traffic modelling, forecasts and outcomes

3.3.1 Models and model teams

There were a relatively large number of models and modelling teams involved in the Lane Cove tunnel project. As noted, four bid teams developed full proposals including traffic forecasts. This involved a large set of firms including, in the losing bid teams, for example IMIS acting for TunnelLink, Aecom for Lane Cove Motorway and Arup for Lane Cove Expressway. Additionally Veitch Lister Consulting (VLC) was employed by a number of banks to undertake an independent audit of traffic forecasts relating to the project. Unfortunately only anecdotal information, as reported in section 3.4 is available about the losing bid teams and forecasts.

Government Models: Some details of the government model and the traffic forecasts used for the EIS and business case are known. The government modelling team was led by Sinclair Knight Merz. There was particular emphasis on the environmental impacts of the project, particularly air pollution and noise due to very active community action groups.

NETANAL (Network Analysis Assignment Model),a traffic assignment program, was used instead of a four-step model. This model focuses on a single step of the four-step model, assignment to the network, making use of inputs from external sources. It also includes detailed traffic condition modelling. A post implementation review (RTA, 2010) noted that NETANAL over- predicted the actual patronage, probably due to the difficulty in predicting total daily travel volumes and inaccurate land use forecast inputs and toll behaviour assumptions. While it may be argued four-step models are superior, it is worth noting that these parameter problems would have also produced overestimates in a four-step model. Unfortunately the modelling process did not include any provision for reduction of estimates in the early years to account for ramp up.

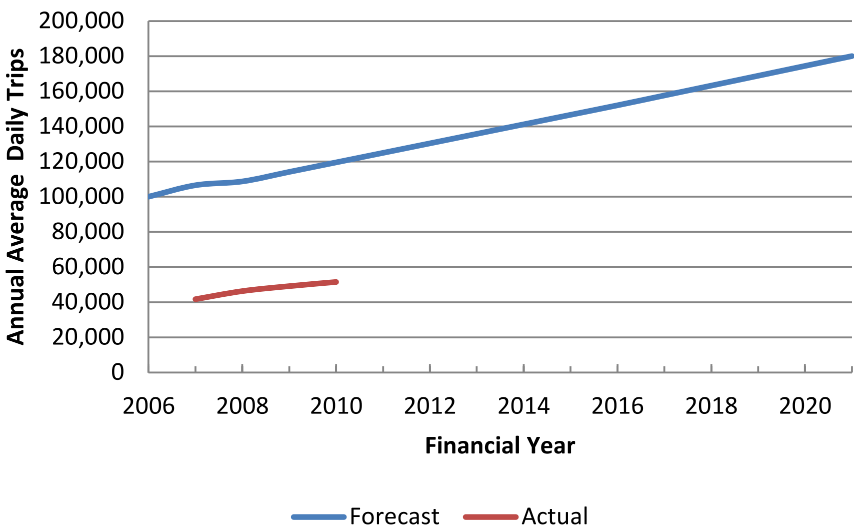
Winning Bid Team: The traffic modelling team for the winning bid, which included Parsons Brinkerhoff, for model development, Access Economics, for land use and economic forecasts, and the Hensher Group for value of time estimation via stated preference analysis, produced a four-Step Model, on a Transcad Platform, using inputs from the Sydney Strategic Travel Model (BTS, 2008). The team must have faced similar data problems to those encountered by the government modellers and some of these issues are covered by interviewee comments.

Auditors: Booz Allen Hamilton (now Booz & Company) provided a due diligence report on the traffic modelling for the debt providers to the winning consortium. URS Asia Pacific was appointed Independent Verifier, Banks' Engineer and Environmental Management Representative for the winning consortium and also responded to RTA questions on behalf of the consortium. The RTA appointed a team of technical auditors each responsible for one section of the bid. Halcrow was the traffic model auditor.

3.3.2 Forecasts compared to outcomes

Figure 10 compares actual traffic with the original traffic forecasts by financial years. As can be seen, traffic was, and is still, very much lower than originally predicted.

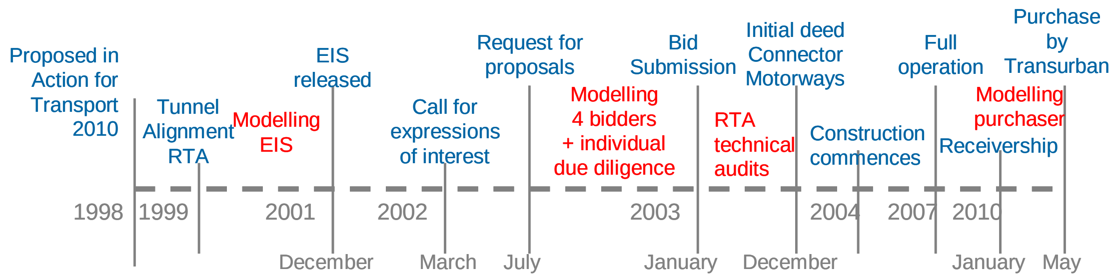
Figure 10: Lane Cove Tunnel and E-ramps Forecast vs Actual



Source: Actual: (2009 onward): Transurban ASX,. Actual Pre 2009 and Forecasts Connector Motorway press releases +NSW Parliament (2006) paras 3.84=3.89

However Transurban (2011) reported a respectable growth rate of 6 percent in 2010 with even faster revenue growth both in line with revised forecasts. Figure 11, with the timing of modelling activity, in red, within the context of the Lane Cove Tunnel timeline, shows this revision.

Figure 11: Modelling within the Lane Cove Tunnel Timeline



3.4 Project specific views from case interviews

We were able to interview people who had direct involvement in all stages of the Lane Cove Tunnel project from pre-bid stage through to the sale of the asset post financial collapse. As noted, differing recollections made it difficult to produce a detailed picture of the models and teams. However interview comments suggest that there were a number of aspects of the project that made forecasting challenging for all teams. Note, as with all reported case interviews, the comments represent opinions.

Project Initiation

In contrast to CityLink, the impetus from this project came from the public sector and the community rather than the private sector:

- The NSW Roads and Traffic Authority (RTA) saw the project as completing the missing link in the Sydney orbital motorway system, and
- There was concerted local community action in Lane Cove for relief from worsening congestion.

The Environmental Impact Model for the Study thus concentrated particularly on environmental cost and benefits in view of community interest. The Business Case which used the EIS traffic forecasts again concentrated on societal benefits. These were then monetised for an economic benefits calculation. Commercial valuation of the project was not a priority. However, the project was planned and announced at a time of strong interest in investment in road projects so that there would have been an expectation of competitive bids.

Local Context

As the missing link in the network, the new tunnel added another toll to a set potentially faced by a motorist. In theory a motorist driving between Western Sydney and the airport might encounter tolls on the M7, M2, Harbour Tunnel and Eastern Distributor. The Lane Cove Tunnel added another toll to this set. As one interviewee said "*this may have been one toll too many*" although another told us less than two percent of trips using the tunnel actually involve paying all the tolls.

The design options for the tunnel were constrained by requirements to link the M2 at one end with the Gore Hill Freeway at the other end by a tunnel leaving only construction methods as a potential differentiator on the cost side. This made differentiation on the revenue side more important.

Tunnels are expensive to build and it was noted that the construction cost for the Lane Cove Tunnel were quite similar to those for the much longer M7. They are also expensive to maintain and operate.

The exit and entrance requirements also meant that the tunnel route length was close to the surface route length limiting any time difference between the two if similar lane capacity and speeds were in place. It was thus planned to reduce lane capacity for cars and impose speed restrictions on the surface road. This would improve public transport services, promote use of active modes and provide traffic calming to improve local amenity as well as increasing the time advantage for the tunnel.

Tender Systems and Review

Concern about the impact of multiple tolls on motorists from the northwest led to the government capping toll levels for the tender. This produced in effect a fixed toll level and a fixed escalation regime tied to CPI.

This made traffic forecasts central to bid competiveness. As one interviewee said the revenue estimates were dependent on just four parameters: toll, escalation rate, concession term and demand (measured in AADT - Average Annual Daily Traffic). "*The first two were fixed and there was no incentive to extend the term, giving AADT primacy*".

The competitive conditions at the time of the bid attracted four serious bid teams. The government proponent saw this as an opportunity to extract the best value for money for the community from bidders. This made the option of accepting an upfront payment as part of the bidding package very attractive. As noted there was a considerable amount of associated road works required for the tunnel and the payment would help defray these costs.

The winning bid, with the highest traffic forecasts and revenue projections was able to offer such a payment. The scale of differences in estimates can be imputed from the fact that the winning bid included an "upfront payment" whereas another bid asked instead for a co-payment contribution.

The technical reviewer of the traffic modelling reviewed each bid separately and also in isolation from its design component. The reviewer was charged with checking the validity of model processes without making any comment on forecast values.

Forecasts and Failure

In summary, it was suggested that a combination of circumstances and events affected the forecasts and the outcomes.

Over-Optimistic Government Forecasts: It is very common for government forecasts to be viewed for practical purposes as the lower bound of forecasts by bidders. One interviewee said "*it would be difficult to get a set of patronage figures lower than the government numbers accepted."*

Competition on Forecasts: Conditions encouraged competitive bidding via optimistic forecasts. One person suggested conditions "*set the stage for winners curse.*"

Bid "optimisation"/ debt maximisation: It was suggested that "*by that time everyone knew a lot more about what could be done with traffic models and that presented some opportunities for bid optimisation.*" This would accord with overseas experience, see Bain (2009b), where aggressive financial modelling to maximise debt resulted in pressure for high revenue forecasts (obtainable by manipulation of traffic models.)

Missing Data: Most bidders had no access to traffic counts from the M2, which feeds into the tunnel, due to that data being held by the private operator of the M2. Other traffic count data was also limited. There was also lack of fine level origin-destination data at both ends of the tunnel. In the absence of data, assumptions are made and as noted there was a very high incentive, in a bid so dependent on traffic numbers, to be optimistic.

Time Penalty Parameters: It was suggested that in most of the bids "*stock standard*" Stated Preference surveys and models were used, when other features of the tunnel, such as potential upstream and downstream tolls, if included in models could have been expected to reduce forecasts.

Alternative Routes: The surface changes were made but some people complained that their effectiveness was reduced because the speed limits and especially bus lanes are not consistently policed. This results in two lanes of traffic travelling at 80kph both in the tunnel and on the surface. Traffic forecasts based on comparison of a faster tunnel with a slower surface route would then be too high.

Cash flow problems due to high operating costs occurred when revenue was low.

GFC "*The final blow*" for the tunnel forecasts versus actual counts was the 2008-2009 Global Financial Crisis which occurred in the period when toll roads commonly begin recovering from low opening figures. Gross State Product growth stalled. Suburbs at either end of the tunnel, with significant numbers of businesses in the financial services sector were particularly affected. Employment reduction led to commuter and business trip reductions. Plus planned office and residential developments, which would have brought more people to tollway catchment, did not go ahead.

Key Points from Lane Cove Tunnel Case Study

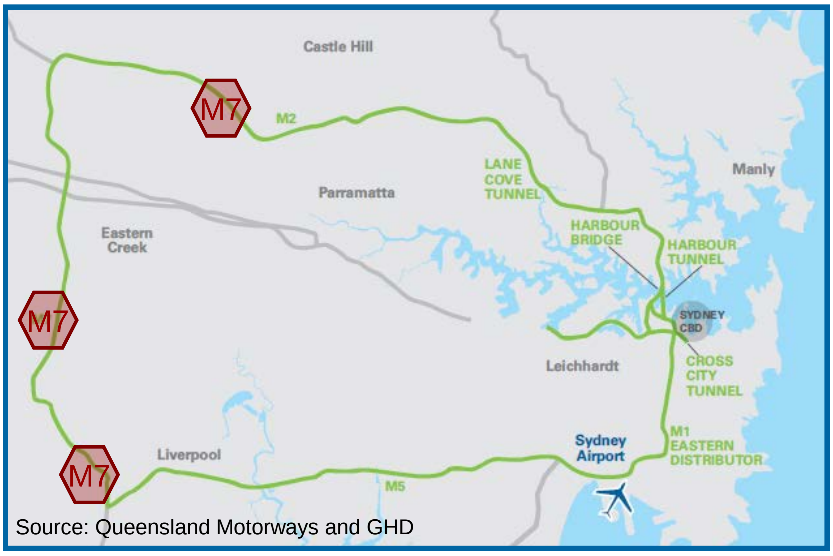
- Lane Cove Tunnel is a 3.6-kilometre tunnel. It links the Gore Hill Freeway with the M2 Motorway providing a key link in the Sydney Toll Road Network and opened in 2007.
- It is a fully electronic tolled road constructed under a Build Own Operate and Transfer contract at a time of very high interest for private sector investment in road projects.
- Four consortia: Lane Cove Tunnel, Lane Cove Motorway, Lane Cove Expressway Consortium and TunnelLink prepared bids for the contract.
- Design was constrained by set requirements and toll levels and escalation procedures were also set. Thus traffic forecasts played an important role in bid differentiation.
- Pressures for high forecasts resulted from the important role the forecasts played, bid optimisation processes applied, and the need for revenue to defray the high costs of constructing tunnels.
- Modellers were challenged by lack of data about traffic and travel patterns and in its absence optimistic parameters may have been adopted.
- Commitments for traffic calming works on the alternative surface route played an important part in forecasts.
- Lane Cove Tunnel Consortium, later Connector Motorways, was awarded the contract on the basis of value for money to the community provided by no call on government funds and instead an upfront payment to assist with costs of complementary works.
- The capital cost of the project ($1.6 billion) was funded by a mix of equity (constructors and private investors), and debt (banks).
- Early year forecasts proved very over optimistic. Likely initial over-optimism was compounded by some failures in traffic calming and the GFC.
- Connector Motorways went into a receivership in January 2010 after experiencing a string of losses.
- Transurban purchased the tunnel in May 2010 and is currently operating it on a concession that runs to 2037. Traffic numbers are now growing.

4. Cases 3 and 4: M7 and Go Between Bridge

4.1 M7 background, location and history

Westlink M7, formerly known as the Western Sydney Orbital, is a 40 km duel carriageway toll road connecting the M2, M4 and M5 motorways, providing a link between Northwest and Southwest Sydney as well as the outer link in Sydney's major toll road network as shown in Figure 12.

This road is thus a major connector, linking one side of the city to the other, and linking through travel from outside Sydney from the north to the southern inter-capital city route to Canberra and Melbourne.



Source: Queensland Motorways and GHD

Figure 12: Location of Westlink M7 in the Sydney Motorway Network

The motorway, opened in December 2005, was purpose built across green field sites with overpasses across existing roads. The road was intended both to accommodate population and employment growth in Western Sydney and to stimulate industrial growth in its corridor.

The M7 is the only distance based toll road in Sydney with tolls collected using electronic tags or electronic passes monitored by number plate recognition. For trips of less than 20 km, the toll is calculated on a cent per km rate, and for trips of more than 20 km, the toll is capped. Tolls are adjusted quarterly in line with movements in the CPI. The July 2011 maximum toll (trip cap) for using the M7 is $7.06 per trip for all vehicles.

A Western Orbital had been included in Sydney region planning for a number of years and in 2000 an Environmental Impact Statement was prepared. In February 2001, the Minister granted planning approval, then in July, the RTA invited registrations of interest from private sector parties for the "*financing, design, construction, operation and maintenance*" of the Orbital. Responses were received from:

- The WestLink Motorway consortium, sponsored by Leighton Contractors, Abigroup, Transurban and Macquarie Bank;
- The Orbital Park Alliance consortium, sponsored by Thiess, Baulderstone Hornibrook, CKI and Deutsche Bank; and
- The Western Link Joint Venture consortium, sponsored by Transfield and Bouygues Travaux.

A formal Request for Proposals was issued to all three consortia in November 2001.

The proposals were assessed for their 'comparative value' against a public sector comparator that was initially prepared by the RTA using the Sinclair Knight Merz traffic forecasts, with the assistance of Arthur Andersen, Ernst and Young, Evans and Peck, NSW Treasury and NSW Treasury Corporation. The 'comparative value' of each proposal was expressed in terms of net present value to the RTA. A 'non-price assessment' was also included in the evaluation of the tenders. All three submitted a detailed proposal by the closing date in March 2002.

In June the RTA advised the Western Link Joint Venture that its proposal had been unsuccessful and requested additional information from the other two consortia.

In October 2002, the WestLink Motorway consortium was appointed and major construction started in July 2003. with the road opening in December 2005 eight months ahead of schedule. The Federal Government contributed $360 million towards this Motorway with the remainder of the estimated $1.54 billion capital cost met by the private sector.

Currently Transurban (50%) and Western Sydney Road Group (50%) are the concession holders, with Westlink Motorway Ltd responsible for operations. The concession period ends in 2037.

4.2 M7 Traffic modelling, forecasts and outcomes

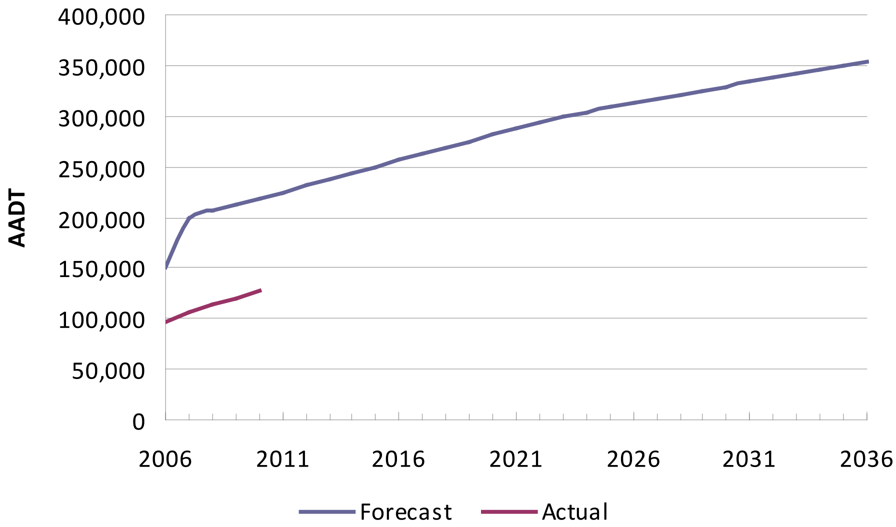
Government Model: As for the Lane Cove Tunnel, the EIS and Business model traffic forecasts were prepared for the government by Sinclair Knight Merz using NETANAL. However in contrast to the LCT experience, the RTA Post Tender Review (RTA, 2010) reports that the NETANAL produced forecasts which compared quite well to actual traffic.

Winning Bid Model: The Modelling team was led by Maunsell/AECOM who developed a four-step model on an EMME 2 platform using inputs from the Sydney Strategic Travel Model and special purpose Stated Preference Surveys.

However, as noted in interview comments, the greenfield site presented many challenges in estimation of land use change and traffic has been considerably below forecasts in its first five yers of operation,   although revenue is trending closer to forecasts.

The average weekday traffic volume of the M7 was approximately 52 percent below its predicted level during its first year of operation, 2006. Figure 13 compares forecast average annual daily traffic volumes with actual values.

Figure 13: Westlink M7 Forecast vs Actual



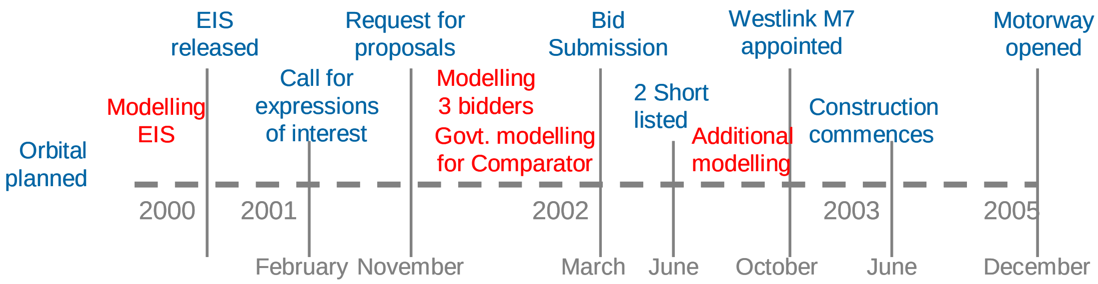
Source: Actual traffic volumes from Transurban ASX (2007-10); Forecasts from Transurban (2004) reporting Maunsell traffic forecasts

Fortunately toll revenue forecasts were better than traffic forecasts. This was due to compensating errors in trip lengths. Short trips were higher than expected and long trips lower resulting in few capped charge trips and more per kilometre fees.

The motorway traffic in recent years has shown strong growth with the southern section of road reflecting a high level industrial development. Western Sydney continues to deliver high employment and population growth. Some of this growth is due to the motorway and much of it benefits the motorway.

Figure 14 shows, in red, the timing of modelling activity, within the context of the M7 timeline

Figure 14: Modelling within the M7 Timeline



4.3 M7: Views from case interviews

Changes in land use due to the motorway were confidently expected but there was less confidence in the timing and nature of these changes due to the predominantly greenfield sites it traversed. This presented challenges for forecasting.

Initially, land use changes were different from expected with rapid development of transport and logistics operations rather than manufacturing industry development. These transport operations increased the commercial traffic on the road but offered less employment than manufacturing.

By 2011 as Figure 15 shows, employment is now growing in the M7 corridor.

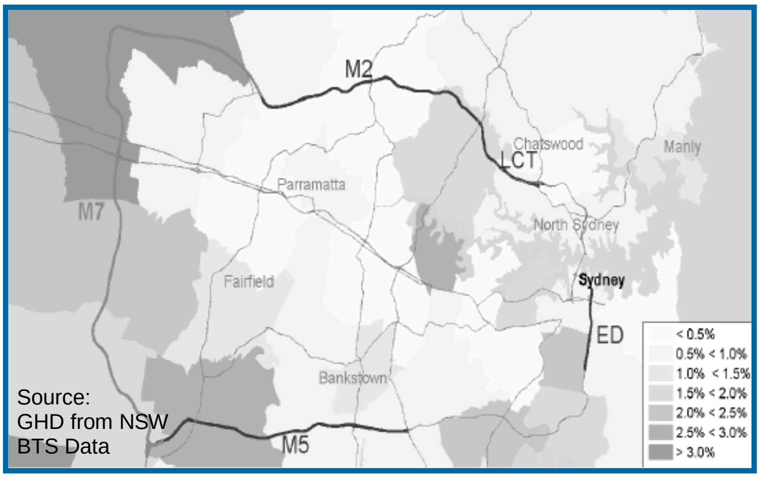


Figure 15: Employment growth rates 2006-2011

The generally low socio-economic profile of the suburbs abutting the route was more similar to that in suburbs around the Western Link of CityLink thus toll affordability was an issue and this affects private trips.

However, the M7 produced substantial travel savings between numbers of key destinations reducing distance travelled, allowing travel at higher speeds and limiting delays due to congestion or incidents. This led to acceptance by commercial users. One interviewee quoted savings that allowed a firm to greatly reduce transport costs by halving numbers of vehicles and drivers required due to the ability to fit return trips in their schedules.

A number of design features were useful for increasing patronage/revenue:

- Walking and bike paths were included for most of the route improving public perception of the motorway and thus contributing to general community support with some indirect impacts on patronage; and
- Off ramp gantries allowed exit at all key roads along the route. This in turn provided resilience in forecasting. In practice, errors in the distributions of long trips, short trips, commercial vehicles and passenger vehicles compensated to limit the overall impacts on toll revenues.

Ramp up forecasts would have been particularly challenging due to lack of suitable comparative data. M7 was the first Sydney motorway to be built in such a green field environment. As noted this was exacerbated by the low socio-economic catchment and uncertainty about job growth.

It was suggested that members of the winning consortium were aware of the short-term uncertainties and were prepared for short-term risk due to expectation of strong returns in later years. The growing economic importance of the western region of Sydney was cited. The Western region was responsible for 33 percent of Sydney's gross regional product in 2008-2009 (RTA, 2010) and that proportion is expected to grow.

Key Points from M7 Case Study

- Westlink M7, is a 40 km toll road between Northwest and Southwest Sydney and forms the outer link in the Sydney motorway network.
- In contrast to other Sydney toll roads, tolls are distance based, with a 20 km cap.
- The road was constructed under a Build Own Operate and Transfer contract at a time of very high interest for private sector investment in road projects.
- Three consortia: Westlink Motorway, Orbital Park Alliance and the Western Link Joint Venture prepared bids for the contract with further information sought from the first two of these.
- Design, toll levels/escalation procedures together with traffic forecasts were all variables in the bid.
- The green field site presented particular challenges to modellers in estimating population and employment change and ramp up in conditions without comparative data.
- The Westlink Motorway consortia, was awarded the contract with the construction cost of $1.54 billion funded by a mix of equity (constructors and investors via the ASX), and debt (banks) with a $360 million contribution from government.
- Early year traffic forecasts proved over-optimistic but the revenue shortfall was not as bad as the traffic short fall due to a higher than expected proportion of short trips.
- Currently Transurban (50%) and Western Sydney Road Group (50%) are the concession holders with a concession to 2037, with Westlink Motorway Ltd responsible for operations. Traffic and revenue are growing.

4.4 Go Between Bridge: background location and history

The Go Between Bridge (formerly the Hale Street Link) is a four-lane tolled bridge across the Brisbane River that provides a link between Brisbane's northern, western and southern suburbs. It connects Coronation Drive and Hale Street in Milton to Montague Road, Merivale and Cordelia Streets in South Brisbane.

Construction of the project commenced in mid 2008 and the bridge opened to traffic on 5 July 2010. The bridge is a key part of Brisbane City Council's long-term plan to improve cross-city travel in Brisbane and tackle congestion. It was the third in a series of TransApex projects planned to accommodate Brisbane’s growth.

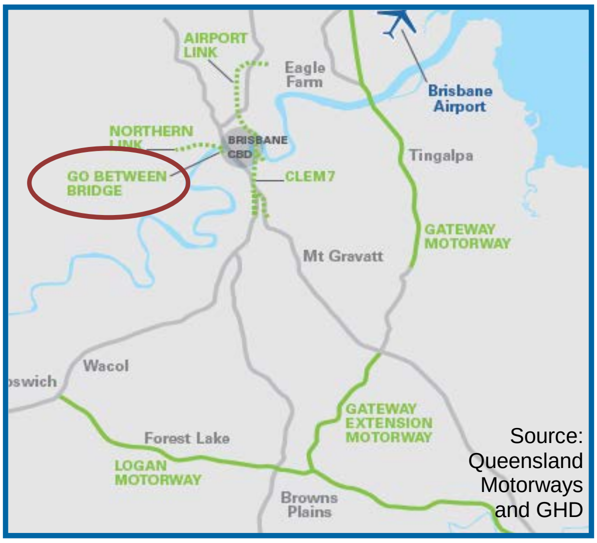


Figure 16: The Go Between Bridge in the Brisbane Motorway Network

In contrast to the first two TransApex Projects, the CLEM7 tunnel, opened in March 2010, and the Airport Link due to open mid 2012, and, importantly, to the other three cases in this study, this project was financed by government rather than private industry. It was selected for this study due to this difference (and due to its location in Brisbane).

The contract to design build and maintain the infrastructure was awarded to the Hale Street Link Alliance, made up of Seymour Whyte, Macmahon Constructions, Bouygues Travaux Publics and Hyder Consulting. Construction commenced in July 2008 and the project was completed for $338 million.

A separate contract covering tolling operations was awarded to Leighton Contractors. Electronic tolling devices installed on the southern end of the bridge recognise either within vehicle electronic tags or number plates, then fees are collected via passes and accounts. The toll charge is a flat fee with rates distinguished by vehicle type. The toll in July 2011 was $1.21 motor bikes, $2.42 cars, $3.63 Light commercial vehicles and $5.30 heavy vehicles (BCC, 2011). Charges are to escalate with CPI annually. However, toll discounts have been applied for most of the time since the bridge was opened with tolls for the first six months of $0.75 motor bikes, $1.50 cars, $2.25 light commercial vehicles and $3.97 heavy vehicles (BCC, 2011).

4.5 Go Between Bridge: Traffic modelling, forecasts and outcomes

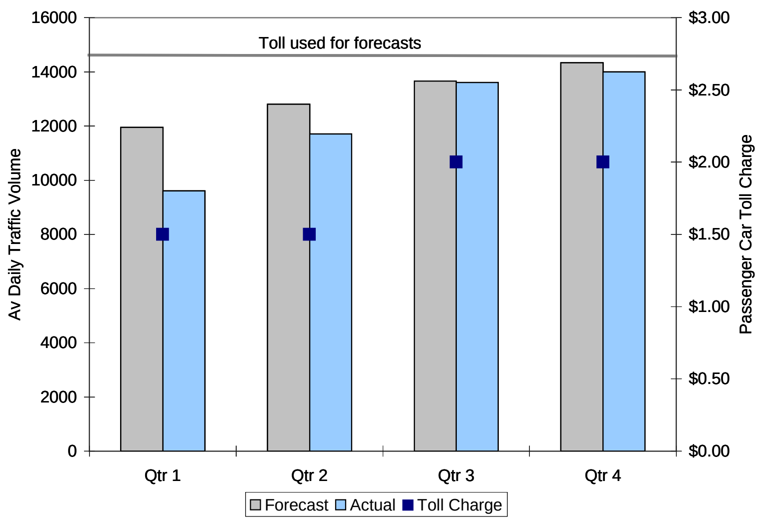
Initial sets of traffic forecasts for the (then) Hale St Bridge river crossing were prepared by Connell Wagner (now Aurecon) and Sinclair Knight Merz (SKM) as part of a larger traffic modelling project covering a set of five road projects proposed by Brisbane City Council in the TransApex initiative. This modelling exercise used a four-step model approach based on the Brisbane Strategic Travel Model (BSTM). The size of the total project meant that more resources than usually available for government modelling could be employed. For example, specific purpose land use and employment forecasts were commissioned and an induced traffic model was developed. (SKM & Connell Wagner JV 2006)

Final sets of forecasts were prepared on behalf of the Hale St Link Alliance by Hyder, again using a four-step model based on the BSTM, with detailed traffic modelling provided by Damien Bitzios and Associates.

The actual traffic has been reported as close to forecasts, with around 11,700 vehicles by September 2010 compared to forecast 12,800 for October 2010. However, the early toll of $1.50, instead of the $2.70 used in forecasts, means such comparisons are invalid. Revenue forecasts were definitely over-optimistic.

Figure 17 shows actual traffic level with forecast level by quarter since opening shown on the left hand axis of the graph. The right hand axis of the chart shows the prevailing toll charges for private cars compared to the toll used in forecasts.

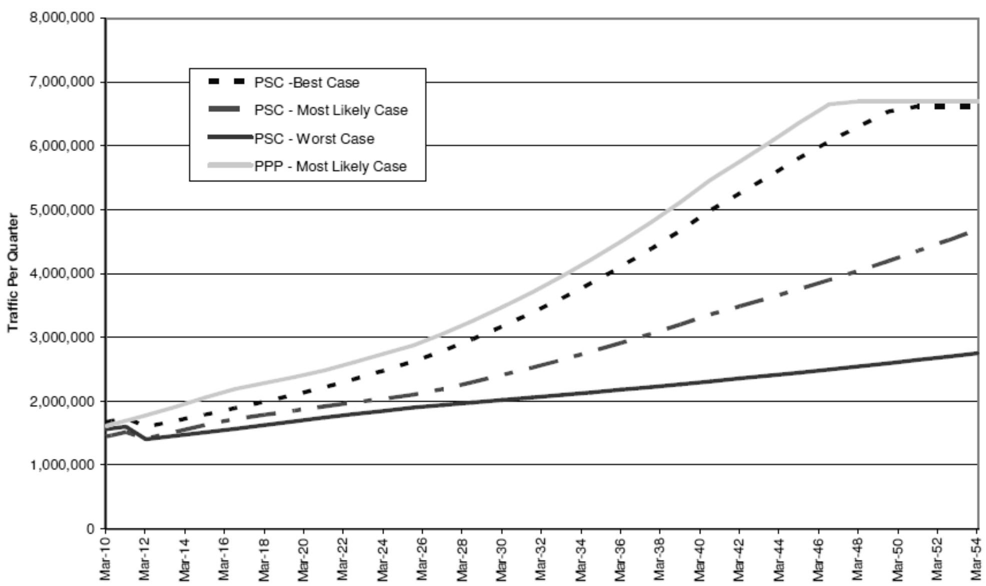
Figure 17: Go Between Bridge Forecasts, Actual Traffic and Toll Rates



Source: GHD based on BCC reports

Figure 18 shows the original Hale St Link Alliance (PPP) forecasts for bridge traffic in the longer term compared to the public sector comparator (PSC) estimates.

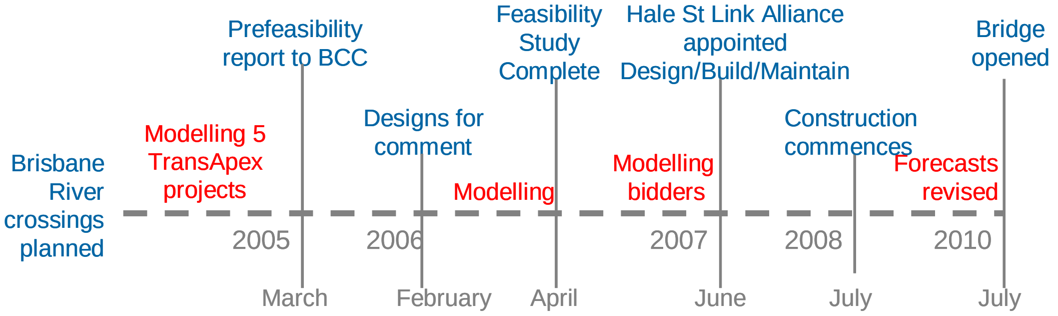
Figure 18: Go Between Bridge Future Forecasts



Source: BDO Kendalls (2009)

The PPP most likely case forecasts are more optimistic than the PSC best case and considerably more optimistic than the PSC most likely case. The PPP and PSC used identical traffic ramp up curves expecting 75 percent of base mode traffic estimates after 6 months, 84 percent after 1 year with 98 percent after 2 years. However, as noted in the next section, these forecast figures were revised downward prior to opening in view of recent experience. This revision is shown in Figure 19, which illustrates, in red, modelling within the Go Between Bridge timeline.

Figure 19: Modelling within the Go Between Bridge Timeline



4.6 Go Between Bridge: Views from case interviews

Community Support: There was significant community and press opposition to the proposed bridge. Considerable effort was thus expended to win community support. For example, the bridge was named the Go Between Bridge after a popular band, formed in Brisbane, and a charity concert featuring a musician from the group plus a community open day were held at opening. The free cycle and walking lanes that form part of the bridge were widely promoted. This effort may have avoided a community “boycott” affecting traffic levels.

Smaller Project: It was noted that the costs for this bridge were very much lower than those for the other case studies. The bridge itself is only 300 metres long. Reduced costs lead to a reduced need for revenue. The bridge does not need as much patronage to be commercially viable and consequently there is less need to “look for” high forecasts. In this context, an interviewee pointed out “*project costs and demand are frequently unrelated and projects with high costs and low demand should not be PPPs*”.

River Crossing: This was the first inner Brisbane road crossing of the river in 40 years and can “*save 15 minutes using this crossing instead of the William Jolly* (existing Bridge).” A direct river (or harbour) crossing may be perceived differently from a tunnel under a surface route.

Ramp Up Slowed: In common with all four-step models, ramp up curves based on experience were applied to estimate the rate at which traffic level would rise after opening. These curves were adjusted in the final project forecasts to produce lower early traffic levels in line with new information on the likely rate of uptake coming from the February opening of CLEM7. Traffic forecasts were revised downward to be quite close to actual traffic, albeit with discounted tolls.

Discounted Tolls: As pointed out by a number of people, it is impossible to compare the actual traffic numbers on the bridge with the model forecasts because the toll levels in place are so much lower than those used in modelling. Nor will comparison be valid if planned toll levels are re-instated now, because people who might have been initially deterred by the higher toll may continue to use the facility, as they have become accustomed to its benefits. Although it is almost certain the toll levels affected traffic numbers, the degree of the effect is unknown.

Operating Costs: Critics complain that Brisbane City Council received about $8.8 million in toll revenue in 2010-11 and the bridge had running costs of $30.4 million. The council's 2010-11 Budget papers show by 2013-14, the Go Between Bridge expects increased tolls - $14.4 million - but the operating costs would also increase to $36 million. (Brisbane Times, 2011)

Early Days: It was also emphasised that it is much too early, just one year after opening, to judge the optimism or otherwise of these forecasts.

Key Points from the Go Between Bridge Case Study

- The Go Between Bridge is a four-lane tolled bridge across the Brisbane River that provides a link between Brisbane's northern, western and southern suburbs.
- The free flow tolled bridge constructed by the Hale St Alliance opened in July 2010.
- In contrast to the other cases the bridge is government funded. The decision to fund this third project in a set of Brisbane Toll projects publicly was based on business case analysis.
- Traffic modelling benefited from recent Brisbane experience that led to reduced optimism.
- As the tolls have been much lower than the tolls used in modelling, forecasts cannot validly be compared with actual traffic.
- Traffic is close to that expected with much higher tolls but there is a significant shortfall in revenue.

5. Influences on Forecasts

5.1 Broad context

5.1.1 Roles of forecasts

A challenging aspect of this project was the breadth of opinions offered. However, it has been possible to assemble a set of broadly agreed factors contributing to over-optimism on the basis of the facts surrounding the case studies, supported by information offered on other contemporary toll roads, both Australian and international.

Overall there were only three areas of universal agreement:

- Recent toll road forecasts in winning bids have been over-optimistic;
- More transparency in processes would be valuable; and
- The various roles of toll road forecasts need to be understood.

Our case studies support all three contentions. It has been possible to divide views into three groupings covering broad context, models and data, then tender processes. While the second and third groupings directly influence forecasts, the first provides the context for considering forecasts.

Numbers of people emphasised the importance of two issues:

- **Revenue forecasts:** rather than traffic forecasts are key to toll roads. Projects meeting traffic expectations can still fail if they do so at reduced toll levels.
- **Winning Bid Forecasts**: are the highest forecasts offered in the bid set. Thus, the level of over-optimism in these bids does not represent the level of over-optimism in all toll road bid forecasts. As one person said "*All may be more optimistic but winners are the most optimistic.*"

The Citylink and M7 cases support the importance of revenue, and the Lane Cove Tunnel case illustrates higher optimism in the winning forecast.

Additionally, almost all the traffic modellers interviewed asked that distinctions between the roles of different sets of models be made. At least three types of model forecasts are produced in each bid and they would be expected to differ according to their purpose and context.

Government forecasts will be prepared to meet two government requirements: provision of an environmental impact statement and provision of a business case for the project, as was done in all four cases. The same set of forecasts may be used for both. Even where the business case modelling is separate, concentration on environmental and social impacts of the road is important because the government economic benefit assessment requires consideration of the monetised societal benefits of the road. Thus the model needs to consider whole-of-day travel and even night time travel for noise issues.

Commonly (and in all four cases), the work is carried out by consultants not government modellers but they usually have access to existing government data. There is seldom provision for specific new data collection and the exercise is frequently time and resources constrained.

Bidders Forecasts in contrast need to concentrate effort on forecasting peak periods since these are typically responsible for about 70 percent of toll revenue. The bid modellers may have less access to government data but in all recent Australian toll road projects, including our four cases, they have had time for primary data collection and devoted considerable funds to the task. In all cases, the modellers produced scenario models and sensitivity tests for at least two sets of forecasts.

- **Debt Case forecasts**: Low end forecasts are produced for the consortium members providing debt funding. These forecasts are expected to be conservative in line with bankers' responsibilities to reduce lending risks.
- **Equity Case Forecasts**; High end forecasts are provided to investors on the basis that these represent the potential returns for investors taking equity in the project who may be expected to have a higher appetite for risk for potential reward.

Modellers in particular warned that, given the differences in approach, government forecasts could be expected to differ from bidders' forecasts. More importantly, numbers of people noted that the equity forecasts were, by their nature, the more optimistic of the forecasts produced and yet it was these that provided the basis for bid submissions.

5.1.2 Physical context

Evidence from the case studies, supported by views expressed in interviews, clearly shows that the chance of poor forecasts is increased by uncertainty about:

- Future growth or land use in the location;
- Current travel patterns; and
- Expectations for complementary or competing routes.

The Lane Cove Tunnel project suffered from all three types of uncertainty. Forecasting risk is also exacerbated when the tolled section is short and/or entrances and exits are restricted as again applied in the LCT. Table 5 shows just some suggestions for potential impacts of physical characteristics on forecasting risk.

Table 5: Physical Context Characteristics & Forecasting

Characteristic	City Link (& similar)	Lane Cove Tunnel (& similar)	Effect on Forecasting Risk
Length	Longer	Shorter	Increased trip options make longer links more forgiving
Location	Surface	Tunnel	Tunnel higher Capex & Opex /km requires higher patronage/km
Entrances/exits	Multiple	Restricted	Increased access more forgiving
Competing routes	Multiple by section	Direct competing surface route	Subject to changes in competing route conditions
% Commercial Traffic	Mid level	Low level	Commercial users more likely to pay tolls

In addition, numbers of interviewees noted the high risks associated with developing forecasts for green field sites and two modellers noted the risk of forecast error due to lack of data at tunnel entrances about travellers' origins and destinations. While the physical contexts of projects, such as a green field location, cannot be altered, there may be options, as discussed in Section 6, for reducing forecasting risk in such contexts.

5.1.3 Temporal context

CityLink the 'oldest' of the cases met traffic forecasts 8 years after opening and continues to show strong growth. M7 and the Lane Cove Tunnel after 5 years and 4 years respectively are now showing respectable traffic growth. Transurban (2011) reported growth in 2010 of 10.4 percent for CityLink, 7 percent for M7 and 6 percent for Lane Cove Tunnel). The Go Between Bridge only opened little over a year ago so it is too early to analyse temporal change.

Several people suggested that over-optimistic forecasts are predominantly early stage problems that are resolved later. However, such early problems can have catastrophic impacts on investors. It is in the first years that most toll road failures occur. For example Connector Motorways went into receivership due to cash flow problems associated with low traffic volumes, within the first three years of operation of the Lane Cove Tunnel. The capacity of models to make early year estimates and options for structuring tenders and consortia to reduce short-term risks, thus deserve consideration.

5.2 Models and Data

5.2.1 Inherent Model Biases

Four-step models used in the winning bids in each of the four cases, and in most other cases mentioned have some inherent biases. For many years, the imminent replacement of four-step travel models with more advanced options has been foreshadowed via modelling improvement strategies. However, the use of four-step modelling is still 'state of practice' and by far the most common choice for toll road patronage forecasting as a 'tried and tested' and 'bankable' approach.

There are, however particular features in each of the four steps: trip generation, distribution, mode split and assignment to the network, that make results particularly prone to over-estimation when modelling toll road demands as shown in Figure 20.

Figure 20: Four-step Models and Travel Demand Over-estimation for Toll Roads

Step Assumption	Assumption	Inflation Effect
1. Trip Generation	Based on exogenous factors so excludes travel costs	The damping impacts of tolls are excluded leading to potential overestimates of trips
2. Trip Distribution	Commonly based on trip purpose	Differential effects of pricing on trips by purpose can impact results
3. Mode Choice	Dependent on service parameters. Simple Logit form	Failure to define model parameters properly may lead to over-estimation (this includes value of time estimates) Davidson (2011) argues a mixed logit form is needed to avoid over-estimation due to inappropriate model assumptions
4. Traffic Assignment	Dependent on network parameters	Selected toll road attributes such as speed flow curves may inflate figures.
Model Limitations	**Assumption**	**Inflation Effect**
Time of day/day of week	Some cover only peaks	Willingness to pay tolls varies by time of day / day of week and is generally lower outside peak periods also possibly leading to overestimation
Trip based models	Do not allow linked trips	May overestimate diversion of trips to a non-stop toll road of trips requiring stops.
Value of Time treatment	Each minute saved of equal value	Overestimates diversion for small time savings on short links.
End state model	Does not account for ramp up periods on new links	Heuristic curves applied to counter initial overestimation as traffic takes time to change to new road frequently a key source of error.

Source: GHD

In addition, toll road models usually do not make use of the full feedback mechanisms of the strategic models. They are based on local strategic models but in practice use origin destination matrices derived from these models.

Model forms and structure therefore may lead to over-estimation and some of the people interviewed believed there was a strong case for model improvement. However, almost everyone agreed that it is likely that data and parameter choices, including those related to ramp up, have a greater effect.

5.2.2 Data and parameter choices

Suggestions for over-estimation due to data and parameters covered (a) current measurements and (b) forecasts and estimates.

Current Measurements include calibration and validation data from traffic counts and network attributes. While in theory these should contribute to both over- and under-estimation, in practice it is likely that 'avoidance of pessimism' in view of missing information leads to over-optimism. It was pointed out by several people that under-estimation could have significant consequences for a bid and the modellers have a "*duty of care to avoid under-estimation*".

In particular, lack of sufficient non-peak time traffic counts, as noted in the Lane Cove Tunnel Case, means that expansion factors (peak-to-day, day-to-week, week-to-year) have to be based on a range of values obtained from elsewhere. In making selections modellers may err on the high side of the range leading to over-optimistic forecasts.

Forecasts and Estimates include:

- Value of time or willingness to pay: These vary over a range of socio-economic and preference values as well as trip purpose and time. Over-estimation of patronage can occur when these differences are aggregated for modelling convenience. The individual estimates of willingness to pay may also be over-estimated in surveys focused on values of time when some people are reluctant to pay tolls under any circumstances. CityLink modellers put considerable effort into accounting for reluctance.
- Land-use/population/employment forecasts: Detailed land development data are usually not available beyond a 10 year horizon. Population and employment (based on economic forecasts) estimates are usually provided on a high, medium and low growth basis. Patronage estimates will differ significantly according to whether high or low growth scenarios are selected.
- Effects of complementary or competing infrastructure: If the government planners are unable or unwilling to provide detail of future infrastructure development, wrong assumptions about the timing and effects of these on the toll project are likely. Again it is likely that optimism will prevail.
- Ramp-up curves: The four-step model is an end state model with ramp up from zero traffic to this end state estimated by use of ramp up curves based on experience. As shown in the Go Between Bridge example quoted in Section 4, improved information improves initial forecasts. Conversely, poor ramp up estimates can have a significant impact on project viability as in the Lane Cove Tunnel.

Overall there was general agreement that over-optimism is not predominantly a technical modelling issue. Appropriate application of tools and use of data is of greater concern.

5.2.3 Optimism bias and strategic selection

Optimism bias may lead to selection of higher growth estimates and higher estimates of values of time. There is considerable evidence of optimism bias in forecasts in general, not just restricted to toll roads. When there is systematic choice of parameters leading to higher values the optimism may become strategic selection.

Bain (2009a) lists ways that traffic (and revenue) estimates for a toll road **can** be increased. Of these 21 selection mechanisms, shown in Figure 21, only some (as marked), were identified as having occurred in our case studies. Those marked with yellow arrows, were due to optimistic choices in the absence of data. Note at least one of the deliberate selections may be justified, since the modellers in our study agreed that electronic payment does reduce perceived price.

Overall while optimism/over-optimism may have prevailed for a number of reasons there was no proof in our case studies of deliberate systematic strategic selection.

Figure 21: Bain's Selection Mechanisms in Cases

It was noted numbers of times that all members of the bid process from the government agencies letting the tender to the modellers providing the forecasts have "*disincentives for pessimism*." These are inherent in the tender and bidding process as considered below.

5.3 Tender process

5.3.1 Structures and requirements

Design rather than Commercial Focus: There is a view that government tender designers may concentrate on engineering design requirements. This advantages design but can reduce focus on patronage potential. This means that considerable effort is put into estimating how the infrastructure should be built, in some cases providing very specific design requirements. In contrast, there is a view that much less attention is given to how it is to be funded beyond realisation that, with government funds not available, private sector money will be needed. The level of attention given to the effect of tender structures on commercial risk or indeed the risk involved in the project can vary from jurisdiction to jurisdiction and over time, from project to project. Where this does occur it can lead to inappropriate risk allocation to the private sector with consequent incentives to look for very optimistic forecasts. Importantly, it is worth noting that implementing the tender process consistent with the National PPP Guidelines[8] and State guidelines such as the NSW Working with Government (WWG) and Queensland's Project Assurance Framework (PAF)[9] should facilitate the appropriate balance between design, engineering / construction and commercial issues.

Upfront Payments: While supporting associated works by providing funds to government, are also likely to increase incentives for optimism re revenue to cover the payments.

Partisan Proponents: The leader of the government team may be a very strong supporter of the proposed project and therefore be personally subject to over-optimism about the project's usefulness and level of use.

Project rather than Network Focus: The project team may focus on local issues and not consider wider network effects on the project. This may limit consideration of outside impacts on traffic such as upstream and downstream tolls, as in the Lane Cove Tunnel case.

Tight specifications: Can lead to competition on traffic forecasts only.

Undertakings to bidders: Regarding issues such as alternative route traffic calming, complementary or competing transport infrastructure and expected land use changes can have a significant impact on forecasts in two ways:

- Lack of information can lead to over-optimistic assumptions for issues such as land development and land use growth; and
- Misleading information, for example exaggeration of the degree of traffic calming to be applied, will lead directly to over-optimistic forecasts.

5.3.2 Cost of Bidding

There was general agreement that the cost of bidding, including the cost of traffic modelling, for toll road projects has been rising. Suggested reasons for this include increasing competition, both real and perceived, and also the desire to improve forecast accuracy in view of earlier poorly performing (over-optimistic) forecasts. There is little evidence of accuracy improvement in proportion to the extra spending. However, while lack of resources has been suggested as a source of forecast problems elsewhere (Johnson, 2008) there is strong evidence that forecast problems in Australian projects are not due to insufficient effort or resources. Certainly modelling was well funded in all for cases.

Some people have suggested that the level of bid costs increases the imperative to win to recover these expenses via very optimistic forecasts. The technical teams, including the modellers, also suffer financially from a loss. It is not uncommon for the technical teams to work on the bids for discounted fees. As the breakdown of bid fees in Figure 22 shows, success fees more than recover the money lost.

Modellers did not see success fees as a significant incentive for higher forecasts. Pressures for high forecasts predominantly come from outside the modelling teams. Occasions where modellers' final fees were not paid due to disputes about forecasts were reported, for projects outside our case set.

However, modellers emphasised that it was wrong to suggest such pressure applied in all cases. Where consortia are spending extra money to specifically improve accuracy they should not want

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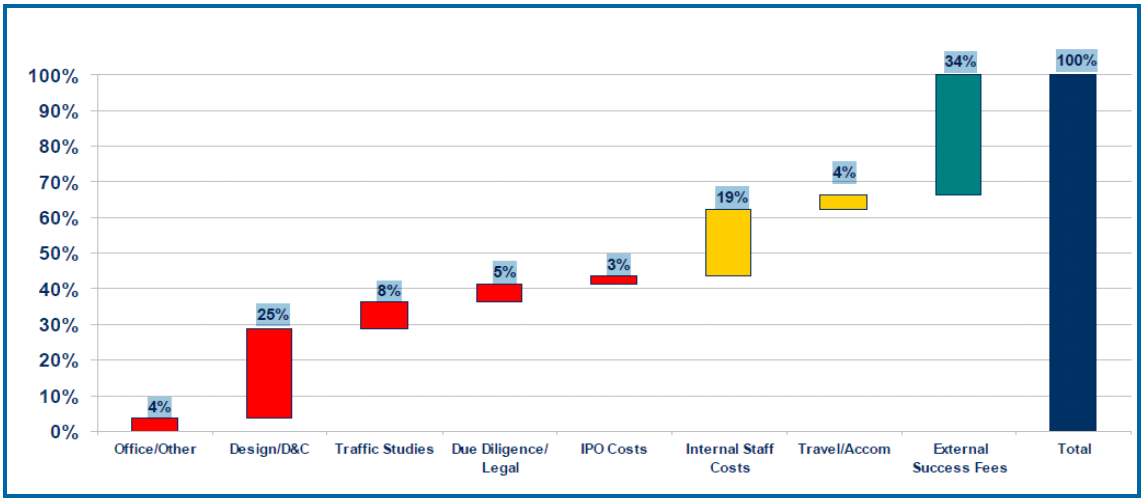
[8] The Council of Australia Governments endorsed the National Public Private Partnership Policy and Guidelines on 29 November 2008. The National Policy and Guidelines effectively replace previously existing policy and guidelines in those jurisdictions.

[9] The PAF (which captures the Value for Money Framework) is the minimum standard for project initiation, evaluation, procurement and assurance across Queensland Government agencies.

to negate that effort. As one consortia lead said "*why would I pay millions for traffic modelling if I did not want an accurate forecast?*"

Others discounted the influence of bid costs noting that a potential loss of hundreds of millions of dollars in project fees is a much stronger spur to competition than potential waste of bid costs.

Figure 22: Approximate Breakdown of Tendering Costs



Source: Hicks Leighton Contractors (2008)

5.3.3 Submission and assessment

Short Listing: Total bidding costs are exacerbated by long short lists and, more importantly, from a forecast quality viewpoint, competitive pressures are increased, and with them incentives for over-optimistic forecasts.

Assessment Processes: Ideally, assessment processes should identify traffic forecasts that seem erroneous, as in an example given (not from our Cases) where the forecast traffic in a submitted and accepted bid exceeded the capacity of the road. This happened where there was no provision for liaison between technical teams involved in assessments of design and traffic. Over-optimistic forecasts would be more likely to be identified where systems are in place to allow the technical advisor to comment on model values as well as model processes.

Co-operation: May reduce over-optimism. Recollections of the CityLink process had faded with time, but the level of co-operation between the Melbourne City Link Authority and first the bidding teams and then Transurban, upon appointment, was remembered. In fact this was reported second hand as a recognised contributor to the success of CityLink by people who were not even involved in traffic modelling or toll road projects at the time of the CityLink bid. While there are probity issues to be managed, it was suggested that closer liaison between the government proponent and the private sector bidders may improve outcomes.

Factors Influencing Over-optimism — Key Points

PPP bid evaluation and contract award processes for toll roads lead to selection of the most optimistic of a set of optimistic forecasts:

- Government forecasts, erring on the high side to avoid under-estimating environmental impacts, may set a forecast 'floor'.
- Traffic modellers in bid teams produce a 'low' forecast above this floor for debt lenders and a 'high' estimate of possible returns for those taking equity.
- Equity forecasts are submitted with bids and the highest forecast almost always wins.

Four-step models used in most toll road forecasts:

- Have some intrinsic positive biases when modelling toll road patronage.
- More importantly they provide many opportunities for optimistic selection of parameters.
- Optimism can more easily occur in the absence of data for example about values of time or traffic flow by day of week and month of year; and
- Estimates of ramp up in traffic after opening may be especially subject to optimism; and/or
- Deliberate selections to raise forecasts, such has high growth rates for population or the economy, may be applied.

Pressures for optimistic selection may occur when:

- Government proponents keen to have a road built do not make use of advice available from government sources, such as treasuries, to consider the commercial viability of the project and so seek full private sector funding for a risky project.
- High private sector 'appetite' for funding road projects leads to bidding for risky projects. At the time of bidding desire for profits exceeds fear of losses.
- High construction costs (as for tunnels) and fixed toll levels mean high traffic forecasts are needed to show costs can be recovered.
- Financial models for optimising the bid encourage high forecasts.
- High levels of competition increase the desire to produce high traffic and revenue forecasts to win (perhaps exacerbated by the high costs of bidding).
- Acceptance by the government of upfront payments as part of bid. This reduces 'costs to the public purse' for associated works but needs to be funded by higher revenue forecasts.

Opportunities for over-optimistic forecasts can occur when:

- Bid technical reviews concentrate on forecast processes rather than values;
- Expected complementary infrastructure does not eventuate or changes to competing infrastructure occur; and
- Liaison between the bidding teams and the government proponent is limited.

Importantly consortia and their modelling teams differ in both pressure applied and response to that pressure and thus not all forecasts are over-optimistic.

6. Potential Remedies

6.1 Applicable now

6.1.1 Under government control

A key aim of the work being undertaken by, and for, the Department, is to ensure confidence in lending and equity investment in the near future. We thus particularly sought remedies to over-optimistic forecasts that are, available in the short term, and, within the control of government, to either help curb provision of, or acceptance of, over-optimistic forecasts.

Both requirements make recommendations for changes to model forms of lower priority. Proven models are likely to be more "bankable" than new models for private sector bidders seeking finance. New model forms usually take time to percolate through to bid models. Moreover it is difficult to envisage a government organisation imposing new modelling processes on the private sector.

It would be possible, as further explained in Section 6.2, for government agencies to require submission of a set of forecasts using new models, in addition to those produced by the bidder using their preferred models.   However practical difficulties might arise in finding sufficient qualified people to implement new models.

Nevertheless, there is one direct modelling remedy taken from the findings of the "Post Implementation Review of the M7 Motorway, Cross City Tunnel and Lane Cove Tunnel" that is very relevant: "*it is recommended that the traffic modelling should incorporate a process of updating and continual improvement during the project development and assessment, rather than hold constant as has been past practice*" (RTA, 2010). This process was applied in the case of the Go Between Bridge resulting in much more realistic forecasts.

'Update and improvement' is just one of the short-term options for addressing modelling and data issues as part of the tender process. Remedies suggested relate to reducing the incentives for over-optimistic forecasts before and during the tenders process.

6.1.2 Pre-Bid

Treasury Input: In contrast to the suggestion that the influence of financiers in bid teams encourages optimism, it was suggested that the presence of government finance officers from treasuries or similar bodies in tender development teams may dampen both enthusiasm and potential over-optimism by project proponents from road agencies.

Apart from a role in limiting optimism bias on the government side from proponents who are convinced of the value of the project and want to see it built, setting up the government team in charge of the bid to include appropriately experienced officers from Treasury or other agency of Government may allow consideration of the suitability of the tender model proposed. Such consideration was suggested by both private sector and government sector people and covered various ways of considering alternatives, either via desktop analysis or via market soundings, to understand private sector appetite for the project as proposed.

Commercial Case Preparation: One straight forward suggestion involved preparation of a "commercial case" in tandem with the government business case. This commercial case would omit monetised social benefits such as pollution reduction and travel time savings from the benefit stream and instead estimate indicative toll revenues based on the traffic estimates in the model.

Such comparison of costs and revenues could alert the tender team to potential cash flow problems that could lead to financial failure.

Co-payments/Risk Sharing: For more risky projects, on greenfield sites with limited information or short sections such as tunnels with alternative surface roads, there may be a case for offering (on a case-by-case basis) options such as:

- Provision of annual co-payments by the government authority; or
- Sharing of traffic risk via a cap and collar provision where the government underwrites the low forecasts but receives payment for traffic in excess of the forecasts.

Such options would apply in early years. In both cases there would be less incentive for bidders to seek optimistic forecasts. Thus such options deserve to be included in remedies for over-optimism, although a full consideration of funding mechanisms is outside the scope of this work (see for instance PWC, 2011 for further discussion).

It is worth noting that neither government nor private sector interviewees recommended availability payments as an option. The concept was referred to by one interviewee as a "*money go round.*"

Bids on the basis of government traffic forecasts or separation of the traffic bid from the "design and construct" portion of the bid were suggested as a way to remove or reduce traffic forecast risk but were not considered feasible by most people, because the revenue from the project, and the costs of construction, are linked considerations for project bidders.

6.2 Tender conditions

Tender conditions were seen a fertile source of ways to limit "exuberant" forecasts. Suggestions ranged from the simple to the complex.

Bidder Set Toll Levels: As is the case in some jurisdictions, toll levels and toll escalation processes should be part of the bid package rather than set in the bid conditions. Fixing the toll can limit the revenue side of the bid to a competition on traffic numbers.

Provision of Models: It was noted that there is a precedent (Auckland City Council) for provision, for a fee, of the government Strategic Travel Model with a set of parameter assumptions for use in PPP project bids. The bidders are at liberty to vary the parameters, or indeed use alternative models, but they are required to provide one set of forecast scenarios using the official model with key specified parameters.

Provision of data: Numbers of people suggested that data availability might improve modelling accuracy. Concerns that "reliance" on such data might leave the government open to legal action might be allayed by having the bidder sign an indemnity and there are precedents for such action.

Two types of data are of particular importance:

- **Historical traffic counts** over time especially and in the immediate vicinity of the project but also on competing and complementary roads. Such data allows better model calibration and the overtime data informs expansion factors. Traffic counts from private roads should be included in the package. While commercial in confidence provisions often preclude this, international precedents for provision were cited.
- **Planning information**: Planned land use changes are required together with any planned transport infrastructure that might either complement or compete with the tendered project. Mis-estimation of the effect or timing of either type of infrastructure can lead to over-optimistic forecasts.

This final data is related to the need for transparency in bid information and also includes the need for government provision of private road data to all bidders. However while such information may help forecast accuracy there is likely to still be a need to discourage exuberant estimates.

Audit Report with Bid. There was quite strong support for a requirement of provision of an independent auditor's report answering a set list of questions as part of the assessment process. Each bid team would appoint their own auditors who would provide commentary on a prescribed list of relevant issues. Examples could include:

- The annualisation factors / values of time / trip rates;
- The relationship between the traffic figures and design capacity;
- Land use and population assumptions; and importantly
- Detail of forecast ranges.

Appendix A shows a process based on Robert Bain's research and experience for investigation of forecast ranges.

This option was originally suggested to help identify sources of very optimistic forecasts but others later suggested that:

- Modellers aware that the forecasts would be scrutinised might think more carefully about optimistic assumptions; and
- As all members of the consortium bid team would want to see the auditor's report prior to bid submission they may wish to amend the forecasts in light of these audit findings.

It was also suggested the Quality Assurance reporting requirements during model developments could help such an audit process. All recent Australian projects including Lane Cove Tunnel, M7 and the Go Between Bridge were subject to QA reporting as a bid condition.

Note: a dissenting voice said this type of audit cannot be done on probity grounds and the earlier interviewee who pessimistically said "*there can be no remedy*" would probably agree.

Refund of Bid Costs: Additionally, since costs spent in bidding may increase the need to win, it was suggested that losing bidders might have some costs reimbursed. It was generally agreed this would be difficult for government bodies (and implies increased costs of procurement). An alternative suggestion was requiring bidders to provide for reimbursement to a capped cost to the losers by the winner. However, doubling or tripling the costs of bidding in this manner may not be feasible for winners. Moreover, someone noted that this might have a perverse effect encouraging high end estimates to recover such extra bid costs.

Consortia Longevity: Finally, as noted in Section 5, a significant number of people believed a short-term focus may produce a cavalier attitude to forecasts. There were a number of suggestions for "*requiring*" the consortium members to be "*in it for the long run*". Requirement for equity holdings by all members of the consortia seem impractical particularly for debt providers. Other ideas, such as including exit permission in the concession contract, could also be difficult. However, it may be possible to give some positive weighting to potential consortia longevity in the bid assessment process described below. Some jurisdictions do have in place change of control approval requirements in project deeds which is viewed as a positive initiative.

6.3 Bid assessment processes

Short Lists: There was almost unanimous agreement that the short-listing process should be relatively simple, based on assessment of consortia experience and skills. As noted above, this assessment could include some weighting for consortia members with a track record of successful long-term toll road operation.

Such bids would not require either early design or traffic estimates. This would both save costs and could open the process to more bidders although there was disagreement over whether more initial bidders was a desirable outcome. However, there was general agreement that short-lists should be short, preferably just two bidders. The specific size of the short-list should be taken as guidance by agencies rather than a standard for all situations.

A process of removing the lowest and highest forecasts and assessing the mid bids was rejected as much too expensive and unlikely to be applicable in Australia where the numbers of bidders is usually small. None of our cases had sufficient bidders to allow this.

Technical bid assessors should not work in independent silos. In particular, the traffic forecasts should be assessed against road design for lane capacity and for capacity of connection at access and egress points.

It was also considered important that the role of the technical assessor be extended beyond comment on processes to comment on values. There was some disagreement about an auditor's ability to compare forecasts. However, comparison with public sector forecast values and explanation of differences in each case would provide sufficient information for a bid assessment team to compare values. This would provide the opportunity for concerns about values as well as concerns about method to inform the selection process.

An extension of this bid audit process would require a bid presentation of the traffic forecasts for each bid following the process described in Appendix A. The range of forecasts might then be explored by the bid assessment team. However, there was more support for this process being applied before, rather than after, bid submission.

6.4 Final comments

It is particularly worth noting that the majority of interviewees believed that there was still private appetite for toll road PPPs in Australia. However, they felt that potential bidders may be much more discriminating and prefer lower risk projects, for example, in brown field sites with good information available. This led to the recommendations for contributory funding mechanisms for higher risk projects.

It was also noted that the Global Financial Crisis effects on available funding and government decisions to defer projects may be more responsible for absence of recent PPPs than poor forecasting performance.

Nevertheless, it was recognised that over-optimistic forecasts, especially if followed by financial failure, definitely contribute to reduced investor confidence. Thus measures are needed. Actions to improve early year forecasts would be particularly valuable.

While it is likely that some private sector firms will themselves be reviewing modelling practices in view of both financial failures and legal challenges, government actions have the advantage of reaching all firms involved in toll road forecasts.

Implementing an appropriate selection of the measures suggested above when new tenders are designed, assessed and let has the potential to reduce both incentives and opportunities for over-optimistic forecasts and, in contrast, reward more realistic forecasts. This is important to avoid loss of confidence in toll road investments and also loss of confidence in traffic models and modellers.

While lack of investor confidence could influence preparedness to bid, lack of confidence in modellers could also affect ability to bid and/or quality of the bids due to:

- **Lack of available modelling teams**: Firms could vacate the toll road patronage modelling field to avoid reputational risk. As the number of local patronage modellers is limited, this could be a significant problem in Australia.
- **Lower quality modelling**: If the modellers who are best able to produce forecasts and also best able, over time, to improve models are replaced by "B teams" or international teams lacking local knowledge.

- **Pessimistic forecasts**: Several people warned of the need to be careful *"the pendulum does not swing the other way"* as modellers err on the side of caution and so under-value investments.

Thus government project proponents, potential consortia members and modellers should all have a vested interest in supporting actions at the tender preparation and assessment stage to limit over-optimism in forecasts. Action might profitably concentrate on improving early year forecasts. There was general agreement that greater collaboration between government and private sector before, during, and after the tender process, would provide better long-term outcomes.

Potential Remedies — Key Points

Remedies under the control of government that can be applied in the short term are needed to ensure investor confidence.

- Major changes to traffic forecasting models are neither feasible in the short term nor usually within government control. Nor would such changes totally remedy over-optimism.
- Options for reducing incentives for over-optimistic forecasts and/or reducing acceptance of over-optimistic forecasts provide more effective and more immediate solutions at all stages of the tender process.

Pre-tender:

- Inclusion of Treasury officers in the proponent team may provide a useful complementary commercial focus to that of the project instigators.
- A commercial case prepared in addition to the economic case for the project could check if full private funding was likely to be commercially viable.
- Consideration of PPP models that include some government payment or early year risk sharing in commercially risky projects may reduce incentives for over-optimism, since there are significant incentives to produce early year revenue forecasts, even if optimistic, which will cover costs.

In setting tender conditions:

- Toll levels and escalation should be set by the bidder.
- Bids include one set forecasts of based on a specified Strategic Travel Model.
- Government supply of traffic and travel data, with suitable indemnities, to avoid over-optimistic 'guesses'.
- A requirement that an audit report be submitted with the bid addressing set key questions about input parameter and forecasts. This process should both identify and discourage over-optimism.
- Encouragement for consortia that are likely to be 'in it for the long run' since they might have greater incentive to produce realistic forecasts. This could perhaps be done via weighting in assessment.

In bid assessment:

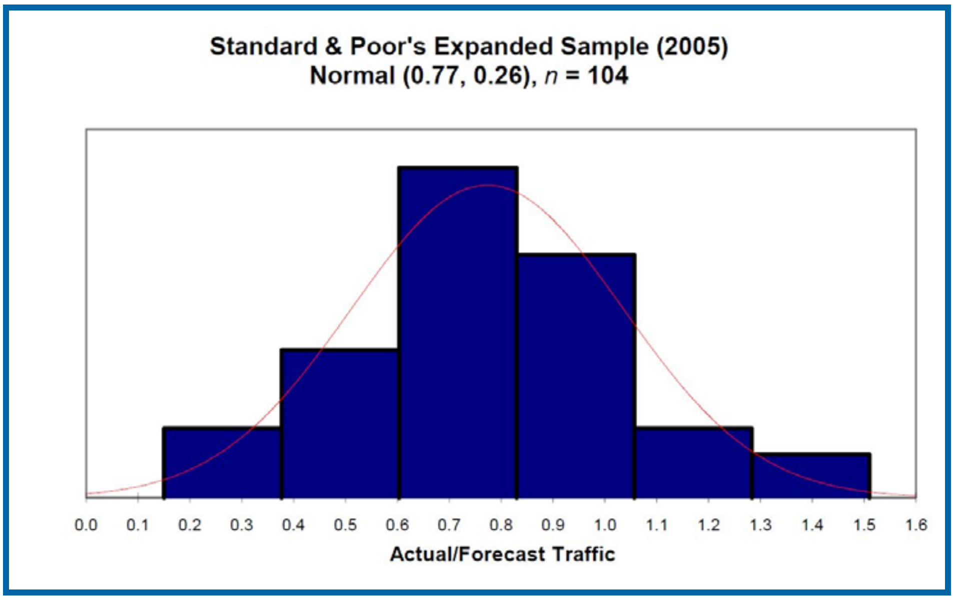
- Short listing based on consortia capacity and experience to two bidders would reduce bidding costs and allow the proponent to work more co-operatively with the bid teams.
- More holistic technical assessment processes that consider forecast values as well as processes and may thus avoid rewarding very over-optimistic forecasts.

A selection of measures could encourage realistic forecasts and increase confidence in both forecasts and modellers. Then modelling teams will be willing to support bids when investors are willing to bid.

Appendix A:
Rethinking the Traffic Forecasting Process

This report has focused on forecasting bias; in particular optimism bias. However, optimism bias is but one characteristic of toll road traffic and revenue forecasts. The other is error — and as a number of authors have pointed out, forecasting errors are common and are commonly large; see, for example, JP Morgan (1997), Flyvbjerg et al (2005), Li & Hensher (2009) and Bain (2009a). The Figure A1 — taken from Bain (2009a) — shows both the influences of bias and error. Forecasting performance, along the horizontal axis, is presented in terms of the ratio of actual-to-forecast traffic. The mean of the distribution sits to the left of 1.0 reflecting bias (over-optimism). The spread of the distribution reflects error. From Figure A1 it can be seen that the forecasting errors range from 85% below the actual (outturn i.e. observed) traffic volume to 50% above it. This is indeed a wide range.

Figure A1: Error and Optimism Bias in Toll Road Traffic Forecasts



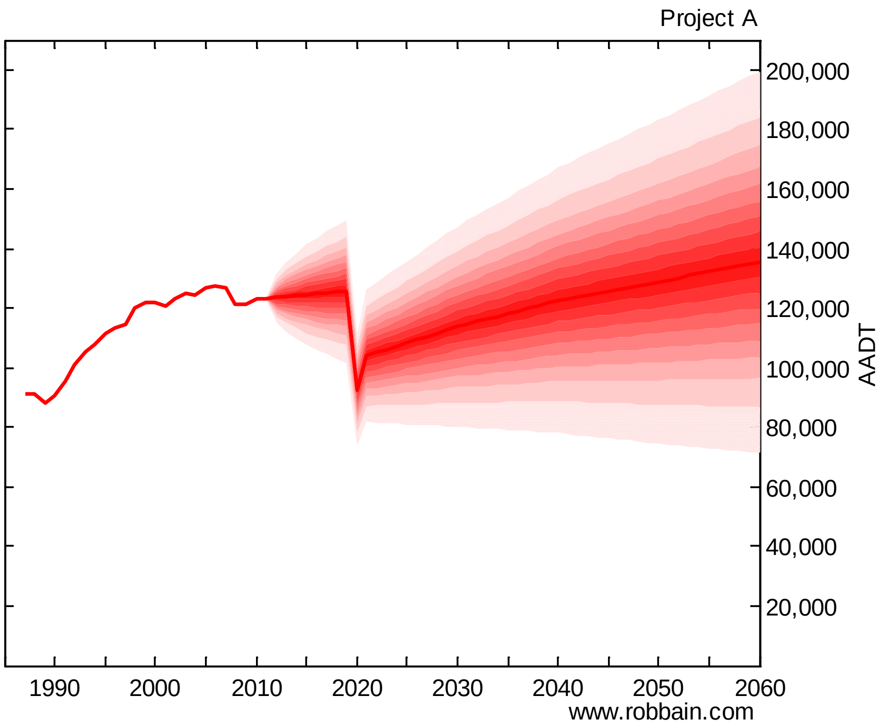
Source: Bain (2009a)

Flyvbjerg (op cit) highlights the fact that, from his research, there appears to have been no improvement in traffic forecasting accuracy over the years. Initially this seems counter-intuitive; given the increasing sophistication of forecasting models and the enhanced scrutiny brought to bear on forecasts by private investors with 'real money' at risk. However there is no evidence linking model sophistication to predictive performance and — in some cases — private investors may be focussed on the required forecasts rather than the accurate ones. The situation is further complicated by the increasingly complex range of policy interventions that traffic models, originally designed for strategic planning purposes and the evaluation of alternative scenarios, are required to accommodate. With Electronic Toll Collection (ETC) applications, for example, the tariff schedule can become much more granular with price differentiation by time-of-day or day-of-week. Perhaps our expectations are unreasonable we are expecting too much — in terms of accuracy — from traffic forecasts?

Other research has focussed on the sources of forecasting error; see Zhao & Kockelman (2002), de Jong et al (2007) and Bain (2011) — and has concluded that the errors associated with the models themselves (sampling error, misspecification error etc.) are small in comparison to the errors associated with the model inputs (projections of population, employment, income, car ownership, fuel price and so forth). This suggests that — irrespective of model sophistication (and the extent of resource devoted to the modelling process) — there is a certain 'upper level' of traffic forecasting accuracy beyond which models would be unlikely (on average) to perform.

Bain takes his findings from (a) a trend analysis of past traffic forecasting performance, (b) a state-of-the-practice survey of transport modellers (asking specifically about predictive capability) and (c) an examination of the uncertainty associated with population forecasts (a — if not the — key input to traffic forecasts) and derives evidence-based prediction intervals for traffic forecasts. An example is shown in Figure A2. The key take-away is that the prediction intervals are likely to be large, and get larger as the traffic forecasting horizon extends.

Figure A2: Evidence-Based Prediction Intervals for Traffic Forecasts



At first glance, aside perhaps from the size of the prediction intervals, there appears to be nothing particularly new about Figure A2. Some traffic consultancies have, for a number of years, been presenting ranges or confidence intervals around their central case forecasts.

However closer examination of the 'confidence intervals' presented by traffic consultants in their reports suggests that they may be:

- Simply 'guesstimates' (e.g. ±10%), or
- High and low estimates (derived from high and low growth scenarios), or
- The results from selective/sample sensitivity tests, or
- The results from selective/sample probability modelling.

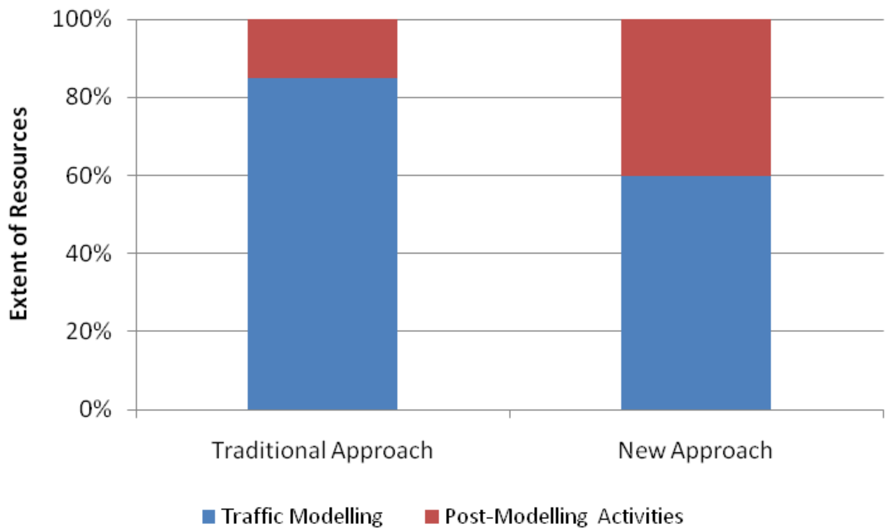
Analysis of the 'confidence intervals' reported by others leaves the reader with the strong impression that they have been crafted in ways that seek to emphasise the 'confidence' that can be placed on central case predictions. It is not uncommon to observe the presentation of unfeasibly narrow prediction intervals around base or central case forecasts and to be left with the feeling that they are being used as some sort of 'sales pitch'. In contrast, the prediction intervals shown in Figure A2 are empirically-derived from the three, independent sources listed earlier.

The empirically-derived prediction intervals shown in Figure A2 represent the starting point from which Bain (unpublished) proposes a different approach to traffic forecasting and working with forecasting models.

Figure A3, to the left, indicates the extent of resources typically devoted to modelling and post-modelling activities in a traditional toll road traffic and revenue study. The percentages are shown for illustration only.

The process is dominated by modelling with post-modelling activities (such as reviewing the model, testing and checking the outputs, running additional sensitivity tests etc.) playing a relatively minor role. Bain challenges this approach — based on the explicit recognition of the limitations of modelling (mentioned above) — and places far greater emphasis on post-modelling activities.

Figure A3: Resources Devoted to Modelling and Post-Modelling Activities



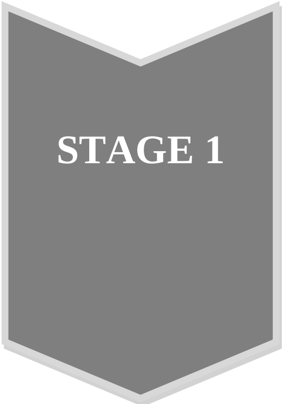
Source: Bain (2011)

Bain's approach derives from work he conducted for highly-experienced institutional investors (from North America) who — based on past performance — are generally sceptical of the capabilities of state-of-the-practice traffic forecasting models. It also builds on forecasting practice from other disciplines (economics and finance) where models are used to inform a process specifically acknowledged from the outset to represent a blend of modelling, statistical analysis, data mining, knowledge, experience and judgment.

Over the past two years, Bain has developed, implemented and refined a 4-stage framework to encapsulate and formalise post-modelling activities. As will be seen, the fourth stage is an option specifically developed for private financiers (with limited relevance for public sector procuring agencies). Nevertheless, for completeness, the 4-stage framework is outlined in full in the following text.

Stage 1 of the process is described in Figure A4. It starts with an independent technical review of the modelling work conducted (and reports produced) to date. Two actions flow from this review. First the central case forecast is adjusted to eliminate any suspected bias. Second, a 'fan chart' (like the one in Figure A3) is super-imposed on the adjusted central case forecast. An optional element in Stage 1 is to 'model the model' in a spreadsheet to test the impacts of alternative assumption sets on key outputs (toll road link flows, for example). As above, the central case forecast may be adjusted as a result.

Figure A4: Post-Modelling Activities — Stage 1



Independent Review

- Full review of technical documentation
- [*option*: Construction of a reduced-form, spreadsheet-based representation of the traffic model ie. model-the-model]
- First-cut adjustment of central case forecast for bias
- Overlay fan chart (standard prediction intervals)
    - *Is uncertainty going to be greater in the future, less or the same?*
- First-cut adjustment of prediction intervals

Summary Report to Client

- Client review, initial comments/feedback
- Make (and document) early adjustments

Source: Bain (unpublished)

Bain's research extends work undertaken by the UK Department of Transport (DfT, 2011) which estimated that the prediction intervals associated with national traffic forecasts could be approximated by the formula: ±2.5% * √n ...where n is the number of years ahead

So, for example, the prediction interval (around a central case forecast) in Year 16 would be expected to be:

±2.5% * √16 ...i.e. ±10%

Bain's work on <u>local traffic forecasts</u> draws a clear distinction between 'stable' and 'dynamic' local areas; following findings from demographic research (which draws the same distinction) — see, for example, Tayman et al (2008) — and the results from his practitioners' surveys. Practitioners reported that modelling accuracy would be greater for established ('stable') highway networks than developing ('dynamic') ones. In short, the predication intervals associated with traffic forecasts are likely to be larger in areas that are characterised by rapid change (significant migration, a highly mobile populace, intense land use or network development). The resulting prediction intervals are presented in Table A1.

Table A1: Empirically-Derived Prediction Intervals

Area 'Type'	Formula	Prediction Intervals		
		Year 1	Year 10	Year 25
Stable	±7.5% * √n	±8%	±24%	±38%
Dynamic	±10% * √n	±13%	±38%	±50%

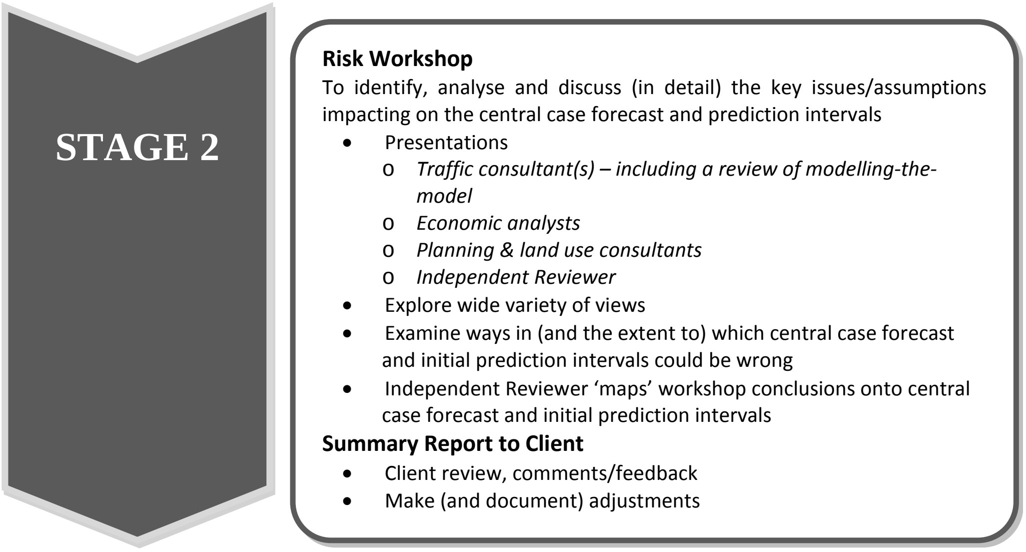
Source Bain (2011) Note: Percentages have been rounded.

To recap, Stage 1 of the post-modelling process framework involves:

- An independent forecast review;
- An option of 'modelling-the-model';
- Adjustment of the central case forecast for any suspected bias;
- Overlay of the prediction intervals suggested by Table A1;
- Adjustment of these predication intervals based on views about future uncertainty in the specific context of the project under consideration.

Stage 2 of the process is summarised below in Figure A5.

Figure A5: Post-Modelling Activities — Stage 2



Source: Bain (unpublished)

A 'risk workshop' lies at the heart of Stage 2. This workshop is entirely separate from any other presentation of the forecasts (e.g. a general presentation of forecast results) — and, as the title suggests, the focus is specifically on risk: risk that central case forecast could be incorrect or that the prediction intervals are inappropriately sized/shaped. In advance of the workshop all of the modelling assumptions are tabulated along with the values employed, the possible range (from which those values are drawn) and — critically — the sources of evidence used in support. A basic assumptions table is shown below:

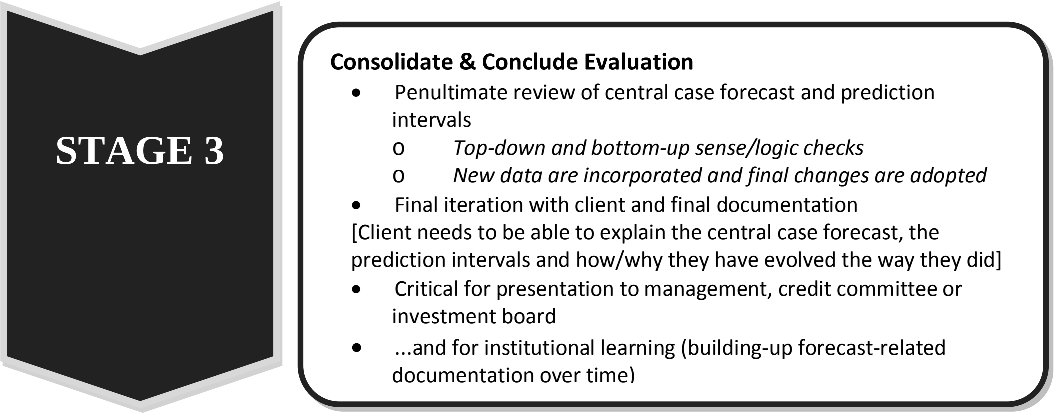
Table A2: Annotated Assumptions Table

Input Variable	Assumed Value	Possible Range	Empirical Evidence/Sources
X			
Y			
Z			

Workshop participants review the assumptions with the respective expert(s) — making presentations — until a consensus is reached. Considerable emphasis is placed on any evidence that can be used to support the assumptions being made and experts are expected to focus their efforts in this area. Any resulting changes to the original assumption set employed are then 'washed through' the traffic forecasting model and, if required, revised central case predictions (and associated intervals) are derived.

Stage 3 of the process consolidates the findings so far (incorporating any new data/ information) and employs a series of top-down and bottom-up 'sense checks'. Top-down checks take an overview and might use the results from a simple ('naive') model — e.g. an extrapolation of historical trends or the outputs from the spreadsheet model referred to earlier — to test the reasonableness of the forecasts. Bottom-up checks revisit some of the basic modelling assumptions; perhaps testing the sensitivity — or robustness — of the model outputs (traffic and revenue forecasts) to alternative input variable values.

Figure A6: Post-Modelling Activities — Stage 3

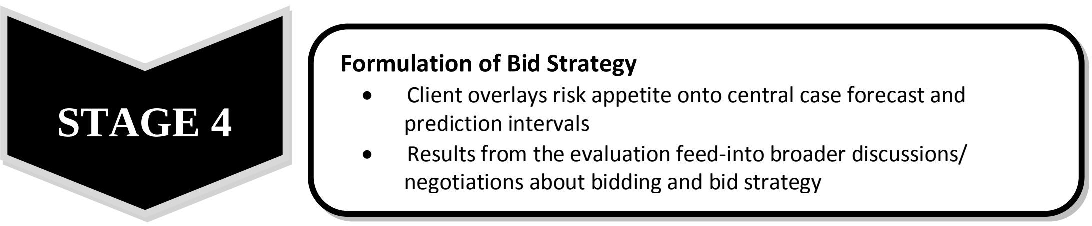


Source: Bain (unpublished)

Note that at the end of each of the three stages discussed so far, the findings are documented. This documentation is essential. It need not be extensive but should — at a minimum — provide a full 'audit trail'; a record of changes made, key discussions held and reasons for actions. One of the key aims of the 3- (or 4-) stage approach is to promote institutional learning. The private infrastructure investors that the approach was initially developed for are long-term market participants with long-term interests (such as pension funds). They are fully aware that benefits derived from employing the framework will most likely be realised over the long-term; yet fully support introduction and use of the framework today.

As mentioned earlier, the final (optional) stage — Stage 4 — has limited applicability for public sector agencies. At this Stage, private investors are overlaying their own appetite for risk (usually in the context of portfolio exposure) and using the results from the exercise to feed-into their bid strategy formulation (see Figure A7).

Figure A7: Post-Modelling Activities — Stage 4



Source: Bain (unpublished)

Closing Comments

Would adoption of the 4-Stage approach outlined above lead to more accurate traffic and revenue forecasts? At this point there is absolutely no evidence to suggest that it would. However, arguably, the past performance of much traffic forecasting has been so dismal that it might prove difficult to perform any worse. However this misses the point. The fact is that forecasts today already have highly subjective assumptions driving them and are commonly subjected to adjustments based on judgment, knowledge, experience etc. The 4-Stage approach simply provides an auditable framework that makes assumptions, judgments and so forth explicit. In the absence of a framework, actions become forgotten and the opportunities to learn lessons from the past are significantly diminished. The 4-Stage approach is presented, in full, in Figure A8.

Figure A8: Post Post-Modelling Activities — Stages 1 to 4

Evaluating Risk & Uncertainty in Transport Demand (and Revenue)

STAGE 1

Independent Review

- Full review of technical documentation
- [option: model-the-model]
- First-cut adjustment of central case forecast for bias
- Overlay fan chart (standard prediction intervals)
  - *Is uncertainty going to be greater in the future, less or the same?*
- First-cut adjustment of prediction intervals

Summary Report to Client

- Client review, initial comments/feedback
- Make (and document) early adjustments

STAGE 2

Risk Workshop

To identify, analyse and discuss (in detail) the key issues/assumptions impacting on the central case forecast and prediction intervals

- Presentations
  - *Traffic consultant(s) – including a review of model-the-model*
  - *Economic analysts*
  - *Planning & land use consultants*
  - *Independent Reviewer*
- Explore wide variety of views
- Examine ways in (and the extent to) which central case forecast and initial prediction intervals could be wrong
- Independent Reviewer 'maps' workshop conclusions onto central case forecast and initial prediction intervals

Summary Report to Client

- Client review, comments/feedback
- Make (and document) adjustments

STAGE 3

Consolidate & Conclude Evaluation

- Penultimate review of central case forecast and prediction intervals
  - *Top-down and bottom-up sense/logic checks*
  - *New data are incorporated and final changes are adopted*
- Final iteration with client and final documentation

[Client needs to be able to explain the central case forecast, the prediction intervals and how/why they have evolved the way they did]

- Critical for presentation to management, credit committee or investment board
- ...and for institutional learning (building-up forecast-related documentation over time)

STAGE 4

Formulation of Bid Strategy

- Client overlays risk appetite onto central case forecast and prediction intervals
- Results from the evaluation feed-into broader discussions/ negotiations about bidding and bid strategy

Source: Bain (unpublished)

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