The Application of a Theory of Real Options (TRO) to the Decision-making of Mega Urban Transport Projects (MUTPs)

Ph.D. Thesis March 18, 2016

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Figure 1: Tandberg Cartoon, source: Cartoon by Ron Tandberg in The Melbourne Age and Sydney Morning Herald, 23 July 2014
Citation

Dr Michael Easson investigated the application of a theory of real options to decision-making on major transport projects. By combining a study of the composition of planning decisions with that of risk management and allocation the research opens new avenues for decision-makers assessing and seeking implementation of major projects.

Declaration

I declare that this thesis comprises only my original work towards a Ph.D. and has not been submitted in any other form for another degree or diploma at any other university or other institution of tertiary education. Due acknowledgement has been made in the text to all other material used. The thesis is less than 100,000 words in length exclusive of tables, maps, bibliographies and appendices.

Signed:

Date:
Synopsis

The Thesis contributes to knowledge by exploring the application of the theory of Real Options (TRO) to mega urban transport projects (MUTPs). The latter are proposed or completed transport infrastructure projects (e.g., road, rail, bridge or tunnel, or a combination) costing at least $US500 million and having major impacts on urban systems. The core hypothesis is that the application of real option theory in the context of superior project management assists in the effective conception and successful delivery of MUTPs. The Thesis sheds new light on and poses new insights about institutional decision-making in transport policy.

Ideally with all MUTPs they develop through a process of informed, rigorous decision-making. Manifestly, this needs to occur cognisant of risks and alert to potential failure. The research of Flyvbjerg and other theorists, however, demonstrates that with MUTPs there is the notorious problem of project costs being usually dramatically under-estimated and benefits grossly over-estimated. The contention of the thesis is that MUTP planning is best developed and pursued in a series of steps, conceived as real options (ROs), learning from experience and developing step-by-step fresh options in deciding whether and how to move forward. Alternative explanations and theories of MUTP planning are considered and evaluated with the judgement made about the heuristic and practical merit of the TRO. In doing so, the Thesis creates a new theory about MUTPs that offers new avenues both for academic research and for decision-makers weighing the merit of projects and their implementation. Because of institutional barriers and presumed patronage hurdles, the argument is advanced that this way of analysing proposals is particularly important for rail compared to road projects. By reference to the experience in Sydney, and references to other Australian cities and international research, the applicability of this research is explored both to transport planning locally and internationally.

The aim of this project is to learn lessons from case studies of MUTPs in Sydney and to explain decision-making leading to the project adoption and execution and whether a TRO would have assisted. Comparisons are made between road
and rail MUTPs, including the lessons that can be learnt and transferred to the project development and implementation of other MUTPs. The study is important because urban infrastructure is increasingly under pressure worldwide as urban populations increase, governments are increasingly using mega projects to deliver urban infrastructure and mega projects have not historically been particularly successful, particularly on typical measures of cost, scheduling, and meeting initial expectations. The promise and achievement of the Thesis is to demonstrate that the TRO is of practical assistance to MUTP planning.

In Popper’s *Objective Knowledge* (1972), he suggested that theories are like searchlights, illuminating evidence, providing perspective, and a rationale for analysis. The TRO is such a theory, but its utility is enhanced, and may not be valuable without, project management and managers capable of its realisation. As every road and railway project and network is a socio-technical system, with human factors at its core, the contribution of a TRO must be used at a management systems level rather than as an isolated tool. This is the proposition that informs this Thesis, filling a gap in the academic literature, and improving, through the consideration of a TRO, transport and urban planning and the project management of MUTPs.
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<tr>
<td>ABN AMRO</td>
<td>a Dutch investment bank</td>
</tr>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<tr>
<td>ACTEW</td>
<td>ACT Energy and Water [a corporation]</td>
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<td>ALC</td>
<td>Airport Link Company</td>
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<tr>
<td>AM</td>
<td>Adaptive Management</td>
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<tr>
<td>AO</td>
<td>[NSW] Audit Office</td>
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<tr>
<td>AoG</td>
<td>Art of Governance</td>
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<tr>
<td>ARL</td>
<td>Airport Rail Link</td>
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<td>ARM</td>
<td>Adaptive Resource Management</td>
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<td>ARRB</td>
<td>Australian Road Research Board</td>
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<td>AS</td>
<td>Australian Standard</td>
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<tr>
<td>$AU</td>
<td>Australian Dollars</td>
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<tr>
<td>BCA</td>
<td>Benefit Cost Analysis</td>
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<td>BCG</td>
<td>Boston Consulting Group</td>
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<td>BCR</td>
<td>Benefit Cost Ratio</td>
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<td>BIM</td>
<td>Building Information Modelling</td>
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<td>BN</td>
<td>Bayesian Network</td>
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<tr>
<td>BOO</td>
<td>Build Own Operate</td>
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<td>BOOT</td>
<td>Build Own Operate &amp; Transfer</td>
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<tr>
<td>BOT</td>
<td>Build Operate Transfer</td>
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<tr>
<td>B/PB</td>
<td>Bechtel and Parsons Brinkerhoff</td>
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<tr>
<td>bps</td>
<td>Basis points</td>
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<tr>
<td>BRT</td>
<td>Bus Rapid Transit</td>
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<td>BTS</td>
<td>[NSW] Bureau of Transport Statistics</td>
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<tr>
<td>CBA</td>
<td>Cost Benefit Analysis</td>
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<tr>
<td>CBD</td>
<td>Central Business District</td>
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<tr>
<td>CCMC</td>
<td>Cross City Motorway Consortium</td>
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<tr>
<td>CCT</td>
<td>Cross City Tunnel</td>
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<tr>
<td>CEI</td>
<td>Commission électrotechnique international (see also IEC)</td>
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<tr>
<td>CKI</td>
<td>Cheung Kong Infrastructure Holdings Ltd.</td>
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<tr>
<td>CPM</td>
<td>Critical Path Method</td>
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<tr>
<td>CP2</td>
<td>Capital Partners, No. 2, an Australian infrastructure fund manager</td>
</tr>
<tr>
<td>CIRIA</td>
<td>[UK] Construction Industry Research and Information Association</td>
</tr>
<tr>
<td>COSO</td>
<td>Committee of Sponsoring Organisations of the Treadway Commission</td>
</tr>
<tr>
<td>CRI</td>
<td>a civil construction company in Australia, originally called Custom Resources International, now defunct</td>
</tr>
<tr>
<td>CSERGE</td>
<td>Centre for Social and Economic Research on the Global Environment</td>
</tr>
<tr>
<td>CSIP</td>
<td>Customer Service Improvement Programme</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
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<tr>
<td>CTI</td>
<td>Committee on Transport and Infrastructure</td>
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<tr>
<td>D&amp;C</td>
<td>Design and Construct</td>
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<tr>
<td>DB</td>
<td>Deutsche Bank</td>
</tr>
<tr>
<td>DBFM</td>
<td>Designs, Builds, Finances and Maintains</td>
</tr>
<tr>
<td>DBFO</td>
<td>Designs, Builds, Finances and Operates</td>
</tr>
<tr>
<td>DEFRA</td>
<td>[UK] Department of Environment, Food and Regional Affairs</td>
</tr>
<tr>
<td>DGTREN</td>
<td>Directorate-General of Transport and Energy of the EEC</td>
</tr>
<tr>
<td>DIPNR</td>
<td>[NSW] Department of Infrastructure, Planning and Natural Resources</td>
</tr>
<tr>
<td>DMR</td>
<td>[NSW] Department of Main Roads</td>
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<tr>
<td>DMRB</td>
<td>Design Manual for Roads and Bridges</td>
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<tr>
<td>DoD</td>
<td>Department of Defence</td>
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<tr>
<td>DoP</td>
<td>[NSW] Department of Planning</td>
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<tr>
<td>DSMC</td>
<td>Defense Systems Military College</td>
</tr>
<tr>
<td>DSMC</td>
<td>Direct Simulation Monte Carlo</td>
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<tr>
<td>EKY</td>
<td>Ernst &amp; Young, a top four accounting firm</td>
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<tr>
<td>EEC</td>
<td>European Economic Community</td>
</tr>
<tr>
<td>ECRP</td>
<td>Epping to Chatswood Rail Line</td>
</tr>
<tr>
<td>EDR</td>
<td>Economic Development Research [group, a US organisation]</td>
</tr>
<tr>
<td>EGAP</td>
<td>Everything Goes According to Plan</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
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EMV  Expected Monetary Value
ERL  Epping Rail Link
EU  Expected Utility
FHWA  Federal Highway Administrator [a US government body]
GAMUT  [Australasian Centre for the] Governance and Management of Urban Transport
GGS  General Government Sector
GFC  Global Financial Crisis
GHG  Greenhouse Gases
GSP  Gross State Product
GST  Goods & Services Tax
HOT  High Occupancy Tolls
IA  Infrastructure Australia [statutory authority]
IARIW  International Association for Research in Income and Wealth
ICE  [UK] Institution of Civil Engineers
ICT  Information and Communication Technology
IEC  International Electro-technical Commission (see also CEI)
IEEE  The Institute of Electrical and Electronics Engineers [US body]
INSW  Infrastructure NSW [statutory authority]
IPART [NSW] Independent Pricing and Regulatory Tribunal
IRR  internal rate of return
IRT  Incident Response Team
ISO  International Organization for Standardization
ITLS  Institute of Transport and Logistics Studies, University of Sydney
KPMG  a top four accounting firm
LCT  Lane Cove Tunnel
LIBOR  London Inter-Bank Offer Rate
LPT  Liverpool to Parramatta transitway
LRV  Light Rail vehicles
MCDA  Multiple Criteria Decision Analysis
MCS  Monte Carlo simulation
MFF  Mitcham Frankston Freeway
MIG  Macquarie Infrastructure Group
MREP  Metropolitan Rail Expansion Programme
MTS  Metro Transport Sydney
MUTP  Mega Urban Transport Projects
NATA  New Approach to Appraisal
NFPS  Non-Financial Public Sector
NPV  Net Present Value
NWRL  North West Rail Link
NZS  New Zealand Standard
Opex  operational expenditure
OH&S  occupational health and safety
OTS  operations, trains and systems
PC  [Australian] Productivity Commission
PDP  Project Development Process
PERT  Program Evaluation and Review Technique
PGEATII Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives
PMBoK  Project Management Body of Knowledge
PMRL  Perth to Mandurah Rail Link
PPP  Private Public Partnership
PRAM  Project Risk Analysis and Management
PRM  Project Risk Management
PT  public transport
PTC  [NSW] Public Transport Commission
PTC  Public Trading Enterprise
PUC  Point of Unstoppable Commitment
PWC  a top four accounting firm
RAC  [NSW] Rail Access Corporation
Railcorp  [NSW] Rail Corporation
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>RBS</td>
<td>Royal Bank of Scotland</td>
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<tr>
<td>RIC</td>
<td>[NSW] Rail Infrastructure Corporation</td>
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<td>RMS</td>
<td>[NSW] Roads &amp; Maritime Services [Authority]</td>
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<tr>
<td>RO</td>
<td>Real Option</td>
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<tr>
<td>ROA</td>
<td>Return on Assets</td>
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<td>ROE</td>
<td>Return on Equity</td>
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<td>Return on Investment</td>
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<td>RSA</td>
<td>[NSW] Rail Services Australia</td>
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<td>RTA</td>
<td>[NSW] Roads and Traffic Authority</td>
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<tr>
<td>RTBU</td>
<td>Rail, Tram and Bus Union</td>
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<tr>
<td>SHT</td>
<td>Sydney Harbour Tunnel</td>
</tr>
<tr>
<td>SHTC</td>
<td>Sydney Harbour Tunnel Company</td>
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<tr>
<td>SPV</td>
<td>Special Purpose Vehicle</td>
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<tr>
<td>SRA</td>
<td>[NSW] State Rail Authority</td>
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<tr>
<td>SRG</td>
<td>Sydney Roads Group [corporation]</td>
</tr>
<tr>
<td>SSRN</td>
<td>Sydney Strategic Roads’ Network</td>
</tr>
<tr>
<td>STA</td>
<td>[NSW] State Transit Authority</td>
</tr>
<tr>
<td>SWR</td>
<td>Statewide Roads Corporation</td>
</tr>
<tr>
<td>TCA</td>
<td>[NSW] Transport Co-ordination Authority</td>
</tr>
<tr>
<td>TDC</td>
<td>[NSW] Transport Data Centre</td>
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<tr>
<td>TNSW</td>
<td>Transport for NSW</td>
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<tr>
<td>TIDC</td>
<td>[NSW] Transport Infrastructure Development Corporation</td>
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<td>TOC</td>
<td>Theory of Constraints</td>
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<td>TOD</td>
<td>Transport-oriented Development</td>
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<td>TRO</td>
<td>Theory of Real Options</td>
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<td>UCL</td>
<td>University College London</td>
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<tr>
<td>UNSW</td>
<td>University of NSW</td>
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<tr>
<td>$US</td>
<td>United States Dollars</td>
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<tr>
<td>UTA</td>
<td>Urban Transit Authority</td>
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<tr>
<td>UTS</td>
<td>University of Technology, Sydney</td>
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<tr>
<td>Vfm</td>
<td>Value for money</td>
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<tr>
<td>WEB</td>
<td>Wider Economic Benefit</td>
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<td>WFR</td>
<td>Western Fast Rail</td>
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<tr>
<td>WSROC</td>
<td>Western Sydney Regional Organisation of Councils</td>
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<tr>
<td>WYSIATI</td>
<td>What You See Is All There Is</td>
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</table>
Details of Figures, Tables and Maps

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Figure 2: When Management Flexibility is Valuable

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Preface

My interest in transport was kindled through experiences at the Labor Council of NSW (1978-1994), including industrial relations negotiations concerning rail, the development of Darling Harbour, and the Sydney Harbour Tunnel (SHT) which extended road capacity under the harbour. In this period, I came to know and respect Dr Lloyd Ross (1901-1987), the retired rail union leader, who had written on transport issues; the founders of Transfield, Carlo Salteri (1920-2010) and Franco Belgiorno-Nettis (1915-2006), who were bold enough to put forward the SHT idea, and spoke to me about their vision; and Sir Peter Abeles (1924-1999), the trucking and transport tycoon, who championed maglev technology for rail and eventually succeeded in getting the Sydney monorail built - though this was a shadow of what he had contemplated. I gathered a perspective not only about big ideas, but also about the promotion and execution of major projects.

More practically, I served as an independent, non-executive Director on various company boards engaged in mega urban transport projects (MUTPs), including the Board of the NSW State Rail Authority (SRA) (1989-1992), which ran city and country rail services in NSW; the Board of the Macquarie Infrastructure Group (MIG) (1996-2007), which invested in and managed tollroads around the world; the Sydney Roads Group (SRG) (2006-2007) which, after divestment into a separately ASX-listed vehicle, ran most of MIG’s former Sydney tollroads; and, Metro Transport Sydney (MTS) (2001-2008), the operators of light rail and the monorail in Sydney. I was also Chair of the Western Fast Rail (WFR) consortium (2000-2010) with Leighton Contractors and the investment bank ABN AMRO. WFR was an unsuccessful, unsolicited Private Public Partnership

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(PPP) proposal to build extra ‘heavy rail’ track, operational and passenger capacity from Penrith to the Sydney CBD.7

Notwithstanding the above, perhaps in some ways in spite of the ingrained perspective gathered from some of this experience in the transport sector, the writing of the Thesis has forced me to think anew - critically, systematically, and constructively about how MUTPs are imagined, are realised, and often fail. Many of my past assumptions and ways of evaluating transport problems were challenged.

This Thesis offers an original interpretation, a theory of real options, of practical value in engaging with the formulation and realisation of MUTPs.

My supervisors, Professor Nicholas Low, Associate Professor Alan March, and Dr John Stone gave me a wealth of advice, some punishing, about earlier drafts. This was an experience worth participating in. What is good in what follows is largely due to them. I am entirely responsible, however, for errors and any failure of expression, imagination, and clarity of thought. The examiners too, in offering detailed comments, enabled the completion of a more considered argument.

Jane Trewin and her team at the School of Architecture, Building and Planning were incredibly helpful in getting me through the administrative hoops and in many other ways. I thank them.

Through Elance, maps and illustrations were designed with the assistance of Chandramohan Ramesh.8 My colleague Catherine Harding intensively scrutinised the manuscript for error and Professor Paul Kerin, formerly of the Melbourne Business School, read through earlier drafts and they both helped to clarify my thinking. Professor Steve Easton, Professor of Finance at the University of Newcastle, Australia, commented on the earlier Chapters, particularly the theory of real options. Sally Holloway, Managing Director, CP2, the infrastructure investment house, offered some comments on the section

7 For background, see Appendix 2 of the Thesis. Because the author is too close to this project to be objective, minimal reference to this project is made in the main body of the Thesis.
8 Elance is a company that connects freelancers with particular projects. See, https://www.elance.com, accessed July 2015. Subsequently the company was renamed Upwork (www.upwork.com).
dealing with the Airport Rail Link (ARL) project in Chapter 5. Dr Jack Gray, an Adjunct Professor of Finance at the Paul Woolley Centre for Capital Markets Dysfunctionality at the University of Technology, Sydney, and former Chief Investment Officer at SunSuper, one of Australia’s largest superannuation funds, and past and present holder of other investment management positions, read the first Chapter and offered insightful comment. Dr Roger Allport, independent transport consultant and Honorary Senior Research Fellow, Imperial College London, in one long chat and several emails encouraged me a few years ago to keep going. The late Barry Garnham (1944-2014)\footnote{Maker, Glenn (2015) ‘Barry Garnham: Transport Strategist Helped Shape the NSW Rail Sector. Barry Garnham (1944-2014)’, \textit{Sydney Morning Herald}, 27 April.}, a former senior UK and NSW rail bureaucrat, offered comments on road and rail planning in NSW in the period 1990 to 2010.

My wife, Mary, encouraged me all the way through and began me on this journey. So I dedicate the Thesis to her. (Darling, it is something to dip into when on the train to the city.)

A punishing thought remains. With so much guidance and assistance, the faults of the Thesis are solely mine.
1. Introduction and Method of Investigation

1.1 Overview

Aim

The Thesis contributes to knowledge by exploring the application of the theory of Real Options (TRO) to mega urban transport projects (MUTPs). The latter are proposed or completed transport infrastructure projects (e.g., road, rail, bridge or tunnel, or a combination) costing at least $US500m and having major impacts on urban systems. The core hypothesis is that the application of real option theory in the context of superior project management assists in the effective conception and successful delivery of MUTPs. The Thesis sheds new light on and poses new insights about institutional decision-making in transport policy.

The Thesis draws from a vast body of literature on mega project flaws (optimism bias, cost blowouts, poor risk management) and addresses remedies frequently put forward (taking the time to research a project’s risks, its design, and shifting responsibility to parties best able to take on risk), in the context of theories of project risk management. The research fills a gap in Flyvbjerg’s (2014c) assessments of MUTPs. What is under-explored in his research is how projects are successfully delivered. The argument is advanced that by imagining projects as real options, breaking them up into components that link together, is a means of reducing risk and ensuring the successful conception and execution of a MUTP.

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1 For clarity where this Ph.D. Thesis is referred to it is the Thesis. The lower-case ordinary use of the word is employed elsewhere.
3 The definition is derived from OMEGA Centre (2009) State of the Nation, Submission by the OMEGA Centre, The Bartlett, University College London. There, the MUTP definition refers to construction costs in excess of $US0.5b at 1999 prices.
Although comparisons are made with other jurisdictions, the argument of the Thesis draws heavily from many examples taken from Sydney over the past few decades. Noticeable is the difference between the conception and delivery of road projects as compared to rail. The hypothesis is advanced that the Sydney orbital – a ring of roads within wider metropolitan Sydney – developed as a large plan, broken into component parts (sections of which became the M2, M5, etc.), with each link separately developed over time, created the overall ‘network’. (The word is placed in apostrophes because it is arguable that nothing more than an orbital was created – something that uneasily fitted with the rest of the road network.) There were many factors involved in the development of the component road options and the exercise of those options via a variety of PPP funding, design and construct (D&C) contracts, political and public service leadership, and the creative opportunism of the investment banks. What is noticeable with rail was the comparatively unadventurous approach to major rail project development, particularly between 1995 to 2005. The learning experience that was cultivated in road project development with the road bureaucrats stands in marked contrast to rail infrastructure bodies where a learning culture did not exist. The question of improvement in terms of roads and, more generally, public transport is really an issue of exploiting the network effect, as discussed in HiTrans.

The research underpinning the Thesis leads to important conclusions because, in evaluating MUTP development, the core challenge is to improve decision-making, enabling acute focus on saving scarce resources and reducing waste in major project development. As large sums are involved, ideally all MUTP approvals should occur through a process of informed, rigorous decision-making that is cognisant of risks and alert to potential failure. The contention here is that MUTP planning is best developed and pursued in a series of steps, conceived as real options, learning from experience, and developing step-by-step

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fresh options in deciding how to proceed. Option generation is defined herein as the \textit{production} of alternatives from which to choose. A live research issue is whether this conception is replicated in actual project development and what the evidence shows about its potential utility. Before directly dealing with that question, it is useful to explore what are real options (RO).

Options are more numerous the more there is room for flexibility and the greater the level of uncertainty - both of which features are evident in major transport infrastructure. The Figure below (from Copeland, Koller and Murrin, 2002) is instructive:

\textbf{Figure 2: When Management Flexibility is Valuable}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{flexibility_value.png}
\caption{When Management Flexibility is Valuable}
\end{figure}


Flexibility, as Figure 2 illustrates, creates value where new information could decisively shape a project – in scale, timing, and in linkages to a system or network. There are plentiful examples of options embedded in mega projects, including infrastructure projects.\textsuperscript{7} Such options have a net value, which potentially improves the flexibility and valuation of a project. In the case of, say, a rail project, a decision might be taken to explore a particular significant

augmentation to an existing network, or a series of improvements, and the
decision-making might be highly contingent on the route, synergies with other
transport modes (inter-connectivity and transfer) such that the overall decision
might be what is for the best with the network overall. Information, enhanced
throughout the project development phase(s), should shape the re-setting
and/or implementation of the project(s) chosen. The best kind of decision-
making is that which generates the most real options.

To avoid confusion, it is essential at the outset to explain what is meant by the
concept of real options. In the theory of strategic transport planning advocated
here, a real option is not a purely mathematical, quantifiable concept, as in
finance theory, although in both cases an option conceives the right, but not the
obligation, to buy (or sell) an asset at some point within a predetermined period
for a predetermined price. The Black-Scholes-Merton Model, first developed in
1973, is one of the most important concepts in modern financial theory and
widely used to determine fair prices of options.8 The model assumes that the
price of heavily traded assets follows a geometric Brownian motion with
constant drift and volatility. When applied to a stock option, the model
incorporates the constant price variation of the stock, the time value of money,
the option’s strike price, and the time to the option’s expiry date. In modern
investment theory the application of option concepts has revolutionised the way
practitioners think about investment projects by explicitly incorporating
management flexibility into the analysis.9 A derivation of the finance theory of
options is the theory of real options – that decision-making in situations of
complexity and uncertainty, such as mega infrastructure investment, is
enhanced through thinking about projects as occurring in stages, through the
exercise of real options.10 A real option, however, is distinct from a synthetic

Option-Pricing Theory: Twenty-Five Years Later’ (Nobel Prize Address), The American
Economic Review, June, pp. 323-349.
9 Schwartz, Eduardo S., & Trigeorgis, Lenos (2001) ‘Real Options and Investment under
Options and Investment under Uncertainty, The MIT Press, Cambridge, p. 1
10 Luehrman, Timothy A. (1998a) ‘Investment Opportunities as Real Options: Getting Started on
the Numbers’, Harvard Business Review, July-August, pp. 51-67; Luehrman, Timothy A.
1998, pp. 89-99; Trigeorgis, Lenos (1996) Real Options: Managerial Flexibility and Strategy in
derivative in finance theory practice. A real option provides: “The flexibility arising when a decision maker has the opportunity to adapt or tailor a future decision to information and developments that will be revealed in the future. A real option conveys the right, but not the obligation, to take an action (e.g.,

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**Figure 3: Common Real Options (ROs)**

<table>
<thead>
<tr>
<th>Real Option Type</th>
<th>Description</th>
<th>Relevant industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deferral or waiting option</td>
<td>Management can wait before making the investment based on need for further information and/or to see how the market unfolds.</td>
<td>Resource extraction industries (e.g., sensitive to price), real-estate development (e.g., sensitive to market conditions), capital-intensive industries (e.g., sensitive to economy-wide pressures).</td>
</tr>
<tr>
<td>Staging or time-to-build option</td>
<td>When a management decision takes time or is done in stages, management can default if market prospects prove worse than expected.</td>
<td>Technology-based firms (R&amp;D), long-development capital-intensive industries (e.g., electric utilities), start-up ventures.</td>
</tr>
<tr>
<td>Expand or extend option</td>
<td>If a project turns out well, there may be grounds for management to expand the project scale or extend the project.</td>
<td>Natural-resource industries (e.g., mining), real-estate development, transport project extension.</td>
</tr>
<tr>
<td>Contract or abandon option</td>
<td>If the market prospects are worse than expected, managers can contract or abandon a project for salvage.</td>
<td>Capital-intensive industries (e.g., airplane manufacturers), new product introductions.</td>
</tr>
<tr>
<td>Switching option</td>
<td>Management can select among the best of several alternatives, e.g., inputs, outputs or locations, under the prevalent market conditions.</td>
<td>Multinational firms with production facilities in different currencies, platform strategy in the automotive sector.</td>
</tr>
<tr>
<td>Compound option</td>
<td>If investment takes place in stages, the first project can be valued in view of the future growth options it creates.</td>
<td>High-tech, R&amp;D, industries with multiple product generations, strategic acquisitions.</td>
</tr>
</tbody>
</table>


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deref, expand, contract, or abandon a project) at a specified cost (the exercise price) for a certain period of time, contingent on the resolution of some
exogenous (e.g., demand) uncertainty.” But this is hard to quantify in precise terms. The perspective offered in this Thesis is that all decision-making is optional. Figure 3 above highlights various common types of real options.

Even if the argument that all decisions are real options is a truism, the real issue is the practical implementation of real options analysis. The proposition is that logically all decisions contain embedded options. It is both desirable and rational to think in this way. In doing so, participants in debates on transport planning, including planners and managers, should be more appreciative of the potential of each decision, along a chain of decision-making, and prepared to revisit assumptions, including direction in the light of new evidence. The variety of ROs described in Figure 3, above, is illustrative of everyday decision-making in an array of industries. All are apposite to transport planning where the option of deferral or waiting, staging, expansion or extension, stop/go, switching and/or compounding are all contemplated in the development of those MUTPs that suit a particular urban environment.

The academic literature on real options covers various disciplines. The Thesis considers literature from transport, economic, finance, and strategy disciplines. From a transport planning viewpoint, a critical issue is whether the benchmark (the do-nothing option) is clear and how to quantify the value of particular real options. The strategy literature tends to discuss real options in an open-ended and imprecise fashion. In contrast, the economics and especially the finance literatures seek to both benchmark and estimate the value of a RO. Quantifying the value of a RO is a theme of finance literature. From a finance academic bias, this rigour has the merit of attempting to quantify the position. For example, how a real option approach might differ from a simple NPV approach. The latter is only valid if there are no real options. It assumes a ‘set and forget’ position. Therefore if there are any real options in existence, then the true value of a project should exceed the NPV calculation. This necessarily holds because options must have non-negative values. It is hard to envisage a real-world case where at least some trivial options do not exist. So the issue of

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using a real options approach is not whether it is theoretically more sound than for example a NPV approach, but whether the empirical challenges in adopting a real option approach can be overcome. Measuring flexibility and uncertainty are the keys here.

One retort might be that NPV analysis ignores options. All that this means is that all NPV analysis includes an embedded assumption of the non-existence of real options – in many cases likely a minor flaw. But with major transport projects this is a fundamental flaw in those applications.12

The Thesis does not look to quantify the value of a RO in the particular transport problems examined. This should be an area for further fruitful research. The analysis posits that ROs are themselves valuable but that the noise associated with lack of transparency between projects, secretive behaviour in government, and lack of information, together with poor management of rail projects, in particular, militates against the favourable environment required for the regular, successful application of a theory of real options (TRO).

Whereas some projects appear decided or a decision to commence is announced, this might seem like everything is decided. But this is far from the case with MUTPs. The point of unstoppable commitment (PUC), a concept considered in the development of this Thesis, is when the decision to do something is implemented.13 Sturup (2010) identifies that a project becomes a project at the point at which someone with the power to do so makes a decision and it is no longer valid to talk about not doing the project.14 In a serious sense, however, certainty as to what might be happening is denied to us. In looking backward an event might seem unstoppable. It happened. But in real time certainty is fluid. A particular action might be paused, stopped, or even reversed. Indeed, there

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12 I am grateful to Professor Steven Easton for assisting my thinking in this passage in email correspondence on 11 November, 2014.
14 Ibid., including pp. 159f. on how the determination of a project affects individuals and leaders. Sturup never, however, calls this point the PUC. Email correspondence, Sophie Sturup to Michael Easson, 8 March, 2015.
are few decisions that are completely and utterly the end of a matter. Perhaps the very idea of the PUC rests on an epistemological mistake.

An example suffices to illustrate the point. There was much fanfare when BHP Billiton announced in 2011 that Olympic Dam would be developed.\(^{15}\) When the project was stalled in 2012 it became apparent that all along, despite hundreds of millions of dollars in expenditure, all decisions associated with the development of the mine were conditional. Mining engineers and scientists were drilling and testing the qualities of a massive ore deposit. As the product was lodes of rock that needed to be separated – copper, zinc, bauxite and uranium – it was somewhat misleading to call the project the largest uranium mine in the world. To be that it also needed to be the fifth largest copper mine in the world. Everything depended on the prices for copper. If the copper price tanked then the whole mine became uneconomic. The project would also become redundant – for now.\(^{16}\) In reaching a decision the project managers commissioned and considered a multitude of processing methods to extract particular minerals from the raw material. The whole decision-making process was a series of optional decisions. This company uses real options in decision-making to maximise flexibility in their analysis and in exercising a decision. Some of the latter might seem to be announced with such finality as if the project was unstoppable, but to interpret or see matters in that way would be intractably mistaken.

Sometimes the unstoppable commitment problem is in fact just the well-known sunk cost problem. Once a decision is taken and significant expenditure made, the temptation is to keep going – even despite new information which requires reconsideration, even bravery, in changing course. This is a problem that exists as much in flawed real options analysis as it does in, say, flawed NPV analysis. Perhaps avoiding the flaw of continuing because of sunk costs rather than freshly re-assessing is arguably easier under a real options approach as noted by Aguerrevere (2003),\(^{17}\) but whatever the methodology, the temptation is present

Nonetheless.

Every project born and acting like it is unstoppable, or sensing by entitlement it deserves to be, is at the start in trouble. To think of a matter as unstoppable, as if completely decided, would be to miscall the situation. Sometimes particular projects look unstoppable. But to understand that this means ‘game over’ would be in important ways an error. Generally, in transport planning in particular, decision-making is a journey – a series of decisions, each one the exercise of a real option.

The Thesis recognises that there are numerous theories seeking to understand, and explain the processes underlying actual decision-making, which is the process of making a judgement and a strategy for its implementation. When the evidence is plentiful, it is easier to evaluate decisions to do things and assess particular actions, than to consider decisions not to. Information about the decision not to proceed frequently relies on speculation and is empirically difficult to consider. Even so, the evidence is plentiful concerning the flawed development of certain rail projects in Sydney, such as the Sydney Metro, and so this experience is examined.18 As the theory developed here, however, postulates that good decision-making is iterative and proceeds as if decision-makers are guided by ideas of staged project evaluation, it is expected that analysis can yield fresh insights on the decision-making associated with particular projects. Expected too are insights from examples where projects were considered and cast aside. The evidence associated with that experience is assessed in the context of real option theory. Thus in the Thesis is an examination of the development of the Sydney orbital and also of other projects the road authorities were - and are promoting - as if ‘ ARISING’ from the orbital experience. With rail, the Airport Rail Link (ARL), the Epping to Chatswood Rail Link (ECRL), the Clearways Project, and the abandoned ‘metro’ projects are examined.

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Inherently the question for decision is: what are the rational reasons in favour of a particular decision. Planning theory is replete with analysis and debate on this topic. In establishing our case, it is not that real option theory is the only variable in the creative development and implementation of MUTPs. The complexity of policy-making in infrastructure mega projects is not just in the disciplinary intricacies of infrastructure (such as with regards to their technological dilemmas, the infrastructure management, and their institutions) but in the interweavements with economic, social, spatial or ecological objectives and domains. In the highly urbanised setting of Sydney the multiplication of policy intentions become visible in the course of the process of project development. The way the matter is considered in the formulation discussed in the Thesis complements the MUTP literature and provides a fresh perspective to evaluate projects, building on the work of Flyvbjerg and other researchers, as discussed below.

The Thesis’s core hypothesis is approached with three main objectives in mind. First, the research enriches the theory of decision-making by developing a coherent concept based on real options theory. This concept is used to discover how the discourse of transport planning may either gain ground or be resisted by political actors operating within an institutional context.

Second, particularly by way of case studies, and comparisons between particular rail and road projects, there is an exploration of the connection between story lines, budgetary and organisational structures, and discourse networks as barriers to paradigmatic change. Through such analysis, a sharper critical edge to discourse analysis can be obtained by using evidential analysis and argument mapping to evaluate the coherence and quality of the theory that appreciation of real options can be applied to improve decision-making with MUTPs.

Third, the analysis is a major contribution to theories of public policy and institutional change. What government agencies do depends not only on plans and programmes espousing particular objectives (e.g., increasing public transport), but also the existence of barriers to implementation and opportunities for innovation, resulting from existing discursive and institutional structures. One major barrier is the conception of a major project as a ‘one spin
of the dice’ decision. It is only through building up expertise in decision-making and experience in projects, step by step, that confidence and robust decision-making can be conceived and effectively implemented.

With particular reference to the experience in Sydney over the last three decades, the Thesis identifies reasons for and differences between decisions leading to certain MUTPs. In doing so, a robust theoretical framework encompassing ROs is advanced and argued for. The Thesis supports Faludi’s observation that “[p]lanning is the application of scientific method - however crude - to policy-making.”\(^{19}\) Necessarily, planning is a “bureaucratic activity, predominantly carried out in large, complex ...organizations, set up by law and with varying relations to and with other complex facets of modern ...society.”\(^{20}\) The realisation of plans never occurs in a vacuum. This is in contrast with “much that passes as planning theory, [which] systematically ignores and obscures this central reality and reifies planning and planners as autonomous agents of change.”\(^{21}\) Yet the effort to obtain certainty needs to be sceptical, mindful of the potential fallibility of theories, and the information on which particular decision-making might be based. Flyvbjerg states that “[t]he prevalent tendency to underweight or ignore distributional information is perhaps the major source of error in forecasting. Planners should therefore make every effort to frame the forecasting problem so as to facilitate utilising all the distributional information that is available.”\(^{22}\) By that complicated phrase “distributional information”, Flyvbjerg alludes to the need to assemble evidence of a set of experiences – such as with mega road and rail projects. As Kahneman says, “[t]he planning fallacy is a consequence of the tendency to neglect distributional data and to adopt what may be termed an internal approach to prediction, in which one focuses on the constituents of the specific problem rather than on the distribution of outcomes in similar cases.”\(^{23}\) Of Flyvbjerg’s argument, Kahneman states that: “This may be considered the

\( ^{21} \) Ibid.
single most important piece of advice regarding how to increase accuracy in forecasting through improved methods." Kahneman argues for practices that mitigate the ‘planning fallacy’ – viz., excessively optimistic planning, dressed up as pseudo-science. He recommends: first, identifying an appropriate reference class (such as historic data on large railway projects); second, obtaining the statistics of the reference class (say, information in terms of cost per km of railway, or of the percentage by which expenditures exceeded budget); and, third, using specific information about the case to adjust the baseline prediction, if there are reasons to expect optimistic bias to be pronounced. A devil’s advocate approach to conceptualising and thinking through ‘what could go wrong’ is required.

Background & Problem Statement

At the core of economics is the concept of efficiency. Overall efficiency requires the pursuit of productive, allocative, and dynamic efficiency. Productive efficiency requires that goods and services are produced at the lowest possible cost, such that “a given industry can be expected to increase its output by simply increasing its efficiency, without absorbing further resources.” For example, where there are several possible methods for producing a given stretch of rail track (of equal quality and reliability), the method that has the lowest cost offers the highest productive efficiency.

Allocative efficiency, on the other hand, requires that the set of goods and services produced from the available resources is the set that maximises value to consumers. “Microeconomic theory is preoccupied with allocative efficiency.” With MUTPs, the ‘resources’ include the available equipment, construction material, as well as the labour, energy and capital used to deliver a transport project. The efficient allocation of those resources provides the mix of goods

25 Adapted from Ibid., pp. 251-252.
28 Overlooked in this summary is a wider perspective on distributional justice. Complacently, it might be said that there is a tacit assumption that the current distribution of wealth and income is ‘right’ or ‘the natural order’ and by dint of that an ethical achievement. That is one theory of justice that is frequently disputed! Especially with steady state economics, the distributional question becomes foregrounded. For an argument about the contestability of ethical ideas in
and services, including environmental outcomes that maximise society’s well-being.

Finally, dynamic efficiency requires that investments expected to produce more efficient production possibilities in the future (as technology evolves and the availability of inputs changes) are made whenever the expected benefits to consumers exceed the costs. Efficiency can be seen in terms of the refinement of existing products, processes or capabilities (static efficiency) or the development of new ones (dynamic efficiency). Examples include investments in research and development, and in upgrading the technology used in train signalling systems. Some reform options, for example, might create an environment that is more conducive to ongoing innovation in the transport sector. Dynamic efficiency requires that this be taken into account.

With MUTPs, value for money means achieving overall economic efficiency in infrastructure delivery and flow-on effects. Governments, as purchasers of infrastructure-related services and goods have a distinct interest in achieving the best deal they can on behalf of society. For example, competitive tension in the procurement of services may cause tendering firms to trim their expected return and this can improve value for money. In addition, the long-term gains – for the physical and social environment, and urban regeneration – associated with transformative MUTPs potentially and dynamically improve urban living.

In a 2014 review of the development of infrastructure projects in Australia, the Productivity Commission (PC), the Australian government’s principal independent research and advisory body on microeconomic policy and

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regulation," commented that: “Selecting the right projects (or provision) is the most important aspect of achieving good outcomes for the community from public infrastructure irrespective of the financing approach ultimately chosen. It is at the stage before contract signing that governments have the best opportunity to ensure infrastructure meets the needs of the community efficiently and cost effectively.”

The PC comments that there are many examples of poor project selection leading to highly inefficient outcomes. Such investment in the medium to longer term lowers productivity and crowds-out more efficient projects. As discussed generally in Chapter 2, when properly conducted, cost-benefit analysis (CBA) is a useful tool for guiding project selection and improving the transparency of decision-making. The institutional arrangements within which project proposals are analysed and decided upon are vital. Institutional arrangements should allow a broad range of costs and benefits to be appropriately taken into account. Importantly, a robust process requires that decisions be based on accurate information. Often, however, the incentives for efficiency are weak and short-term considerations dominate decision-making.

1.2 Twelve Alternative Theories Concerning MUTPs

Although Flyvbjerg’s theories concerning MUTPs have been already referenced as providing superior insight into the problems, dilemmas, and management of MUTPs, there have been a plethora of studies that explain and cast light over the field. The proposition that the TRO fills a gap is apparent from a survey of relevant analysis. Thus this section of the Chapter outlines some other theories, besides Flyvbjerg’s, that illuminate methodologies of decision-making with MUTPs. In the consideration of transport policy development, 12 competing ideas explaining MUTPs are worth explicating. Alternative explanations and theories of MUTP planning are considered with the judgement made about the heuristic and practical merit of the TRO in guiding project design and implementation. Besides Flyvbjerg’s theory – now arguably the most

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34 Ibid., p. 69.
prominent of all MUTP explanations - are 11 others that seek to ‘explain’ MUTPs. Beginning with a summation of the so-called rational model, the discussion moves to the ‘drift and stab’ descriptor of government (perhaps better described as really existing governing, as distinct from tidier summaries), then naturally to the political contention of transport planning. Next turn is to the point about MUTPs being inherently complex, huge exercises in risk management, the very stuff of wicked issues management, which frequently leads to delusional project development. Some alternatives to the procurement of projects are discussed with questions raised about the shift of responsibility and management of risks to those actors who can best handle them, then to Sturup’s concept of the Art of Governance (AoG), and last the issue of institutional networks favouring certain projects over others, including road over rail.

The Rational Comprehensive Model

The Wilsonian rational comprehensive model is characterised by separation of analysis, decision-making, and implementation - and by rigorous technical analysis leading to an organised, optimised solution.\(^{35}\) For more than a century this has been the defining framework for transport planning, often helpful in setting out what people intend to do, but not always in explaining what happens and how this is derived from organisational factors and politics. It is interesting to see the contrast between those theories characterised by a ‘rational comprehensive’ model\(^{36}\) and Lindblom’s ‘incremental or muddling’ through model\(^{37}\) - as is discussed below.

The ‘Drift and Stab’ Model

In considering typical, muddling-through government behaviour, Cohen, March, & Olsen (1972) refer to the ‘garbage can model’.\(^{38}\) The phrase is

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somewhat confusing as a summative expression. Preferred here is the descriptor of the ‘drift and stab’ model of public policy decision-making. This is where policy preferences are not clearly specified, the processes of organisation not well understood, with people drifting in and out of decision-making roles. This mentality is described as “a collection of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be the answer, and decision-makers looking for work.”

One can delineate four separate streams: problem, solutions, participants (in decision-making) and opportunities to decide (‘choice opportunities’). Shockingly realistic as is this analysis, the authors recognise that debate and confrontation are often essential to resolve issues and cannot be subordinated to technical analysis: People do not set out to solve problems, instead they work on problems only when a particular combination of “problem, solution and participants” in a choice situation makes it possible.

Nor do they go through a logical routine: defining the problem, canvassing an array of possible solutions. Rather, solutions and problems have equal status as separate streams in the system, and the popularity of a given solution at a given point of time often affects the problems that come up for implementation. This well describes some of the NSW case studies and is highly relevant to any consideration of MUTP conception and development.

The Political Contention of Transport Planning

From an investigation of public policy transport failure in Melbourne since 1970 through comparisons with Perth and Vancouver, Stone observes that per capita patronage on Melbourne’s transit system declined rapidly after 1950 and remained largely static since 1980. Melbourne’s transit performance, in keeping pace with population and urban development in the last 30 years, is disappointing given the city’s extensive rail and tram systems, and it is not explained by the physical character of the urban footprint or by the absence of knowledge of alternative policies. Instead, the broad hypotheses is that

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39 Ibid., p. 2.
40 Ibid., p. 16.
Melbourne’s transit performance is the result of political contention over transport policies and that therefore political factors are crucial in the rebuilding of mass transit. To develop an analysis of this political contention, a conceptual model of the processes of ‘challenge and resistance’ surrounding contention over urban transport policy was developed. This was drawn from understandings of the economic power of business in urban politics; the influence of institutional path dependencies and the relative powers of central and local governments; and the nature of policy networks and their resistance to change. This raises questions as to whether a similar framework to Stone’s applies to Sydney. Stone argues that there is the importance of ‘windows of opportunity’ for change that can occur when the legitimacy of existing urban transport policymakers is publicly challenged and when this challenge is associated with change in the membership of urban governments and with new opportunities for proponents of alternative transport policies. Such ‘windows’ are highly relevant to the TRO. The zig zagging of policy in NSW with six Premiers in eight years (2006 to 2014) is a case in point. To determine the validity and relative importance of hypothesised explanations for Melbourne’s transit performance a comparative analysis was utilised. Perth and Vancouver were chosen for Stone’s analysis because they are similar to Melbourne on a range of relevant variables but show differences in broad approaches to transport and planning policy: differences that explain the variability in transit performance trends and in prospects for future improvement. Variations in transit performance are best explained by the striking differences in the behaviour of political entrepreneurs, leaders of transit management agencies, and civic action groups before and after the election of reformist governments in the early 1980s. In Vancouver following the defeat of freeway proposals in the early 1970s, politicians and new professional appointees established a progressive planning policy network through decisive action. This network has maintained its influence through decades of conflict and is identified as the key factor in the relatively strong performance of transit in Greater Vancouver. The experience in Sydney is in marked contrast. The development of MUTPs cannot be divorced from the political environment. On Stone’s analysis, the political

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42 Ibid., pp. 233-238.
context, arguably more than the technical is crucial to a public transport MUTP reaching completion.

The Dynamic Complexity of MUTPs

The dynamic complexity of MUTPs was tellingly investigated by Allport.\textsuperscript{43} He examined the management of dynamic complexity for a particularly demanding form of megaproject – the ‘meTRO’ - defined as urban rail systems carrying a mass ridership rapidly. His research straddled Asian and western cities, noting an increasing trend that large cities, that are not poor, turn to metros as the centre-piece of their sustainable development policy. Because of this and because of their opportunity cost, metros are important and it is evidently necessary that these decisions are soundly based. Allport, having spent his career working in the transport planning and project delivery sector, became convinced that there was a major problem - of a lack of success in developing metro projects. The research purpose was to identify what could be done to improve things – “not theoretically but practically.” A comprehensive review of existing knowledge about decision-making, major project development and experiences of project success, together with nine in-depth case studies of metros in Asia and the UK provided the basic research that yielded insights on why projects either succeed or fail. This was supplemented with interviews with key stakeholders and accessed documentation so as to establish what had happened, why and with what consequences for whom. His example is a model of research, which this Thesis hopes to build on. Allport’s research revealed degrees of success, albeit with caveats; and a common failure to deliver the projected operational benefits used to justify their costs. He notes that success can be extremely hard to define but, at a minimum, encompasses financial success with robust forecasts made at the commitment stage; policy success, the outcome compared to forecast at commitment – necessarily involving financial success, but also economic, social, development, and environmental factors. This involves some matters of objective fact and subjective considerations, such as stakeholder satisfaction. Sustainability

success concerns the ability of the project to maintain its service delivery over the medium to longer term such that policy success is maintained. Much of what he wrote about concerns the operational performance against expectations, and he strongly advocates that an operator’s perspective should inform project development from its earliest stage. Allport developed an understanding of how projects come about, such as sponsor characteristics and strategies, central government’s role in creating an enabling environment, how strategic misrepresentation could be reduced, and how optimism bias might be countered, the potential role for the private sector, and changes in the management of metro projects, and in particular planning. Practical approaches, such as including operators in the design and delivery management of a project, were developed and a change agenda formulated that could improve success. Allport argues that this agenda appears to provide a resource for effecting improvements that is richer and more comprehensive than previous approaches. This is critically useful for evaluating how and why projects reach completion. His analysis suggests that MUTPs are always complex exercises in risk management and management expertise and an openness to learn from past successes and mistakes is key. Crucial to ‘learning’ is the transparency of information so as to make comparisons between projects possible – and to create a positive “enabling environment” for project development. Secrecy is the enemy of experience.

**MUTPs as Complex Exercises in Risk Management**

MUTPs and their risks are comparable to mega projects in other industries. Project risk management operates in a complex and dynamic environment that is constantly confronted with various risks. It is therefore imperative that project managers consider all possible risk factors for a given project. Furthermore, they should take corrective actions to control and manage the

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47 For a discussion relevant to MUTPs and large scale projects generally, see: Fineman, Milijana (2010) 'Improved Risk Analysis for Large Projects: Bayesian Networks Approach', Ph.D. thesis, Queen Mary, University of London.
identified risks. An effective risk management approach can provide a framework for project managers which enables them to identify and assess potential risk factors and to then take the necessary actions in order to achieve the desired objectives of a given project. This summary is very much in the ‘rational comprehensive’ tradition. The problem with it is that risk management can be a challenging process because it requires anticipation of future events. The best available means of trying to look into the future to manage risk is by looking at the past. By examining prior project experiences, insights into risk probabilities can be obtained; theoretically, if you can anticipate an event, you should be able to weigh up potential consequences and influence the outcome. But all novel projects are risky, and once a project has commenced, even experienced project managers can make ineffective choices. Hence a major objective in the field of risk analysis is the development of a robust definition of risk. Yet risk has different meanings to different people. Risks are not always associated with negative outcomes and may represent opportunities as well. Taking big risks can be beneficial to a party able to accept them because it enables opportunity to exploit that party’s understanding of risk compared to a higher beta ($\beta$) for the other party. Generally the standard risk measure is: Risk = Probability x Impact. But the causal risk framework could improve the modelling approach in order to help develop better decision support systems. Fineman considers the trade-offs that may be made in project risk management, specifically time, cost and quality.48 The main objective is to provide a model which addresses the real problems and questions that project managers encounter, such as: If I can afford only minimal resources, how much quality is it possible to achieve? What resources do I need in order to achieve the highest quality possible? And, if I have limited resources, and I want the highest quality, how much functionality can I afford?

Such questions suggest that with complex projects, including MUTPs, a TRO is appropriate so as to develop a rational pathway leading to decision-making. A project’s viability can be indicated using conventional financial indicators such as Net Present Value, Internal Rate of Return (IRR), Benefit-Cost ratio, Pay Back Period and Return on Investment (ROI), as well as non-financial indicators.

48 Ibid., pp. 18-20.
such as the number of jobs created and, most importantly, the number of lives saved. In deriving these indicators, it is important to take project risks into consideration through using sensitivity analysis, decision-tree analysis, probabilistic modelling and Monte Carlo simulation. The objective is to justify the investment to address business needs, and recommend the most appropriate response to the business needs. Thus for effective decision-making Fineman proposes the use of a causal risk framework that is an improvement on the traditional modelling approaches, such as the risk register approach, and therefore contributes to better decision-making based on Bayesian Networks (BNs). The latter provide a framework for causal modelling and offer a potential solution to some classic modelling problems. Major weaknesses are that they do not allow sensible risk event measurement and they do not allow full trade-off analysis. The main hypothesis is that it is possible to build BN models that overcome these limitations without compromising their basic philosophy. The implication of this analysis is that MUTP decision-making needs to be a rational process. Fineman seeks a better or a more robust model to plan and assess risk. This requires assessment of experience and good governance with mega projects and the realisation that something better needs formulation; thus, to the consideration of the vast literature on mega projects and the suggestion that TRO fills a vital gap.

Wicked Issues Management

Ney focuses on the intractable conflict that characterises debate about messy or ‘wicked’ policy issues. He argues that major transport planning increasingly takes place in ever more complex and interconnected networks that blur the boundaries traditionally used to define social and political spaces.

Accordingly, the policy problems that governments are called upon to deal with are less clear-cut and more disorganised. This is particularly the case with factors such as climate change, environmental policy, transport, health and

49 These methodologies are discussed in Appendix 1 of the Thesis.
51 Ibid., pp. 91f.
Anatomy of Ambition

Sometimes stupid politics is involved, pork may happen on the reef rocks below, waiting to tear apart and sink the project. Indeed what constitutes a ‘rational solution’ is itself now the subject of considerable debate and controversy. Ney discusses the implications of the analysis for collective learning and adaptation processes. His aim is to contribute to a more refined understanding of policy-making in the face of uncertainty and, most importantly, to provide practical methods for critical reflection on policy that point to sustainable adaptation pathways and learning mechanisms for policy formulation. This analysis is fruitful and highly relevant to how decisions get made.

Delusional Project Development

As is discussed elsewhere in this Chapter, the track record of transportation mega projects is poor. The costs are usually significantly under-estimated, and traffic is typically and dramatically overestimated. Thus it is difficult to get public and political support for much needed mega projects without better performing project delivery models. As already referred to, Flyvbjerg et. al. discussed the problem in their book *Megaprojects and Risk.* They document its global nature, analyse its causes, and offer useful ideas on doing better.

Flyvbjerg has criticised the excessive optimism of planners, and sometimes attributes aggrandising, corrupt interest by promoters, and their hirelings in over-estimating the positive, and under-estimating the potential risks and losses of a project. One might call this the Costa Concordia critique of those captaining a project: too much focus on the spectacular view ahead, and too little on the reef rocks below, waiting to tear apart and sink the project. This may happen, but generally, it is a colourful and exaggerated perspective. For it is not that most promoters of MUTPs are always knaves and charlatans. Sometimes stupid politics is involved, pork-barrelling, and rushed decision-

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making, but usually project promoters actually think they have rationally calculated the risks and sensibly estimated within a responsible range the probability of delivering on time (or almost), at cost (with a healthy contingency buffer). Flyvbjerg’s work is widely cited and highly influential. Anecdotal evidence is that this work is widely known among decision makers. It was a factor in scepticism amongst Treasury officials about attempting any rail MUTP in Sydney in the period between 2000 and 2011.\footnote{This opinion is derived from conversations in 2012 by the author and NSW Treasury officials.} With the risk of so many things going wrong, in the light of a great deal of historical evidence, the attitude seems to be ‘why bother at all?’

This research is highly relevant to the issues to consider in deciding between real options. Flyvbjerg, et. al. critique the conventional project development process as: 1) over-commitment of resources and prestige at an early stage; 2) project development as a technical exercise with a heavy focus on technical solution with little discussion of policy objectives; 3) concerns relating to external effects not addressed until too late; 4) little involvement of negatively affected stakeholder groups potentially laying foundation for public dissent; 5) poor risk analysis; and, 6) institutional accountability weak. The conclusion is to recommend ‘four instruments of accountability’: 1) transparency in public and private sectors achieved through greater openness and competition; this should be mandated, including public funding of participation, and peer review at key decision points; 2) performance specifications setting policy ends, rather than means concerning project performance and impacts; 3) a comprehensive regulatory regime; and, 4) a requirement for risk capital with no sovereign guarantees to force rigour on the critical commitment decision.

A potentially useful exercise is to consider those recommendations in the context of MUTPs in Sydney. One of the propositions of this Thesis is that Flyvbjerg’s recommendations would be insufficient in achieving significantly better outcomes in MUTP development. The idea to be tested through empirical research is the merit of the TRO as a complementary guide to project development.
Shifting Responsibility of Risk and Management

The popularity of build-own-operate-transfer (BOOT) and build-own-operate (BOO) schemes and the supposed transfer of risk to the private sector increased the number of approvals of infrastructure projects in Australia in the 1990s. Arndt (2000) noted that in that decade there had been an increasing trend by governments throughout the world to use the skills and expertise of the private sector in developing and implementing infrastructure projects. The contractual agreements for these projects typically allocates responsibility for dealing with the risks which may arise to either the government directly on behalf of consumers, or to the private sponsor. Arndt’s thesis investigated risk allocation in the private provision of infrastructure, particularly in BOO and BOOT projects, suggesting that such means would become increasingly popular. In so doing the primary objective is to identify a framework for efficient risk allocation so that decision makers can assess the efficiency of the risk allocation in past projects and can attempt to increase the efficiency of the risk allocation in future projects. This is a critical point of contention with MUTPs. Arndt defined an efficient situation as one where the risk allocation cannot be varied without the total risk premium for the entire project being increased, an approach based on Pareto optimality. As, however, it is almost impossible to determine the true risk premium charged by parties for risk bearing, risks should be allocated to the party best able to control and manage them. This can obviously be a contentious point. It means distinguishing between the party with the best access to reasonable mitigation techniques and the party least risk averse. Those exogenous risks, which are not easily allocated, should be shared so that both parties, the sponsor and the government, have an incentive to manage them. Some of the options for sharing these risks were examined in his work. The application of the theory of efficient risk allocation is simplified by using a categorical risk framework. This approach is then tested

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57 See further discussion on Pareto optimality in the Thesis at p. 80.
59 Ibid., pp. 337-341.
on seven case studies of recent Australian projects spanning several industry sectors. Finally, the theoretical hypotheses and assumptions are tested in a survey of key participants in the Australian private infrastructure industry. This survey not only confirms that the basic theory for efficient risk allocation is valid but also identifies the key areas of concern to the private sector when it considers project risk allocation. Risks of concern were identified and possible options for risk sharing investigated.\(^6^0\)

This line of analysis posits technical solutions for problems where there is agreement that they need solving. Arndt concludes that it is possible to achieve efficient risk allocations in practice, and that the achievement of this outcome allows for cheaper infrastructure services to be supplied to the community. But several hurdles to achieving this outcome are identified. These include the peculiar characteristics of banks and their position in projects funded with non-recourse project finance, and the fact that most private firms fail to value potential upside risks as highly as they fear potential losses due to downside risks. One model is the long-term concession or build-operate-transfer (BOT) model, under which a private consortium, selected by a competitive process, gains a long-term ownership interest in the project, sufficiently long that it has a reasonable likelihood of making a return on the investment. Where there is a long period of responsibility (such as with BOOT), the consortium has strong incentives to build it right in the first place and to minimise lifecycle costs (as opposed to just upfront costs). The point is to create accountability and risk-management, which the conventional government-dominated model simply does not provide. A private sector consortium with its own funds at stake is also likely to be better equipped to resist expensive additions. It has a clear bottom-line orientation. Its expenditures must be related to the transportation service it provides and for which customers pay (say, via tolls or fares.) A consortium, however, is limited by what money it can raise in the capital markets to the amount that revenues can service debt and equity return expectations. It is better placed to “just say no” to demands for ancillary expenditures. “We just cannot do it,” the consortium can honestly say. By contrast, the public tends to view government as some kind of bottomless pit of money. Government officials

\(^6^0\) Ibid., pp. 333-337.
themselves rarely suffer decreases in remuneration if projects result in cost overruns – though occasionally a few have their employment terminated, usually with a hefty redundancy bonus. Thus they have no true incentive to rein in runaway costs. With a private consortium betting its survival on good project management, limits on the capital that can be raised will force the project to be administered austerely. Basing a project on prospective revenues introduces a strong constraint on capital spending that is absent in projects funded only by governments, where the argument can always be made that by re-ordering priorities, borrowing more or getting additional grant funds, extra money can be found. When the private sector takes on a major project and puts a financing package to the capital markets, it usually only gets one shot. After the financial closing, it has a discrete sum beyond which it cannot spend. This inherent discipline throughout the detailed design and construction of the project argues favourably for transferring risk to the private sector. Arndt says that more work is needed to understand and overcome these hurdles if efficient risk allocation is to be achieved in the real world. It is only then that governments can be sure that they are providing private sector infrastructure services to the community at the lowest overall cost. Arndt’s work and its implications are highly relevant to how technical experts, including engineers, forecasts and financiers, perceive what should be the logical development of a MUTP.

The Art of Governance (AoG) of MUTPS

Sturup put forward the art of governance (AoG) of MUTPS as a major factor in their conception, approval and development.61 In important ways, this Thesis builds on her research findings. MUTPs projects involving large-scale construction of roads railways and bridges are increasingly being used in urban environments to ameliorate the problem of congestion. The need for such projects is growing as cities seek to increase accessibility internally, replace aging infrastructure, transform cities to a more sustainable footing, and increase connectivity between regions. The size (in cost terms) and complexity

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of these projects is increasing as space in inner cities becomes more crowded, engineering solutions become more innovative, and complex partnership arrangements are used in their delivery. Despite various studies that have produced a number of solutions to the problems of MUTPs, including the various methods for the inclusion of the private sector in project provision, and various well researched and designed methods for inclusion of the public in consultation on the development and implementation of projects, they have failed to significantly alter the outcomes for MUTPs. In situations where problems are resisting well-developed solutions, it is often because the problems are arising in response to underlying conditions the solutions do not address. Sturup argues that in MUTPs this underlying condition is the art of government of mega urban transport projects (the ‘AoG of MUTC’). The AoG of MUTC being the amalgam of rationality, knowledge and technology which provides those involved in the MUTC with a particular ‘way of being’. This examines the issue by looking at MUTPs through the lens of Foucault’s theory of governmentality. Sturup’s argument about the AoG of MUTPs involved a study of three Australian MUTPs, Melbourne’s City Link, the Perth to Mandurah Railway, and Sydney’s Cross City Tunnel. The play of rationalities, knowledge, and technologies used in each project was examined for evidence of the AoG. The study works through the construction of a problem, the solution of which is an MUTC. The key technologies of stakeholder consultation, CBA, engineering, private sector involvement, and governance are examined for how they support and are defined by the AoG of each MUTC.

Institutional Networks

Ney has suggested that: “Far from a straightforward process of technical planning, policy-making in transport has become a process of exchange, transaction and bargaining between different institutions and policy actors.” According to Ney, “Transportation planning is not a discipline with well-defined topics and modes of inquiry. Rather, it is an area of application, in which intellectual inquiry in many disciplines provides support for action in the world of

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practice." Transport policy-making is rarely straightforward. Where it appears so, this is often due to powerful institutions and their leaders shaping and dominating the agenda. Such was arguably the case, for example, with the post-war government road bodies in the UK. Similar thinking pervaded the RTA in NSW and other agencies, such as the Premier's Department and the NSW Department of Transport. The men who ran the Department of Transport and kin authorities believed in roads as the primary transport solution. Public transport solutions were seen as inefficient and sub-optimal. From the 1970s onwards, however, as competing voices and institutions gained influence, the dominant, pro-roads paradigm became more contestable and subject to dispute. Environment groups and citizens-groups favouring more liveable cities became more powerful and more involved in decisions than ever before, usually in policy-making battle, though the effectiveness of such intrusions depended on networks and political action. The presence and absence of same has been characterised as hegemonic or hollow depending on the policy support networks of particular ideas and advocates:

In contrast to trunk roads, where for forty years the sector was dominated by a hegemonic policy community which successfully imposed road building as the principal transport policy ‘solution’, the rail policy network (or lack of it) has been characterized by a ‘hollow core’ with no dominant interest, resulting in long periods of inertia and indecision..."

As matters have become increasingly contestable and debated between highly articulate, competent players, it might be observed that: “Transport policy, once

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65 From a review of RTA Annual Reports, it seems they were all men in NSW in the relevant period.
a symbol for policy making prowess, has become embroiled in divisive conflict.”

These insights are effectively followed up in a study discussed next.

**MUTPs and Their Approval Over Time**

Altshuler and Luberoff (2003) analysed the political economy of MUTPs in the United States with airports, highways and mass transit case studies. They characterise three eras of megaproject development: the ‘great megaproject era’ from the late nineteenth century to the 1960s, the ‘era of transition’ and the ‘era of no harm’ to the present day. Insightfully, the authors discuss the continuing changes to policy agendas, public finances and attitudes in this period. Their work is of value to an assessment of MUTPs as they discuss the development of alliances of mayors, transit interests and contractors/suppliers in the drive for public investment in transit, highways and other infrastructure. In any era, however, politics and political coalition building, as well as technical questions and ‘dollars and cents’, decides what gets done, when and how. Although their work is highly focussed on experiences in the United States, the part of their analysis cited here is useful in understanding the environment leading to MUTP decision-making more generally. They say that “[t]he issue of faulty cost estimation is perhaps even more significant, in that it calls into question the bases for political decisions to undertake mega projects.”

Perhaps in the modern era the cost of construction and the complexity of decision-making make the whole process more difficult.

Seeing the policy-making process illustrated in the context of a problem, shows that technical matters are always important, but not alone. In this regard Altshuler (1979) has written perceptively on the interplay between technical expertise and political context, and on mega projects, most of which are transportation related, to provide a deeper understanding of urban

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71 Ibid., especially pp. 45-75.
72 Ibid., p. 245.
public works projects so enormous that they are rarely undertaken, but dominate regional politics for decades.  

Low (2010b) distinguishes between: “the institutional ‘hardware’, the rule-bound social structures that enable collective action, the bureaucracies... [and] the institutional ‘software’, the ideas and storylines that direct and justify collective action.”

Policy-making is more than the process, weak or good, of how things get done. It requires actors and institutions. It always involves disparate concepts and interests fighting it out. In a word, it is politics. Policy governance needs to answer three questions: how are priorities decided, who gets to decide and how are decisions enforced and delivered. If policy-making emerges from a process of discussion, debate and conciliating, it may be messy or fraught with complications and tussles between players. If it were otherwise it would simply be submission to a ruling interest. To aspire for the straightforward is to betray a simple-minded view of life. We might well say that without conflict and debate there is no politics or, such as it would then exist, it would be at a very low level. Crick (1962) defined the idea: Politics is “the activity by which differing interests within a given unit of rule are conciliated by giving them a share in power in proportion to their importance to the welfare and the survival of the whole community.”

On this view, policy-making depends on the framework, which should not exclude efforts to understand alternative points of view, information exchange, and critique. “The upshot is that, in debates about messy issues, agreement is possible but inherently unstable.” Thus, conflict and opposition are never to be regarded as signs of trouble or confusion, they are the ways of resolving issues. One might say, with Anderson (1943), that a healthy politics depends on the existence of a plurality of movements, which take their chance in the social struggle.

A problem, however, for Crick’s view of matters is that there is a tendency in his formulation to see matters simplistically as if, with reason and civility, players

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75 Low, Nicholas (2010b) ‘How Organizations Shape Infrastructure: Roads Organizations’, unpublished draft, University of Melbourne.
would work to a logical conclusion. This is to ignore that we all work through different frameworks or viewpoints. “Technical expertise can inform such public decisions, but technology cannot resolve highly politicized, democratic debates completely.”79 For example, in the environmental debate where: “…[a] truly sustainable transportation has not been achieved in any region of the world.”80 Wach (2006) comments that:

Over more than 50 years, the transportation literature reveals a fundamental and continuing tension. On one hand, there are many who have confidence that democratic political institutions can use technology and market principles to affect behavior so as to allow continual growth in mobility while preserving environmental quality. On the other hand, many view reliance on the automobile as an environmental, aesthetic, and health disaster that is already upon us, that could be irreversible, and that could eventually threaten human existence. Economists and engineers explain why transit is not more influential in American cities, while environmentalists insist that it must become so.81

At the heart of such ideas – at their extremes environmental catastrophists and scientific optimists – are different worldviews or policy frameworks. Such ideological constructs inform us on what are the important matters to consider as well as what facts count. Sometimes, “…advocacy coalitions in the transport debate fail to agree on the definitions of the issue, the causality of the problem or even the approach for understanding the phenomenon.”82 Understanding of such perspectives is the beginning of any potential resolution process. As Schön and Rein note,

...we advocate a frame-reflective approach to policy practice, which would recognize the ability of practitioners to reflect on the frames that shape their conflicting positions and thereby foster a normative approach to

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public discourse within which policy controversies are more likely to be resolved through reflective inquiry.\textsuperscript{83}

The potential for dialogue and, in Crick’s term, the conciliation of difference is sometimes possible.\textsuperscript{84}

**Summing Up**

Despite protracted, divisive disagreement, policy change does take place over time. Sometimes it occurs through the use of alternative policy ‘arenas without rules’ by outsider groups, leading to a radical new ‘framing’ of transport policy.\textsuperscript{85} Buehler identifies intense communication and constructive conflicts between citizens and politicians, as well as more citizen engagement, as necessary preconditions to change.\textsuperscript{86} With strongly held views and different policy frameworks, coalitions between interests groups are often fragile. Yet it is not a chaotic free-for-all. How ‘solutions’ are worked through is the interesting stuff of policy formulation and outcome. This is especially so where infrastructure costs have risen as a result of poor governance of investment and implementation decisions, including an over-reliance on ‘mega projects’, which are highly vulnerable to undue optimism about costs and demands and which are rarely designed in such a way as to provide flexibility when difficulties arise; insufficient attention to optimising the timing of maintenance, expansion and scrapping decisions, which leads to unnecessary ‘boom/bust’ cycles in infrastructure investment, compounds inherent cost pressures. If MUTPs are now more complicated and expensive, occurring in a more competitive, even messier, policy environment, this is not to say it is all too hard.

As we saw earlier in this Chapter, Kahneman, drawing on Flyvbjerg, argues for rigorous practices for overcoming base-rate neglect, such as referencing comparable projects, obtaining data from the reference class, using the statistics

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\textsuperscript{84} Though not, of course, where differences are truly fundamental.


\end{footnotesize}
to generate a baseline prediction; and adjusting the baseline prediction, should there be good reasons to expect the optimistic bias to be more or less pronounced in one project as compared to others of the same type.\textsuperscript{87} He puts forward useful suggestions, but not enough. Funding, technical rigour and policy sophistication, and savvy, are needed to capture those limited ‘windows of opportunity’ that sometimes open up. But the window has to be capable of being opened. To get there may require creative opportunism. It is the Thesis’s contention that the TRO, in the context of superior project management, is an important aide to that objective.

\section*{1.3 The Theory of Real Options (TRO)}

This brings back into play TRO, as a research gap in the literature. With project selection, public infrastructure is often initially proposed before detailed consideration is given to funding and/or financing. Decision-making encompasses assessment of a range of potential decisions, including whether a major investment in infrastructure is merited (for example, an addition to the current public transport infrastructure); about the type of infrastructure to provide (for example, whether road, bus, light rail or heavy rail is the appropriate transport mode); whether the overall project might be broken up into stages; the timing of project delivery, and/or component stages; and about key project features such as location, size, and service quality standards (for example, the frequency of service and costs to a consumer).

TRO is different from undertaking proper sensitivity analysis on timing. Decisions may be made at an initial stage but then varied in response to new information. For example, a project might be modified or abandoned before the final decision to proceed where, say, a detailed scoping reveals that costs are likely to be much higher than originally estimated. Accordingly, project selection can be conceived as a process that commences with initial planning

\textsuperscript{87} Kahneman, Daniel (2011) \textit{Thinking Fast and Slow}, Allen Lane, London, pp. 251-252.
and continues through to the point where contracts for project delivery are executed.\(^88\)

The option value arises in part because the act of investing in the first stage project reveals information about the pay-offs in subsequent stages that would not otherwise be revealed. The insight of RO theory is that the option to delay could have value and that this is more critically understood under the TRO than a mere NPV analysis. The naïve investment timing rule - proceed if BCR is even slightly positive - is sub-optimal, because the rule does not account for the value of holding the option.\(^89\) In addition to the examples already cited, commercialisation opportunities (i.e., second stage projects) only become apparent once the initial, more basic, research has been undertaken.

There is a desperate need in Australia to comprehensively assess all MUTPs. If, however, real information is secret and data on project conception, delivery, and performance is opaque, then mega mistakes will continue to be made. Research with transparent results is therefore vital to improved decision-making.

The analysis posits that uncertainty about future benefit and cost flows raises major complexities that are not dealt with appropriately by standard CBA approaches. In some circumstances, uncertainty should lead to a more conservative investment stance that results in an optimal decision to delay an investment (relative to the standard CBA methodology). The potential importance of options created by particular infrastructure investments means that a standard ‘needs analysis’ may be an insufficient basis from which to begin an *ex ante* evaluation of a potential investment. In the cases discussed in the Thesis, an ‘opportunities analysis’ is included prospectively. Furthermore, it is important not to restrict opportunities to those that may be exercised (or even internalised) just by the infrastructure provider or by existing agents. Future agents (e.g., new arrivals, start-up firms or international companies not yet present in the location) may be the agents that take advantage of opportunities that are created. A corollary of this approach is that disinvestment decisions


need to take account of future opportunities that are potentially lost through a
decision to scrap existing infrastructure. Hence the opportunity (or option)
approach may be particularly important where discontinuities are possible. For
instance, a decision to close (large parts of) the rail network owing to its inability
to pass a conventional CBA may have a large negative outcome if fuel prices
were to surge massively, in which case the option to increase rail traffic would no
longer be available. Of course, this option value must be weighed against the
costs of ongoing operational deficits in determining the closure decision. 90
Usually, the value of holding such an option is typically ignored in CBA. But it
does not need to be so. TRO can complement other tools used in the assessing
of MUTPs. Indeed, the Thesis argues that this is necessary – not just in cases
where CBA is not carried out well, but to add to the analytical tools available to
decision-makers.

In some cases, especially where learning may occur within a sequential
investment process or where there may be international competition for firms to
locate around new technologies, uncertainty can lead to investments optimally
being fast-tracked. In addition, complementarities across projects may lead to
investment in a project with zero or even negative NPV where investment in that
project is essential in order to realise option value associated with benefits
attached to a separate project. 91

So far the discussion has been mostly normative. The challenge for the
empirical research associated with the Thesis is to discover whether the evidence
backs the proposition that the TRO is a useful tool in deciding on and
progressing MUTPS. How, then, might this occur? The argument of the Thesis
is that an analysis of particular projects, the Sydney tollroads, as well as rail
projects, yields insight into the proposition. This question can be broken into
two parts: (1) Was some version of TRO applied (or was evident) in the cases
studied?, and (2) Did its application/non-application result in better or worse
outcomes?

91 Ibid.
A young couple decide to buy a house. To begin with, a modest one-bedroom house meets their needs, but they intend having children and so are likely to need more room later on. They are uncertain how many children they want and how they might live as a family (for example, whether they will want two or more bedrooms). Their future level of income is also uncertain.

One approach is to buy a house big enough to meet their maximum future space requirements. But this might be an expensive step, buying “excess capacity” ahead of need. The health of the housing market might also be relevant at the time they weigh making a decision. (Is it rising, flat, declining, etc.) Taking a real options approach, however, might entail purchasing a smaller house capable of being extended later on. While this might not be the most cost-effective option for meeting their maximum likely future needs, it might be cost effective overall, given the uncertainties.

The choices available in the context of uncertainty (fertility, number of children to be raised, income, etc.), leads to consideration of potential decisions to meet future needs. Thinking about the selection of the ‘right’ option involves judgement based on information and the unsettling doubt that comes from not being certain of the future. The clarity and quality of decision-making is enhanced by the evaluation of a range of real options.


The Figure 4 above illustrates how in everyday life the decision to purchase a house can be considered as the exercise of a real option. The example in this Figure shows how a TRO might apply to simple decision-making. Adopting real options as a methodology of thinking is the first step. Achieving the potential offered by real options in more complicated situations, however, requires the development of specialised analytical tools that are then used by the people and organisations responsible for making major decisions. Not surprisingly, the PC notes that “political involvement in ...decisions can be a barrier to taking a real options approach and minimising expected costs.”92 In the PC’s view, there are several impediments to realising the potential gains from adapting a real options approach to infrastructure provision generally. First, there are current institutional and governance arrangements, that in most jurisdictions are characterised by: absence of clarity over the roles and responsibilities of cabinet, ministers, government departments, and utilities, which can cause delays and uncertainties that erode the benefits available from a real options approach; and, inappropriate political involvement in decision-making that can bring with it an undue level of risk, and other incentives that work against

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achieving the lowest expected cost in balancing of supply and demand or, in the case of a MUTP, determining the route, mode or timing of a project. Lack of clarity of objectives and political irrationality, as we will see in Chapter 2, are opprobriously debilitating in MUTP conception and implementation.

Not all significant infrastructure or transport projects need be mega or sit outside of existing infrastructure systems, such as a transport network. Figure 5, below, highlights that in certain circumstances, operating existing assets more efficiently and augmenting an existing network can reduce, delay, or avoid the need for new infrastructure. In considering the optionality of decision-making, such actions provide alternatives to the mega project.

Nor do all expansion decisions in the system of a transport network need be single route MUTPs, such as one new road or rail link. Augmentation of existing networks, such as the Sydney rail Clearways project discussed in Chapter 5, can have immense benefits, though fewer ribbon cutting opportunities for project sponsors. In certain cases, working better and augmenting existing infrastructure can have tremendous benefits for a network. Figure 5, below, illustrates the point.

Poor regulatory frameworks impede the use of a real options approach. Delays and uncertainties in gaining approvals from government agencies can result in some options becoming unviable. Such risks and their management point to the need for detailed preparatory work, and deep expertise, in order to maximise project flexibility in the face of uncertainty.

In staking the claim for the utility of the TRO, it is useful to briefly outline the transport policy problems of NSW then outline various theories that seek to interpret performance in project conception, implementation, delivery or abandonment. In that context the reasons for the focus in the Thesis on a TRO is advanced.

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93 Adapted from Ibid.
Figure 5: Operating Existing Assets Efficiently Reduces Need for New Investment

Low service standards from public infrastructure can take a variety of forms, often involving queuing or rationing. For example, traffic on roads can become congested, public transport services may not keep pace with demand.

Government investment in new infrastructure is usually aimed at alleviating such problems (which have political consequences). Frequently, more efficient operation of existing assets can provide a less costly solution. Some aspects of efficient operation include:

1. Improving the productivity with which infrastructure is used can reduce or delay the need for new investment. For example, investment in the NSW Clearways projects and improved signalling technology on rail networks – aimed at improving capacity and throughput.
2. Adopting more cost-reflective pricing and other demand management practices can lower peaks in demand, lessening the need to invest. For example, peak demand fares in peak hours and lower fares in non-peak hours streams more people to travel in off-peak periods.
3. Timely maintenance of infrastructure can extend its useful life. Maintenance neglect leads to higher than necessary costs and demands for additional infrastructure ahead of optimal requirements; improved procurement such as through BIM and lean production can also benefit the management of maintenance.

Where there is a bias among public officials to build new capacity, rather than make the most of existing infrastructure, this leads to more expensive and less sustainable infrastructure solutions.


1.4 Research Context

Sydney is chosen for particular case studies mainly because Sydney evidences both successes and failures in MUTP development and planning; and secondarily because the author has useful experience and knowledge of the political and institutional context in that city.

Although public political debate is often characterised by the demonisation of politicians and the exaggeration of virtue and vice, all the decision-makers of the MTUPs discussed in the Thesis were intelligent, well-motivated individuals, keen to do good. So what were the causes of the policy confusion? A lack of a policy compass, gross incompetence in formulating and thinking through public policy on mega projects, and considerable naïveté were manifestations of
a deeper malaise. In the advancement of policy and priority, the refusal to be transparent made the public highly sceptical of the merits. But, crucially, there was the broader or even deeper issue of policy and project formulation failure.

In NSW in the decades, 1990-2010, only two rail projects, the Airport Rail Link (opened 2000) and the Epping to Chatswood rail project (opened 2009), were initiated and built in Sydney. Yet, during this time, the same city built many road projects (Sydney Harbour Tunnel, M4, M2, M5, M7, Cross City Tunnel, etc.). There would seem to be a prima facie case that Sydney’s orbital road planning was a success and the planning of the railway infrastructure was an abject failure, but this can only be a tentative hypothesis. Chapters 4 and 5, the Case Study Chapters, explain how such projects were developed and the relevance of TRO to their conception, development, and implementation. There is a question of why certain projects reach the point of unstoppable commitment (PUC) rather than others.\(^95\) Sydney’s experience illuminates some of the theoretical issues associated with project conception, development and implementation, as well as risk management of MUTPs. The analysis also raises questions as to why competing transport modes – rail versus road – compete, win approval, and proceed or face delay or rejection.

As discussed in Chapter 4, the research work demonstrates the proposition that over the 1990s road planners learnt from their experiences and became sophisticated in dealing with private sector proponents. The NSW Roads and Traffic Authority (RTA) developed a strategy that mapped out Sydney’s future road network. This was based on decades of work on potential road priorities, packaged as a detailed plan. Partly this was inspired by the road ring around London, the 188km (117 mile) M25 motorway that almost encircles Greater London.\(^96\) In conceiving their blueprint for Sydney’s road orbital, RTA engineers thought about each component being developed link by link. The orbital connected projects that had long been on the drawing board. This was clever marketing of a long desired set of projects, a wish-list branded as an orbital, a ring road around Sydney that would mostly take road users around the core of the city.

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95 The phrase is useful shorthand, although this Thesis queries just how much so.
In contrast, as discussed in Chapter 5, the rail planning process was almost exclusively public sector driven and even hostile to embarking on new rail projects that included private sector engagement. The Airport Rail link was considered by NSW government policy-makers as a financial disaster, a cautionary tale of smart private sector players shifting risk to the public sector. In the public sector, the rail bureaucracy became increasingly marginal as NSW State government demanded ‘answers’ to problems of congestion in key transport corridors – and in response to political pressures. As the Federal government’s Infrastructure Australia required well researched transport proposals, there was an absence of available expertise.

Yet from pronouncements by Ministers, public sentiment, and government policy, including the NSW Department of Planning’s Sydney Metropolitan Strategy, rail projects seemed to have had a political environment favourable to their approval. But few reached completion. There was a considerable gap between the State government’s public rhetoric and outcomes.

The reasons for this striking success rate between advocates for road versus rail in Sydney seem to arise from the strategic nous of the road lobby to pursue their objectives; their ‘roadmap’ guided them in the exercise of decisions that ultimately pieced together the orbital. Their apparent success is considered in the context of a) the respect held for the RTA leadership by political decision makers; b) the road advocates simplifying and piecing together a road system, whereas the rail proponents were not as cleverly positioned; c) a worldview within government that rail would always require huge subsidies to survive; d) disdain for the planning capacity of public transport agencies, such as RailCorp; e) the leadership of various agencies, including strong opposition by Treasury to ‘new’ projects; and, f) the belief within rail agencies that the overwhelming priority was to ‘fix’ the existing system rather than build something new. A former Railcorp CEO quipped “I am a tradesman, not a dreamer,” alluding to the considerable challenges of the existing network.97 There was also a fundamental issue of poor project conception and implementation that bedevilled the creative and effective implementation of various rail project proposals. Had a TRO been applied to rail projects, success in project conception and delivery might have been different.

97 In a conversation with the author in 2009.
It is worth emphasising that, in the period under review, as explicated in Chapter 4, it would appear that the RTA was not only capably led, but also seen to be so within government, as it confidently and ambitiously engaged with the private sector to build new toll roads. Such projects generated their own revenue streams from long-term concessions, with the roads eventually returned to public ownership. Sometimes, as with the Cross City Tunnel, the RTA for the government, obtained hundreds of millions for consolidated revenue and sometimes value ‘in kind’. Critics, however, claim that such projects represented a financial ‘windfall’ for private sector investors and should have been differently structured.98 This point is briefly discussed in Chapter 2.

Related to this is the exploration of what problem is being ‘solved’ by these large projects delivered as ‘solutions’? What did decision-makers, and opponents think they were doing? Such questions raise issues pertinent to political science, management processes, and the preference of particular solutions over others.

Crucially, consideration of problem and proposed solution raise questions about the framework for policy determination, the epistemological and practical issues for policy makers to reach decisions. Every MUTP raises questions as to how decisions are made - whether as a process along the lines of predict-and-provide, or as a step along a process of decision-making, or as a Big Bang decision. As discussed in Chapter 2, CBA and other tools provide insight for why a decision might be justified. But such tools and the theory underlying them are not terribly fruitful in understanding how decisions occur. The insight of the research of this Thesis is the application of real option theory to the decision-making process. For the theory proposed here to be useful in the context of a particular industry or problem, managers must be able to see in their own environment the applicability of real options.99 The argument seeks to apply research that posits that flexibility and optionality are critical to how decisions are made, and that management

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typically requires strategic liveness for resource allocation, including timing. They typically require strategic liveness for resource allocation, including timing. Mega complicated projects, the building of an airport, the construction of a power station, an oil refinery, a new rail line, begin as optional projects. They firm up depending on patronage forecasts, expectations of energy demand, and projections of likely future cash flow and/or subsidies to financially realise the project.

Based on the theoretical constructs associated with the TRO, the Thesis discusses the management of public transport policy and priorities in Sydney, and examines why certain projects were chosen and the merits of a particular choice. In so doing, the research underpinning the conclusions provides a credibly robust assessment of best practice that contributes to theory.

1.5 Method

The key data resources are: Reports of NSW Auditor General, which contrast aim and consequence, and usually discuss in detail with each NSW MUTP the steps from initial concept, design modification, and implementation – including delays and cost blowouts; publicly available reports by rail, road, and investor bodies, which show intention compared to result; the NSW Parliament Public Account Committee reports, some of which deal with MUTPs; the NSW Transport Data Centre reports, relevant to transport use, which is relevant to the assessment of problems to be solved; and the NSW Hansard, for public comments on commitments by the governments of the day concerning MUTPs.

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Reference is made to the studies on public transport known as the HiTrans Best Practice Guides, collaboratively prepared by university and independent researchers in Europe and elsewhere. HiTrans stands for an acronym, an abbreviation for “the development of principles and strategies for introducing high quality public transport in medium size cities and urban regions.”

The Thesis primarily relies on qualitative and quantitative research based on the available literature, including material that has hitherto not been extensively researched and systematically assessed. The Thesis comments on data sources and directions for further research. With the latter, interviews with key decision makers, advocates, etc., were not attempted as there was a wealth of information and sources to establish conclusions responding to the research question (see p. 25).

Interestingly, by mapping out the development of projects, in the context of the TRO, the research points to further work that might be undertaken by other researchers such as through mixed methods, and interviews with key decision makers, including in-depth interviews with advocates, bureaucrats, executives, stakeholders, and opponents, including Railcorp, the RTA, politicians, and environmental groups.

The method of investigation includes more than just the empirical case studies – namely, a very substantial examination of problems of MUTP management and of the theory of real options as applicable. The case studies are designed to test the proposition of the utility of TRO.

In this respect, care has been taken in assessing the evidence, including constant iterative ‘to-ing and fro-ing’ between the proposition and its investigation. In various chapters, particularly Chapters 4 and 5, the case study research focuses on the major toll road projects, all tied to the conception of the Sydney orbital in the late 1980s, as well as several rail projects – the Epping to Chatswood rail link (opened in 2009), the Airport Rail Link (opened in 2000, widely regarded in the

102 The main researchers included those drawn from the University of Newcastle, Civitas Consultants, Transek AB. The project was funded by the European Commission. See next footnote.

NSW government bureaucracy as a ‘failed model’), the Clearways program (long debated internally in the rail bureaucracy as the ‘key rail project’ to fix the current network), and the aborted metro projects which, despite the endorsement of several Premiers, and over half a billion dollars in spending, nonetheless went from seemingly certain to abandoned altogether. Whatever the ‘reputation’ of certain projects within government, the Case Study Chapters aim to generate argument and supporting data that show that the testing was genuine, in the sense of there always being the possibility of the results not supporting the proposition. Particularly in the light of Flyvbjerg’s admonishment about consultants to MUTPs selecting data that only supports their case, there has been deep consideration of alternative views and competing perspectives.

In this respect, the case study analysis is grounded on asking searching questions, based on a firm grasp of the issues being studied, requiring an alert consideration of the data, adaptive and responsive to alternative and contradictory evidence. Whereas the hypothesis provides a searchlight to explore the evidence, care is taken to ensure that there is openness and flexibility to competing assessment of the utility of TRO. Thus the aim and accomplishment of the case studies, as was once famously formulated (Becker, 1968), is to encompass:

…pondering the possibilities gained from deep familiarity with some aspect of the world, systematizing those ideas in relation to kinds of information one might gather, checking the ideas in the light of that information, dealing with the inevitable discrepancies between what was expected and what was found by rethinking the possibilities of getting more data, and so on.104

Certain information on Australian MUTP case studies from the Omega Centre at University College, London (UCL) and the Australasian Centre for the Governance and Management of Urban Transport (GAMUT) are referred

to.\textsuperscript{105} Information and data from Railcorp, the NSW Traffic Data Centre, and other sources is also analysed.

Several Appendices have been created that deal with matters tangential to the main argument. Inclusion in the overall narrative would unnecessarily clutter the presentation. The first Appendix, on competing methodologies in avoiding risk is clearly highly technical and touches on points raised in Chapter 3 on the management of risk. Flyvbjerg’s assessment of the typical flaws and pitfalls of MUTP planning is extensive and highly regarded. In some ways the TRO extends his analysis. Appendix 2 on Western Fast Rail, as alluded to in the introduction, is a project the author is too close to and cannot be objective about. Hence there is only a brief ex postulation in this Appendix.

\textbf{1.6 Research Objective}

The research objective is to understand those factors that lead to the development of a MUTP and, from the public interest viewpoint, analyse underlying causes of problems and mindsets, including identifying practical ideas, particularly the TRO, for improvement that on application could materially improve decision-making.

In addressing our task, a “mixed methods research” approach – combining quantitative and qualitative forms is pursued. This involves the evaluation of philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both in the study. It is more than simply collecting and analysing both kinds of data; it also involves the use of both approaches in tandem so that the overall strength of a study is greater than either qualitative or quantitative research alone. The research considers, with respect to various case studies, the balance in risk assessment, environment and socio economic effects, the appropriate regulatory regime, performance specifications, transparency and public participation as

\textsuperscript{105}See the various studies, OMEGA Centre (2009a-e), cited in the Bibliography to this Thesis.
important factors to consider. This requires consideration of qualitative and quantitative factors in the wisdom of choosing one course over another.

Expected Outcomes and Research Limitations

There is a gap in the academic literature about correcting the notorious problem of optimism bias concerning MUTPs. As insightful as is Bent Flyvbjerg’s work in this field, for example, his brief, forthright recommendations on countering such bias is slight compared to the problem under investigation. This is explained in the Thesis. The theoretical work of Sturup (2010) on the ‘art of governance’ of MUTPs is extended in new ways to a focus on the TRO.106 This Thesis develops the concept of decision-making, including referencing the PUC as a step, albeit a crucial one, along a decision chain. Appendix 1 speculates that the PUC is misconceived if it merely means that a particular decision to do x excludes the myriad of other decisions required for implementation, adjustment, or even abandonment. In fact there may never be ‘a’ point of unstoppable commitment, if every project is always subject to a degree of optionality. The only ‘stop’ we can be sure of is when the project is finished or abandoned. Arndt’s work on the involvement of the private sector in infrastructure projects is noted, particularly his identification of “a framework for efficient risk allocation so that decision makers can assess the efficiency of the risk allocation in past projects and can attempt to increase the efficiency of the risk allocation in future projects.”107

Appendix 4 discusses theories other than Flyvbjerg’s on MUTPs. Dudley’s and Richardson’s (1998; 2000) pioneering work on road agencies in the UK is highlighted in the context of rivalry between certain transport modes and their ability to persuade.108 The way such agencies operate in a competitive market for scarce transport funding resources is applicable in the Australian context. This is discussed and contrasted to Mees’ research (2009) which suggests that

planners and policy makers are highly influenced by an extremely conservative and unambitious policy framework for assessing major rail transport projects.\textsuperscript{109} Lindblom’s work (1959), including his \textit{Politics and Market}, on the way decisions are made, is discussed in light of Ney’s assessment (2009) of the messiness of decision-making in transport planning.\textsuperscript{110} Earlier, in this Chapter, TRO is discussed in the context of other theories examining or offering explanations of the development of MUTPs. There are many complementary insights in the material briefly surveyed here and nothing to contradict the tentative conclusions and the hypothesis that a TRO enhances - that is, adds value and depth – to the ‘solutions’ offered by Flyvbjerg in his analysis.

\textbf{1.7 The Thesis Outline}

Explaining decision-making in the context of real option theory is important in theoretical and practical terms. Comparisons are made between roads and rail to show that lessons can be learnt and transferred to project development and implementation of various MUTPs. An outline of competing theories seeking to explain MUTPs is put forward. As argued for in this first Chapter, there are many theories explaining MUTPs. Chapter 1 has canvassed many of them, all of which are insightful. If theoretical rigour and coherence can be measured through the discovery of verisimilitude and comprehensiveness, however, such that a particular theory is preferred over another because it explains more than its competitors, then Flyvbjerg’s constructs meet this test.\textsuperscript{111} His arguments broadly subsume all the others covered in the discussion. Yet even here there is a gap in the analysis filled by TRO. This naturally leads to the discussion in Chapter 2 on a prominent issue in urban planning and transportation studies – namely, the ‘problem’, broadly defined, with accurate forecasts and management of the delivery of MUTPs. That Chapter, in evaluating the MUTP literature, dwells on Flyvbjerg’s critique in particular and calls attention to a gap in his analysis. This is the problem of stating that

MUTPs should be better managed through the assignment of risk (and reward) to the party best able to manage them. Risk depends on the entity delivering. Urban planning theory is at its best when multi-disciplinary and able to draw insights from related and disparate fields to illuminate important issues and to thereby provide solutions to vexed situations. This is what the Thesis sets out to achieve. In Chapter 2, the important conclusion is reached that the academic literature, including studies by Flyvbjerg, are inadequate to the challenge of better managing MUTPs.

Chapter 3 goes on to explain why this is so, and how a TRO is a useful tool for considering and solving problems with MUTPs. The point is made that the management of projects by project leaders, learnt experience, and an exacting approach to risk management, go together with a TRO. The hypothesis is advanced that real option theory is practically useful in combination with those other factors. The Chapter argues that risk management is the key to a real options approach to MUTP development. The virtue of simplicity in project conception is supported, as is rigorous risk management aided by transparency of information to the market place. The last point is effectively covered in the manifesto of the Smart Infrastructure Facility of the University of Wollongong in its 2014 Green Paper on infrastructure, referred to in the Thesis.\textsuperscript{112}

Having established the theoretical background, it is appropriate to test hypotheses in the light of experience. Chapters 4 and 5 do so by evaluating case studies of major road and rail projects in Sydney.

Chapter 4 discusses the conception and practical realisation of the Sydney orbital. This is an exercise of real options, in the development of each part of the jigsaw that ultimately delivered a ring road in Sydney. The management of the RTA, within the objectives it set itself, was able and learnt from experience in realising ambitions. Similarly, with the private tollroad owner and operator Transurban, part of its story involved the exercise of real options, both in the way the original Melbourne CityLink project deed was conceived (providing a

\textsuperscript{112} Bowditch, Garry, et. al. (2014) \textit{Green Paper, Infrastructure Imperatives for Australia}, Smart Infrastructure Facility, University of Wollongong.
real option to defer certain costs recoverable to government), and in the development of Transurban from a special purpose vehicle (SPV) to Sydney’s dominant tollroad owner and operator. The Chapter also demonstrates that in the advancement of new projects put forward by the RTA, now the RMS, that they are justified by reference to the existing road system, as enhanced by the Sydney orbital. Effectively they are proposals to exercise the real option of extending the orbital. But it is more than that. Whereas we find vindication of the hypothesis that a TRO assists in improving the development of road MUTPs, this is in context of management expertise, a ‘horses for courses’ approach to funding mechanisms and project development (whether via a long-term PPP concession or D&C). It also occurs in the context of road services and charges not being fully transparent and usually funded from general revenue, a scenario that generally favours road over rail projects.

Chapter 5 evaluates the three largest rail projects in Sydney developed over a 20 year period – the Airport Rail Link (ARL), the Epping to Chatswood Rail Link (ECRL), and the Clearways project (which at the time of writing is mostly completed). In particular, the discussion advances understanding of the ARL, long regarded within the transport bureaucracy, Treasury, and government overall as a costly project disaster. Poor conception of the project at the beginning, as well as a complicated contract with the private party and the government, immeasurably added to the complexity and the ultimate cost to government when the project failed to achieve patronage forecasts. The ECRL was a more predictable project, but costs also blew out, largely because the project brief was not clearly specified at the beginning, with changes in design, an under-the-river- tunnel rather than a bridge across the Lane Cove River being the single most expensive factor. Still, the project enabled the rail authorities flexibility in routing trains (some northern line services through ECRL, some through Epping to Strathfield to the city, etc.), and in creating a hub, from Epping to the new North West Rail link (NWRL) now underway. The option of extending the line from Epping through Carlingford, then on to Parramatta was not exercised, though this is a potential extension in the years ahead.
Chapter 5 also discusses the Clearways program, a series of projects to untangle the complicated, interconnecting Sydney rail network. This has been the single most expensive NSW rail project to date, and should create many options for further extending and developing the Sydney rail network.

The idea is that a TRO is more than a tool for management. It is integral to the effective system of project management. Failure to appreciate this fact and misapplication of a TRO outside of that context, risks repeating the mistakes of the past and failing to actually learn from error. This, at least, is the promise of the Chapters that follow.

The next Chapter discusses the reasons why MUTPs often go wrong and why a framework for incorporating TRO into project assessment and development methodology is required.

\[113\] As we see in Chapter 5, in years to come, the NWRL is projected to easily eclipse the Clearways project.
2. Problems With Mega Urban Transport Projects (MUTPs)

Introduction

As stated in Chapter 1, the conception and attempted realisation of MUTPs is an area of detailed research in the academic literature of urban and transport planning. This Chapter surveys this literature, particularly highlighting Flyvbjerg’s diagnosis, including his suggestion that optimism bias can be curtailed if there is a transfer of risk to those parties best able to manage them. Such diagnosis calls attention to how such risks might actually be managed. This introduces the concept of cost-benefit analysis (CBA), the original use and limitations of this methodology, particularly with respect to uncertainty and the potential value of real options in decision-making. Additionally, the phrase “parties able to manage” requires some account of management expertise. Therefore the aim of this Chapter is to relate MUTP diagnosis with management theory and to explicate how a TRO can assist in the conception and delivery of MUTPs.

The Chapter proceeds by first noting the reasons why MUTPs frequently go wrong, including dwelling on the research by Flyvbjerg on this phenomenon. Second, reference is made to cost-benefit analysis (CBA), its origin, utilization, and abuse in assessing MUTPs. Next, different types of project management are discussed. Finally, the analysis ties into a discussion on the relevance of the TRO.

2.1 Delusional Project Development

In conceptualising transport mega projects, Frick refers to the six Cs: colossal in size and scope; captivating because of their size, engineering achievements or aesthetic design; costly - and often under costed; controversial; complex; and with control issues. Sturup argues that mega projects are “an interruption in

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their location environmentally, socially and politically. When they go wrong they go very wrong. When they go right they become potential great wonders of the world. MUTPs are mega projects ...with the attendant potential to change land use and settlement patterns.”

Flyvbjerg provides a 'Machiavellian' formula for this cost overrun: Under-Estimated Costs + Over-Estimated Revenue + Under-Estimated Environmental Impacts + Over-Valued Economic Development Effects = Project Approval. Given the inaccurate estimates implicit in this formula, colossal errors are bound to follow. Where it is government left ‘holding the baby’ and the contractor and other parties have inordinately benefitted from the project without corresponding risk, then there is a huge misalignment of interest. Ownership of risk is therefore particularly important. Its management becomes more active and less merely ‘interested’ the more the stakes are higher, such as owned by the private contracting partly or residually held by government. Knowing exactly was is the project definition, the tasks assigned to the relevant parties, and the responsibility of managers is the stuff of project management. For government, rationally, therefore, the balancing of interests, risks, and rewards is critical in project conception and management.

Of those MUTPs that have attracted significant private sector support, there is a history of costing far more than initially projected and attracting far fewer users than forecast. There is a consistent underperformance of result compared to promise. The experience in Boston in the 20 years to 2005 provides a classic example of what can go wrong.

The Big Dig

A famous example of a MUTP, an instance that has served to be a warning of the folly of poorly planned projects, is Boston’s Central Artery/Tunnel project, the first portion of which opened to traffic in 2003, with all portions in operation by "

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2007. Popularly known as the Big Dig, this project teaches many lessons about the risks involved in mega projects.4

The Big Dig rerouted the Interstate 93 highway through the heart of Boston into a 5.6km tunnel under the city, created the Rose Kennedy Greenway in place of the elevated highway, extended Interstate 90 across Boston Harbour through the new Ted Williams Tunnel to Logan International Airport, and built two new bridges over the Charles River. The project was a civil engineering marvel, replacing a congested elevated freeway with a technically challenging set of tunnels. Although traffic ramp-up was slower than expected, after full operation it fulfilled promises of saving time by diminishing traffic congestion. An EDR Group study estimated the time savings as worth $US177m per year (2005 dollars or $US214.8 in 2015), with another $US120m ($US145.63m in 2015 prices) per year in new property tax revenue, thanks to $US7b ($US8.50b in 2015) in new development made possible by removal of the former elevated highway.5 But as an example of the development of a MUTP, the Big Dig was a shambles. The $US2.6b in 1982 dollars ($US6.39b in 2015 dollars) projected final cost of the project ended up costing $US14.8b in 2007 dollars ($US16.92b in 2015 dollars) and its development dragged on for over two decades. Taxpayers were left to carry a huge debt with limited revenue to cover interest and repayment costs. A financial disaster, quality control was poor - as evidenced by defective concrete work, thousands of leaks, and the collapse of a tunnel ceiling. Project administrators were left with near-zero public credibility and confidence.

The initial concept for the Big Dig was to replace the elevated I-93 expressway through downtown Boston with a tunnel.6 A decade later the project combined the nascent I-93 undergrounding with an I-90 extended alignment through an entirely industrial area of South Boston for the third airport tunnel. The general

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4 OMEGA Centre (2009) The Big Dig (Central Artery/Tunnel Project), OMEGA Centre for Mega Projects in Transport and Development, Bartlett School of Planning at University College London.


plan was to replace the elevated six-lane I-93 with an eight-lane, mainly underground highway system for about three miles north-south, including the Leonard P. Zakim Bunker Hill Memorial Bridge over the Charles River - one of the widest cable-stayed bridges in the world - and construction of a new four-lane expressway to extend I-90 from its then-terminus downtown eastward to the airport. The project involved a huge, new I-90/I-93 interchange. Though covering a circumference of only 7.5 miles in overall length, the project required 161 lane-miles of roadworks. The then U.S. House of Representatives’ Speaker Tip O’Neill became the Big Dig’s most powerful proponent once the airport tunnel was routed away from his East Boston constituency into South Boston. Despite an initial presidential veto of the legislation, the Big Dig was incorporated in the Surface Transportation Assistance Act of 1987. Although President Reagan also vetoed this bill, his veto was overridden, winning the project federal financial support.

Responsibility for the project was contested. The Massachusetts Department of Public Works headed it initially, although the Massachusetts Highway Department was the recipient of federal funds. At the height of construction in 1997, the Massachusetts Turnpike Authority gained nominal control of the project. But in 1985 a joint venture of Bechtel and Parsons Brinkerhoff (B/PB) was mandated by the State to manage the project, working on an hourly basis as consultants. The B/PB team took responsibility for design, which they largely and apparently loosely subcontracted to other consultants.

Despite many years of pre-construction design, the project became notorious for poor preparation, with project briefs and contracts for parts of the project being put out with incomplete designs and sketchy data on existing conditions. Contractors found themselves with hundreds of change orders. The project ultimately consisted of 118 prime contracts. As soon as federal funding came into play, the politics became more difficult: special interest groups, government organisations, and individual communities all wanted a piece of the well-funded action. Scores of buildings got money for noise control. Mitigations of this sort accounted for one-third of the project’s ultimate cost.
The airport tunnel portion was broken away from the rest of the project in the early 1990s and construction began by the end of 1991. This particular tunnel opened in 1995 without connections at a cost of $US2b ($US3.11b in 2015 dollars). This was an instance of breaking up an unwieldy large project into parts. The option to accelerate the airport road link became a priority and this piece of infrastructure was segmented from the rest. This is an instance of TRO – breaking an unwieldy project into parts and accelerating one part.

By 1987 the project cost was put at $US3.2b ($US6.68b in 2015). By 1991, when construction of the airport tunnel portion began, it had grown to $US5.8b ($US10.09b in 2015), and by 1994, when the design firmed up enough for construction to begin on its main portions, the projected cost was officially put at $US7.8b ($US12.47b in 2015). A 2001 report by the Massachusetts inspector general found that B/PB in 1994 had forecast that eventual costs would be in excess of $US13.8b ($US22.07b in 2015). This calculation, however, was suppressed by Governor William Weld’s office, which worked with local Federal Highway Administration (FHWA) officials to reduce the ‘official’ estimate by $US6b (in 1994 dollars or $US9.60b in 2015) to avoid jeopardising requests for continued federal funding. Before the spring of 2000, however, the Big Dig’s acknowledged project cost had increased to $US10.8b ($US14.87b in 2015). Then, in a moment of great drama, then-Governor Paul Celucci accused Turnpike Chief James Kerasiotes of intentionally concealing $US2 billion worth of cost overruns and destroying the trust of the federal authorities. Kerasiotes was fired. FHWA’s main office in Washington by this time accused the state authorities of fraud. The Big Dig was finally completed with all lanes open to traffic in 2007.

Many of the lessons of the Big Dig are obvious. Mega projects need: teamwork; goals, benchmarks and schedules set more precisely; projected costs expressed in construction year dollars and, where uncertain, in ranges of dollars rather than single numbers; contingencies carefully estimated; co-operation of the various stakeholders; champions to fight for these projects; honesty and candour throughout - otherwise bad news will come as a shock, eroding public confidence; and, finally, vigilance against project creep. The latter is a major source of cost increases in mega projects. When the scope of a project grows as
it is developed, unanticipated elements are added and with them unforeseen complexity. Special interest groups inject new objectives to serve their agendas calculated on the windfall of funding.

**Figure 6: Estimates of MUTP Costs and Benefits Often Inaccurate**

Flyvbjerg conducted various international surveys of mega transport projects to determine the size of the ‘gap’, on average, between original estimated and actual project costs, and between estimated and actual passenger traffic.

For project cost estimates, Flyvbjerg examined 258 projects in 20 nations on five continents over 70 years, and found the following (in constant prices).

*Rail projects:* for 58 case studies examined, on average, the actual cost was 44.7 per cent higher than the estimated cost.

*Bridge and tunnel projects:* for the 33 case studies examined, on average, the actual cost was 33.8 per cent higher than the estimated cost.

*Road projects:* for the 167 case studies examined, on average, the actual cost was 20.4 per cent higher than the estimated cost.

The data show that 90 per cent of projects experience cost overruns, and that cost overruns in the order of 50 per cent over original estimates are common. Forecasting errors vary widely across types of projects and significantly differ between sectors. Cost overruns are constant for the 70 year period covered by the study — that is, the accuracy of cost estimates did not improve over time.

Flyvbjerg separately, from another survey, presents evidence on the inaccuracy in the forecasts for rail passenger traffic. Having examined 208 projects in 14 nations on five continents over 30 years, he found:

*Rail projects:* for the 25 case studies examined, on average, the actual traffic was 51.4 per cent lower than estimated.

*Road projects:* for the 183 case studies examined, on average, the actual traffic was 9.5 per cent higher than estimated.

The data show that for rail projects, 90 per cent overestimated traffic, and 84 per cent overestimated that traffic by more than 20 per cent. For road projects, the number of roads with overestimated and under-estimated traffic is about the same, but 50 per cent of road forecasts have under or overestimated passenger traffic by more than 20 per cent.

Passenger forecasting errors differ substantially between road and rail projects, and inaccuracy in passenger forecasts is constant for the 30 year period covered by the study — that is, the accuracy of passenger forecasts has not improved over time.


If the project goes beyond the electoral cycle, politicians do not live with the consequences. With the Big Dig, most of them left office long before the project was completed, let alone before its viability as an operational project could be
subjected to scrutiny. This project set the ‘clay feet’ standard for a poorly conceived and managed MUTP.7

Although an extreme example of what can go wrong, the Big Dig development typifies many features in common with other MUTPs. Indeed, on average, the track record of transportation mega projects is terrible. The costs are usually significantly under-estimated and traffic is typically dramatically overestimated.

Rail projects have similar, well-documented histories. Though one Australian example, the $AU1.6b (in 2007 or $AU1.96b in 2015 figures), 70.1km Perth to Mandurah rail link (PMRL), constructed between 2002-2007, stands in contrast to typical experience. For the PMRL was delivered in line with budget and stands as a model of MUTP planning.8 This particular project illustrates that is difficult to win public and political support for much-needed mega projects without efficiently performing project delivery models.

Over a decade ago, in their study *Megaprojects and Risk*, the challenge of carefully evaluating why certain MUTPs fail and some succeed was comprehensively taken up by Flyvbjerg and his Aalborg University colleagues.9 The book documents the global nature of the problem, analyses its causes, and offers useful ideas on doing better. Improving upon these remedies is what this Thesis is most concerned with.

First, Flyvbjerg et. al. show that this is not a new problem, nor is it restricted to a few countries. This is highlighted in Figure 6, above. They conclude that the “cost estimates used in public debates, media coverage, and decision-making for transport infrastructure are highly, systematically, and significantly deceptive. So are the cost-benefit analyses.”10 Figure 6 illustrates the research findings.

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7 After those words were written, Dr Jack Gray mused on The Big Dig: “All is forgotten now that the surface is so strikingly attractive.” Email, Jack Gray to Michael Easson, 22 June 2015. Maybe. But the project management and cost blowouts are the stuff of legend.
10 Ibid., p. 20.
Many other analysts have reached similar conclusions.\textsuperscript{11} Flyvbjerg goes on to explain why this comes about. He cites several MIT researchers’ conclusion that “the incentives to produce optimistic estimates of viability are very strong and the disincentives weak.”\textsuperscript{12} He sees the main reason for this is due to a lack of accountability of the parties involved, rather than a lack of technical skills or insufficient data.

Another key insight is that “risk is simply disregarded in feasibility studies ... by assuming what the World Bank calls the EGAP principle: Everything Goes According to Plan.\textsuperscript{13} That in megaprojects things seldom go according to plan is the inescapable conclusion. Asking why risk is under-estimated or disregarded leads Flyvbjerg to question conventional approaches to project development, in which government is the project promoter and financier, and private firms are only too happy to do the best-case feasibility studies, produce the designs, and take on construction contracts fattened by numerous variation orders – as we saw occurred with the Big Dig. What is sometimes called a public-private partnership can be a perverse use of the term if, in practice, that model does not adequately protect the public interest. Where major risks of cost overruns and of inadequate traffic are placed on the shoulders of hapless taxpayers, then the model is gravely flawed. If somebody else is picking up the tab, neither government officials nor private contractors have strong incentives to anticipate the issues that lead to problems and then costly variations. Not only are lack of incentives and imbalance in rewards inherently undesirable, a system set up in this way “is likely to increase the total risks and costs of a project.”\textsuperscript{14} It leads directly to the results seen with the Big Dig and other projects documented in the Aalborg University study.

Arguably a more efficient delivery model is an actual partnership of public and private interests that appropriately “allocates risks to parties who have an incentive to reduce the negative impacts,” as Flyvbjerg puts it. He advocates putting commercial risks, such as construction cost and traffic risk, with the

\textsuperscript{11} As we see later in our discussion in this Chapter of the Thesis.
\textsuperscript{13} Ibid., p. 80.
\textsuperscript{14} Ibid.
private investors. To bring this about requires true risk capital in a mega project. Indeed, one of Flyvbjerg’s strongest conclusions is that the decision to proceed with a project should be based on “the willingness of private financiers to participate in the project without a sovereign guarantee.”\textsuperscript{15} By putting their own capital at risk, investors are personally and financially involved in monitoring how the project is achieved, and therefore desirous of mitigating their risk. If private parties shy away from investing in proposed mega projects this is a signal that the project is not fiscally sustainable or viable.

\subsection*{2.2 Cost-Benefit Analysis (CBA)}

Countering optimism bias and assessing \textit{cui bono} (who benefits) with projects is partly an exercise in CBA, sometimes called Benefit Cost Analysis (BCA),\textsuperscript{16} from which the Benefit Cost Ratio (BCR) is derived, which involves a methodology for aggregating impacts on all members of the community and appropriately taking account of risks. A summary of CBA and its various elements is in Figure 7, below. Discounting of future costs and benefits to the present is used on the assumption that idealised individuals prefer to receive benefits or goods now rather than later.\textsuperscript{17} Flyvbjerg is particularly sceptical of doctored, biased or shoddily done CBAs – tailored to suit the project or, at least the project beneficiaries. Even so, at least in theory, CBA should be a rational, useful tool in project planning. Though this cannot be applied as if all projects are the same or can be simply monetised – as Figure 7 highlights. To provide a reliable guide as to what is in the community’s overall interest, CBA must take into account economic, social, and environmental factors. CBA, however, usually struggles to incorporate or avoids distributional (or equity) considerations and so judgments about the need for a response to distributional issues (such as whether any groups that are left worse off by a project should be compensated) are left to decision makers, ideally following community debate.

Projects can have disparate benefits, including economic and social, as Figure 8 illustrates, below. Some of the limitations of CBA are readily apparent. It

\begin{flushleft}
\textsuperscript{15} Ibid., p. 141.
\textsuperscript{16} In the Thesis the term CBA rather than BCA is employed.
\textsuperscript{17} As illustrated below, this is one of many contestable assumptions of BCR analysis. Future benefits, such as cleaner, more sustainable urban environments arguably deserve no ‘discount’ at all.
\end{flushleft}
attempts to provide a monetary value for intangibles, e.g., loss of amenity, privacy, sense of community. These things can be impossible to exactly quantify, but in some cases they can stop projects stone dead or cause emendation to the original proposal.

**Figure 7: Cost-Benefit Analysis (CBA)**

CBA is a method economists use that evaluates whether an infrastructure project (or a policy) makes the community better off overall, compared to the status quo (or some other alternative). That is, whether it is expected to produce a ‘net benefit’ and, if so, the extent to which benefits exceed costs. This evaluation should be broad, taking into account economic, social, and environmental outcomes.

In CBA, benefits are usually valued according to the perceived willingness of individuals to pay for them, which can be more than they would actually need to pay for a given quantity. For example, the price of the water supplied to a household is often less than the willingness to pay for it. Similarly, costs are valued according to the willingness of others to pay for the resources involved and, therefore, reflect the best alternative forgone (this is called ‘opportunity cost’).

A financial analysis only takes account of the market price (and total revenue) of supplying the service relative to its cost of production. CBA takes into account the monetary value of the service to consumers beyond the price paid by them, and the cost beyond what is paid to the factors of production. CBA should take into account any externalities - other costs and benefits - that fall on people outside those involved in the transaction. For example, savings occasioned by faster travelling time and reduction in pollution.

Some externalities, such as effects on the environment or social amenity are difficult to value. There are various methods to value such effects. Alternatively their importance can be discussed in qualitative terms.

The costs and benefits of projects and policies often accrue over a considerable length of time. To take account of people’s preference to receive benefits now rather than later, future values are discounted to a present value. The choice of discount rate is contentious, but government guidelines often dictate the rate (or range of rates) to be used.

Costs and benefits are commonly aggregated across idealised individuals without regard to actual winners and losers from the policy. Governments and other interested parties may be concerned about how particular groups, such as low-income households or rural communities, are affected, and so may not think it appropriate to base decisions purely on a cost-benefit rule. Such distributional (or equitable) concerns can be addressed in CBA by presenting disaggregated results showing the effects on particular groups. Decision makers can then make judgments about the need for any particular response to equity issues.

CBA enables projects to be judged, not only on construction costs, but also long-term maintenance and operating costs. A good project assessment has the capacity to provide information as to the relative resources that should be devoted to the initial construction versus longer-term operating costs. For example, information on the type and quality of a construction that could reduce on-going costs. Not all projects can be evaluated purely or easily in financial terms, as the Figure 8 below, developed by McKinsey, highlights.  

### Figure 8: Infrastructure Projects and Value of Benefits

<table>
<thead>
<tr>
<th>Example</th>
<th>Wireless telecom</th>
<th>Toll highways, roads</th>
<th>Parks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Returns</td>
<td>Projects with discrete revenue streams and clear costs can be evaluated in purely financial terms</td>
<td>Projects where both financial returns and economic spill-over effects need to be quantified</td>
<td>Projects where benefits are largely social (equity, health, environment) and difficult to quantify in economic terms</td>
</tr>
<tr>
<td>Social cost-benefit analysis</td>
<td>Typically private competition, and user fees cover costs</td>
<td>Toll revenue assessable in terms of return on investment (ROI)</td>
<td>Typically publicly funded with no user fees</td>
</tr>
<tr>
<td>Economic returns/cost-benefit analysis</td>
<td>Investment decisions on a purely financial basis (net present value, return on investment)</td>
<td>Non-financial economic costs and benefits (e.g., mobility and higher economic activity) justify additional charges or subsidies and require evaluation in economic terms</td>
<td>Most benefits intangible, such as improved health, better air quality, or increased sense of community, and require societal agreement on their value</td>
</tr>
</tbody>
</table>

*Source: Adapted from McKinsey (2013) *Infrastructure Productivity: How to Save $1 Trillion a Year.*

For CBA to play a useful role in guiding project selection, it needs to be of high quality and consistently applied. CBA is not an exact science. Benefits are extremely difficult to quantify across the board.  

### The Use of CBA in MUTP Assessment

For over fifty years CBA has featured in the assessment of major infrastructure projects.  

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19 Ibid., p. 36.

long-term consequences of decision-making. As Roberts (2013) notes: “The benefits of a project should outweigh the costs; however, the point at which the cost are outweighed by the benefits may be some way into the future.”

The aim is to enable policy makers to assess whether a policy initiative or project yields a net community benefit. Done well in transport planning, this requires that: “advanced CBA needs to be capable of tracking the long term and ‘second round’ benefits of major transport projects.” In a straight-forward example:

<table>
<thead>
<tr>
<th>Year</th>
<th>Benefits</th>
<th>Costs</th>
<th>Net</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-</td>
<td>2,500</td>
<td>-2,500</td>
<td>-2,500</td>
</tr>
<tr>
<td>1</td>
<td>13,000</td>
<td>15,850</td>
<td>-2,850</td>
<td>-5,350</td>
</tr>
<tr>
<td>2</td>
<td>70,000</td>
<td>64,620</td>
<td>5,380</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>71,000</td>
<td>27,400</td>
<td>43,600</td>
<td>43,630</td>
</tr>
<tr>
<td>4</td>
<td>81,000</td>
<td>24,250</td>
<td>56,700</td>
<td>100,380</td>
</tr>
</tbody>
</table>


In the refinement of CBA there is also the generation of discounted cash flow techniques over the life of a project. Values of costs and benefits are discounted to the present using a ‘discount rate’. A basic formula for discounted cash flow (DCF) is:

$$ DCF = \frac{\text{Future Cash Flow}}{(1 + \text{discount rate})^{\text{number of periods}}} $$

DCF gives a present value calculation. The discount rate mentioned in the formula is the opportunity cost (time value of money), including the inflation and lost interest of the capital invested. If, say, in the example given above, an

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assessments made of DCF in Year 4, where, say, the interest rate for the discount rate is 6%, this would mean the Discount Factor is \(1/(1+0.06)^4=0.79\), which yields a net present value of $81,158.22 (compared to $100,380 in the example in the Table above).\(^{23}\) A dollar’s worth of value received today is more valuable than a dollar’s worth of benefit delivered a few years later.

Without delving deeply into finance theory, there are three main performance measures of project value in CBA:

- **Net present value (NPV)** - the sum of all costs and benefits expressed in present day values;
- **Benefit-cost ratio (BCR)** - the sum of benefits divided by the sum of costs expressed in present day values; and,
- **Internal rate of return (IRR)** - the percentage return (of benefits) on the costs invested.

In sophisticated analysis a host of factors are weighed. In every case a quantifiable monetary value is ascribed to each factor. Critics argue that because there are assumptions involved in the quantification of ‘intangibles’ or non-traded costs and benefits, a false accuracy is attributed to the results of CBA. The UK’s Roskill Commission on the Third London Airport in the early 1970s attracted criticism for an unsatisfactory discussion on the use of CBA. This was related to inadequate treatment of issues associated with regional planning.\(^{24}\) Part of the criticism was that certain of the assumptions and/or attribution of value to certain factors in the analysis distorted the framework for arriving at a decision. This points to the contestable, sometimes arbitrary, calculations involved. Flowerdew notes that: “The purpose of cost-benefit analysis is to assist decision-makers by providing an account, quantified where possible, and so far as possible in terms of a common unit such as money, of all the positive and negative effects (benefits and costs) of a decision on all those who are affected both in the short and in the long term.”\(^{25}\) But because of the limits of the analysis it is important to describe the non-quantifiable costs and


benefits fully, thereby transparently calling attention to the judgment call by
decision makers – ultimately, with MUTPs, the politicians.

Buchanan (1964) notes that the purpose of a cost-benefit study is: “A type of
study designed to ease the burden of decision between various alternative
possible measures involving differing expenditure and differing degrees of
benefit.” Note the word “burden” which suggests that some kind of objective,
independent aid to assist rational decision-making was the intention. The early
adopters of CBA in the UK in the 1960s and early 1970s (Buchannan, Roskill,
etc.) were mindfully aware of the assumption-laden, even tentative, nature of the
analysis. In time, however, the methodology became standard and less
controversial, in fact ‘normalised and depoliticised’.

At the heart of CBA is the idea of discounting. Typically, the discount rate
chosen (usually 4-10%) means that any costs and benefits beyond 25 or 30 years
are ‘discounted’ to a point where they have a negligible to nil impact on the
benchmark indicators, therefore tending to heavily ‘discount the future’. For
MUTPs which potentially re-shape the urban environment for generations and
for projects which have a major future environmental pay off, this neglect or
under-appreciation highlights a problem.

Farrow and Toman (1999) suggest utilising CBA as a four steps process: The
first is to define a baseline in which there is no change (such as a scenario where
a transport project is not adopted.) This allows an overview of the current state-
of-play and the implications if the project is not implemented. For example, if
the main objective of the policy is to generate better travel time for the
population, the baseline would be a scenario where no new action is
implemented and therefore existing travel times and mobility patterns are
maintained. CBA requires calculation of this baseline as a reference point to
compare the real benefits of the alternatives proposed.

27 As evident in countless textbooks in finance theory.
The next step is to identify the different alternatives. For example, the alternatives for the transport policy could be modifications in the current infrastructure. In identifying and describing the possible alternatives in a technical and economical way, the main objective is to comprehensively delineate the benefits and costs for the baseline and each of the options. This requires an economic, environmental, and social evaluation of the costs and benefits of each alternative. Evaluations utilise technical models and expert knowledge, usually based on past practice that predict future effects. The second step in most practical situations, therefore, involves information, multidisciplinary skills, and sophisticated software.

Having yielded a comprehensive picture of the alternatives, the third step then identifies the differences over time between the various policy scenarios and the baseline case. With a transport project, the assessable benefits typically include: the difference in travel times, environmental impacts, better mobility, etc., between the alternatives and the baseline, the nothing-is-done scenario. (Though it is noteworthy that the idea of a baseline or a ‘do-nothing’ approach presents methodological challenges, as the starting point to establish is slippery. Moreover, especially with MUTPs, the concept of do-nothing is rarely appropriate and then there is a debate about what the do minimum might be).

The fourth and final step assigns to those identified benefits and costs a monetary value. Some benefits and costs are easier to estimate than others (e.g., the construction cost of a road or the incomes from a toll). Certain costs and benefits, however, are not normally reckoned in monetary units (e.g., the changes in noise levels for residents near new or augmented infrastructure; the impact on certain natural habitats of a route cutting through, etc.). Even so, the model requires that each factor is monetised. Multiple technical methodologies are employed to provide an estimation of the effect in terms of financial benefits or costs (e.g., changes in real-estate values because of the new infrastructure; the various environment impacts, etc.). Finally, with these results, an aggregation of the effects over time is calculated.

With MUTPs, in order to improve the reliability of CBA, further sensitivity analyses are developed to determine how robust are the results in the CBA model as well as qualitative information on non-monetised benefits and costs.
From this work, the main outcome of a CBA is to produce indicators for decision-makers. Such indicators - called the net present value (NVP) and the internal rate of return (IRR) - are numbers and percentages that represent the net benefits to the community, considered as a whole, would achieve if a particular alternative is implemented. They represent a picture (signalled in monetary value) of the benefits of a policy alternative. This amount is calculated for a fixed period of time, which typically is for 20 to 30 years.

It is interesting here to note how pioneering and controversial was once the construct of CBA. The Roskill Commission was established in 1968 to consider the location of an airport for London. The commission, speculating that by the end of the century London might have to accommodate 100m airline passengers, concluded that a new airport should be built to the northwest of London at Cublington, between Aylesbury and Milton Keynes, with matching improvements to road and rail links. Although its reliance on CBA was widely criticised, the authors emphasised in their arguments that CBA was not employed to make decisions but rather utilised as a guide to the careful organisation of the evidence.

Reporting in 1971, a government of different complexion rejected its findings immediately. A scheme to build an airport at Foulness, on Maplin Sands in the Thames Estuary, was chosen instead. This option, considered by Roskill, had been decisively rejected on the grounds that the proposed airport was too expensive to build, too far from London and on the wrong side of the city for most prospective passengers. In the end, neither Foulness nor Cublington was built. The complexion of the government changed yet again. After some delay, another scheme was devised: a limited expansion of an existing airport at Stansted, near Cambridge. In the late 1980s the newly privatised British Airports Authority used the money generated from Heathrow to finance that project.

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29 This was from a then base of 15m passengers. Their estimate was prescient. The actual number was 115m. See: Kay, John (2012) 'London’s New Airport Held to Ransom by Folly’, Financial Times, 6 November.
A furious critique of CBA peppered much of the early academic literature. Self (1975) suggests that assumptions on externalities are always controversial. “Supposing the posited time and vehicle operating savings were realised, we cannot know how much motorists would actually pay for them if a market existed; and the doubt is increased in this particular case by the high valuations put upon time costs.”32 He elsewhere, alluding to a phrase by the classic social scientist Jeremy Bentham, refers to CBA as “nonsense on stilts.”33 MacIntyre notes that, “...problems of a cost benefit kind – of a utilitarian kind in general – can only be solved when all the elements of the problems are treated as belonging to the realm of the calculable and the predictable.”34 But the difficulties of doing this can be glossed over with various ad. hoc. strategems employed to make calculations. Many of the associated complexities and absurdities were understood by Roskill. In the anonymous, unpublished Technical Appendix to the Roskill Commission’s Report are a number of passages highlighting the dilemmas they faced in putting a number on the unquantifiable:

Oh Commissioners may sing
Of the value of a thing
Such as quality of living or disturbance due to noise
And we justify each figure
With considerable vigour
On the basis of our models and our pretty little toys.
No matter how we try
We can never quantify
Those poor dark-bellied Brent geese

(if we leave them in the lurch)

So we cancel as we wish

These sad geese against the fish

Or a thorough bredded gee-gee or a Stewley parish church.  

However imperfect, CBA is an attempt to introduce rationality into decision-making. Sturup (2010) suggests that “[CBA] can be viewed as an attempt to produce an uncontroversial analysis which identifies a real need for the project...”36 Note that its methodologies should not mask certain judgement calls. Transparency on those is important for assessment of alternatives. CBA is an adjunct to decision-making rather than its substitute. Young (1968) observed: “The gazer into the future has never yet found a really comfortable intellectual position, and perhaps never should unless, that is, he is a preacher.”37 CBA and other techniques of attributing value to a proposal are attempts to move beyond preaching to estimating and evaluating. Perhaps, however, the tendency since Roskill, with the utilisation of CBA by MUTP proponents and assessors threatens “to put the expert on top rather than merely on tap.”38

**Lessons**

From this brief description of the origins of utilisation of CBA can be made these observations: First, the Roskill Commission was an extremely thorough, pioneering effort at systematically thinking through potential sites and risks with each, and in making judgement calls on a host of controversial issues. The Commission membership (a judge, an academic planner, an engineer and transport consultant, an official of the UK Planning Inspectorate, a businessman, an economist, and an expert in aircraft design), independent research team (rather than heavy reliance on outside consultants), comprehensive analysis of alternatives, and observations on the difficulties (and

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absurdities) of certain assessments, together with the 9 volumes of the final report, shows that they were alive to and independently considered all (or certainly most) of the key issues in an exemplary manner.

Second, CBA was an aid to decision-making, rather than some god-like apparatus - *Deus ex machina* - to determine an outcome. Third, some of the weighting given to certain factors was particularly subjective and probably very much a product of time and place. Lichfield (1971), as we have noted,\(^{39}\) was critical of the decision to recommend Cublington rather than Foulness, and argued that had the CBA been better applied (skewed differently for regional, local, and environment factors) that there would have been a different outcome. Significantly, Litchfield did not dispute the utility of CBA, he contested some of the assumptions fed into the analysis. Given the controversies in the late 1960s through to the early 1970s on CBA,\(^ {40}\) in some ways it is surprising how overwhelmingly common is the use of CBA in infrastructure assessments worldwide.\(^ {41}\)

Certain ‘lessons’ from the Roskill Commission experience were absorbed by the bureaucracy and scheme-proponents, which are arguably deleterious to a healthy evolution of infrastructure analysis. For example: concern at the length of time a thorough-going research assessment of a project might take. Commissioned in 1968, Roskill reported three years later. For many politicians anxious to make their mark this is too long. Indeed, this ‘problem’, the time to do analysis comprehensively and well, clashes with the political imperative to ‘get-on-with-it’. Second, public consultation under Roskill, which was extensive, became fraught with the community often unappreciative of some incredibly complex issues. Roskill noted that the 100,000 people who might be adversely affected by a ‘rational’ policy can be expected to shout far louder than the 100m who would benefit. But the issues were more than that. Clearly, as a

methodology, CBA presents peculiar difficulties when presented to stakeholders for public comments. The quality and comprehensiveness of consultation is a complex question that all MUTPs need to consider.

Third, the denial of transparency became a problem. This is related to the expert-myth tendency within government (and private sector) bureaucracies to curtail public consultation in case the potential noise from opponents defeats a project – or make a proposal more robust by considering new information. Reducing and hiding information from the public became very strong temptations in the bureaucracy, by proponents, and by naïve politicians hitching their careers to particular ‘bold decisions’. Sometimes the assumptions and conclusions of the CBA exercise have been crimped and hidden. Experience in 2014 in Melbourne concerning the East West Roadlink, since abandoned, is an instance. Fourth, the bandwidth limitations of computer software from the 1980s to the early part of this century meant that the ability to consider new factors and to go beyond 20 to 30 year time horizons was limited by the technology. Thus certain MUTP longer-term impacts were downplayed (as is canvassed in Chapter 5 of the Thesis).

Fifth, in the quest for standardisation in CBA methodology comes the desire for consistency compared to past calculations. This, however, should be challenged given societal changes, including a more sophisticated and sympathetic environmental outlook of the modern world. If, for example, the dark-bellied Brent geese must be monetised, its value in 2015 is presumably more valuable than in rougher times (such as in 1970). The Pareto Principle (that specifies an unequal relationship between inputs and outputs such that, for example, for many events, roughly 80% of the effects come from 20% of the causes) is apposite here since CBA highlights issues such as why there is no inbuilt distributional focus through the decision rule of potential improvements.

42 Strikingly, Sturup (2010) notes that with three Australian MUTPs examined for her Ph.D. thesis – City Link in Melbourne, the Cross City Tunnel in Sydney, and the Perth to Mandurah Rail Link, CBA was conducted after a decision to proceed had been taken, Op. Cit., p. 119.
(winners and losers) and also the assumption of constant marginal utility of income (impact on different income groups). Whilst there is no inbuilt distributional considerations, this does not mean that explicit consideration of these issues cannot be made ex post either by suitable sensitivity analysis or consideration of different categories of winners and losers.

The CBA is a ‘magic pudding’\(^45\) to some proponents and politicians, a lazy way of getting quickly to a conclusion – driven by ‘expert’ opinion. Certainly, it is fair to conclude that “[m]any CBA studies have a qualitative presentation of plus and minus factors that have not been expressed in money terms at the end. CBA also requires a certain level of professional skill to apply the method properly.”\(^46\) A problem for proponents of ROs is that under traditional applications of CBA and NPV, and associated methodologies, there is no value to the option of waiting for further information, deferral, or the other ROs sketched in Figure 3.

What is needed is a return to the original spirit when CBA was introduced to MUTP planning. Decision-making is always improved through debate, transparency, a well-informed public (even if much of the technical detail is more of interest to specialists than to lay people), and by rigorous comparisons of projects and searchingly thorough re-evaluation of assumptions. Decision-making may be messy and not always straight-forward, but the alternative is a disaster – ill-considered, costly decisions.

Thus the TRO fits into a larger debate about the style and substance of MUTP decision-making, including developing the skills of decision-makers to learn from past practice, from each other, related projects, and best practice. The lack of independent, credible bench-marking on the latter is an on-going issue with MUTPs.

**Countering Optimism Bias**

Conducting CBA requires attention to the potential for optimism bias. According to the UK Government’s appraisal:

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\(^45\) The term ‘magic pudding’ is an Australian term that comes from a mythical children’s story where: “The pudding is a magic one which, no matter how much one eats it, always reforms into a whole pudding again.” See: Lindsay, Norman (1918) *The Magic Pudding: Being The Adventures of Bunyip Bluegum and his friends Bill Barnacle and Sam Sawnoff*, Angus & Robertson, Sydney.

There is a demonstrated, systematic, tendency for project appraisers to be overly optimistic. This is a worldwide phenomenon that affects both the private and public sectors. Many project parameters are affected by optimism — appraisers tend to overstate benefits, and understate timings and costs, both capital and operational.\(^\text{47}\)

A review commissioned by the UK Treasury examined 20 years of major public procurement projects in the UK found the average optimism bias was estimated at 17 per cent for work duration, 47 per cent for capital expenditure, 41 per cent for operating expenses, and 2 per cent for benefits shortfall.\(^\text{48}\) The study, however, found that the level of bias in projects procured using PPPs was lower, perhaps because of a more rigorous approach to risk analysis in those cases and in retrospect, more robust and realistic business cases. Weaknesses in decision-making persist, however, including the incentives in political decision-making leading to an emphasis on ‘ribbon cutting’ opportunities, generally associated with very major projects, at the expense of periodic maintenance and of small-scale ‘de-bottlenecking’ options that could postpone or even avoid the need for costly asset expansions. In Australia’s case, the fact that the Commonwealth government provides funding for major projects, but not for ongoing improvements to asset condition, accentuates this bias. It also undermines integrated planning of the road network, notably in urban areas, by encouraging a focus on individual major projects rather than on the network as a whole.

Optimism bias can be countered by rigorous analysis of the risks faced by the project. An additional approach is to use reference class forecasting. As the OECD explains: “With this technique an outside view is taken in order to add a reality check to planning forecasts by examining outcomes (time taken for completion, cost, traffic levels, etc.) for similar past projects.”\(^\text{49}\) This is akin to what was discussed in Chapter 1, referencing Kahneman’s and Flyvbjerg’s concept of distributional information.


While these technical approaches are useful for countering optimism bias, unrealistic cost and demand forecasts also arise due to strategic misrepresentation. That is, proponents of a project seek to make it appear better than it really is. While technical guidelines on how to conduct CBA can go some way to countering strategic misrepresentation, strategic forecasting techniques tend to evolve to out-manoeuvre rules established to counter them. Accordingly, the institutional and governance arrangements within which analyses are done - as well as transparency of information (for comparison and debate) - are of critical importance.

Wider Economic Benefits (WEB)

Infrastructure projects create direct benefits for subsequent users of the services provided they use that infrastructure. When a CBA of a proposed project is done, such benefits are routinely estimated. Certain projects can also create wider economic benefits (WEB), such as ‘agglomeration spillovers’. For example, Lowe (2013) argues that investment in transport infrastructure, in addition to reducing travel times and stress, has less obvious benefits:

One of the less obvious benefits is what economists sometimes call agglomeration spillovers. Effective transportation networks deepen markets. They bring consumers closer to more businesses, and they bring workers in contact with more opportunities. These deeper markets and connections promote competition. They promote greater specialisation by both firms and workers. And they promote innovation and a more dynamic economy.\textsuperscript{50}

How to include WEB in CBA and how to estimate them is contentious. Genuine WEB should be taken into account in assessing the merits of projects. In this context, it is worth noting that increased travel might also have environmental costs, both global and local (congestion, pollution, GHG). Project selection deficiencies can be aggravated by poor quality project evaluation such as sloppy use of WEB to get questionable projects over the line, and incorrect setting of discount rates which do not properly incorporate a mark-up for optimism bias, as well as other distortions in public sector decision-making. The extent of that mark-up should reflect the option value of deferring investment, which in turn

\textsuperscript{50} Lowe, P. (2013) ‘Productivity and Infrastructure’, record of a speech presented to the IARIW-UNSW Conference on Productivity Measurement, Drivers and Trends, Sydney, 26 November. Lowe was then the Deputy Governor of the Reserve Bank of Australia.
depends on the extent to which updated cost and demand information could lead to a reconsideration of the timing and extent of investment.

The WEBs which accrue through increases in spatial density giving rise to greater productivity are relatively straightforward. These are measurable and have an accepted methodology based on measuring effective density using widely accepted econometric methods. This has been applied in the Australian context (e.g. Hensher, et. al., 2012). But there are other agglomeration economies which do not yet have accepted methodologies such as the benefits to individuals from making destinations closer for making non work trips. A difficulty for measuring WEB arises because the methodology of estimation is in its infancy.

Infrastructure Australia (IA) accepts studies on the WEB of projects, but treats them separately to traditional CBA. It provides advice on the preparation of such studies. This would appear to allow for a consistent treatment of WEB. The key here is full transparency which necessitates the open justification of the underlying methodology and assumptions. This acts as a significant constraint on poor decision-making and arbitrary, poorly constructed analysis to justify a favoured project. As there are limited resources for infrastructure procurement (like all procurement), the opportunity cost of choosing the wrong projects, or having the wrong scale, is significant.

The importance of well-conducted and transparent CBA is clear. Therefore an enhanced role for CBA in project selection is merited particularly where a government is the decision maker. Even so, there is the notorious, historic problem that estimates of costs and benefits for public infrastructure projects have been often overly optimistic.

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53 Infrastructure Australia (2013) Reform and Investment Framework Templates for Use by Proponents: Templates for Stage 7, Canberra.
54 Ibid.
Flyvbjerg documents the large differences often seen between *ex ante* and *ex post* estimates of costs and benefits for major infrastructure projects internationally. He concludes that “it is not the best projects that get implemented, but the projects that look best on paper.” These are the projects with the largest cost underestimates and benefit overestimates.

As an important aside, relevant to NSW in the decades of the 1990s and 2000s, is the actual implementation of CBA and the limitations of particular modelling. In the early 1990s with the RTA excelling in attracting political support for road projects, the SRA faced a number of major problems in presenting rail investment opportunities to the government. In completing CBA there were two major issues inherent in the assumptions used. First there was the issue that road projects had a higher value of time than rail projects. Rail projects had some of their benefits measured by highly subsidised and consequently very low fare levels. The overall CBA process was based on a thirty-year time horizon which started from the commencement of construction. Underpinning this assumption were the constraints of the computers in the 1980s - they could not cope with a fifty year timeline. As a consequence, large projects with prolonged construction but a long service life, like all rail MUTPs, were balanced against a diminished benefit stream caused by a short period of time and artificially lowered fares. In the mid-1990s, RailCorp scored an internal bureaucratic victory: there was established a common value of time between road and rail, but other factors remained unchanged. To cut a long story short, in March 2013 Transport for NSW (TfNSW) released a new manual which brought together the RTA road evaluation manual and the Railcorp equivalent.

With the rail case studies addressed in this Thesis, projects were assessed based on forecasts from the government’s own transport forecasting model. These forecasts, especially in the earlier years, had a number of basic faults. Chief

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56 I am grateful for insights and knowledge from the late Barry Garnham, the former senior Railcorp official who is mentioned in the Introduction, in this and the next paragraph.
among these was the fact it could not show rail improvements as attracting patronage from car users. All increases were either from bus or from other rail services. There was also a 20-minute penalty for anyone changing trains, regardless of frequency or ease of change. Some of these features of the Sydney Strategic Transport Model were improved in the past decade, with transparency adopted.\textsuperscript{58} Even so, relevant to the case studies addressed in Chapters 4 and 5, the deficiencies in the software importantly include the inability to have shifts between the peak and off-peak travel when prices change and that land use is treated as fixed.

The other big drawback to the government’s model was that it could not forecast increased commercial activity nor population changes that result from transport investments. For example prior to 2013, the assessment of, say, the Western Express (or Western FastRail) meant that Railcorp’s transport software model could not adequately estimate increased employment in Western Sydney with its consequential benefits including additional patronage from those investments. It only worked from the population forecasts ex-ante any investment, not ex-post.

Thus in this context, CBA became a blunt instrument that rarely favoured rail in the period under review.

As indicated, appropriate treatment of risk in CBA is necessary to counter optimism bias. In essence, this means ensuring that the costs and benefits used are expected values based on the probability of different outcomes, and that the relevant discount rate is appropriate for the project. Another aspect of dealing with risk and uncertainty is recognising that better information may become available over time. For example, waiting a year to more thoroughly research a project may allow uncertain variables to be modified by more accurate

\textsuperscript{58} The software underpinning this modelling was initially based on the government’s internal assumptions. The model and assumptions were eventually publicly released. The secrecy at first made comparison between projects, particularly by outsiders, hard to impossible to do - perhaps to the satisfaction of those privileged to the exclusive use of this methodology. Nowadays, the code of the software is not publicly available but there are technical descriptions available such as included on the NSW Bureau of Transport Statistics (BTS) (formerly Transport Data Centre) website, \url{http://www.bts.nsw.gov.au}, which carries these documents. Bendall, Kirk, & Xu, Min (2010) Creating Public Transport Networks for Strategic Transport Modelling from Electronic Timetable Data’, paper delivered at the 33rd Australasian Transport Research Forum Conference, Canberra, 29 September - 1 October.
calculation. This can improve estimates of the benefits of proceeding with a transport infrastructure project. There can also, however, be a cost of delay.

2.3 Means of Delivering a Project

Having discussed ways MUTPs go wrong and the employment of CBA to assist in the estimating of project risk and potential success, this leaves the ground clear to traverse the various means of delivering a project.

First, it is useful to highlight traditional and long-term concessions as a major focus by government in risk transfer to the private sector.

Figure 10 below provides a summary of key differences between the concession model and the traditional model.

<table>
<thead>
<tr>
<th>Figure 10: Long Term Concession versus Traditional Road Funding Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Issue</strong></td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Funding source</td>
</tr>
<tr>
<td>Procurement process</td>
</tr>
<tr>
<td>Cost overruns</td>
</tr>
<tr>
<td>Schedule slips</td>
</tr>
<tr>
<td>Traffic risk</td>
</tr>
<tr>
<td>Maintenance funding</td>
</tr>
<tr>
<td>Maintenance incentive</td>
</tr>
</tbody>
</table>

*Source: Author’s private research*

One obvious question provoked by this discussion is what happens in a concession project, if the investors’ miscalculate and the project ends up with significant cost overruns and/or significantly less usage than estimated? A good example of just such an outcome is the Channel Tunnel between the United Kingdom and France. Developed privately under a PPP 55-year concession agreement reached with the two governments, the ‘Chunnel’ opened in 1994, several years late and 80 per cent over its original budget. Six years in operation, traffic numbers had reached only 43 per cent of the original estimate.
for its opening year.\textsuperscript{59} This ranks alongside the Big Dig as a mega project debacle.

Unlike the Big Dig, where taxpayers footed the bill for enormous cost overruns, the lower revenues and higher costs of the Channel Tunnel were borne entirely by the private investors (mostly European banks and approximately a million individual shareholders). Nevertheless, the project had to be refinanced, with the banks taking a significant 'haircut'.\textsuperscript{60} The share price plunged to a few percent of what it had been in the project’s buoyant, earliest days. The only relief offered by the two Euro governments was to extend the life of the concession, so that the investors, over a very long period of time, would have some possibility of receiving an eventual, if significantly discounted, return on their investment.

Another example is Sydney’s Cross-City Tunnel. Intended to reduce congestion on major downtown streets, the four-lane, 2.1km, $AU680m ($AU942.01m in 2015 figures) project opened in 2005, attracting only one-third of the originally forecast traffic.\textsuperscript{61} By the end of 2006 the concession company went into administration. At that point a syndicate of creditors appointed a receiver, which took control of the tunnel project to keep it in operation while the finances were sorted out.\textsuperscript{62}

Despite financial difficulties, the project usually remains in service, meeting transportation needs. In some cases the original company may go bankrupt and the assets purchased by new owners (sometimes with the approval of the government agency that is a party to the concession). By purchasing the asset at


\textsuperscript{60}In debt restructuring agreements, a haircut is a percentage reduction of the amount that will be repaid to creditors. See, ‘Definition of a Haircut’, \textit{Financial Times}, http://lexicon.ft.com/Term?term=haircut.

\textsuperscript{61}OMEGA Centre (2009d) \textit{Sydney Cross City Tunnel}, OMEGA Centre for Mega Projects in Transport and Development, Bartlett School of Planning at University College London, and the Australasian Centre for the Governance and Management of Urban Transport (GAMUT), University of Melbourne.

a fraction of the original cost, the new owners hope to operate it in a financially sustainable manner.

Although the case Flyvbjerg and others make for using the concession approach for transportation mega projects is a strong one, even here spectacular cost overruns and estimating errors are possible – and happen. Once rosy assessments asserting that “experience has shown that the private sector can and will take on those risks under well-drafted concession agreements”63 is a proposition requiring revisiting, including because the cost of equity and debt post the GFC has risen considerably.64

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attracting 95 to 125bps over LIBOR, whereas the Pennsylvania Turnpike required over 40% equity with debt more steeply priced at around 225bps above LIBOR.

With MUTPs and indeed most complicated projects, post the global financial crisis (GFC), the increased cost of equity and capital have increased project costs and thereby put increased pressure on the financial viability of projects. Figure 11 illustrates this point with reference to US tollroad experience. The story in Australia is similar. In part this reflects the problem that the past, pre-GFC, pricing of risk of certain MUTPs was inadequate and that capital providers now price the value of risk more prudently.

Because of their complexity, mega projects are inherently risky. Accordingly, Flyvbjerg’s proposition is that good public policy allocates risks to the parties best able to handle them, with financial incentives for success and dire consequences for failure. Governments, however, have become concerned that the private sector’s willingness to bear the demand risk and to a lesser extent the cost risk associated with major projects may have been substantially reduced by adverse experiences (for instance, with Sydney’s Cross-City Tunnel), and by the global financial crisis (GFC). As Figure 11, above, indicates, since the GFC the cost of capital has increased, risk is priced more expensively by lending institutions, and more than before, partial government financing may be essential to get a project over the line.

Large infrastructure projects have a poor record of meeting their expected outcomes of costs and demand. They are risky due to the long lead times before delivery and because most such projects have high technology and construction

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65 The beginning of the GFC is usually dated from when the financial services firm Lehman Brothers filed for Chapter 11 bankruptcy protection on 15 September 2008 in the United States. But the prime mortgage crisis had begun in August 2007 and for over a year there was the unraveling of financial markets, which culminated in Lehman’s collapse. For a useful overview, see: Burkhanov, Umar (2011) ‘The Big Failure: Lehman Brothers Effects on Global Markets’, *European Journal of Business and Economics*, Vol. 2., pp. 17-20.

66 As equity ranks below debt and requires a higher return, the more equity required for a project, the more expensive it is to fund. For a general discussion, Galbraith, James K. (2014) *The End of Growth*, Simon & Schuster, New York, pp. 171-187.

risks. Long lead times add to the inherent uncertainties of forecasting demand, while technology risks often result in delays in implementation and cost overruns. There is now extensive international research into the post-implementation performance of major infrastructure projects, notably by Figure 12: Forms of Public Infrastructure Provision

**Construct only:** Government retains responsibility for the design of the infrastructure, and contracts a private party (through tender or other process) to construct the facility. An example is the Epping to Chatswood Rail link.

**Design and construct/maintain:** Government contracts a private party to design (based on a design brief from government), and construct an infrastructure facility and might also contract that party to maintain the facility.

**Managing contractor:** Government engages a private party as head contractor to manage, and coordinate the designs, and construction works on its behalf. The contractor engages sub-contracting third parties, and typically accepts some delivery risks. The M5 East extension is an example.

**Alliance contracting:** Government engages with one or more private parties (for example, a designer and constructor) to share the risks (benefits and costs) and responsibilities of delivering an infrastructure project. An alliance contract essentially turns a project into a joint venture. This is rare in MUTPs. The expanded Cotter Dam in Canberra (opened in 2013) is an example in the water sector.

**Public-private partnership:** A PPP is a contract between the public and private sectors where the private party delivers infrastructure, and associated services over the long term. PPPs generally include private financing where the private party is set up as a consortium using project financing through a special purpose vehicle, although the private party is not limited to this form, and can be set up under a number of structures, including as a subsidiary of a company (where the project is financed from the company’s balance sheet), a joint venture, or a trust. PPPs may be delivered through a variety of models including where the private party designs, builds, finances and operates (DBFO) the infrastructure facility, or designs, builds, finances, and maintains (DBFM) the facility for a period before transferring it to government or owning it indefinitely. Other PPP models are used, including build-own-operate (BOO) and build-own-operate-transfer (BOOT). PPPs may be government funded through contractual payments from government (for example availability payments), directly funded through a user pays mechanism (sometimes called a concession), or a combination of the two.

**Concession:** Government grants a private party the right to use, and invest in a public asset on the understanding or with a contract to build an unrelated (or partially related) infrastructure project.

**Private provision (with or without regulated prices):** A private firm identifies a project, and finances it from private sources. Often this is to expand or extend infrastructure previously owned by a government. The asset may or may not be subject to economic regulation.

*Source:* Author’s research and Infrastructure Australia (2008b) *National PPP Guidelines.*
Flyvbjerg and colleagues. There has been no improvement in performance over the past thirty years. Hence the financial performance of many large-scale infrastructure projects has been poor and the costs to governments and to private investors consequently high. Once built, major infrastructure usually cannot be demolished, even after bankruptcy of the project financiers. With the passage of time, they become permanently established as demand builds up and initial problems fade from public memory. This may partly account for the apparent lack of learning from past experience. There are lessons, however, from the past worth learning, including the increasing reluctance of the private sector to take on risks considered too difficult to manage. Consequently these risks tend to shift back to the public sector. Major infrastructure projects frequently attract a strong lobby of interest groups to support them. These lobby groups have an interest in promoting projects by means of optimistic forecasts. Another factor limiting the ability to learn from the past is that some types of projects attract public and political support on the basis of apparent strategic benefits that success would bring, without proper consideration of risks or the reality of those benefits. Whatever the method of delivery, Figure 12, above, setting out the main delivery modes, transport infrastructure projects often exhibit these features. Rail projects are particularly prone to optimistic forecasting bias and have a poor record of implementation. The research already noted by Flyvbjerg, summarised in Figure 6 above, found that the average error in the traffic forecasts in rail was considerably greater than the sample of road projects examined. On average rail schemes experienced a 45 per cent cost overrun which has meant that rail schemes have generally failed to meet expectations. The very poor performance of rail projects is partly because they often involve solving unique technical and engineering challenges. The market for rail travel is more complex to forecast because it is influenced by a mixture of commercial and public interest influences and by competition with road transport.

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Flyvbjerg et. al. considered various explanations for the scale and consistency of this optimism bias that systematically overestimates the chances of success for major transport projects. Some of it can be explained by the inherent uncertainty in forecasting, including technical weaknesses in data and modelling. There are also psychological factors leading to delusional optimism and herd mentality. The activities of vested interests and lobby groups representing those expecting to gain from major projects have a significant influence. Incentives on politicians may tend to favour optimistic expectations of success. Political and economic pressures influence the work of project planners. The extent and impact of these various influences are hard to disentangle. There is sufficient evidence of the systematic nature of the bias that occurs, as well as case study evidence from the experience of specific projects, to recognise the relevance of these factors. Flyvbjerg et. al. made recommendations about how to offset optimism bias in project appraisal. They identified a real problem: “There is a paradox here... At the same time as many more and much larger infrastructure projects are being proposed, and built around the world, it is becoming clear that many such projects have strikingly poor performance records in terms of economy, environment, and public support.”

Moreover, in consequence, the cost-benefit analyses, financial analyses and environmental and social impact statements that are routinely carried out as part of megaproject preparation are called into question, criticised and denounced more often and more dramatically than analyses in any other professional field we know. Megaproject development today is not a field of what has been called “honest numbers”. It is a field where you will see one group of professionals calling the work of another not only “biased” and “seriously flawed” but a “grave embarrassment” to the profession. And that is when things have not yet turned unfriendly. In more antagonistic situations the words used in the mudslinging accompanying many megaprojects are “deception”, “manipulation” and even “lies” and “prostitution”. Whether we like it or not, megaproject development is currently a field where little can be trusted, not even – some would say especially not – numbers produced by analysts.

71 Ibid., p. 5.
This is to return to the now familiar critique of MUTPs as beset by quackery, naivety, risk mispricing, and mismanagement. Flyvbjerg’s case surely requires more than a ‘punch and judy’ portrait of bad behaviour and suspect motives. This Thesis aims to link the critique of MUTPs with a view of risk management and management competence that suggests that a TRO fits with a management theory that integrates all those factors. With MUTPs in Australia, there is always a principal-agent issue. The next section of the Chapter addresses that question because it is vital to project implementation.

The Principal-Agent Issue

Investments in public infrastructure can be characterised as a principal-agent relationship, where the government is the principal, the owner of the infrastructure or the purchaser (sometimes funder) of infrastructure services, and the private party is the agent (for example, a construction or operating company or a consortium under a PPP). In practice, principal-agent relationships in public infrastructure projects are more complex than in the private sector. For example, the government is itself the agent for the community (which can be likened to the equity holders of public infrastructure). Also a public agency, such as Railcorp or the RTA, is an agent of the government. There may also be principal-agent relationships within private party PPP consortia. For example, construction and operating companies are agents for the private party sponsor which contracts with government.

Principal-agent relationships are typically assumed to be motivated by efficiency gains from comparative advantage. The definitive paper on the principal-agency problem was penned by Jensen and Meckling (1976). An agency relationship is “a contract under which one or more persons (the principal(s))

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engage another person (the agent) to perform some service on their behalf which involves delegating some decision-making authority to the agent.”75 Principals delegate to agents because they lack the time and/or the expertise, at least in a comparative sense. Having so delegated, principals face a dilemma: “there is good reason to believe the agent will not always act in the best interests of the principal.”76 The resulting challenge “of inducing an agent to act in the principal’s welfare” exists at every level of “management in firms, in universities, in mutual companies, in co-operatives, in governmental authorities and bureaus, in unions ...in the performing arts and the market for real estate.”77

Agency cost is the difference between the potential benefit the principal would receive if the agent performed the task completely in the principal’s best interests, and the actual benefit the principal received. Common sources of agency costs include over-servicing (where unnecessary services are charged for), ‘shirking’ where agents fail to do the best possible job, and rent-extraction where agents capture some of or all the surplus. Jensen and Meckling, who emphasise that “[a]gency costs are as real as any other costs,”78 propose market-driven ways of reducing them.

The main tools for reducing agency costs are ‘bonding’ (including contracting), and ‘monitoring’, both of which are costly and leave principals facing a trade-off between those costs and agency costs. Because no contract can cover every contingency and no monitoring can cover every action, principals generally accept some modest remaining ‘residual’ as the (extra) cost of delegating to an agent. Ideally, agency costs will be reduced to the point where any further reduction reduces the net benefits received from the agent’s services. Two not unexpected barriers hinder the assessment of residual cost, both of special relevance to transport planning. First, hidden actions occur when the principal cannot observe and hence cannot monitor the agent’s efforts because it is either prohibitively expensive to do so or because the efforts are contaminated by ‘noise’. Second, hidden information occurs when the agent has superior

75 Ibid., p. 308.
76 Ibid.
77 Ibid., p. 309.
78 Ibid., p. 357.
information. This is an eternal problem in investment environments where informational asymmetry is ubiquitous and potentially leads to failure of the price-discovery mechanism.\textsuperscript{79}

Agency costs can be expected to be high where these hidden barriers are high, such as with MUTPs. Agency costs can be expected to be low where hidden barriers are low, as they should be where open transparency and full disclosure rules apply. In principle these should so inhibit agents that only minimal residual agency costs remain.

It is common for agents to fail the impractical standard of acting 100 per cent for the principal’s interest. The agents tend to support decisions, activities, products, strategies or comments that are self-interested (such as to those to whom loyalty is owed within the agent’s organisation) rather than those of the principals.

Principal-agent arrangements typically involve asymmetric information, where one party has more information about certain risks than the other. For example, the government may not be able to determine the reasonableness of an agent’s claim for costs associated with construction or operation of an infrastructure service. The competence and experience of authorities to monitor and enforce PPP contracts in design and delivery is crucial to their role in managing agents. The agent may also pursue its own interests - for example, if they reduce costs at the expense of the quality of the service - which may run contrary to the interests of the principal (and consequently the community).

Figure 13 highlights four key life cycle stages of a major project and draws attention to agency issues. In the planning phase, the sponsor, usually government with a MUTP, considers the need for and requirements associated with a particular project. A potential agent, say a private sector party, might lobby for or argue with government as to the merit of the proposition. If subsidies or funding are provided by government, there is the potential of conflict and the potential of blurring the principal/agent roles. In the acquisition of land, say

required for the project, government is intricately involved. In the operation and maintenance, this might be for a long term concession at agreed tolls, with the asset ultimately returned to government at the end of the concession period. Disposal or renewal or replacement of the asset might cause the whole process to be reinitiated – new tender(s). The monitoring, performance, and management of a project covers a host of factors, including contractual arrangements, the anticipated, expected, and actual consequences of new infrastructure.

Lack of clarity by government as to the objectives to be pursued can be destructive – of trust and efficient outcomes, broadly considered. Principal-agent problems reduce the efficiency benefits of private sector involvement. The challenge for government is to select the delivery model that best addresses these problems and enables risk to be allocated at an acceptable price, in a way that aligns with each party’s incentives. Equally important is the design and enforceability of
contractual arrangements that allocate risks between parties and the role of contestability in procurement. Contracting with the private sector for the delivery of public infrastructure can be thought of as a repeated game, which can be influenced by the level of trust between the client and the private contractor. Ironically, where governments act secretly, refusing to reveal information to the wider public domain concerning a MUTP, by for example shielding access to a CBA study, this is likely to contribute to their own difficulty of monitoring and controlling costs of a project.

The second section of Chapter 3 discusses risk issues in detail. But for the moment, the schema below flags the risk dimensions under varying procurement delivery models. A key aspect of the assessment of value for
money relates to the way project risks are allocated between parties. Delivery models vary in their ability to scope and allocate risks (Figures 14 and 15). An argument for the risk premium being higher for the private sector is that here risk is costed on a project-by-project basis. In the public sector, certainly when more projects were undertaken only by the public sector, the argument was shared over all the projects and so, on average, could be lower. But this was only one consideration. The key point is that the delivery model needs to be appropriate to the types of risks the particular project is likely to face in practice.

Figure 15: Main Cost Elements of a Major Project


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Work practices, expertise in containing costs are amongst other important factors relevant to whether the actual risk premium in the public sector is “lower”. It depends on particular circumstances, expertise, and “the project”.

Contracting models, such as design and construct, or construct only models, enable construction risk to be transferred to the private party but do not enable risk transfer during the operational phase. On the other hand, PPP models can be an effective means of transferring project risks to the private sector.

Costs generally can be divided into those incurred prior to the construction phase (including approval, bidding and design costs); the input costs (direct and indirect) of construction, and those costs incurred following the construction phase (for example operation and maintenance costs). Figure 15 illustrates the main cost elements of a major project.

| Figure 16: Lend Lease’s Comparison of Rail Project Costs in Remote and Built-up Areas |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Cost per km $AU/m               |                                |                                |                                |                                |                                |
| Cronulla Duplication NSW        | 50                             | 75                             | 100                            | 125                            | 150                            |
| Richmond Line Duplication NSW   |                                |                                |                                |                                |                                |
| Kingsgrove Revesby Quad NSW     |                                |                                |                                |                                |                                |
| Southern Sydney Freight Line NSW|                                |                                |                                |                                |                                |
| South West Rail Link NSW        |                                |                                |                                |                                |                                |
| South Morang Rail Extension VIC |                                |                                |                                |                                |                                |
| Regional Rail Link VIC          |                                |                                |                                |                                |                                |
| Moreton Bay Rail Link Qld       |                                |                                |                                |                                |                                |
| Corinda to Darra Qld            |                                |                                |                                |                                |                                |
| Robina to Varsity Lakes Qld     |                                |                                |                                |                                |                                |
| Caboolture to Beerbunum Qld    |                                |                                |                                |                                |                                |
| Salisbury to Kuraby Qld         |                                |                                |                                |                                |                                |
| Helensvale to Robina Qld        |                                |                                |                                |                                |                                |
| Metrorail Perth WA              |                                |                                |                                |                                |                                |
| Joondalup line extension WA     |                                |                                |                                |                                |                                |
| Noarlunga Seafood line extension SA |                            |                                |                                |                                |                                |

Source: Lend Lease (2014) PC sub. 46, p. 22.

Land costs influence the choice of construction technique used to deliver infrastructure and may lead to costly solutions such as tunnelling and viaduct construction — as seen in Sydney’s Epping to Chatswood project, the Airport Rail link, the M2, the CCT, and the LCT. Building in highly urbanised environments requires measures to be taken to minimise the disruption caused to the use of existing and interconnecting infrastructure. Such measures come at some cost,

such as determining when construction can take place (for example, works are conducted at night) and at what rate. Lend Lease has shown that the construction costs of rail projects, in different Australian locations, varies vastly. Figure 16 underscores that conclusion. The reasons are complicated but provide scope for evaluating lessons from past experience.

As a general principle, there is a need to ensure that the resort to expensive techniques takes place only after all other alternatives are exhausted. Thus, in the detailed design of a project, the generation of options such as tunnel and overground phases of a project need to be accurately estimated to minimise construction costs. The thinking through of options – and timing - should include detailed consideration of the enhanced use of existing infrastructure, possibly in combination with pricing instruments and consideration of cheaper construction alternatives.

2.4 Project Management

Successful management of construction projects requires knowledge of modern management, as well as an understanding of the design and construction process. Construction projects have a specific set of objectives and constraints such as a required time frame for completion. While the relevant technology, institutional arrangements or processes differ, the management of such projects has much in common with the management of projects in other specialty or technology domains such as aerospace, pharmaceutical, and energy. As noted in Chapter 1, in those industries the use of real options is common.

Project management is distinguished from the general management of corporations by the mission-oriented nature of a project. Usually, a project organisation is terminated when the mission is accomplished. Hopefully, however, a core expertise develops within a sponsor organisation (such as in the RTA and the rail infrastructure procurement authority), that means that learnt experience is available for the next project.

The basic ingredients for project management are represented schematically in Figure 17 below which reflects the sources from which the project management framework evolves.
According to the UK Project Management Institute:

Project management is the art of directing and co-ordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality, and participation satisfaction.\(^{84}\)

In contrast to the discipline of project management and the general management of business, industrial corporations assume a broader outlook with greater continuity of operations. Nevertheless, there are sufficient similarities as well as differences between the two so that modern management techniques, developed for general management, are adaptable to project management.

In construction, project management encompasses a set of objectives able to be accomplished by implementing a series of operations subject to resource constraints. There are potential conflicts between the stated objectives with

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regard to scope, cost, time, and quality as well as the constraints imposed on human material and financial resources. These conflicts are resolvable at the outset of a project by making the necessary tradeoffs or creating new alternatives. This is to conceive matters in the sense of the exercise of real options. The functions of project management for construction generally include: a) specification of project objectives and plans including delineation of scope, budgeting, scheduling, setting performance requirements, and selecting project participants; b) maximisation of efficient resource utilisation through procurement of labour, materials, and equipment according to the prescribed schedule and plan; c) implementation of various operations through proper coordination and control of planning, design, estimating, contracting, and construction in the entire process; and, d) development of effective communications and mechanisms for resolving conflicts among the various participants. Stating matters in this way reveals that every construction project is a complicated exercise in resource, risk, and people management.

Implementation can involve hundreds of decisions in project delivery on a daily basis. MUTPs are even more complicated, many degrees more so. This fact is under-appreciated in the MUTP literature. For the gravest errors and mistakes in such projects are usually failures of project conception and management. The UK Project Management Institute focuses on nine distinct areas requiring project manager knowledge and attention. First, project integration management to ensure that the various project elements are effectively coordinated. Second, project scope management to ensure that all the work required (and only the required work) is included. Third, project time management to provide an effective project schedule. Four, project cost management to identify needed resources and maintain budget control. Five, project quality management to ensure functional requirements are met. Six, project human resource management system that effectively develops and employ project personnel. Seven, communications management to effectively manage internal and external project communications. Eight, project-risk management to analyse and mitigate potential risks. Finally, project procurement management to obtain necessary resources from external sources.

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These nine areas form the basis of the Institute’s certification program for project managers in any industry.

Success in a major project represents mastery over myriad problems and their solution. Sustainable competitive advantage stems primarily from good management strategy. The Porter theory (1996) is that: “Strategy is creating fit among a company’s activities. The success of a strategy depends on doing many things well - not just a few - and integrating among them. If there is no fit among activities, there is no distinctive strategy and little sustainability.” On this view, integration of an array of activities requires project managers to be aware of the strategic position of their own organisation and of the other organisations involved in a project. The project manager faces the task of trying to align the goals and strategies of these various organisations to accomplish the overall project goals.

Strategic Planning and Project Programming

Once a decision is made to initiate a project, political and market pressures may dictate the timing of completion.

In order to gain time, some managers are willing to forego thorough planning and feasibility study so as to proceed with inadequate definition of the project’s scope. In practical terms, such ‘short-cutting’ is the exercise of an option to rush through a project on the optimistic assumption that the main risks are known, and that the potential costs parameters are within a tolerable range. But as noted in the earlier discussion, such a view might be contaminated by what Flyvbjerg calls optimism bias.

Invariably, changes in project scope - sometimes caused by rushing a project in the design phase - increases construction costs. Sometimes, however, profits derived from the earlier delivery of an operation can justify these increases. This is rarely the case for public transport projects. But theoretically, say with a well-conceived tollroad, starting and finishing early might be financially rewarding. (Tolls start the cash rolling in ahead of original projections, for example.)

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Generally, if the concessionaire or the owner can derive reasonable profits from the operation of a completed facility, the project is a success, even if construction costs exceed the estimate based on an inadequate scope definition. The risks and the response to such risks may be attributed in large part to the uncertainties inherent in construction projects. Figure 18 underscores this point.

**Figure 18: Ability to Influence Construction Cost Over Time**

![Diagram showing the ability to influence construction costs over time](image)


The project sponsor holds the key to influencing the construction costs of a project, because any decision made at the first stage of a project’s life cycle has far greater influence than those made at later stages, as shown schematically in Figure 18, above. This point highlights the principal-agent problem. The sponsor might be the government, but the agent – the private sector party engaged to do the work – becomes the key party after the award of a project. Design and construction decisions influence the continuing operating costs and, in many cases, the revenues over the facility’s lifetime. Therefore, a sponsor or owner should obtain the expertise of professionals to provide adequate planning and feasibility studies. Where a sponsor does not maintain an in-house
engineering and construction management capability, there is the requirement of establishing an ongoing relationship with outside consultants in order to respond quickly to requests for information and decisions.

The initiation and execution of capital projects places demands on the resources of the sponsor or the owner, as well as the professionals and contractors to be engaged. For very large projects, it may bid up the price of engineering services as well as the costs of materials and equipment, and the contract prices of all types. Consequently such factors ought to be taken into consideration in determining the timing of a project and, potentially, the option to proceed in whole or in part.

While a successful project manager must be a good leader, the members of the project team must also learn to work together, whether assembled from different divisions of the same organisation, or from different organisations. Some problems of interaction may arise initially when the team members are unfamiliar or uncertain about their roles in the project team - particularly so for large and complex projects. These problems must be resolved quickly in order to establish an effective, functioning team.\(^\text{87}\)

Construction projects require successful interventions by thousands of disparate individuals, groups, and organisations. The fundamental challenge is to enhance communication among them so that obstacles impeding inter-personal relations are removed or at least minimised so as to be containable. Inter-personal clashes are often the sources of serious communication difficulties among participants in a project. For example, members of a project team may avoid each other and by doing so withdraw from active interactions about differences that need to be dealt with. They may attempt to criticise and blame other individuals or groups when things go wrong. They may resent suggestions for improvement and become defensive to minimise their own culpability rather than take the initiative to maximise achievements. All these actions are detrimental to project organisation.

While these problems can occur with individuals in any organisation, they are compounded if the mega project team consists of individuals put together from different bodies. Invariably, organisations have their own particular cultural dynamics or modes of operation. Individuals from different groups do not have a common loyalty and left unattended may expend their energy in the directions most advantageous to themselves instead of the project team. A project team does not work harmoniously just because its members are placed physically together in one location. On the contrary, it must be assumed that good communication is achieved only through the deliberate effort of the management of each organisation contributing to the venture.

Perceptions of Owners and Contractors

These points are sufficient to emphasise the reality that mega transport projects are projects – complicated exercises in project management. Although owners and contractors may have different perceptions of project management for construction, they have a common interest in creating an environment that produces a successful project in which performance quality and completion time occur so that final costs are within prescribed limits and tolerances.

One study in the context of a large construction project in Thailand evaluated KPIs as perceived by various stakeholders (client, consultants, and contractors). The findings indicate that the iron triangle criteria (on-time, on-budget, and according to specifications) are important but not decisive in measuring project success. Other performance indicators such as safety, efficient use of resources, effectiveness, satisfaction of stakeholders, and reduced conflicts and disputes, are also important.88

Generally, the key factors cited for successful projects are a) well defined scope; b) extensive early planning; c) good leadership, management, and first line supervision; d) positive client relationship with client involvement; e) proper

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project team chemistry; f) quick response to changes, and, g) engineering managers concerned with the total project, not just the engineering elements.\(^{89}\)

Conversely, the key factors cited for unsuccessful projects are a) ill-defined scope; b) poor management – including poor leadership with unanticipated problems and problem-solving; c) poor planning; d) breakdown in communication between engineering and construction; e) unrealistic scope, schedules, and budgets; f) many changes at various stages of progress; and, g) lack of good project control.\(^{90}\)

Such points are particularly relevant to the Sydney experience with MUTPs, addressed in Chapters 4 and 5. The governance of projects, both in their initiation and management, might arguably have profited from the formation of a Sydney Metropolitan Authority, so as to take a broad perspective, co-ordinating various government agencies. Such an Authority could have concentrated on three or four emerging projects each year, thereby galvanising the city to focus on merit, risks, and alternatives.\(^{91}\)

### 2.5 Concluding Comments

This Chapter has addressed the multi-faceted ways that MUTPs are conceived and are implemented. Focus is drawn to Flyvbjerg’s analysis on why most mega road and rail projects go horribly wrong – in cost blowouts and under-appreciation of risk and optimistic patronage and ramp up forecasts. Colossal, captivating, costly, complex, and controversial are words that characterize most such projects. The Big Dig is highlighted with side references to better performing projects. The calamities of poor performance call attention to ways of better management of projects, and management tools, such as CBA. The latter concept is critically analysed – including its origin and history with MUTPs. Its chief virtue is in highlighting the choices that need to be made in determining whether a particular project proceeds, is modified, is deferred or abandoned, and the potential quantifiable benefits that might accrue, one way or

\(^{90}\) Ibid.  
\(^{91}\) The argument for a Greater Sydney Authority is sketched in Easson, Michael (2014) ‘A Minister for Sydney’, *Daily Telegraph*, 21 March. This Authority might have complemented INSW’s more formal and considered assessments of projects.
the other. “To whom?” is one question Flyvbjerg raises as he suggests some CBAs are corrupted by special pleadings, impure assumptions, and miscast methodologies. Given that in the development of projects there can be an almost overwhelming bias in favour of doing ‘something’, being ‘positive’, the TRO usefully introduces and emphasizes the proposition that no project is – or ought to be – a certainty. They should all be considered as options, and the reasons for their progress, abandonment, or delay, rationally discussed. The discussion on the principal/agent conflict naturally fits into this narrative. Not all principals fully appreciate the risks associated with their decision-making. Management of projects is therefore key. Indeed the TRO operates as a high order management tool, which dovetails into the conception, delivery, and management of a MUTP.

Relevant to this Thesis, referring to real options, a 2014 submission by the Victorian Government to the Productivity Commission inquiry into public infrastructure observes that “[t]here is an emerging area of infrastructure planning that changes the traditional management of project contracts.”92 Governments frequently enter into contracts for ‘full’ project delivery. The authors, however, also observe that in the use of real options the investor retains flexibility to respond to systemic impacts beyond the control of the client or supplier. ROs could be exercised by government (as the investor) that deliver a different outcome to that anticipated in the business case, but which in the circumstances provide for a greater value for money outcome.

It is worth critically considering how this might be so with a MUTP. The insight is that there are considerable inherent risks attached to any mega project. Because systemic events impacting on a project include global/systemic shifts, quantum technology changes, unforeseen weather events, extraordinary industrial relations developments, unknown unknowns, and known unknowns, it is prudent to include flexibility in the delivery of a project, including stop/start/pause options along the way.

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Desirably therefore, the use of real options (with well-defined trigger points) ought to be planned in the business case and, if approved, documented as the investor’s options and/or ‘break points’ in the project contract. Real options are of particular interest for projects that have benefits, costs, and/or risks that are volatile or uncertain. In such cases, value can be created by designing and introducing investor flexibility - that is, options to potentially exercise during the contract period of detailed planning and also in the delivery stages.93

In a general sense, the exercise of a RO by the investor in response to such information is responsible and informed resource management. “It is a response to external (systemic) factors and not to the performance or non-performance of the project delivery stage.”94 But can the TRO assist in the conception and execution of MUTPs? This Chapter has explained what can go wrong with MUTP planning. In canvassing the merits of CBA as a tool to assist credible decision-making, in discussing the rudiments of project management, this leads naturally to consideration of the TRO as a tool in MUTP decision-making – the topic of the next Chapter.

93 Ibid.
94 Ibid.
3. Real Options (ROs) as a Tool for Understanding MUTPs

After tallying in the previous Chapter the various flaws and pitfalls of MUTPs and discussing the need for TRO to adapt and complement methods of project management, such that the latter is improved, this Chapter argues that ROs are essential tools for understanding and managing MUTPs. The Thesis advances a theory about ROs that creates new avenues both for academic research and for decision makers weighing the merit of MUTPs. This conception envisages that strategy development, policy design, implementation, and learning should not be seen as distinctly separate phases, but rather as a continuous process of mutual adjustment.¹

To recap, a RO confers the right but not the obligation to make a decision under uncertainty that can later be reversed or delayed. It is best seen as sequential flexibility such that a productive resource or asset can be designed, acquired, utilised, improved, or scrapped. For this idea to be meaningful, for option flexibility to be capable of real world exploitation, managers need to be attentive to the actual real options present in their operating environments. In thinking about transport planning, the concept of real options contributes to the visualisation, analysis, and utilisation of their flexibility platforms and opportunities.

The response to the research question – namely, how a TRO can assist in the conception and management of MUTPs - considers identifying reasons for and differences between decisions leading to MUTPs for the purpose of developing TRO as a foundation of planning. This Chapter outlines the argument encompassing how decision-making occurs in the development, assessment of competing alternatives, possible options, and the formation of momentum in achieving transport project approval.

After analysing in the next section the utility of real options for sponsors, proponents, and policy debate, the second section of this Chapter discusses real options in the context of risk assessment. In particular, the argument is advanced that TRO fits with a system of management excellence that enables parties to better grasp the opportunities to effectively realise MUTP development.

### 3.1 The Utility of Real Options

The utility of the claim for real option theory can be explicated by reference to other theories seeking to explain MUTPs, their conception, governance, and execution. As Flyvbjerg’s analysis of MUTPS is canvassed in earlier Chapters and as his theory is considered the benchmark for MUT analysis, it is merely necessary here to reference the earlier discussion. Generally, MUTP policy-making requires an integrated view with respect to the various alternative options, their possible consequences for transport system performance, and societal conditions for implementation.² The policy challenges are vexed. One might say that “transport infrastructure …provides crucial services, is a major force in society, and is the basis for planning investments in industry and trade. Furthermore, the presence or absence of transport infrastructure has a significant effect on economic growth.”³ So the real world policy implications are striking.

In framing the problem to be solved, it is important to note that problems are not born isolated and crying into the world. They occur in particular circumstances. The problems of transport planning are always in the context of an existing system of human settlement and population movement. As Clark (1968) wrote, transport is the maker and breaker of cities.⁴ Seen in this way, the issue is how to enable the efficient mobility of a population. Also relevant to an appropriate framework is the deleterious impacts of climate change. Taking that

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perspective into account is to radically galvanise transport planners to limit pollution outputs that threaten the planet. This is particularly appropriate with transport planning in the way one might consider the appropriate, ‘rational’ options. Navigating through MUTP decision-making is complex. The careful combining of policy commitment and political opportunism is typical of actors in pursuit of their objectives. Frequently, decision makers consider a range of options, including whether deferral is appropriate, until a time that more information becomes available. The evidence to be considered is whether superior decision-making occurs by those actors who pursue a particular course and consider simultaneously whether to invest in real options to enable facilitation of decisions that might be taken at a future time.

This is relevant to consideration of good governance with mega projects. From a review of the literature, Sturup regarded the problems of mega projects as:

... cost underestimation, benefit over estimation, selection of the ‘wrong’ projects, lack of strategic positioning of projects, and the dilemma of gaining community acceptance and approval. The solutions to these problems, greater community consultation, technical improvements to CBA, risk allocation in PPPs have failed to have a statistical impact on the problems. They exhibit a circular relationship between problem identification and proposed solution.5

The failures that plague NSW’s transport system seem to bear this out – noting the problems of governance. Indeed, bad decision-making concerning Sydney’s public transport has resulted in a system that leaves some capacity under-utilised, while struggling to provide the expanded and new services consumers need.

Morris and Hough (1987) define three rubrics of success with MUTPs: project functionality (does the project perform financially, technically or otherwise in the way expected by project sponsors?); project management (is the project on schedule, implemented according to budget and to technical specification?); and, the contractors’ commercial performance (did those who provide services profit commercially?).6 Flyvbjerg says: “We do not believe risk can be

eliminated from risk society. We believe, however, that risk may be acknowledged much more explicitly and managed a great deal better, with more accountability, than is typically the case today.” He argues for a more rigorous assessment of risk, and more nuanced understandings of the politics of the conception and delivery of mega projects. Although he suggests better methods of accountability and risk assessment, these are not expansively thought through solutions. This observation, however, is in no way to disparage Flyvbjerg’s immense contribution to economic, transport, and political literature associated with mega projects.

The Thesis discusses the management of public transport policy and priorities in the context of project delivery and management debates, including the significant issue of risk management, and does so in the context of case studies concerning particular projects. A core theme of this Thesis is that good governance is at the heart of good transport and urban planning. Governance is more than the process, weak and good, of how things get done. “[It is a]...term to describe a myriad of criss-crossing activities, institutions and processes.” Governance is about the rules that guide collective decision-making. It is multi-layered, socio-political, and deliberative. Good governance needs to answer three questions. How are priorities decided? Who gets to decide? And how are decisions enforced and delivered? Governance always involves disparate concepts and interests fighting it out. The TRO is meaningful in that context, for the idea is about not only whether to, say, commence a project, but also when and the ROs for delay, deferral, commencement, modification, and the need for good information in deciding to do something.

It is most useful to see governance illustrated in the context of a problem. Often the existence of a problem is itself disputed. Solutions involve a battle of

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institutional change. Existing institutional traditions inform the behaviour of particular actors and inter-personal competition, and cannot be ignored. So culture, habit, leadership, and rivalry are highly relevant. With major projects there are notable limits, such as the practicality of the scale of change needed to achieve a coherent realisation of aspirations. Some obstacles and unwelcome legacies need to be worked around. Particular constraints of historic built form matter. Patterns of urban development whose irregularity may be incompatible with any ‘systematic’ access and movement, even if there were the ability to bring it about, can be a bedevilling issue. Political tension between competing groups for corridor space, such as car users, pedestrians, cyclists, bus and coach passengers, taxis, goods, and servicing vehicles, are inherent in transport planning in an existing urban context.

A well-known concept is that developed by Bannister and Berechman on Economic + Investment + Political, policy and institutional = economic development. This theory posits that economic development occurs through the combination of an assessment of economic consequences and investment performance, together with political impetus. Nowadays, however, solutions cannot just be technically based, context free, such as in the days when transport planning equated to ‘predict and provide’. What to do in contemporary society has become extremely controversial. Where transport planning was once considered an area of considerable policy prowess, there is now considerable confusion as to what the right projects and priorities should be. This is a way of acknowledging several things, including that community voices, particularly environment lobby groups, are becoming more powerful and more divergent. Further, conflicts between government agencies on priorities are now more manifest. ‘What to do’ becomes increasingly contestable. Hence there is the need to be nuanced and nimble in the conception of a project, responding to criticisms and resolving problems. If the problems are insurmountable, then project death is inevitable.

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The Fallibility and Conditionality of Decisions

The outlook of the Thesis is consistent with the insight of Partridge who wrote about the dynamic and unpredictable aspects of planning of any sort:

Our political activity cannot accurately be represented as a deliberate approach towards a foreseen end, for events manipulate us as much as we manipulate them. Our policies and the ends we profess change from moment to moment as we are affected by the succession of events; it is not only that, taking account of the characters of certain social conditions, we formulate a policy, but it is equally the case that in attempting to put some policy into operation, we find out for the first time – and could not have found out in any other way – certain features and characteristics of our social environment, and the ends and policies we entertain are modified in consequence.\textsuperscript{13}

This analysis effectively argues that policy and implementation are not a matter of, \textit{ex cathedra}, deciding the ‘right’ course. Policy and implementation – and the revisiting of the original decision - always occurs in a dynamic environment, usually in a series of steps. This is consistent with the TRO. Real options, considered as conditional decisions, are inherent in all transport planning.

In fact, all our lives constitute a series of deliberate decision-making events. All decisions are exercises of options. To explain further, one can distinguish between hard and soft options. Between decisions that seek the immediate allocation of resources and action (hard), and those that defer a decision or seek to consider at a later point a course of action (soft). Both involve the exercise of a real option. A key variable is in the commitment of the proponent of a decision and the dynamic associated with deliberation on changes to that decision. This is essentially a Popperian view. In Popper’s book \textit{Objective Knowledge} (1972), he writes that all knowledge is uncertain.\textsuperscript{14} He sees hypotheses as searchlights to the evidence, arguing for a general tetradic schema as a description of the growth of theories:


\textsuperscript{14} Popper, Karl (1973) \textit{Objective Knowledge}, Oxford University Press, London, pp. 106-152.
P1 » TT » EE » P2.

Where ‘P’ stands for ‘problem’; ‘TT’ stands for ‘tentative theory’; and ‘EE’ stands for ‘(attempted) error-elimination’, especially by way of critical discussion. Popper aims to show that the result of criticism, or of error-elimination, applied to a tentative theory, as a rule, leads to the emergence of a new problem; or, indeed, of several new problems. Problems, after they have been solved and their solutions properly examined tend to beget problem-children: new problems, often of greater depth and ever greater fertility than the old ones: “This can be seen especially in the physical sciences; and I suggest that we can best gauge the progress made in any science by the distance in depth and expectedness between P1 and P2: the best tentative theories (and all theories are tentative) are those which give rise to the deepest and most unexpected problems.”

Popper’s schema can be elaborated in various ways; for example, by writing it as:

P1 » TTa » EEa » P2

P2 » TTb » EEb » P3

P » TTh » EE » Pn

Tentative theory “a” leads to attempted error elimination “a” which leads to new problem P2. In this summation, “n” equals all the potential number of tentative theories or error-elimination tests, and new statements of the problem. Stated in this form, the schema indicates that there should be proposed as many theories as attempts to solve some given problem, and that critical examination should follow each tentative solution. Anticipating that each gives rise to new problems, we might thus follow up those which promise the most novel and most interesting new problem: if the new problem, P2 say, turns out to be merely the old P in disguise, then we should note that our theory only manages to shift the problem a little; and in some cases this might be a decisive objection.

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15 Ibid., p. 287. See also: Easson, Michael (1975) ‘An Examination of Sir Karl Popper’s Political Philosophy with Reference to Popper’s Exposition and Critique of Marxism’, BA (Hons.) thesis in Political Science, University of NSW, Chapter 1.
to the tentative theory, TTb. This shows that error-elimination is only part of the critical discussion: the discussion of the competing tentative theories might compare them and assess them from many different points of view. The decisive point is always: how well does a theory solve its problems, that is, P1, P2, and onwards.

This outline shows immediate affinities with real options, conceived as conditional hypotheses to develop a course of action. Looking at ROs as embedded in the development of a major investment decision can be helpful. Smit and Trigeorgis (2001) argue that: “An option-like thinking framework helps when making strategic investments in complex infrastructure, such as airports, transport systems, energy supply systems and production plants.” All these instances are examples of complex products and systems. In transport planning, the relevant options include options to phase delivery (stage option), grow capacity (growth option), and switch the operational regime (switch option) – such as in capacity, including new rolling stock, or mode changes, such as from rapid bus transit to rail. Additionally, attitudes to risk by decision-makers plays a role.

**The RO Opportunity**

Lewis (1998) in *Why Flip a Coin* summarises good decision-making as identifying all reasonable actions, listing potential consequences of each and their utility; evaluating the probability that each action will lead to a given

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16 It is perhaps worth noting *en passant* Thomas Kuhn’s objections to Popperian theory. He argues that a paradigm shift (or revolutionary science) is a change in the basic assumptions, or paradigms, within the ruling theory of science. Anomalies - results a paradigm cannot explain - accumulate and eventually make the paradigm unsustainable. The science enters a new phase as a new theory comes to seem more plausible. Defenders of the old order, who cannot accommodate the change gradually die out and the new paradigm is left in control of the field. This analysis, putatively based on historical analysis, stands in contrast to the idea of normal science. Popperian theory, in contrast, is hypothesis based, requiring falsifiable tests. There is an on-going dispute in the philosophy of science on so-called rational and historical interpretations of scientific ‘progress’, of which Popper and Kuhn are the major antagonists. See, Kuhn, Thomas (1962, 1970) *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago, Second Edition, Enlarged, pp. 111-135, and more generally, Lakatos, Imre, & Musgrave, Alan (1970), editors, *Criticism and the Growth of Knowledge*, Cambridge University Press, Cambridge, which includes essays by Popper and Kuhn. For a devastating critique, see Franklin, James (2000) ‘Thomas Kuhn’s Irrationalism’, *New Criterion*, Vol. 18, No. 10, pp. 29-34.

consequence; and, choosing the action quickly which has the best expected outcome or positive contribution to a project. Apart from the emphasis on speed in making a decision, this is sensible advice. Each decision moment, however, should be guided by the facts, risks, and the aim of any potential action. Ultimately, forming the best judgement call should not be arbitrarily set by the clock. To say someone ‘makes decisions’ is often stated as a tribute. It is commonplace to say “any decision is better than no decision.” But this is manifestly untrue, except in the most trivial sense that excessive dithering and prevarication could represent muddled thinking. Better than any decision is a good decision, whether made quickly or with measured deliberation. Generally, strategy selection is contingent upon both the characteristics of the decision task and the characteristics of the decision maker.

We know that what decision-makers do depends on what issues and answers they focus their attention on. What they focus on depends on the specific situation and on how the organisation’s rules, resources, and relationships distribute various issues, answers, and decision-makers into specific communications and procedures. Traditional approaches to project valuation are based on discounted cash flows (DCF) analysis which provides measures like net present value (NPV) and internal rate of return (IRR). DCF-based approaches, however, exhibit two major pitfalls. One is that DCF parameters such as cash flows cannot be estimated precisely in the uncertain decision making environments. The other one is that the values of managerial flexibilities in investment projects cannot be exactly revealed through DCF analysis. Therefore, as outlined in the earlier Chapters, the methodological challenge is to incorporate project valuation under uncertainty and the value of flexibilities embedded in a project.

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The TRO is a relatively new concept. Only infrequently are there references in the MUTP literature to this or to economic theories of ‘robustness’. Robustness characterises a model’s, test’s or system’s ability to effectively perform under stress while its variables or assumptions are altered. The concept relates to both statistical and economic contexts. In statistical terms, a test is robust if despite having its assumptions altered or violated it still provides insight to a problem. In economics, robustness is attributed to financial markets that continue to perform despite alterations in market conditions. In general, being robust means a system can handle variability and remain effective. A robust concept can operate without failure under a variety of conditions. Some recent literature refers to decision-making in circumstances of uncertainty and complexity. In the analysis proposed here, potentially there is an original and useful methodology as to what merits consideration in the development of a project. Following Barnett, we can say that real option decision-making can be defined as encompassing a project leader’s ability to notice, maintain, champion, and exploit real option opportunities in their business environments.\textsuperscript{22} RO analysis presents an alternative methodology to straight-line decision-making or decision tree analysis or like theories, taking into account managerial flexibility, such as responding to change or a new situation in business conditions.\textsuperscript{23} But a problem with RO analysis is that although it brings to the surface new factors for analysis, they cannot easily be analysed because RO models, as originally envisaged by Black/Scholes/Merton, are typically and strictly quantitative, whereas major transport investment decisions typically experience both tangible and intangible factors. The gist of the methodological dilemma is this: “Bayesian models require that the hypotheses be precisely formulated, and thus they could not be applied to option generation.”\textsuperscript{24} Even so, notwithstanding the difficulty of precisely calculating the value of ROs, it is plausible that a manager would ascribe a higher value to a project with several embedded options than an entirely inflexible programme.

In this respect, the research underpinning the Thesis leads to the examination of the management of transport policy and priorities in the context of debates on why certain projects are chosen, and the merits associated with a particular choice. With complex MUTPs decision-makers are confronted by uncertainty. Their strategies need to take the strategic behaviour of other actors into account. The ability to shape the future is limited by the extent to which external developments (such as the strategies of other actors but also exogenous developments) can vary. And it is enhanced by coherent actions of a range of key decision-makers in research, policy, economy, and society.

The insight is that when a situation involves great uncertainty and managers need flexibility to respond, then ROs are an essential tool. The standard theory of decision-making under uncertainty advises the decision maker to form a statistical model linking outcomes to decisions and then choosing the optimal distribution of outcomes. This assumes that the decision maker completely trusts the model and its inputs. But what should a decision maker do if the model cannot be trusted – due to uncertainty or complexity? Hansen and Sargent, two Nobel Prize economists, have developed a theory of ‘robustness’ to let decision makers acknowledge mis-specification in economic modelling, arguing about the variety of problems in dynamic macroeconomics and complexity, in aiming to improve the robustness of decision-making processes.

Another side to the complexity of decision-making is the Collingridge dilemma, which was coined in the context of innovation in information technology. This is the methodological quandary in which efforts to control systematic technology development face a double-bind problem: (a) with an information problem the impacts cannot be easily predicted until the technology is extensively developed and widely used; and, (b) a power problem - control or change is difficult when the technology has become entrenched. In patronage forecasts, for example, predictions can be highly uncertain. Yet their consequences are permanent and potentially excessively expensive. MUTPs have their own Collingridge-like dilemmas.

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Policies, in theory at least, can be evaluated via models, but necessarily these representations are abstractions. A concern is that the model used to evaluate policy will provide poor guidance in practice. This leads to the search for policy that performs well for a broad class of problems. The subtleties of an uncertain world require a robust theory, a model in which an individual’s or organisation’s probabilistic belief can cope with noise and uncertainty.

The question is whether the real options lens clarifies or obscures decision-making and whether the facts and factors fit the theory. The idea is to apply the TRO to decision-making on large investments in cases of uncertainty. Whereas much of finance theory is aimed at minimising uncertainty and making more rational and logical the derivation of NPV, in some major cases the risks and uncertainty can never be entirely eliminated. As Schwartz and Trigeorgis (2001) noted: “In most capital investment situations ...the sources of uncertainty in a project do not have future prices from which to easily obtain the risk-adjusted process needed for valuation. In many cases the sources of uncertainty in the project are state variables that are not traded assets. A few examples include: product demand uncertainty, geological uncertainty, technological uncertainty, and cost uncertainty.”²⁸ These are all characteristics of MUTPs. In large investment calls, the improvement in decision-making comes from creating the right, but not the obligation, to proceed to build or develop an asset. For example, by breaking up the ultimate decision into a series of options leading to the big call, risks and costs can be diminished. The utility of this course depends on the circumstances and overall project merits. A series of projects, each dependent on the predecessor’s completion, might actually add to overall costs. A larger, well-thought through project might gain greater economies of scale by seeking its commissioning early. The point here, however, is not that breaking up a project is always right, it is that the option to do so is valuable and should be contemplated in project development and management. Where, with MUTPs, funding might be uncertain, decision-makers might feel compelled to start something, rather than wait. Again, the circumstances and the particular merits of a project are everything.

To refer to another area of complex decision-making, the information and communication technology (ICT) industry, one of the most capital intensive of all, the risks of investment particularly after periods of deregulation are extremely high. Traditional quantitative cost-benefit analysis is not sufficient for capturing the complexity of the problem. Thus, decision-making analysis that combines real option, game theory, and qualitative analyses for modelling competitive interactions of players are frequently recommended.29

The insights of option theory can reveal the factors upon which valuation depends. This has clear policy implications for government in seeking involvement of the private sector in large-scale infrastructure investments by potentially offering options attached to investments.

The existence of embedded options depends on the nature of the investment project. According to Adam (1996), however, “[n]ot every investment project contains embedded options. Necessary conditions are that there is uncertainty about the possible outcomes of the project; the investment project is to some extent irreversible; and, delay in commencement is possible.”30 But the latter, the option to delay, is a real option. Indeed, in his summation Adam is simply wrong. It is not a pedantic point to note that an option must exist if there is uncertainty and if there is any type of potential decision. The use of the word “and” in the quotation “to some extent irreversible; and, delay in” should be “or”. In elaboration, all projects involve uncertainty (with the arguable exception of investing in government-debt) so Adam’s formulation without amendment is useless. It is actually not possible to conceive of a situation where at least one embedded option does not exist – be it the option to invest, option to defer, option to expand, option to abandon, option to change technology.31 Reversibility is more fruitful in highlighting the potential for option generation. What Adam suggests is that where the decision to proceed is not capable of reversal – a project is happening no matter what – then there are various 

31 I am grateful to Professor Steven Easton for assisting my thinking in this passage in email correspondence on November 11, 2014.
options in *how* to proceed. But his formulation should not exclude the option generation process associated with *whether* to proceed.

Projects that require immediate investment do not provide an investor with an embedded option of this sort. This applies where the sponsor or the investor is unable to delay the start of investment in the hope that more information may be collected that would enable a reduction in the uncertainty associated with the project outcomes. If delay is possible, an option appears. There may be costs to delay, as competitors might enter the market or cash flows may be lost, possibly an alternative project (such as an alternative route or mode) might preclude this particular option, but the costs of those scenarios can be weighed against the possible gains of delay. If the net effect is positive, then the option has a positive value to the sponsor.

The relevance to transport decision-making is that the value of the option increases with the level of uncertainty of the underlying variable. Subject to the research findings of this Thesis, in real-life managerial decision-making, especially with large investment decisions subject to uncertainty, consideration of ROs ought to be the way that decisions take place.

High uncertainty makes safeguarding less attractive as it can lead to sunk costs that may not pay off over an MUTP’s operating life. Conversely, high modularity - the degree to which a project’s components may be separated and recombined - increases the attractiveness of safeguarding because (1) safeguards can be limited to marginal investments at the interfaces between the functional elements with other MUTPs subsystems, and (2) the stability of modular design rules increases the likelihood that safeguards remain valid over time. Safeguards build options into integrative MUTPs. This flexibility and redundancy makes them potentially resilient to change stemming from option exercising if uncertainties resolve favourably in the future.32

The Thesis agrees with Eriksson that: “The practical tools and methods are available, based on many years of experience with foresight, adaptive planning, evaluation, and monitoring; what is still missing is the integration of these

methods in a continuous and long-term strategy development process.”

This Thesis partly bridges that gap. In the next section is explored the utility of that point in the context of risk and project management.

### 3.2 Risk

In the opening Chapter, the observation is made that overall efficiency in the development of a MUTP requires the pursuit of productive, allocative, and dynamic efficiency. This requires that goods and services are produced at the lowest possible cost, with the set of goods and services produced from the available resources being the set that maximises value to consumers; and therefore that preferred investments should be those that produce the most efficient production possibilities in the future. This is clearly a controversial point – as not everything turns on ‘efficiency’; the discussion in Chapter 2 noted that all projects attract particular champions and are never purely ‘logical’ affairs – they embrace a choice to do something. To the extent that better MUTP planning, however, requires deep understanding of the range of available decision-making, a theory of real options, particularly with respect to dynamic efficiency, is crucial to the successful development of a MUTP within this framework. This Thesis disagrees with Sturup’s (2010) suggestion that “on mega projects, risk management is just not practicable.” Risk is key – almost everything – in deciding what to do, when, and how. A mega project can be seen as a system of interrelated, independent processes that work together to turn inputs into outputs in the pursuit of a goal. Moreover, by seeing project management as a series of opportunities to exercise ROs, it is clear that if/when risk strikes, there is a range of effects on the achievement of project objectives, from total failure to a surprisingly good/better than expected outcome. The ability of project managers to deal with competing views affects the quality and

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34 Sturup, Sophie (2010) ‘Managing Mentalities of Mega Projects: The Art of Government of Mega Urban Transport Projects’ Ph.D., Melbourne, p. 22. Sturup is thinking that projects develop according to particular story lines and that risk analysis can be impervious to the motivations driving a particular project, what she calls their unique ‘art of governance’. “Maybe so”, is one response to that point, but the more substantive argument is to say all projects in different ways require risk analysis, assessment of their containment and exploitation of opportunities.
acceptability of their projects. Despite this, traditional project risk management process concentrates on the potential negative effects of risks. As a result of this focus, considerable effort is spent identifying and managing risks, while opportunities are sometimes overlooked. If the synergy between risks and opportunities is recognised and properly managed, this can ensure that unwelcome negative effects are minimised while at the same time maximising the chances of exploiting unexpected positive effects.

Identification of Risks

At page 68 of the Thesis, the case for “a more efficient delivery model” was put forward for MUTPs. Linking risk, management, and real options is the key to successful project delivery. There are many techniques for risk identification, such as brainstorming and workshops, questionnaires and interviews. Depending on the project, any of the commonly used risk identification techniques could be used effectively to identify opportunities as well as risks. As noted, risk practitioners often find it easier to identify potential problems than to look for hidden advantages and upsides.35

Factors affecting risk, and the potential options to counter and manage them, are often difficult to consider and misunderstood by those making vital decisions for projects. As risk is arguably neither tangible nor visible, a manager’s risks perception in a particular project varies according to experience, appreciation of opportunity cost, and the project’s internal and external environment. Indeed, what makes a risk risky is the possibility of destruction of value – loss – including loss of opportunity. It seems clear that the degree to which people engage in risk-taking behaviour is related to the degree to which they perceive risk taking as an opportunity for some good.

Therefore, it is important to define risk. In common usage the word implies that ‘risk’ only sees the downside. Asking a person in the street if s/he would be willing to take a risk almost always results in a focus on negative consequence.

This is reflected in the traditional definitions of the word, both in standard dictionaries and some technical usage. The *Oxford English Dictionary* defines ‘risk’ as: “A situation involving exposure to danger” and “[t]he possibility that something unpleasant or unwelcome will happen.”\(^{36}\)

The Australian/New Zealand Standard has an ambiguous definition where the nature of the effect is undefined and hence could implicitly include both positive and negative effects. In this definition risk is an uncertain event or set of circumstances that should it occur would have an impact on the project.\(^{37}\) A guide published by the US Project Management Institute is explicit in naming both positive and negative effects on the project objectives. In traditional behavioural decision theory, the term risk is used inter-changeably with uncertainty. Decision makers are said to be risk-averse if they prefer a sure thing to an option whose outcome is uncertain (i.e., a risky option).

The fact that risk documentation today typically incorporates both negative and positive aspects within their definition of ‘risk’, is a clear recognition that both are important influences over project success.\(^{38}\) Yet there is something unsatisfactory and binary to this summation. For the risk of a project is rarely binary. The idea of real options encourages the consideration of more than stop-go, start-continue-finish, and instead invites the consideration of a richer range and more nuanced assessment of project development.

### Effects of Project Risks on an Organisation

The uncertainties in undertaking a MUTP come from many sources and often involve many participants in the project. Since it is rational for each participant to minimise their own risk, the conflicts among various participants can be significant and potentially detrimental. Organising everyone involved in a project’s realisation to be on ‘the same page’ is part of the management challenge, as is the task of identifying and understanding areas of conflict and

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the motivations of particular players. At least in principle, the project sponsor has capacity to moderate such conflicts through contractual relations with other participants. Failure to recognise, or act on this responsibility, leads to undesirable results. The concept of ‘risk sharing/risk assignment’ contracts is a response to this challenge.

In approaching the problem of uncertainty, it is important to recognise that the willingness of a participant to accept risks usually reflects the professional competence of that participant, including expertise and experience, as well as their propensity to risk. Parties associated with any major construction project aim to mitigate and, where possible, eliminate uncertainty stemming from regulatory agencies, environmental issues, and financial aspects of construction. Project sponsors are keenly interested in achieving some form of breakthrough that lowers the costs of projects and reduces or eliminates lengthy delays. Breakthroughs generally happen such as when innovation is permitted or when a basis for incentive or reward exists. During periods of economic expansion, major capital expenditures are made by industries. This bids higher the cost of construction. In order to control costs, sponsors might attempt to use fixed price contracts so that the risks of unforeseen contingencies related to an overheated economy are passed on to contractors. Contractors then try to raise their prices to compensate for the additional risks.

Regulatory risk is by definition external and can be extremely hard to manage accurately and/or anticipate changes. Environmental and planning approval processes have become more complex and complicated and contribute to the uncertainty for construction because of the inability to know what is required and how long approvals might take from the regulatory agencies. Requirements of continued re-evaluation of problems, and lack of definitive criteria to resolve them, result in added costs. Public safety regulations are also dynamic.

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39 This was characteristic of the mining boom in Australia, 2005-2010, which saw an explosion in construction costs for major infrastructure projects as the costs escalated of scarce resources and personnel attracted to the ‘mining States’ of Western Australia and Queensland.
influenced also by insurance claims and costs (and fluctuating premiums) and can have similar effects. The situation has created constantly shifting guidelines for engineers, constructors, and owners as projects move through the stages of planning to construction. Such regulatory unpredictability add a new dimension of uncertainty which can make it virtually impossible to schedule and complete work at budgeted cost. Hence the place for ‘contingencies’ in MUTP budgets. Shifting economic conditions reinforce the climate of uncertainty, such as circumstances of high inflation and interest rates.

Risks related to technological problems are particularly relevant to types of facilities that have great complexity or scale or both. Site conditions, such as subsurface conditions and geological features, always present some degree of uncertainty and can create potential uncertainty for MUTPs with heretofore unknown characteristics during operation. Because construction procedures may not have been fully anticipated, in the project delivery the design may need to be modified after construction has begun. Therefore the consideration of options to respond to this dynamic should always constitute part of the decision-making process.

If each of the problems cited above cause uncertainty, their combination is even riskier. Thus the issue of apportionment of liability influences the practices of engineers and constructors, who in turn have influenced the actions of the sponsors.

Governments, owners, construction companies, and the myriad sub-consultants associated with them try to understand risks and seek to address them. Coordination throughout the project duration and good organisational communication can avoid delays and costs resulting from fragmentation of services, even where components from various services are eventually integrated.

In the public sector, the ability to deal with complex issues is sometimes limited by available expertise. The situation becomes more difficult with the proliferation of regulatory requirements and resulting delays in design and construction, while awaiting approvals from government officials who do not participate in the risks of the project.
All these factors provide additional grounds for the proposition that transparency and high-level knowledge about MUTPs are of crucial importance. Without comparative, information-rich evidence of performance, the ability to learn from best practice and, especially, past mistakes is constrained. It is an extraordinary shackle on the community as a whole that a lack of openness is tolerated by and within government. Moreover, the denial of performance knowledge and facts, including consistent comparative data, to researchers also handicaps proponents of real option theory. If the TRO provides a potential light through the darkness, the lack of information means that the searchlight merely reflects back from locked doors.

Principles for Efficient Risk Allocation

As with all infrastructure projects, effective risk management with MUTPs minimises the economic costs, the effect of uncertainty on objectives,\(^{41}\) and maximises the potential economic opportunities associated with risks, thereby helping to ensure that public infrastructure is delivered in a way that provides the highest value to the community. Inherent in that summary is the concept of the management of risk, understanding their potential to unravel a project, the potential frailties of decision-making.

For risk management to be effective, risks should be appropriately priced and allocated with consideration given to allocating risks in a way that creates entitlements to the upside benefits as well as downside costs from a materialised risk. There are a limited number of ways in which risks can be allocated.\(^{42}\) Risks could be held by government. Risks could be transferred to and retained by the private party. Risks can be transferred to the private party but then reallocated to third parties, including by passing them on to subcontractors, or covering them by insurance. In the case of concessions (a contract granting the right to control, operate, and demand payment for the use of an infrastructure asset), risks can be...


transferred to end-users through the project company having a right to impose service fees. Figure 19 summarises typical risks with MUTPs.

**Figure 19: Risks Associated with MUTPs**

Risks that typically relate to mega urban transport projects include:

*Site risk*: the risk that the project land will be unavailable or unable to be used at the required time, or in the manner or at the cost anticipated, or the site will generate unanticipated liabilities (for example, due to planning delays).

*Design, construction, and commissioning risk*: the risk that the design, construction or commissioning of the facility is carried out in a way that results in adverse consequences for cost and/or service delivery.

*Sponsor risk and financial risk*: sponsor risk is the risk (taken by governments that use a project financing model of procurement) that the special purpose vehicle (SPV) or its subcontractors will not fulfil their contractual obligations. Under a project financed PPP, the sponsor typically establishes the private consortium in the form of an SPV, which contracts with government. Financial risk is the risk that private finance will not be available, the project will not prove financially robust or changes in financial parameters alters the bid price before financial close.

*Operating risk*: the risk that the process for delivering the contracted services, or an element of that process (including the inputs within or as part of that process) will be affected in a way that prevents the private party from delivering the contracted services according to agreed specifications and/or within projected costs.

*Market risk*: the risk that demand or price for a service will vary from that initially projected so that the total revenue derived from the project over the project term will vary from initial expectations.

*Network and interface risk*: network risk is the risk that the network(s) needed for the private party to deliver the contracted services will be removed, not adequately maintained or otherwise changed in a way that prevents or frustrates the delivery of the contracted services, affects the quality of the specified outputs or in some other way affects the viability of the project. Interface risk is the risk that the contracted services will not be compatible with the delivery of core services.

*Industrial relations risk*: this is the risk of industrial action occurring in a way that adversely affects commissioning, operation or viability of the project.

*Legislative, government policy, and sovereign risk*: the risk that government will exercise its powers and immunities, including but not limited to the power to legislate and determine policy, in a way which negatively impacts or disadvantages the project.

*Force majeure risk*: the risk that an event (of a natural or political kind) entirely outside the control of either party will occur and will result in a delay or default by the private party in the performance of its contractual obligations.

*Asset ownership risk*: the risk that events such as technological change, construction of competing facilities or premature obsolescence will occur that may vary the economic value of the asset from the value upon which the financial structure of the project is based.

*Source*: Adapted from Department of Treasury and Finance (Victoria) (2013b); and Productivity Commission (2014) Public Infrastructure Report.
A Successful Project?  

Project success is a core concept of MUTP management. After all, as noted in Chapter 2, Flyvbjerg’s analysis with road and rail projects, cost overruns of 50-100% in real terms is common and demand forecasts are often wrong by 20-70%. Oisen (1971) suggested cost, time, and quality as the success criteria for project management and the success of projects. Those criteria are always included in the description of project management. From the 1990s onwards more comprehensive definitions were developed. Baker et. al. (1998) defined project success: “If the project meets the technical performance specifications and/or mission to be performed, and if there is a high level of satisfaction concerning the project outcome among: (a) key people in the parent organisation, (b) key people in the client organisation, (c) key people in the project team, and (d) key users or clientele of the project effort, then the project is considered an overall success.” This seems to be a rarified conception.

Admittedly, as Freeman and Beale (1992) noted, success might mean different things depending on a particular perspective. An architect might measure success in aesthetic appearance, an engineer in terms of technical accomplishment (perhaps with pride in turning dreamy drawings into physical reality), an accountant in terms of spend under budget, a human resource manager (perish the term!) in terms of OH&S record, industrial disputation, worker satisfaction, etc.

Clearly, time, cost, and quality are the basic criteria to project success and they are identified and discussed in almost every article on project success. Atkinson

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(1999) christened these three criteria the “Iron Triangle,” suggesting that while other definitions on project management success proliferate, the iron triangle is always included in every alternative definition. All projects, to a certain degree, are unique, complex, and therefore dynamic undertakings. Kohrs and Welngarten (1986) reported that project managers are forced to make choices: “Good! Fast! Cheap! Pick any two.”

If a project is to flow smoothly, according to plan, there is frequently a need for trade-off analysis. Most mega projects eventually get into crises such that it becomes extremely difficult to maintain the delicate balance necessary to attain the desired performance within time and cost. This calls attention to the fact that project management requires the understanding, generation, and exercise of real options as to what might be done to keep the project on target or close enough. As no project exactly mirrors another, trade-off analysis is an ongoing effort throughout the life of the project, continuously influenced by both the internal and external environment. Experienced project managers plan trade-offs, keeping some options in reserve in the event that anticipated crises arise, hence recognising that effective project risk management and delivery requires this sort of discipline and dexterity.

What Flyvbjerg discovered with MUTPs has parallels with construction management generally. There are many reports on project overruns and a conservative estimate is to state that approximately 50% of construction projects overrun; approximately 63% of all information systems projects encounter substantial budget overrun, with overrun values “typically between 40 and 200 percent.” Project sponsors in large, though not mega projects, typically claim

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that although “most projects are eventually completed more or less to specification”, they are “seldom on time and within budget.”

At first glance, a project that fails to meet the three success factors of time, cost, and quality is a failure, but this is not necessarily so. For, provided a project achieves a satisfactory level of technical and financial performance, it might pass the grade. In retrospect, a project might be considered a success by the parties involved, despite exceeding its cost and time targets. In part depends on whether cost and time targets were fixed or not. In addition, although a project might take longer to realise than the sponsor or manager originally perceived, the client might accept that this was unavoidable, was for good reason, was nonetheless value-for-money. Concerns might be mollified if the project was still a commercial success. The criterion of success or failure is whether the project sponsor, owner, client, and other parties concerned including, say, the project manager’s parent company, are satisfied with the final outcome.

Competence in the management of a project is the consistent, key factor in success or failure. Associated with this is the insight that simplicity of project tasks and risk expertise (thinking through challenges, rigorously assessing risk), experience with major projects are corollaries of superior MUTP management. Risk and the TRO are inextricably linked. This is because, as noted with Flyvbjerg’s analysis, risks with MUTPs should be borne by the party best able to manage them. Technical skills and data are important, together with accountability and the encouragement of the management thinking that projects can be broken into discrete options, real options capable of exercise, including actioning, stalling, discarding. How such options might be generated is considered next.

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3.3 Innovation and Interaction in Project Formulation

So far left out of the discussion is research on creativity in idea generation. One assessment is that expertise turns on experience and judgement, requiring the “application of experience to detect fruitful starting points in the construction of novel courses of action.” In working through the merits of a particular MUTP past experience can be extremely useful. Gettys’ and his colleagues’ (1986) research on the generation of hypotheses and acts is relevant. Hypotheses are generated by searching memory using retrieval cues such that the hypotheses generated are those that most resemble the available data. In contrast, in act generation there is the assumption of a set menu of options, such that activation springs from one single activated node. Following such analysis, it is valuable to distinguish between views of option generation as construction and retrieval. In the searching for a potential solution, the search can be defined as the process of sequential consideration of particular options. This corresponds to hypothesis retrieval and plausibility assessment. But the more important point, as Johnson and Raab (2003) note is that: “...it is often assumed that the options are there, and one must simply discover a way to get to them. For example, subjective utility theories describe how the attributes for various options are weighed and integrated, without mentioning from where the options under consideration come.”

Some of this raises focus on individual versus group thinking, the quantity of ideas generation and sometimes their uniqueness, and then regard for

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evaluating quality.\textsuperscript{60} Keller and Ho (1988) suggest that, in considering various alternative options, “different option-generation procedures can be seen as different strategies for traversing the cognitive network to search for and/or create new options.”\textsuperscript{61} They discuss option generation in the context of how to structure decision problems to improve decision-making. Johnson and Raab (2003), on the other hand, claim that they are more concerned with identifying what generation strategies can perform well, that practitioners would naturally use in real situations. These are all instances of the attempt to apply real options to decision-making.

Relevant too is the concept of fast and frugal heuristics which are based on three basic elements – a search rule, a stopping rule, and a decision rule such as to Take the Best:\textsuperscript{62} “Applied to preferential choice tasks, this lexicographic strategy uses a search rule of decreasing (highest to lowest) importance, or quality, of attributes; a stopping rule determined once an attribute is reached that sufficiently discriminates; and a decision rule of selecting the alternative with the highest value on this final attribute.”\textsuperscript{63}

An important requirement for successful application is repeated exposure to situations with feedback. This is not always contained internally (in memory) though it can be, as with an often-repeated task. For MUTPs, such simple methods are hardly comprehensive or illustrative of the deep uncertainty and complexity associated with them. Simple methods can be useful but not sufficient guides to action. For example, there is the issue of determining or finding a model of option generation for ill-defined tasks and a resulting suitable heuristic for such situations.

Different strategies generate different types of options and choice quality. Some research suggests that it is not better to generate as large a set of options as

possible. For example, in ‘brain-storming’ research, there seems to be a direct, negative correlation between idea quantity and idea quality.\textsuperscript{64}

Foresight processes provide a mechanism for collecting and focusing beyond vague future expectations, and for developing shared views on requirements for individual and collective action.\textsuperscript{65} On this view, it is preferable that even those immediate actions that might be needed right away should aid the creation of a framework for future actions that allow for adjustments over time. Policy makers can abate uncertainty and respond to new information by developing policies that respond to changes over time, that make explicit provision for learning, leverage the self-organising potential of actors and the decentralisation of governance to detect emerging issues, thereby crafting necessary adaptive responses.

This is important in the evaluation of how real option generation and the exercise of decision-making might take place. The point here is that the efficient management of projects requires expertise and experience, and is rarely the exercise of the lonely judgement of a single genius. Management is teamwork with assigned responsibilities (the ‘buck’ stops with someone.\textsuperscript{66}) The generation of ideas in response to uncertainty, to new information, to the dynamics of project development and implementation is in some measure the production of real options. Management capability is vital.

Certain vulnerabilities can be anticipated by implementing mitigating actions – actions taken in advance to reduce the reasonably knowable adverse effects of a policy. Uncertain vulnerabilities are handled by implementing hedging actions – actions taken in advance to reduce or spread the risk of the possible uncertain adverse effects of a risk event. Shaping actions are those taken in advance – aiming to control the future as much as possible - i.e., to reduce the chance that an external condition or event could cause the project to fail. For possible future


\textsuperscript{66} Famously, President Truman had a sign ‘The Buck Stops Here’ on his desk in the Oval Office. The phrase, “passing the buck” means to pass on to someone else responsibility for a decision. Truman wanted to remind himself that certain decisions he could never avoid.
actions, signposts could be defined and a monitoring system established to determine when actions are needed to guarantee progress and success. For example, critical signpost variables (triggers) could be specified, beyond which actions should be implemented to ensure that the policy progresses in the right direction and at the proper speed. Adaptive planning, then, is strategic planning that handles uncertainty by considering robustness, flexibility, and adaptivity within a common framework. A proposed package of decision options resulting from this approach typically consists of both robust (fixed and flexible) and adaptable parts.

To be useful and effective, forward-looking exercises should enable decision-makers to better understand and cope with the interactive, complex, and inherently uncertain character of innovation. This requires first that approaches are based on and reflect an appropriate understanding of the changing characteristics of innovation and decision-making in an industry. Second, they should contribute to the mobilisation and co-ordination of the decision-making by different actors. Third, they must be able to deliver insights on possible strategies and options for individual actors on how to ‘change course’ and direction, or at least enable them to think ‘out of the box’ about qualitatively different approaches and strategies. The purpose is to develop new ideas, to upset established agendas, and give rise to new approaches. In attempting to shape the future there is the need to adapt to actions by others, to exploit the upside of uncertainty, as well as abate its downside.

A complication with major infrastructure investment is that the sponsor is often (or generally) uncertain of the benefits that accrue arising from subsequent investments. For example, where project A is the core infrastructure investment and project B is the aggregate of many smaller complimentary investments, The planner of project A does not have the information to accurately assess the marginal benefits flowing from project(s) B since the latter information is decentralised and may not even be within the knowledge base of the team.

involved in initial project formulation. Only in response to project A’s completion might project B be developed. (In which case, we can see that project A stimulated the production of a new real option, or series of them, the development of complementary and ancillary projects.) Yet ignoring the potential benefits - even where these benefits are uncertain – could result in under-investment in project A. For example, capacity constraints, failure to adequately prepare for potential growth, might be an instance of this. In particular, treating potential benefits within an expected value framework (as in a conventional CBA) or even worse, in a risk averse manner, may result in under-investment where the original project itself helps to elicit the nature and quantity of benefits that may arise.

Where long-term transport planning decisions are made it is desirable that: (a) the range of possible futures is known well enough to generate and predict future changes to the transport system, (b) there is sufficient knowledge regarding an appropriate transport system model to estimate policy outcomes, and (c) there is enough knowledge regarding the importance stakeholders currently assign to the various outcomes or will assign in the future. For long-term transport policy decisions, however, those assumptions often cannot be made, since decision-makers, analysts, and experts do not know or cannot agree on (1) how the future would or should develop, (2) the system models, and/or (3) the value system(s) to be used to rank alternative policies. To cite just one instance, as Marchau and others (2010) laments: “Demographic and economic developments are normally dealt with via scenarios, but other uncertainties, such as shifts in activity behaviour and related mobility, changing opinions on transport performance by crucial stakeholders, and trend breaks, such as technological breakthroughs, are not handled very well — if at all.”69

Stakeholders tend to have different views about the importance of future transport problems. This results in different, often conflicting, opinions regarding the various transport policies. As such, the willingness of stakeholders to accept (or reject) outcomes of transport policies is uncertain. In addition, over time, new stakeholders might emerge and/or current stakeholders might leave, and/or the opinions of the current stakeholders might

So, even the degree of uncertainty cannot be well estimated. Decision-making occurs under ‘deep’ uncertainty. Under conditions of deep uncertainty, analysts and/or decision-makers cannot agree upon system models, policy outcomes, or how to value the desirability of alternative outcomes. Hence, relating to the subject of this Thesis, where project conception occurs haphazardly, without a learning culture, where major decision-making is secretive, almost random (highly contingent on the ‘drift and stab’ decision culture and actions of the politicians, for example), then the handicaps of this environment are destructive. In the case study Chapters, the next on roads and the following on rail in Sydney, the extent to which this was the ‘Sydney environment’ is explored.

3.4 Risk and TRO

An observation made by Flyvbjerg is that with MUTPs risks should be borne by the party best able to handle them. In introducing the issue of risk, and the concept of optimism bias, together with his research on case studies of numerous MUTPs, Flyvbjerg has significantly aided a deeper appreciation of MUTPs.

Risk and its management are extremely complicated with large projects, especially with MUTPs. Appendix 1 describes some of the main methodologies useful to that task, including the Critical Path Method (CPM), the Program Evaluation and Review Technique (PERT), Monte Carlo Simulation (MCS) methods, Risk Registers, Fault Tree Analysis, Cognitive Mapping, and Decision Tree Analysis.

Background of Project Risk Management

Concentrating on the tasks of project scheduling, formalised project risk management was pioneered in the 1950s.\(^\text{70}\) Gaddis (1959), for example, systematically focused on planning, procurement, and administrative

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functions. Project risk management flows from this, consisting of risk identification, estimation, risk response development, and risk control. During the 1990s, however, the theory and application of project risk management extended from the quantitative side into developing and better understanding the risk management process. The rapid development of computer technology enabled the application of project risk management in more advanced and complicated settings.

Problems with the Standard Measure of Risk

As noted earlier in this Chapter, the iron triangle in project risk assessment is time, cost, and quality. As discussed in Chapter 2, the main objective with superior MUTP management is to provide a model that addresses the real problems and questions that project managers encounter. Problems, however, are usually dynamic and not as simple as an iron triangle. Every major project considers trade-off analysis. The issue is whether real world risk can be replicated in a credible, dynamic model of high, predictive value. Despite the enormous attention project risk management has received since the 1990s, the track record of mega projects is fundamentally poor. Much of the literature evaluates the classic ‘trade-off’ problem between cost, time, and quality, but do not provide a decision-support system for trade-off analysis, in such a way that project managers can monitor and see which projects are on target in different phases of a project. A TRO is helpful to such analysis as there is embraced the consideration of a wide range of decision-making in developing a project.

To effectively do so, it is crucial to consider project risk management processes and general risk issues for large projects. Numerous works have been conducted on how project success can be measured. Project success is usually defined as meeting time, cost, and quality objectives. There are a variety of models that attempt to do that. These vary in focus from concentrating on planning and scheduling, to the risk register approach, through to alternative approaches. These include a variety of planning and scheduling models, including critical path method, PERT, and Monte Carlo simulation techniques. Also, there is the

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classical risk register and alternative techniques including fault trees, cognitive mapping methods, and decision trees. Finally there is the analysis of the suitability of various modelling approaches to risk analysis for large projects.

Project Risk Management Process

In advocating the use of project risk management, Wideman (1992) observed that: “Experience on many projects reveals poor performance in terms of reaching scope, quality, time and cost objectives. Many of these shortcomings are attributed either to unforeseen events which might or might not have been anticipated by more experienced project management, or to unforeseen events for which the risks were not fully accommodated.”

Wideman’s observation encapsulates a central idea in project risk management practice: after identifying ‘risk events’, then the challenge is to estimate the probability of each occurring and the impact on the project if any one does occur. Moreover, there is the need to anticipate an appropriate response to the ‘risk event’.

The literature of project risk management is replete with accounts of methodologies for managing risk through distinct phases: identification, analysis, response planning, tracking, and control. For example, in its Guide to the Project Management Body of Knowledge (2004), the Project Management Institute (PMI) gives an overview of four phases of project risk management (PRM): identification, quantification, response development, and control.

General Risk Issues for Major Large Scale Projects

Risks differ according to the type of project. Sometimes the fatal risks in any project are hard to recognise or anticipate. Thus, when identifying potential sources of risk, a broad scope should be adopted, thereby reducing the chances of overlooking important areas of risk. The emphasis should be on generating a comprehensive list of risks, rather than prematurely identifying a limited set of

key risks. During the identification of risks there is a natural tendency to simply omit recording some risks because their impacts are immediately considered to be of a minor nature.\(^7^4\) This has obvious dangers in that omitting seemingly minor problems obscures the risk that, in combination, they can have large consequences. The combined effect of large numbers of apparently minor risks might be under-estimated.

Experience, the name “for learning from our mistakes”,\(^7^5\) was incorporated into the analysis. Project failures lead practitioners to pay attention to learning and experience-based solutions of how risks could be avoided. Industries and companies emerged that specialised in project risk management.\(^7^6\) All of the major accounting firms developed expertise in this area, as well did the major consulting engineering firms. The field has spawned a vast literature in finance, business, and project management.

### 3.5 Concluding Comments to Chapter 3

The above discussion emphasises the frequently fraught context of conceptualising the planning associated with major projects. The suggestion is made here that effective project conceptualisation and adaption is dynamic, and proceeds through the development, consideration, and exercise of real options.

Use of a real-options framework reveals that value can be created through the development and exercise of sequential projects, with option values attached to each successive project.\(^7^7\) The key requirements for a project to create positive option value are: (a) project cash flows are made sequentially; (b) there exists uncertainty or volatility concerning the value of a project; and (c) flexibility is


\(^7^5\) The phrase appears in Oscar Wilde’s (1899) play *The Importance of Being Earnest* and is an epigram introducing Popper, Karl (1963) *Conjectures and Refutations: The Growth of Scientific Knowledge*, Routledge and Kegan Paul, London.


retained about whether successive projects are undertaken or not, with decisions on those projects reflecting new information that comes to hand after completion of earlier projects in the sequence. Under these circumstances, the \textit{ex ante} economic value of a sequence of projects must be greater than the discounted present value of the expected future cash flows. The reason is that value is increased through the creation of options for subsequent sequential choices through the completion of initial projects.

This Chapter has described and justified the employment of real options as a useful tool for the project management of MUTPs. Whereas Chapter 2 dwelt on the theoretical weaknesses in the literature associated with MUTP delivery and suggested that real options could assist in planning and implementation, this Chapter has explicated on what the TRO entails, its underpinnings in the literature associated with economic theory, management, and decision-making. All along, the focus is on how the TRO can be a useful tool for practical decision-making.

In the next Chapter, the discussion focuses on the development of the Sydney orbital to illustrate the unfolding of a series of ROs in road development. The Chapter following then addresses the Sydney rail experience. The idea is to test the TRO in the light of particular case studies. Both case study Chapters illuminate theory in the light of practical experience – and vice versa.
4. The Sydney Orbital Network: The Exercising of Real Options (ROs)

Earlier Chapters focused on the unholy messiness of MUTP development and some of the major weaknesses in the formulation and implementation of such projects. The TRO, as the last Chapter proposed, is at least a potentially useful tool in MUTP formulation and implementation. By reference to the development of the Sydney orbital as discussed in this Chapter through its various component parts - namely, the sub-projects - the idea is in the context of particular case studies to assess how useful is the TRO concept. This Chapter explicates the development of the Sydney orbital was the exercise of a series of ROs by the authorities responsible. Along the way there is an embedded critique of the road projects, their development and financing. Some of which were successful and some failures (in a financial sense). The creation and evolution of Transurban, now Australia’s largest toll-operator and owner is also discussed in the context of TRO.

The TRO happens within a context of other causal factors which may permit or hinder the application of TRO. Explored in the case studies below is how the sequence of projects permitted what the theory says TRO does – namely, to create the option to retreat, postpone, cancel, or modify.

4.1 The Sydney Context

Before discussing the Sydney orbital, it is useful to briefly highlight the context of road development in Sydney. Pressures in the major metropolitan centres reflect the demand that rising population creates to expand roads and other facilities in brownfields contexts – such as in densely trafficked CBDs or through long established suburbs – where adding lumpy increments to infrastructure capacity is inevitably costly and disruptive with the costs being all the higher in those cities, such as Sydney, where insufficient attention has been paid to reserving transport corridors. New public transport projects require reliance on extremely expensive solutions such as tunnelling.\(^1\) At the same time, Sydney, as with other Australian

\(^1\) Project tunnelling costs vary considerably - as we saw in Figure 16 in Chapter 2 with Lend Lease’s assessment of differences across Australia with rail projects. A rough rule-of-thumb is that the building of double-tracked passenger rail tunnels in Australian cities costs some $AU200m per km.
cities, is expanding geographically, accommodating a growing population’s demand for space. Meeting that demand requires costly investment in greenfield physical and social infrastructure, while the increased traffic generated by new outlying areas adds to congestion on major transport links.

![Figure 20: Sydney Road Orbital Network](http://sydneymotorways.com/rta_map.html), accessed September 2011.

The NSW Department of Main Roads (DMR) in the middle 1980s developed a comprehensive plan proposing a ring of roads around Sydney, which became a blueprint for new road projects in the subsequent decades. Having conceived the Sydney orbital road model, the re-named Roads and Traffic Authority (RTA) patiently sought to join, link by link, the orbital together as tenders were issued for parts of the network. This was the clever generation of options that gradually were exercised as funds became available, private sector interest accelerated, and as


3 Previously known as the DMR to 1989.
government became more confident about Private Public Partnerships (PPPs). Buttressing their case was the use of CBA, a methodology championed with practice guidelines by the National Association of State Road Authorities and the Australian Road Research Board (ARRB).4

A worldwide trend, governments of all persuasions in the late 1980s were seeking the participation of the private sector in the supply of transport facilities and services. The road bureaucracy was motivated in favour of the efficient freeway city.5 Private sector participation in the financing, construction, operation, and maintenance of infrastructure was considered a serious option in the search for ways of providing investment that would otherwise be deferred.6 This Chapter considers some economic and financial problems in the private sector provision of major road infrastructure within urban areas including attaching prices (i.e., tolls) to the provision of the service, the value of government rights which are given up either permanently or temporarily, and the identification required by the promoters of the cost of capital which is essential information in quantifying risk. Broader environmental and equity issues, key to some of the events that occurred, are also addressed. If the approach to establishing a private presence in a previously public supply context is handled properly from the outset, the benefits can be significant. Contrarily, the prospects could be quite undesirable if badly managed.7

One of Sydney’s strategic planning documents, ‘Cities for the 21st Century’ (2005), identified the need to improve a number of transportation corridors.8 One of these was the north-south corridor linking the National Highway system across Sydney.

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The route also planned to link Sydney’s planned second international airport at Badgery’s Creek some 70 kilometers (43 miles) from the city centre. The route travels through areas reserved for residential development, through a major regional open space corridor, and through existing development.9

Sydney’s orbital network now consists of over 160 km of uninterrupted motorways, freeways, and other main roads around and through the Greater Sydney metropolitan area.10 From 1 July 2013, the entire Sydney orbital network became fully cashless.

The questions associated with road capacity, better transport links, and transport funding for western Sydney had long been a contentious political issue.11 The orbital was planned in the mid-1980s as a new freeway/motorway route around Sydney, intended to link all the radial and inter-city freeways, while bypassing busy urban centres.12 At the time of announcement in 1987, the only parts completed were short sections of the Southern Arterial, the Prospect Arterial, and the Warringah Freeway. The biggest sections of the orbital were the South-West Motorway (which became the M4) and the Castlereagh Freeway (which became the M2). Other works included a section of the Western Freeway at Strathfield and the City West Link Stages 1 and 2 along with other arterial road upgrades.

Part of the background to the development of these projects came with the corporatisation of the Department of Main Roads (DMR) in 1987. From that year, the Commissioner and three directors functioned as a Board. This leadership team accepted a private sector proposal for a second harbour crossing which, instead of being a response to a government tender, was initiated by the private sector. Designed by the Transfield-Kumagai joint venture, supervised by the DMR and financed by Westpac, the Sydney Harbour Tunnel Project was ratified on 31 May 1989.

11 See for example, WSROC (1985) Roads in Western Sydney: a Submission to the New South Wales Minister for Roads, the Hon. L.J. Breton, M.P., on Road Planning and Funding Issues in Western Sydney, prepared by the Western Sydney Regional Organisation of Councils, Blacktown, May.
12 For background, see: RTA (1995) Western Sydney Orbital: Regional Environmental Issues, working paper number 1, prepared by Rust PPK Pty Ltd for the Roads and Traffic Authority, Rhodes, October.
1987 by the Unsworth Labor government. A second harbour crossing was long part of the DMR’s road plans for Sydney. But with its cost outweighing the DMR’s Sydney roads budget, the private sector proposed to fund the project. The Greiner Liberal Opposition, then government of 1988 (elected that March), opposed the tunnel - wanting a public tender and transparency - but continued the project after a review of the legal position indicated that it would cost as much to cancel as it would to continue. Promising to reduce the state’s debt, the Greiner government paid the $AU8.3m still owed on the Sydney Harbour Bridge account - including the loans used to finance the Cahill Expressway (opened 1958) & Warringah Expressway (opened in stages in 1968 & 1978) - but retained the bridge toll to contribute to the cost of the tunnel, which also attracted a toll.

A major restructure of the DMR came into effect in June 1988, three months after the new government took office. The new road authority, the RTA, amalgamated the responsibilities of its DMR predecessor with those of the Department of Motor Transport and the Traffic Authority. Government policy towards roads was defined in the mission statement of the RTA: “Manage the use, maintenance and enhancement of the State’s roads and traffic system with emphasis on road safety and transport efficiency as part of an integrated and balanced transport strategy.”13 The RTA commenced operations on 18 January 1989.

The government was adopting an economically liberal perspective in common with other jurisdictions in the Anglo world. The NSW Commission of Audit, chaired by businessman Charles Curran, advocated a wind-back of public/state activity where the private sector could do better.14 Financing of the urban road system was headed towards a user-pays strategy with the 3X3 Accelerated Road Improvement Program on 1 July 1989. For a 3 year period, the government collected 3 cents from every litre of petrol sold, adding more than $AU600m ($AU1080.40m in 2015 figures) to road development projects. Extension of existing roads, bitumen sealing, road

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rehabilitation, and bridge replacement were given highest priority under this Program.

As the economic recession of the early 1990s reduced finances from motor vehicle taxes and fuel levies, the Greiner government had to find other ways of raising funds for roads. These included the sale of surplus assets, the closure and sale of the Central Ashphalt Depot, and the reduction of the RTA direct-labour workforce. Labour was contracted out to private enterprise, leaving the RTA to concentrate on managing the road system. The RTA sought innovative funding and delivery solutions in response to this new environment.\textsuperscript{15}

4.2 Sydney Orbital Network

Sydney’s modern day toll roads developed over a period commencing with the Sydney Tunnel Crossing, and forms the Sydney orbital network. A toll road, sometimes called a tollway, toll highway, or express toll route, is a privately or publicly built road for which a driver pays a fee for use. Structures for which tolls are charged include toll bridges and toll tunnels. The first modern such project in Sydney started with the construction of the Sydney Harbour Tunnel in 1987. Twenty years later, by 2007, through private road concessions and its own works, the RTA had delivered 160 km of high standard Motorways in Sydney. This represented a sustained achievement over a twenty-year period. The last of these motorways, the Lane Cove Tunnel, was developed and constructed in the period 2000-2007, with opening of this part of the network on 25 March 2007. The total capital cost of the Sydney Motorway Network, in real terms in 2009 $AU, was estimated at about $AU11b\textsuperscript{16} (or $AU12.72b in 2015). The focus was to deliver each of the projects

\textsuperscript{15} Cooper, M.A., & Morris, R. (1991) ‘The 1st Commission of Inquiry in New South Wales into a Major Road Project: A Turning Point for Freeway Projects in New South Wales’, paper to the National Engineering Conference 1991, ‘Development and the Environment’ session, Hobart, April, Conference Report, Institution of Engineers, Barton [ACT, Australia], pp. 63-73. The RTA in the early 1970s was technologically innovative such as in the development, between the RTA, and AWA & Philips (later both acquired by Tyco) of SCATS\textsuperscript{TM} (Sydney Coordinated Adaptive Traffic System), which has been utilised in traffic signals control in hundreds of cities worldwide. See: www.scats.com.au, & www.powerhousemuseum.com/australia_innovates/?behaviour=view_article&Section_id=1080&article_id=10087, both accessed June 2014. Note that the RTA was merged with the Maritime Services Authority to become Roads and Maritime Services (RMS) in 2012.

independently. Sydney’s motorway network now has a number of operators, including the RMS, Transurban, and various single purpose entities, such as the Sydney Harbour Tunnel Company, Cross City Motorway, and Connector Motorway. Ernst & Young (2008) calculated the total economic contribution of Sydney’s toll road network at a net present value of $AU22.7b (or $AU26.64b in 2015), approximately 15 per cent greater than the sum of the initial economic valuations undertaken as part of the EIS.17

Figure 21: Sydney’s Developing Toll Road Network, circa 2004


The following sections of this Chapter piece together the story of the development of the Sydney orbital.

Sydney Harbour Tunnel

Sydney Harbour Tunnel was completed on a BOT basis through a joint venture between Kumagai Gumi Co. Ltd., a Japanese-based corporation, and Transfield Ltd., an Australian privately owned construction group. Together they created the Sydney Harbour Tunnel Company Ltd. (SHTC) to complete, operate, and maintain the Harbour Tunnel until August 2022 when it is due to be transferred into public


17 Ernst & Young (2008) The Economic Contribution of Sydney’s Toll Roads to NSW and Australia, Ernst & Young Transaction Advisory Services Limited for Transurban, Sydney, July.
ownership. Muhammad and Low (2006) note: “[i]n 1987, the Department of Main Roads (DMR) produced a new strategy, *Roads 2000*. The aim of the strategy was the designation of an orbital road around Sydney... The strategy included new links which promised to relieve traffic congestion on the approaches to the Harbour Bridge. One of the extra links was a Harbour Tunnel proposed in 1986...”

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**Figure 22: Sydney Harbour Tunnel Summary**

<table>
<thead>
<tr>
<th>Sydney Harbour Tunnel</th>
<th>Description</th>
<th>Length</th>
<th>Contract Term</th>
<th>Opened</th>
<th>Handback</th>
<th>Private Partners</th>
<th>Toll</th>
<th>Contract Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Connects the Warringah Freeway and the Eastern Distributor</td>
<td>2.7km</td>
<td>June 1987-June 2023</td>
<td>August 1992</td>
<td>31 August 2022</td>
<td>SHTC: Transfield-Kumagai Joint Venture and Westpac</td>
<td>Time based toll, charged southbound only</td>
<td>AU670 million (estimated amount payable at the time of the contract award; or AU1,565.76 b in 2015)</td>
</tr>
</tbody>
</table>

*Source: Author’s research and information derived from: http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have_been_awarded/roads/sydney_harbour_tunnel, accessed May 2014.*

The project involved design, construction, finance, and operation of a 2.7km, four-lane underwater tunnel running below Sydney Harbour. An additional cross-harbour route, the project aimed to ease traffic congestion on the Harbour Bridge during peak travel times. The BOT agreement between SHTC and NSW government was signed on 29 June 1987 and secured through an Act of Parliament.

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Construction began in January 1988 and the tunnel was opened to the public in September 1992.\textsuperscript{21}

This project was the first privatised toll road in Sydney. Details of the contract were treated as commercial-in-confidence by both parties and therefore ‘secret’. The strict confidentiality arrangements were successful in shutting out close scrutiny of the contract and limiting transparency on performance compared to expectations.\textsuperscript{22}

**M4**

The M4 Western Motorway is the road traffic spine for the western suburbs of Sydney, extending 40km from Concord in Sydney’s inner west through to Lapstone at the foot of the Blue Mountains. With the completion of 10km of new dual carriageway expressway, 21 major bridge structures, and the upgrade and widening

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\textsuperscript{21} Ibid., p. 10.

of 11km of existing expressway, the M4 - previously known as the F4 - was opened by Premier Nick Greiner on 15 May 1992.\textsuperscript{23}

The first section of the M4 Motorway - from Prospect to Penrith - was completed by the NSW Government during the early 1970s. Several stages of the second section from Concord to Parramatta were completed in the 1980s. There remained a missing link of about 10km between Mays Hill (outside Parramatta) and Prospect to connect these two sections. The M4 tollway was one of the first PPPs established by the NSW Government. In 1989, Statewide Roads Limited (SWR) won the right to finance and build, and then operate and maintain the M4. SWR was incorporated in 1988 with a Board led by former senior managers of the DMR.\textsuperscript{24}

The M4 PPP between SWR and the NSW RTA, covered the upgrade, management, and toll collection of a 12.2 km long road, including 2.2km between Silverwater Road and James Ruse Drive, and 10.0 km between Mays Hill and Prospect in western Sydney. The estimated total cost of the M4 PPP was $AU246 million (1988 dollars) including construction, interest, operations, maintenance, and taxation (equating to $AU536.40m in 2015 prices). SWR made a one-off payment of $AU46.6m ($AU101.61m in 2015 prices) in rent for the land on which the tollway was built. During the course of the PPP, the deed was amended with SWR undertaking additional roadworks in exchange for toll increases.\textsuperscript{25} As at 2008, the toll was $AU2.75 (equivalent to $AU3.22 in 2015) for cars and motor bikes and $AU6.60 (equivalent to $AU7.74 in 2015) for large vehicles. SWR received $AU 88.5m ($AU103.86m in 2015) in gross revenue from M4 tolls in 2008, and $AU970m ($AU1138.37m in 2015 prices) in gross revenue up to June 2008. As part of its campaign to win the 1995 NSW State election, the Labor Party promised to remove the toll from the M4 and the M5 Motorways. The tolls were controversial. In his 1995 election campaign launch speech, the then Leader of the Opposition, Bob Carr, said: “The tolls will be lifted on the M4 and M5 and F6. The M4 and M5 were promised as freeways, not tollways.” He promised that a State Labor government

\textsuperscript{23} Legislative Assembly (1992) \textit{Hansard}, June 24.

\textsuperscript{24} Zeibots, Michelle E. (2003) ‘Before and After Sydney’s M4 Motorway: Did It Make the City More Sustainable?’, December; Zeibots, Michelle E. (2007) M4 Motorway from Mays Hill to Prospect, Institute for Sustainable Futures, UTS.

would legislate to remove the tolls on the M4 and M5 if an agreement could not be reached with the private companies which ran them. But after its election, the new Labor government found that, without significant financial penalty for abrogation of the contract, it could not do so until the end of the PPP arrangements. Instead, it implemented a ‘Cashback’ scheme in 1997, such that motorists driving NSW privately registered vehicles on the M4 and M5 Motorways could claim a refund of the tolls paid (excluding GST) from the NSW Government. In 2008-09, $AU37.5m (equivalent to $AU43.39 in 2015) in tolls were claimed by M4 users. As at the end of 2008-09, the Government had reimbursed M4 users $AU255m ($AU295.07m in 2015 figures). At midnight on 15 February 2010, the PPP contract finished with SWR handing the road back to the RTA. The Government then removed the toll and ended the M4 Cashback (though it continued on the M5 South-West). Cashback did not apply to other tolled motorways.

In 2004 SWR was absorbed into MIG. Later, MIG disaggregated its interest in roads in Sydney to the Sydney Roads Group (SRG) which was merged with Transurban in 2007. The latter hoped to extend the life of the toll, through the development of West Connex (previously called the M4 East). But the Labor government of the day wanted no more tolls at the end of the concession in 2010. The concession for the M4 toll road ended at midnight 15 February 2010 and ownership returned to the NSW government. The motorway subsequently was placed under the control of the RMS, which operates the M4 on behalf of the government.

Since the election of the O’Farrell (2011-2014), then Baird (2014-) Liberal National coalition governments there has been the proposal for WestConnex, to extend the M4 into or close to the city, depending on the route chosen. This is discussed towards the end of the Chapter.

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26 Sydney Morning Herald, March 23, 1995. The F6 was a proposed tollroad, never built, linking Wollongong to Sutherland, and on to the City.
29 Effectively Transurban hoped that it had acquired a free option – or at least an option that would be valuable - should the government extend the toll concession on the M4.
M2

The M2, previously known as the Hills Motorway and earlier still the ‘North-west Transport Link’, is a 21km road that carries around 110,000 motor vehicles and 45,000 bus passengers a day. A four lane motorway linking the lower north shore and the northwest regions of Sydney, the M2 is generally of four lanes, between Epping Road and the Lane Cove Tunnel in North Ryde and Old Windsor Road and

<table>
<thead>
<tr>
<th>M2 Summary</th>
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<tbody>
<tr>
<td>Description</td>
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<tr>
<td>Connects the M7 and the Lane Cove Tunnel.</td>
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</tbody>
</table>


the Westlink M7 motorway in Baulkham Hills. The M2 is a key public transport corridor with dedicated bus lanes that carry more than 120 buses during the morning and afternoon peak. There is a two-lane busway between the motorway’s general

traffic lanes along an 8 km section between Beecroft Road in Epping and Windsor Road in Baulkham Hills.

The project was initiated by the Greiner-Fahey coalition governments. The project occurred as a result of the then government’s predisposition to support private projects, the initial success of the M4, and due to RTA funding shortages. The concession was competitively bid and won by a private consortium, the Hills Motorway Group, advised by Macquarie Bank. Construction started in 1993. The road opened 7 months ahead of schedule on 26 May 1997 as a part of Sydney’s orbital motorway network. It now connects seamlessly with the M7 motorway and links up with the Lane Cove Tunnel - both projects completed subsequently.

Variations:

1994-2010

In this period, there were a series of amending and/or additional contractual arrangements including refinancing of the project’s debts, advertising on the motorway, the effect on tolls of the introduction of the GST, electronic tolling, the change in ownership of the trust established by the Hills Motorway Group, the acquisition of some Hills Motorway entities by Transurban, and the conversion of westbound portion of the motorway between Lane Cove Road and Beecroft Road from two to three road lanes.

2010-2013

Transurban acquired the M2 from the original concession holders and put forward to the RTA proposals to enhance and widen the motorway.\footnote{Roads and Traffic Authority (RTA) (2009) Annual Report 2009, p. 18.} The Upgrade Project Deed took effect on 18 November 2010 according to which Hills Motorway Group designed, constructed, completed, and commissioned specified M2 upgrade works. The upgrade was completed in August 2013. The private sector by 2013 had funded the works of the estimated capital cost of $AU546 ($AU570.96m in 2015 figures), and received a 4 year further extension of the maximum concession term upon the works’ completion.
Eastern Distributor

The Eastern Distributor, a 6km motorway, runs from the eastern side of the Sydney CBD to Sydney Airport. The motorway was tunnelled under the inner eastern suburbs for environmental and consent reasons. The twin tunnels are each 1.7 km long and have been constructed in a ‘piggy-back’ configuration to further reduce environmental impacts. The privately financed project formed a total transportation package with complementary road, public transport, and urban environment improvements.

<table>
<thead>
<tr>
<th>Eastern Distributor Summary</th>
<th>Description</th>
<th>Length</th>
<th>Contract Term</th>
<th>Opened</th>
<th>Handback</th>
<th>Private Partners</th>
<th>Toll</th>
<th>Contract Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connects the Warringah Freeway and the Eastern Distributor</td>
<td>6.0km</td>
<td>18-Aug-1997 to 18-Dec-2048</td>
<td>December 1999</td>
<td>23 July 2048</td>
<td>Airport Motorway Limited (AML), Leighton Contractors Pty Limited and National Australian Bank Limited (NAB)</td>
<td>Time based toll, charged southbound only</td>
<td>$AU680 million (estimated financing, development, design, construction, fitout and commissioning cost at the time of the contract award, equivalent to $AU1092.67 in 2015.)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s research and information including that derived from: [http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have Been_awarded/roads/eastern_distributor](http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have_Been_awarded/roads/eastern_distributor), accessed May 2014.

Self-described as “an important link within Sydney’s motorway orbital,” in December 1999 the Eastern Distributor was opened to traffic as a toll road, forming an eastern segment of the Sydney orbital. The motorway initially slashed city-to-

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airport travel times by at least ten minutes and made journeys faster by bypassing 19 sets of traffic lights. The NSW Auditor-General, however, was critical of the RTA’s appraisal of the project, commenting that:

Even though some economic appraisal guidelines have been followed, the process gives the impression of being driven by the private sector’s ability to undertake related road improvements on the RTA’s behalf, without a cost to the RTA, rather than by the State’s wider road-building, transport and environment priorities. The limitations of cost-benefit methodology, and the lack of clarity in the State’s agreed strategies and plans to implement these priorities, have contributed to this shortcoming.36

This brief critique illustrated the concern about value for money, queried how the road fitted into the overall roads network, and questioned the utility of CBA in this instance.

**M5 South West**

The M5 South West Motorway (M5) is the key route between Sydney, its south-western suburbs and beyond, connecting with the F5, the M5 East, and the M7.

**Variations**

**29 June 1993 M5 Western Extension**

The RTA and Interlink negotiated to extend the M5 to the west from Moorebank to Prestons. The western extension with estimated capital costs of $AU65m involved the RTA making an additional $AU50m loan to Interlink, with the balance of the cost being financed by the Commonwealth Bank of Australia (CBA); the extension of the concession period by 8 years to 2022; and renegotiation of tolling arrangements, requiring Interlink to peg tolls for 3 years and then escalate at CPI (foregoing the right to increase tolls at 9 per cent per annum, as provided in the original deed).

**30 June 1997 Sale of RTA Loans**

The loans previously advanced by the RTA to Interlink (totalling $AU85M, including capitalised interest) to construct the M5 South West and the M5 Western Extension

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were sold in 1997 to CBA for $AU110m. The proceeds were used by the NSW government to partially fund the construction of the M5 East extension.

15 May 2002 Moorebank Avenue Interchange

Interlink proposed to finance and construct the grade separated interchange at the intersection of the M5 and Moorebank Avenue with the estimated capital cost in 2002 of $AU32m ($AU44.90m in 2015 figures), to be funded by the increased traffic projected as a result of the improved traffic flow, with the balance of the cost being funded by an increase in the M5 concession term until August 2023.

**Figure 26: M5 South West Motorway Summary**

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Contract Term</th>
<th>Opened</th>
<th>Handback</th>
<th>Private Partners</th>
<th>Toll</th>
<th>Contract Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connects the M5 East and the M7</td>
<td>20.8km; the original project involved financing, construction, operation and maintenance of a 14.5km motorway between Beverley Hills and Casula, in the south-west of Sydney. Due to variations the project was extended to cover 21km of motorway between Beverley Hills and Prestons.</td>
<td>22-Feb-1991 to 2014 (since extended to December 2026); a concession period of 22 years post-completion after which the road would revert to public ownership (since extended to 34 years)</td>
<td>Oct-1992. The M5 western extension and Moorebank Avenue Interchange were opened to traffic in 1995 and February 2003 respectively.</td>
<td>Originally 22 August 2014, now December 2026</td>
<td>Interlink Roads Pty Limited (Interlink) and the Commonwealth Bank of Australia (CBA)</td>
<td>Toll of $AU1.10 ($AU2.14 in 2015 figures) for cars and $AU3.30 (equivalent to $AU6.42 in 2015) for trucks, escalated at the greater of CPI or 9% per annum (the right to increase tolls at 9% per annum was removed in 1993 under the M5 Western Extension arrangement). As at June 2015, however, actual tolls were $AU4.42 (cars) and $10.48 (trucks).</td>
<td>Connects the M5 East and the M7</td>
</tr>
</tbody>
</table>

Source: Author's research and information derived from: [http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have_been_ awarded/roads/M5_South_West_Motorway_Widening](http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have_been_awarded/roads/M5_South_West_Motorway_Widening), accessed May 2014.
19 June 2012 M5 Motorway Widening

Interlink Roads, concession holder of the M5 Motorway, proposed to the RMS, the successor to the RTA, the widening of sections of the motorway to three lanes in each direction between Camden Valley Way and King Georges Road.\(^{37}\) The RMS and Interlink Roads reached final agreement to widen the M5 South West Motorway to three lanes in each direction between Beverley Hills and Prestons. The 2012 $\text{AU}400m$ ($\text{AU}428.28m$ in 2015 figures) project was funded through a 3.3-year concession extension to December 2026, an increase in truck tolls to 3 times that for car (implemented following construction completion), and the NSW Government contributing around $\text{AU}50m$ towards the project cost - being for noise walls, drainage, and other works arising out of the final Planning Approval conditions.\(^{37}\)

M5 East

Part of Sydney’s orbital road network, the M5 East is 10km long connecting the M5 South West Motorway at King Georges Road in Beverly Hills with General Holmes Drive and on to the Eastern Distributor. Built on a D&C basis, at the time of completion the $\text{AU}750m$ ($\text{AU}1082.21m$ in 2015 figures) project was the largest infrastructure road project commissioned under an RTA contract.\(^{38}\) The roadwork includes the 4km long tunnel between Bexley Road and Marsh Street, and the 0.5km long tunnel under the Cooks River. A 3.3km section for a cycleway around the western side of Sydney Airport was opened in December 1999. Bypassing more than

20 sets of traffic lights, in non-peak periods, the M5 East can take up to 20 minutes off a trip between Liverpool and Sydney Airport.

A major controversy with the 4km tunnel was the issue of health standards associated with air quality. In April 2008, construction began on a $AU65m (equivalent to $AU76.28m in 2015) trial filtration plant to remove particulate matter and nitrogen dioxide from air extracted from the western end of the M5 East westbound tunnel, capable of continuously drawing 200m$^3$ of air per second from the westbound tunnel, removing particulate matter from this air, removing nitrogen dioxide from 50m$^3$ of the same air and then returning the treated air to the westbound tunnel. The M5 East tunnel air filtration trial ended in September 2011 with documentation on air quality, including the CSIRO’s peer reviewed reports, accepted as submitted to the Department of Planning and Infrastructure.

M7

The 40km M7 (previously known as the Western Sydney orbital and/or as Westlink) between the M5 at Prestons and the M2 at West Baulkham Hills forms part of the National Highway through Sydney and is a key link in the Sydney orbital motorway network. The toll concession was competitively bid with MIG (45 per cent), Transurban (45 per cent) and Leighton Contractors (10 per cent) forming the original consortium. The M7 is a fully electronic toll by km capped at 20 km. More than any other Sydney tollroad, it led to considerable development of industrial and residential greenfield sites along and feeding into its corridor. In its first year traffic numbers opened 50 per cent below revenue predictions; but thereafter traffic steadily increased. The Carr Labor government of the day considered this project of vital importance to western Sydney and it was strongly championed by the then NSW Roads Minister, Carl Scully.

In the assessment by the approval authority, the NSW Department of Planning, the conclusion was: “The need and justification of the WSO has been primarily based on

the desire to provide an efficient National Highway link between the F5 and F3, providing wider transport choices and to facilitate freight movement to, from and within Western Sydney and thereby enhancing the economic development of Western Sydney.” The reference to the National Highway link was largely due to Federal government funding to assist freight and passenger movement through western Sydney. Thus this particular project was not only justified as another piece to the Sydney orbital. Interestingly, in the Department’s assessment, there was a reference to public transport connections to complement the M7: “In order to achieve the desired long term and strategic outcomes, the Department has placed significant emphasis on the early provision and integration of public transport opportunities within the WSO corridor and the need to promote the proposal as the

<table>
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<th>Figure 28: M7 Summary</th>
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<tr>
<td><strong>M7</strong></td>
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<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Connects the M5, M2 and M4</td>
</tr>
</tbody>
</table>

*Source: Author’s research and information derived from: [http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have_been_awarded/roads/westlink_m7_western_sydney_orbital](http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have_been_awarded/roads/westlink_m7_western_sydney_orbital), accessed May 2014.*

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primary freight corridor through western Sydney.” But this seems no more than a pious comment, as commensurate public transport projects never eventuated, although to be fair, the Department required as “Condition of Approval No. 36” that “the RTA ... design the WSO to allow for simple retrofitting of dedicated bus lanes or light rail services.” No such lanes have been subsequently introduced.

Wire traffic loops built into the road provide continuous, real time information to the control room regarding traffic volume, traffic flows, and vehicle types using the road, queue lengths and times, and incident reports. The loops detect and measure the time a metallic object takes to pass over them and, within set parameters, the data generated can differentiate between vehicle types.

The WestLink Consortium was contracted in February 2003 to finance, design, build, maintain, and operate the project. Equity was provided from Transurban, MIG, Abigroup Contractors, and Leighton Contractors. The M7 was opened to traffic on 16 December 2005, eight months ahead of schedule. The Commonwealth government provided $AU392m ($AU536.13m in 2015 figures) to the project with the remaining funding of $AU1,540b ($AU2.10b in 2015 equivalent) provided by the private sector, with Abigroup-Leighton Joint Venture the D&C contractor. The Westlink Consortium has the right to toll the road for the concession period ending February 2037. From the start, tolling had been fully electronic and interoperable with other Sydney toll roads. There were no toll booths on the M7. The M7 has 17 sections and users are charged on a rate per kilometre basis. By June 2006 the M7 was carrying more than 90,000 vehicle trips per day with many vehicles travelling on only part of the motorway. The M7 bypasses 56 sets of traffic signals and saves up to one hour in travel time (in peak periods) between Liverpool and Pennant Hills.

Interestingly, according to the Minister, the design included “Australia’s longest ever urban cycleway... stretch[ing] 39 kilometres from end to end. Effectively, it [is] a

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44 Ibid.
45 Ibid., p. 49.
bicycle freeway.” But as this did not form part of a bike network, its utility is questionable. (Oddly, data has not been kept on bike use on the M7 and so learning from this dimension of the project and the integration of the cycle lanes with nearby ‘bike pathways’ has not been carefully evaluated).

Cross City Tunnel

The Cross City Tunnel (CCT) links Darling Harbour to Rushcutters Bay through separate east and westbound tunnels, avoiding 16 sets of traffic lights westbound and 18 eastbound. The CCT comprises twin, two-lane tunnels linking the Kings Cross tunnel with the Western Distributor. During 1999/2000 there was extensive consultation over design options and EIS. The latter was released in August 2000 and the Minister for Planning approved the project 14 months later. The Minister for Roads announced in February 2002 that the Cross City Motorway Consortium (CCMC) had been selected as the preferred proponent to finance, construct, and operate the tunnel. CCMC included Cheung Kong Infrastructure Holdings Ltd (CKI, 50 per cent), DB Capital Partners – the private arm of Deutsche Asset Management (30 per cent) – and Bilfinger Berger BOT GmbH (20 per cent), the investment company of Bilfinger Berger.

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52 The RMS has not recorded data on bike use along the M7. The assessment of cycle use was discussed in the assessment of the merits of the project made by the Department of Planning. See: NSW Department of Planning (2002) Proposed Western Sydney Orbital, Director General’s Report, Op. Cit., pp. 94-99. Perhaps, to adapt the ‘green wash’ phrase, there is an element of ‘bike spin’ in including such cycle tracks in freeway construction. This alludes to the concept of ‘green-washing’, such that an organisation or business ‘spins’ more time and money extolling its ‘green’ credentials than actually implementing business practices that minimise environmental impact. See: Hagerman, Eric (2008) ‘Little Green Lies - How Companies Erect an Eco-Façade’, Wired, Vol. 16, No. 11, November.
Figure 29: Cross City Tunnel Summary

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Contract Term</th>
<th>Opened</th>
<th>Handback</th>
<th>Private Partners</th>
<th>Toll</th>
<th>Contract Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connects the Inner West with the Eastern Distributor and the eastern suburbs</td>
<td>2.1km</td>
<td>19-Dec-2002 to 18-Dec-2035</td>
<td>28-Aug-2005</td>
<td>19 December 2035</td>
<td>CrossCity Motorway consortium, comprising: Bilfinger Berger AG, Baulderstone Hornibrook Pty Limited, and Deutsche Bank AG</td>
<td>Flat rate, charged northbound and southbound</td>
<td>$AU680 million (estimated Capital Cost at the time of the contract award, equivalent to $AU942.01m in 2015)</td>
</tr>
</tbody>
</table>

Source: Author’s research and information derived from: [http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have_been_awarded/roads/cross_city_tunnel](http://www.treasury.nsw.gov.au/ppp/nsw_projects/projects_which_have_been_awarded/roads/cross_city_tunnel), accessed May 2014.

The project was funded, designed, and built by CCMC at an estimated cost of $AU680m (including development, design, construction, fit-out, and commissioning). The consortium was due to operate and maintain the tunnel for a term of 30 years and two months.\(^{56}\) CCMC proposed some design changes purportedly to enhance environmental aspects of the project and improve road safety, transport efficiency, and community amenity. Following public display of a supplementary EIS for the proposed modifications in August 2002, the RTA sought and obtained an updated planning approval in December 2002 and the consortium reached agreement with the RTA in the same month.\(^ {57}\)

Construction began in late January 2003. The tunnel was opened on 28 August 2005, two months ahead of schedule, with surface works to upgrade William Street completed in May 2006. As at June 2006 the tunnel was used by around 30,000 vehicles daily, well below CCMC’s projected traffic of more than 90,000 vehicles per day.\(^ {58}\) From opening, tolling was inter-operative with other Sydney toll roads, with no toll booths on the Cross City Tunnel,\(^ {59}\) becoming Sydney’s first motorway with full


The project involved the financing, design, construction, operation, and maintenance of two east-west tollroad tunnels under the Sydney CBD; and Darlinghurst/Woolloomooloo, between Darling Harbour and Rushcutters Bay and associated tunnelled links to Sir John Young Crescent, the Cahill Expressway and the Eastern Distributor; and the financing, design, and construction of associated improvements to surface roads, including new bus and bicycle lanes, intersection improvements, ‘traffic calming’ measures, wider footpaths, and other improvements to pedestrian facilities, supposedly to take advantage of the opportunities afforded by reduced traffic congestion.

Variations:

January 2005
The amendments took effect according to which the CCMC parties undertook to fund up to $AU35m ($AU45.82m in 2015) of changes to the project’s works directed by RTA, in return for specified increases in the maximum permissible tolls on tunnel users.

September 2007
As the CCT only attracted one-third of the forecast traffic, by the end of 2006 the concession company filed for bankruptcy. At that point a syndicate of creditors appointed a receiver, which took control of the tunnel, and kept it in operation while the finances were sorted out; it was sold in 2007 for approximately $AU700m ($AU852.20m in 2015 figures) to a consortium led by the investment bank ABN AMRO (later taken over by Royal Bank of Scotland) and Leighton Contractors.

The NSW Audit review of the CCT raised some fundamental issues concerning agencies involved in privately financed projects. These include the importance of a) having value for money for motorists as an explicit objective of the bidding process; b) the need to define project costs; c) separate funding of costs not directly related to a project so the user-pays principle can apply in a fair way; d) handling contract variations transparently; e) effective community consultation; and, f) patronage projections in determining project impacts.60

A widely held view is that the road changes – including closures and diversions - were not necessary, but were introduced to force motorists into the tunnel solely to profit the tunnel operator. When the project was put to tender there were only limited road changes specified. All bids were made on that basis. But subsequently more extensive changes were made including road closures that forced certain road journeys to use the CCT. The Auditor General concluded:

In our opinion ...[w]e cannot say that the road changes were robustly assessed, either collectively or on a road-by-road basis. Consultation with stakeholders about the road changes failed to clarify the cumulative impact of the changes, especially in eastern Sydney. It was not inclusive enough to capture the significant resentment the changes caused. Any loss of patronage from this resentment will further hinder the tunnel’s main objective of reducing traffic in the City. In our opinion the concept behind the road changes was to implement long-standing government planning objectives to reduce congestion in and around Central Sydney, and to improve public transport routes and urban amenity. The initial strategy was to make car travel on ['free'] surface roads ‘unattractive’ and could therefore be described as ‘funnelling’ traffic into the tunnel. But the motivation was primarily to clear up the congestion on surface roads rather than to make the tunnel profitable. The financial viability of the tunnel, and the RTA’s interpretation of ‘no net cost to government’, did however influence some important planning decisions.61

This was a gentle critique of the public controversies surrounding the project, at one level reading like a grudging acknowledgement of the merit of the RTA’s argument, and at another level, ambiguously implying criticism.

Lane Cove Tunnel

The Lane Cove Tunnel (LCT) links the M2 with the Gore Hill Freeway and completes a ‘missing motorway’ connecting the north-west sector of Sydney with the CBD. Its twin, two-lane tunnels are electronically tolled. The project included widening the

Gore Hill Freeway to provide transit lanes to improve bus travel through bus priority lanes along Epping Road and transit lanes on the widened Gore Hill Freeway from the M2 at the Lane Cove River to the Warringah Freeway. Journeys from the north-west to the city through the Lane Cove Tunnel bypass five sets of traffic lights; motorists travelling between Falcon Street and the M2 avoid the Pacific Highway, bypassing 26 sets of traffic lights.

**Figure 30: Lane Cove Summary**

<table>
<thead>
<tr>
<th>Lane Cove Tunnel</th>
<th>Length</th>
<th>Contract Term</th>
<th>Opened</th>
<th>Handback</th>
<th>Private Partners</th>
<th>Toll</th>
<th>Contract Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connects the M2, Gore Hill Freeway and Military Rd/Falcon St</td>
<td>3.6km</td>
<td>9-Dec-2003 to 9-Jan-2037</td>
<td>25 March 2007</td>
<td>10 January 2037</td>
<td>Lane Cove Tunnel consortium, comprising: Thiess John Holland, Transfield Holdings Pty Limited, and ABN AMRO (interest later taken over by Royal Bank of Scotland)</td>
<td>Flat rate, charged northbound and southbound and on the north facing ramps at Falcon Street</td>
<td>$AU1.1 billion (estimated capital cost at the time of the contract award, equivalent to $AU1.48b in 2015 figures)</td>
</tr>
</tbody>
</table>


The project involved the financing, design, construction, operation, and maintenance of a 3.6 km long motorway in twin tunnels between the Epping Road bridge crossing of the Lane Cove River in Lane Cove West and the Gore Hill Freeway in Artarmon; the financing, design, construction, operation, and maintenance of two tolled north-facing ramps connecting the Warringah Freeway in North Sydney with Falcon Street and Military Road; and the financing, design, and construction of associated improvements to existing surface roads and intersections, including widening of the

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Gore Hill Freeway to six lanes with a transit lane in each direction and major modifications to Epping Road and Longueville Road between Wicks Road in North Ryde and the Gore Hill Freeway in Artarmon, to improve facilities for cyclists, pedestrians, and public transport. An overview report on the Lane Cove-Gore Hill corridor, which examined the impact of the proposed tunnel on the corridor, was released in December 1999. An EIS was released in early 2001.

The Minister for Roads announced in October 2003 that the preferred consortium to design, build, maintain, and operate the LCT was the Lane Cove Tunnel Consortium (LCTC). The ownership of the LCTC changed in June 2004 when the equity interest held by ABN AMRO and others was taken up by Cheung Kong Infrastructure Holdings Limited (CKI) and the Li Ka Shing (Overseas) Foundation and the consortium renamed as Connector Motorways in December 2003. Remaining equity was provided by Thiess Pty Limited and Transfield Holdings Pty. Limited. Connector engaged the Thiess/John Holland Joint Venture for D&C of the project. Transfield Services Limited operated and maintained the motorway.

The LCT was opened on 25 March 2007. By linking the M2 Motorway and the Gore Hill Freeway, the project completed the Sydney orbital motorway, connecting the north-west sector of Sydney with the city. The LCT has been a 'high profile' toll road with usage below expectations. Actual traffic level was 37% lower than predicted during the first year of operation (2007-2008). In the first half of 2009, the tunnel was being used by around 58,000 vehicles every weekday. Tolling is fully electronic and interoperable with other Sydney toll roads. Connector Motorways had a contract to operate and maintain the tunnel and adjoining motorway areas for 30 years. Connector, however, after a string of losses went into receivership in January 2010. Transurban purchased the tunnel in 2010.

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66 Ibid., p. 25. Whilst the EIS was a significant milestone, several years were to elapse before planning approvals were granted and tenders called.
Variations:

March 2004

The additional costs of the new and revised north-facing and south-facing Falcon Street ramps, of just under $AU11.5m ($AU15.41m in 2015 figures), were met by the RTA which also provided a net amount of $AU30m ($AU40.21 in 2015) for a series of other changes to the project.

August 2010

The tunnel was sold by the Lane Cove Tunnel consortium, in administration, to Transurban.

4.3 Transurban

Listed on the Australian Stock Exchange in 1996, Transurban (originally called the CityLink consortium) was at first a single purpose entity set up to finance, design, construct, market, operate, and maintain the 22km of privately developed toll road known as the Melbourne CityLink Project, linking the north-western and south-eastern suburbs of Melbourne.\(^6^9\) As shown in Figure 31, above, CityLink has two major sections: the Western Link, connecting the Tullamarine and West Gate Freeways, and the Southern Link, connecting the Monash and West Gate Freeways.\(^7^0\) Transurban negotiated with the Victorian government as part of the concession deed to defer payment of certain costs – land rent and other charges government wished to recover. The government contribution became valuable, with CityLink able to create and ultimately defer such costs which, had they been upfront or paid early in the project development, would have considerably weakened the project’s IRR. Rose (1998) estimates that in the project contract, Transurban’s exercised option to defer payment of the concession fee to the government had a very significant value. “In fact the option value could account for more than half of the market value of


Figure 31: CityLink circa 2014

Source: https://www.citylink.com.au/whatiscitylink.asp#jumpToVisitorsMap
Transurban securities. This significant value is attributed to the fact that the option preserves investor returns for (approximately) the first 15 years of the project’s life.”

The Western Link opened on 15 August 1999 with tolling commencing on 3 January 2000. The Southern Link was completed on 21 December 2000. Soon after Transurban sought to extend its activities to Sydney – where ultimately it became the dominant tollroad operator.

In April 2001, Transurban’s consortium filed expression of interest for Sydney’s Lane Cove Tunnel. In June 2001, Transurban joined with MIG and Leighton in the Westlink consortium bidding for the Western Sydney orbital. With the piecing together of the Sydney orbital, Transurban saw Sydney as one of the world’s biggest markets for greenfield tollroad projects. Released by agreement with the Victorian government from its single-purpose restriction, Transurban secured positions in consortia, bidding on three major developments in Sydney: The Cross City Tunnel, The Western Sydney orbital, and The Lane Cove Tunnel. Only one of those bids was successful. Transurban won a 40 per cent share in what was then called Westlink M7.

In 2002 the company set up an office in Sydney. Unsuccessful in a consortium which bid for the Lane Cove Tunnel project, Transurban’s board commented that: “...the bid reflected our strict investment criteria. We will only invest in projects which we believe will add value for our security holders.”

In Melbourne, Transurban unsuccessfully bid for a new toll road project, the Mitcham-Frankston Freeway (‘MFF’), also called East Link after the name off the winning consortium. Failure in its backyard led Transurban to further concentrate

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75 Ibid., p. 3.
76 Ibid., p. 6.
78 Ibid., p. 9.
79 Ibid., p. 9.
on opportunities in Sydney, including acquisitions and mergers, and to look even further afield, particularly in North America and Europe.\textsuperscript{80}

![Figure 32: Westlink M7](source: Transurban City Link Limited (2003) Annual Report 2003, p. 18.)

Projected revenue from the M7 considerably boosted Transurban’s share price and market capitalisation.\textsuperscript{81} Transurban was in a mood to expand. On 19 April 2004, for $AU96m ($AU128.67m in 2015 figures), Transurban purchased an 8.1 per cent share in Hills Motorway, which owned and operated the M2. Management commented that: “[s]ecuring a stake in Hills allows us to work with its management to extract the benefit of synergies between the [M7 and M2].”\textsuperscript{82} The M2 was later acquired by Transurban in June 2005.\textsuperscript{83}

When the NSW government foreshadowed that Sydney’s then six manual toll roads would move to electronic tolling, Transurban identified an opportunity to assist in the transition. In December 2003, Transurban and MIG agreed to set up a tolling joint venture (JV) and consider joint participation in future bids in Australia. The JV

\textsuperscript{80} Ibid., p. 10.
\textsuperscript{81} Transurban Limited (2004) Annual Report 2004, p. 10. In the actuality, after opening, ramp-up was slower than expected, but traffic outcome was on the lower end of Transurban’s forecast.
would offer full electronic tolling and customer management services to all Sydney’s toll roads.  

In the US, Transurban targeted the acquisition of existing tollroads and High Occupancy Toll (HOT) lanes, which are electronically tolled lanes constructed adjacent to congested freeways, so drivers have the choice to pay for travel time savings. There is an added incentive in that cars with three or more passengers travel free of charge. HOT lane projects on existing roads have relatively low traffic risk, as traffic patterns are already established.

In 2007, Transurban acquired the Sydney Roads Group, which had been spun out of MIG, thereby acquiring control of the M7.

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**Figure 33: Transurban’s Tollroads in Sydney, Post Absorbing Sydney Roads Group**


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In a little over a decade, Transurban went from an SPV for a Melbourne tollroad to a global player and the dominant owner of tollroads in Sydney. After Melbourne City Link opened in early 2000, the business effectively sought to extend its knowledge base, and expertise further afield. It learnt from MIG in joint venturing on the M7 and, as Macquarie sought to exit its Australian toll businesses, Transurban capitalised on its stronger financial, investor, and operational base to mop up comparable tollroad businesses. In doing so, Transurban leveraged its expertise to create a series of options, which it exercised. In finally acquiring the LCT in 2010, the story of the Sydney orbital, as the exercise of a series of real options, was finally complete.

Notwithstanding the considerable success of what might broadly be called ‘the roads lobby’ to build the Sydney network, the current Australian PPP market for toll roads is characterised by the failure of revenue streams to meet debt servicing requirements. There are various features of this problem: First, the revenue forecasts from traffic models were much higher than that achieved, e.g., the Cross City Tunnel, Lane Cove Tunnel, and Eastlink in Melbourne. Second, there has been a significant loss of equity in some high profile projects, e.g., the Cross City Tunnel and Lane Cove Tunnel. Third, there has been a considerable write-downs in share price or market capitalisation of some tollroad companies, e.g., Eastlink, RiverCity Motorway, and Brisconnections. Four, despite most projects receiving by-partisan support, the delivery of some of the latter projects, notably the Cross City tunnel resulted in political controversy, due to public criticism of reducing the capacity of the existing network thereby driving traffic to use the toll road. Fifth, there are high costs of bidding and high barriers to entry. Six, the global financial crisis resulted in a considerable tightening of credit availability. Seventh, investors are more selective and risk adverse in their choice of projects to bid on, and looking for more secure and not necessarily high rates of return. Finally, there has been a lack of readily available funds from the private sector for infrastructure building.87

4.4 Potential, New Road MUTPs in Sydney

Congestion on public roads remains a major public concern. While the incidence of congestion differs substantially between and within capital cities, there is no doubt that peak time congestion levels are high on the primary links in Sydney, Brisbane, and Melbourne, with congestion also becoming more severe in Perth. This results in strong pressure to expand the metropolitan road network, which inevitably involves high costs and more traffic and therefore more congestion. Continued growth in freight, most of which is carried by trucks, and light commercial traffic, only adds to the pressure. After 2007 all new Sydney PPP MUTP road projects stalled; these included Connex West, the Inner West Bypass, the M2 to F3 Motorway, the M5 corridor improvement, and the F6 Motorway. Each are extensions of the present Sydney orbital. New projects, linking to the Sydney orbital are described by the RMS and Infrastructure NSW as the Sydney Strategic Road Network (SSRN).88 The redefined, new ‘missing links’ are outlined below.

WestConnex, formerly Connex West, and earlier still called the M4 East Motorway, is the proposed M4 extension connecting the eastern end of the M4 at Strathfield to the City West Link/ ANZAC Bridge (estimated cost $AU16.8b).89 The RMS envisages that this would need to consist of 6 lanes from Homebush Bay Drive to Concord Road and then in a multi-lane tunnel to Anzac Bridge with a connection to Parramatta Road. Douglas and Brooker (2013) note: “This $10 billion road project was included in the INSW 2012 Infrastructure Strategy before any Cost Benefit Analysis was done.”90 With the previous toll concession on the M4 having expired in early 2010, the government did not re-tender for a new concession and so the toll booths were removed. This caused an immediate increase in demand, making traffic peaks longer, slower, and more difficult to manage. The loss of tolls is also a lost

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opportunity to raise significant funds towards the construction of public transport
networks. There are presently no funds from the M4 for WestConnex.91

The Inner West Bypass is the proposed motorway that involves the construction of a
multi-lane tunnel to the Botany Port and Sydney Airport in the south and to the
north connecting with the M2 (estimated cost $AU12b). An interchange near Rozelle
Goods Yard would connect an M4 East with the new Inner West Bypass. Due to the
limited road surface corridor access available, the bulk of this bypass would be in
tunnel(s), and as such should not be intrusive on the inner urban landscape of
Sydney. Access to Sydney Airport and Port Botany would be considerably improved,
especially from the north and west. INSW and RMS are said to consider this project
to be important for industrial and commercial traffic movements, and they are
seeking funds from IA. But with current funding shortfalls of both the
Commonwealth and State Governments, it is hard to see this project quickly moving
ahead. It might be broken into stages.

The M2 to F3 Motorway is a motorway tunnel connection from the F3 to the M2
(estimated value of about $AU3b). There have been numerous assessments by RMS
of possible alignments with the most expensive (and therefore least likely) being
under Pennant Hills Road to connect the M7 with the F3 via the M2.92 The
construction of an Inner West Bypass makes the construction of a shorter and more
direct link from the F3 to the M2 not only less costly, but more effective for freight
and motorists alike. In addition, a connection east of the previously Federal
government preferred alignment under Pennant Hills Road would take some traffic
pressure off the Pacific Highway leading into the CBD. This connection is promoted
by RMS as a critical piece in the road network improvements needed for Sydney. It
arguably would enhance the ability of the Inner West Bypass to work effectively, and
would provide a motorway service standard for northbound vehicles heading out of
Sydney as well as vehicles approaching Sydney from the North.

91 At the time of writing, this $AU15.0b, 33km project appears to lack robust assessment, yet it is
strongly pushed by the NSW Baird Liberal National Coalition government. See: SGS Economics and
Sydney, February.
92 For example, see: Transurban & NSW Transport/RMS (2013) F3-M2 State Significant
Infrastructure Report, September.
With the M5 Corridor Improvement program, it is worth noting that almost since opening the M5 East experienced long periods of congestion. To cope with present demand, the RMS believes it needs additional lanes in both directions. When the improvements are completed motorists would have 4 lanes going in to the CBD, branching off to 2 lanes to Marsh Street and 2 lanes to General Holmes drive. This would effectively feed and manage traffic to the airport and surrounding industrial areas. West bound there would be 2 lanes out of Marsh Street and 2 lanes out of General Holmes Drive. This would then branch off with 1 lane exiting at King Georges Road and then 3 lanes on to provide a new wider 6 lane M5 all the way to Camden and beyond (estimated cost $AU 4b). This project is a major priority of INSW. The project and rumblings to ‘improve’ the corridor is indicative of how the original M5 tollroad has defined a ‘mindset’ that supports more and more extensions of the existing network: instead of thinking of car alternatives, the mindset is to build more of the existing network.

The F6 Motorway is a proposed corridor for the extension of the F6 Motorway to the south of Sydney. The construction of an Inner West Bypass opens up the F6 Corridor for road and public transport opportunities. Traffic coming in from the southern suburbs of Sydney would be able to connect with General Holmes Drive and the new Inner West Bypass. This addition to the motorway network is considered by the RMS as desirable, but not an essential addition to the network.93

The concept of the Inner West Bypass coupled with the motorway standard connections to the South (Wollongong), to the South-West (Hume Highway to Melbourne), to the East, and to the North (Newcastle), together with the current orbital motorway network is promoted by RMS as making travel to, from, and within – and around - the Sydney region far more efficient. This summary of potential road projects shows how advanced the RMS is in having projects ‘oven ready’94 for funding should windows of opportunity open up. Having conceived and created the

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93 Or perhaps, given INSW support as a given, the RMS is ‘gaming’ in seeking support for additional projects.
94 This phrase is common with infrastructure and transport projects. An oven ready project means a planned and approved project, awaiting financing and/or construction start, as if with cooking, the ingredients are ready to pop into the oven. See reference to the concept in Clapham, David F., Clark, William A.V., & Gibb, Kenneth (2012), editors, The SAGE Handbook of Housing Studies, Sage Publications Ltd., London, pp. 39f.
Sydney orbital, the road lobby is seeking to create new options to build upon that foundation.

### 4.5 A Flawed Model?

What has been outlined, the development of the Sydney orbital as the implementation of a series of ROs is a practical illustration of the theory underpinning this Thesis. As time went on, the RTA/RMS grew more experienced and clever in extracting value from the concessionaire consortium bidders for new projects. Whereas with some of the earlier projects, the RTA/RMS contributed to the cost of projects, by the time the CCT and the LCT were up for consideration, the bidding parties paid upfront concession fees to the government. Overly ambitious patronage forecasts underpinning the financial model of particular bids and the resulting loan default of concession parties show that it is not only the public sector that can make colossal mistakes.

Though contestable, it can be said that the Sydney PPP road procurement method for road infrastructure has in general proved its worth by bringing about improvements in the provision of public infrastructure through shorter delivery times, better value for money, and increased innovation. There are several important lessons to be drawn here. The first is that having to persuade investors to part with capital for such mega projects typically produces a higher degree of scrutiny of the project’s underlying feasibility than is often the case for government funded mega projects. The second is that even when such scrutiny is flawed, such that a concession project does badly as we saw with the CCT and the LCT, it is the investors who are most at risk financially, rather than taxpayers. Third, despite financial difficulties of several high profile road projects, they have remained in service meeting transportation needs. In some cases the original company went bankrupt with the assets purchased by new owners (with approval of the government agency that is a party to the concession). By purchasing the asset at a fraction of the original cost, the new owners sought to operate it in a financially sustainable manner. Thus, the case for using the concession approach for transportation mega projects is a strong one. The PPP model has encouraged private investors to fund services that would have normally been provided by government over a much longer time period, and as a
result freed up government funds for other high priority services. Fourth, as with the Sydney tollroad experience, the ability to ‘bundle’ finance and operation over the project’s life creates incentives for life-cycle management of the asset, including the timing and extent of maintenance and capacity expansion.

Seen as a series of discrete projects, the Sydney PPP model is characterised by such efficiencies. But from an overall systemic or network basis, a less sanguine perspective is merited. For example, with respect to the setting of tolls on an efficient basis, taking account of the need to manage congestion; and the interaction between the tolls set on the road managed by the concessionaire and the road network as a whole. NSW does not manage road assets on a commercial basis. The ‘gap’ filled by the Sydney orbital begs consideration of persistent deficiencies in the operation, maintenance, and expansion of those assets. Undoubtedly, within its own terms a successful organisation, the RMS operates on a non-transparent basis, with only vague statements (in its annual reports) about performance indicators such as road condition targets, traffic flow, and the estimation of the maintenance and expansion investment required to efficiently meet reasonable public demands on the road network. Arguably, that estimate should be subject to approval by an independent regulator, including the efficient schedule of maintenance and expansion - with a view to the life cycle values of costs and benefits.

In Australia a central problem with major rail projects is sorting out funding/financing models. By funding, this is derived from general revenue today (funds allocated in a Budget) or for a future generation (e.g., borrowings), or a version of user or beneficiary pays (such as fares or developer charges) to service the costs of the infrastructure. This can be helped by clearly defining property rights ahead of time (as indicated below). If this is sorted, decisions whether to have the infrastructure financed/owned by the public or private sector should be easier, at least in principle.

Government

Institutional arrangements that have a government as the entity selecting projects vary in their make-up. They generally involve a government department or agency that undertakes planning, considers a range of options, develops and assesses project
proposals, and provides advice on those to its political master. Ministers then decide which projects are put forward for consideration by Cabinet which thereafter decides on whether they proceed. In some cases, there is also a separate agency that reviews infrastructure project proposals developed by departments across a range of portfolio areas (for example, Infrastructure NSW).\textsuperscript{95}

In Australia multiple levels of government are often involved in these arrangements. For example, a State or Territory Government’s decision to proceed with a project may be conditional on receiving a Commonwealth grant. Accordingly, the Commonwealth’s assessment and prioritisation of a state-based project may determine whether or not it is built. Since 2008, Infrastructure Australia (IA) plays a role in advising the Commonwealth on these matters. Local governments also develop infrastructure project proposals that depend on financial support from higher levels of government to proceed.

Institutional arrangements that include governments as the ‘project selector’ are the norm for roads, passenger rail networks, public transport, and social infrastructure (including schools, hospitals and prisons). Governments sometimes also select projects in sectors where government-trading enterprises are responsible for delivering services using the infrastructure. When governments select projects, in principle, they can weigh up costs and benefits from a community-wide perspective (using CBA and WEB). This means that benefits that are not captured by direct user charges (for example, reduced travel times from a non-tolled road) can be taken into account.

An important qualifier, however, needs to be made about road funding as distinct from, say, rail. Road funding is notorious for lack of rigorous CBA assessment. From formation in 2008 to 2014, IA was insistent that roads funding required market reform before further spending would elicit more efficient outcomes: IA’s \textit{State of Play} report (2013) labelled roads the worst utility, by all measures. Roads “stood out” for poor performance, with “no economic efficiency objective”, “no coordinated planning or

\textsuperscript{95} Infrastructure NSW was created in July 2011. For background, see: \texttt{http://www.infrastructure.nsw.gov.au/about-insw.aspx}, accessed June 2014.
design”, “no review of proposals or results”, and “no commercial medium for users to influence capacity or design.”

Private Sector

Private sector investment is generally based on an analysis of the expected net benefits that will accrue to the company concerned. Their assessment is narrower than a CBA conducted by government, where the WEB for a particular firm, perhaps understandably, might be of secondary importance. Due to the existence of market failures and equity issues, private investment decisions may not always align with the public interest.

There are various models of private sector engagement. One is the long-term concession or build-operate-transfer (BOT) model, under which a private consortium, selected by a competitive process, gains a long-term ownership interest in the project of sufficient length to ensure that over the period it has a likelihood of making a reasonable return on the investment. Because of this long period of responsibility, the consortium has strong incentives to ‘build right’ in the first place, minimising lifecycle costs (as opposed to only the upfront costs). This summary points to the significance of accountability and risk-management, which the conventional government model frequently fails to provide.

Basing a project’s viability on prospective revenues introduces a strong constraint on capital spending that is absent in projects solely funded by governments, where arguments can always be made that by re-ordering priorities, borrowing more or getting additional grant funds, extra money can be found. Yet experience with the Sydney Cross City Tunnel and the Clem Jones Tunnel (North South Bypass Tunnel) in Brisbane shows that the private sector can also be gullibly optimistic and quite capable of making huge estimating errors leading to those particular projects going into administration.

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97 The Cross City Tunnel is discussed above. In Brisbane, in February 2011, the managers of the Clem 7 tunnel put themselves into administration, with the business sold a few years later. See O’Sullivan, Matt (2013) ‘Turning $3b into $618m, Brisbane’s Failed Clem7 Tunnel Sold Off’, Sydney Morning Herald, 27 September.
When the private sector takes on a major project and puts a financing package into the capital markets, it usually only gets one shot. After the financial closing, it has a discrete sum beyond which it cannot spend, at least initially. This inherent discipline throughout the detailed design and construction of the project argues favorably for transference of risk to the private sector. For example, as we saw in Chapter 2, Melbourne’s CityLink joins three existing radial highways together with tolled sections of road to provide a route through the centre of Melbourne. It is a tolled mega project that includes major elevated and tunnel portions through the downtown CBD. Built in a period overlapping Boston’s Big Dig in a similar urban environment, both projects had to cope with challenging soil conditions: Boston’s in bay edge fill, Melbourne’s in river and creek beds. Both had to go to great lengths to maintain existing rail transit services and underground utilities while not interfering with traffic during construction. Boston’s tunnels were much bigger, but Melbourne’s were deeper, involving enormous water pressures and uplift. Each encountered significant construction problems. Each included a signature bridge. Both projects had smart, competent engineers and managers. Yet Melbourne’s was built in one-third the time and at one-third the cost ($US27m per lane-mile vs. $US91m per lane-mile).

A key difference was the project delivery model. CityLink was developed as a long-term concession, by a private firm funded with equity and debt. The chief constraint on cost escalation was provided by the company’s need to limit overall project spending to that supportable by tolls.98 There was always a clear limit to which everyone had to work in Melbourne. In Boston there was a constantly escalating ‘estimate’ for which no one was accountable.

Allen Consulting Group and the University of Melbourne (2007) studied the performance of 54 large infrastructure projects, nearly half of which were in transportation. 21 were done via the private finance (PPP) model and the other 33 via traditional public sector procurement. Cost overruns on the PPP projects averaged 1.1 per cent, compared with 15 per cent for the traditional projects. In

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98 OMEGA Centre (2009c) *Melbourne City Link*, OMEGA Centre for Mega Projects in Transport and Development, Bartlett School of Planning at University College London, and the Australasian Centre for the Governance and Management of Urban Transport (GAMUT), University of Melbourne.
terms of schedule, the PPP projects averaged 3.4 per cent ahead of schedule, compared with 23.5 per cent late completion for the traditional projects.99

Consider the very different incentives involved in this model – assuming a government tender on a defined project requiring a fixed price contract. Putting the arguments at their strongest: First, the fact that businesses bid on the project brief suggests that they did so on the basis of fiscally viable and sustainable proposals. The winning consortium almost certainly would use the design-build method, in which a single team designs and constructs the project, thereby facilitating efficient constructability because everyone has the same incentives. Design-build also generally cuts the overall development time significantly.

Second, since the investors who finance the project (banks, toll revenue-dependent bond buyers, and equity investors) are strongly motivated to avoid cost overruns, the design-build team are held accountable to a fixed price that allows for various contingencies. This exerts strong pressures to produce a buildable design and to solve problems efficiently - because it is the consortium’s own money at stake in cost overruns. (Except, of course, when it is not – such as where there is lack of alignment between the manager and the investor(s) in a consortium, when for the former the latter is just ‘other peoples’ money’.100)

Third, because the investors are concerned about toll revenues flowing on time, so the consortium can start making the required debt-service payments, they typically insist on a guaranteed completion date, with significant daily financial penalties (liquidated damages) if the deadline is not met. And finally, because the team that develops the project is also responsible for operations and maintenance (and returning it back to the government agency in good condition at the end of the concession term), the consortium has strong incentives to design and build the project in ways that minimise not only its initial cost but its lifecycle cost. This is why toll roads and bridges are generally built in a more durable way. Stronger and

more durable pavement means lower maintenance expenses over time. Furthermore, the investors typically require legally enforceable bond covenants that guarantee proper maintenance of the facility over the life of the bonds, to protect the asset value of their investment.

The lack of user charges on the road network creates the impression that road services are a ‘free good’. IA complains that from a national perspective, “there is no explicit or implicit objective of economic efficiency for roads.”\(^\text{101}\) Hence the focus in both the PC review of public infrastructure (2014), and the Henry review of taxation in Australia (2010), that road user charges, subject to approval by an independent regulator, should be introduced. Such a regulator would form a view as to what charges are reasonable, taking into account other charges to which road users are directly subject (such as petrol, licence, excise, and registration fees, as well as tolls on certain roads). Relevantly, there has been extensive discussion of the scope to improve road use, investment, and financing through congestion charging. This is a part of the debate concerning enhancing the quality and implementation of investment decisions, and improving the financing of investment in roads and other publicly funded infrastructure. Seen from an efficiency perspective, congestion charges equalise the private and social marginal cost of using scarce road surface. On the principle that “user charging can be an efficient means of financing some government-provided goods and services and of rationing individual access to community resources”,\(^\text{102}\) congestion charges were recommended by the Henry Report as a way of ensuring better use of, with better investment decisions with respect to, roads. Henry proposed that: “In major cities, location-specific congestion charges would vary according to the time of day. City roads would be less congested during peak periods, with higher travel speeds and shorter travel times saving time for road users, reducing vehicle costs and reducing greenhouse emissions. The revenue from congestion charges on existing roads should flow back to the community, initially to finance public transport in affected areas.”\(^\text{103}\) Note that “city roads” include more than just the existing toll roads. Another consequence of this


\(^{103}\) Ibid., Section E.4.
recommendation is that the efficient charging of roads could also help alleviate pressures to excessive dispersion in the settlement pattern, thus reducing the need for investment in extending social and physical infrastructure.

The alternative of building new roads, avoiding required investment in public transport and perpetuating the mantra of more roads to ‘fight’ congestion, seems to be the contemporary position of the RMS and INSW. The latter states, “The success of the network in serving previously unmet need means that today, some two decades since this cycle of motorway construction began, congestion is a major issue on many parts of the SSRN. Some motorway sections are operating well in excess of design capacity.” 104 In contrast to that perspective, IA in a 2013 review of infrastructure projects lamented the lack of rigour and application of competition principles to road funding: “The approach to roads has been different [to rail and other transport infrastructure], with no attempt to apply national competition policy, economic or location concepts.” 105 Where user charges are not imposed, investment is underwritten by future taxpayers. Governments have sought to relax the constraint this imposes by means of PPPs, which are concession contracts involving designated road structures. In most cases, these involve roads for which users pay tolls determined on the basis of the concession contract. Where the project merely involves providing a private entity with the right to ‘tax’ users in the form of a toll, it may actually reduce efficiency if the resulting tolls are above efficient levels.

The scope to finance major projects by imposing such hidden taxes may worsen project selection, by increasing the opportunity costs – including the cost of passing up the next best choice when making a decision. The CCT, largely driven by private sector proponents, is a case in point. The danger is in a system which induces government to artificially reduce or restrict competition to the project, for instance by degrading competing roads or not upgrading them as and when such upgrades should occur. Where, from negotiation with the RMS, the toll concessionaire has generously set tolls, where tolls are indexed above CPI, effectively over time the public pays an expensive price. Moreover, if the government remains the primary

risk-bearer, for instance because the project is effectively ‘too big to fail’, then the incentives for it to be undertaken efficiently may be blunted.

There is significant debate on road user charges – which do not necessarily need to be in the form of a tax. Experiments in the Netherlands which have rewarded good behaviour have been piloted,\(^\text{106}\) as have discussions on how the current fixed charge of registration may be translated into a variable charge dependent on usage.\(^\text{107}\) Ultimately, any efficiency gains the PPP provides needs to be obtained at less cost to the community by means of a conventional ‘design and build’ contract. PPPs should be used when the requirement to enter into a contract forces the government to clearly articulate objectives and lock them in, under circumstances where doing so is efficient in terms of managing risk.

There are doubts, however, about the continued financial sustainability of the Sydney PPP road model,\(^\text{108}\) and whether the past represents a good guide for the present and future of such projects. In recent literature, there is debate about government co-investing with the private sector, in what is still a PPP, but with some of the financing provided by government. In PPP projects, it is often necessary for host governments to provide guarantees to investors due to the large scale of investments involved, long tenure of the project, and hence greater risks. Thus the observation that, with RO theory, the government guaranteeing of part or all of a PPP project has value that can be priced. Recent research “illustrate[s] the significance of the valuation to both host government and investors, and provide them with a clear reference when negotiating on the level of restrictive competition.”\(^\text{109}\) Thus the private funding of new major


road projects are likely to be highly dependent on government funding; this begs
issue with the model applied hitherto in Australian tollroads.

Intriguingly, in 2012 INSW paid homage to the original vision and strategy of the
roads bureaucrats 25 years before by lamenting that: “No new motorway project has
been tendered in NSW for almost a decade. One factor behind this has been the lack
of an affordable coherent network strategy for the SSRN. Before any new project is
commenced, NSW needs an overarching vision equivalent to the Sydney Orbital
Network plan of two decades ago.”

4.6 Conclusion

This Chapter has focused on the RTA/RMS’s systematic, disciplined approach
to realising ROs in the development of the Sydney orbital, and how Transurban’s
experience too can be seen as the exercise of ROs in its transformation from SPV to
tollroad behemoth. In both cases, management expertise, innovation, the
containment of risk, and the search for innovation led to the creation of ROs and
their exercise.

From a close reading of the orbital road projects, it seems in practice there was some
flexibility within each project. The more acute question, though, is whether that also
exhibits signs of the TRO. Taking the orbital as an overall project, it can be argued
that dividing the concept into a number of individual projects, which in combination
constitutes a coherent whole, is prima facie evidence of TRO. Needed though was a
plan and a strategic remit that enabled the constituent parts to be pieced together.
The evidence is that particular projects were delivered that way. A simple sequence
of projects by itself, however, does not support the existence of TRO. The
appropriate response to that doubting proposition is to show what options existed at
each stage (to retreat, postpone, cancel, modify, or commence). The particular case
studies provide evidence on what happened when and how. More detailed research,
interviews with participants for example, might provide buttressing evidence. But
the frequent references to ‘missing links’ and the orbital development contained in
the public justifications of each project is evidence enough for the case proposed in

The orbital created its own momentum. Gleeson, Curtis, & Low (2003) remark that: “...the survival of Sydney’s road program is a remarkable testament to institutional and professional resourcefulness in the face of profound dilemmas that were to overtake and obliterate other areas of public endeavour...”\textsuperscript{111} It seemed ‘logical’ to extend it. Each new part of the freeway network created a need for the next part. The entrepreneurial approach of the roads lobby, including the state bureaucracy, stood in marked contrast to the rail authorities. The blueprint was crucial. Caulfield & Painter (1995) note that in road planning “[w]hile strategic planning was a high priority, other factors drove investment decisions, such as the state of readiness of inherited plans and projects including the availability of land corridors.”\textsuperscript{112} The Sydney orbital was developed as the exercise of a series of ROs, the funding for each project was opportunistically sourced. The next Chapter discusses and contrasts rail with road projects in Sydney and addresses the relevance of the TRO to MUTP development and actualisation.


5. Real Options (ROs) and Sydney’s Rail Transport System

This Chapter sets out the context of and rationale concerning the major strategic thinking of the rail authorities concerning Sydney rail MUTPs and the reasons for the characteristics of decision-making with respect to such projects between 1990 and 2010. The methodologies associated with the TRO are contrasted with the actual unfolding of rail MUTPs in Sydney. In so doing, the utility of TRO is explicated. Some arguments are put forward as to why the prescriptions recommended in this Thesis would have been more appropriate. Three major projects are highlighted: the Airport Rail Link (ARL), the first major Sydney rail line project since the Eastern Suburbs Railway opened in the late 1970s; the Epping to Chatswood Line, originally slated to also connect Epping to Parramatta, and the Clearways Project. Comment is also made about other rail projects and extensions (most of which were abandoned).

Because the Sydney rail network story is complicated and any critique of past plans necessarily nuanced, the first section of the Chapter is contextual, under the sub-heading ‘The Sydney Public Transport Environment’. This section of the Chapter provides basic information on the NSW public transport history, particularly covering rail; constant changes in management, along with a discussion on the culture of secrecy and a discussion on why poor progress was made, despite most of the main problems were well known and discussed in management reviews. The second section of the Chapter deals with the case studies, Airport Rail Link (ARL), the Epping to Chatswood Rail Link (ECRL) and the Clearways Project. All three are examples of completed projects. A third section deals with several abandoned plans, in north-west Sydney, the Metro projects, and brings the reader up-to-date on current projects. A brief section comments on choosing between projects. Finally, the last section is a conclusion which points to the relevance and utility of TRO to the planning of mega rail projects in Sydney and more generally.

5.1 The Sydney Public Transport Environment

With the NSW rail system, one clear feature of the history of the two decades under consideration is the chaos of changes in strategic direction, management changes, structural and legal changes, and policy turmoil. In contrast, the RTA was relatively
stable in personnel¹ and direction, learning from each contract as it pieced together the Sydney orbital. The RTA had a plan and exercised a series of ROs to realise it.

Of the mess that was NSW transport policy, former NSW Minister for Planning, and earlier, Mayor of Sydney, Frank Sartor, persuasively summarised that:

The provision of transport, particularly public transport, represents the greatest policy failure of the state governments of New South Wales, extending back at least sixty years. Today there is a thorough mismatch between the public transport network and the distribution of population in the Sydney basin. The rail system is interminably playing catch-up on issues of maintenance, safety, efficiency and reliability, and it is invariably underfunded.²

Despite such problems, when MUTPs were proposed, the NSW Labor Government (1995-2011) shifted and zig-zagged in so many directions that an increasingly frustrated community enthusiastically voted it out at State elections in March 2011.³

In June 2005, six weeks before Bob Carr (Premier, 1995 to 2005) departed the NSW political scene, he announced a new public transport program, the Metropolitan Rail Expansion Programme (MREP), which proposed a new CBD rail line from the city, across (under) the harbour north to Chatswood, a south west line between Leppington and Glenfield, and a north west rail link from Cheltenham or Epping to Rouse Hill.⁴ His successor as Premier, Morris Iemma (Premier, 2005 to 2008) scrapped those plans, apart from the south west line. He proposed instead a metro

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¹ Until at least 2005, when the then Minister for Roads, Joe Tripodi, sacked the RTA chief executive Paul Forward for allegedly providing him with misleading information on the Cross City Tunnel. [AAP report] (2005) ‘RTA Chief Falls on his Sword over Tunnel’, Sydney Morning Herald, 27 October. In 2010, the then Minister for Roads, David Campbell, stood down the then RTA head, Michael Bushby, for allegedly failing to provide the government with an ‘adequate’ report on what occurred with certain major traffic delays on the F3 delays that week. Crennell, Andrew (2010), ‘Leave Me Alone, I’m Just the Minister’, Sydney Morning Herald, 15 April. Notwithstanding the capricious behaviour of the ministers, the RTA had already executed contracts for all of the Sydney orbital road projects, including the Lane Cove Tunnel.


³ Other factors were significant too, including corruption allegations, leadership turmoil, and a botched electricity privatisation proposal that forced the resignation of the then Premier as well as the Treasurer. See: Cavalier, Rodney (2010) Power Crisis: The Self Destruction of a State Labor Party, Cambridge University Press, Port Melbourne.

system as ‘the answer’, including a north-west rail metro. With that project he argued that as most of the former ‘above ground’ rail corridor had been sold by previous administrations (effectively killing off the option of a less expensive rail link), an underground tunnel was the only way to deliver new rail capacity. Premier Nathan Rees (Premier, 2008 to 2009) made a version of the metro the lynchpin of his transport policy, scrapping the north-west metro, but insisting on an inner city core metro as a ‘first stage’ – an option on which to build in the future. Premier Kristina Keneally (Premier, 2009 to 2011) scrapped the metro and announced her own initiatives, including an upgrade of the main western line’s capacity, which was called a fast western rail service. This was never implemented. The Liberal/National Coalition government of Barry O’Farrell (Premier, 2011 to 2014) abandoned previous priorities announced by the Labor Government and instead focused on delivering the North-west Rail link and extensions of light rail into the CBD, as well as completing the south-west link. These rapid changes of policy were extremely costly, as was noted in a NSW Audit review: “Until the Government’s decision not to proceed with a metro for Sydney, over $AU600m [$AU673.3m in 2015 figures] in State and Australian Government funding had been allocated to Sydney Metro for the development of metro projects.” Even more tellingly, the NSW Audit office commented that: “As at 30 June 2010, $412m [$AU462.3m in 2015 equivalent] has been spent on metro projects with more costs expected in 2010-11. Outgoings included $176m [$AU197.5m, 2015 number] in project expenditure written off as a result of the Government’s decision to stop work on metro projects, $94.9m [$AU106.5m, 2015 number] in cost reimbursement claims, and $103m [$AU115.6m, 2015 number] in property acquisitions. Of the $412m [$AU462.3m, 2015 number] spent, $356m [$AU399.5m, 2015 number] represents expenditure for which there does not appear to be any future benefit to New South Wales.” INSW bluntly commented that the figure of lost expenditure was close to $AU600m and that “there is nothing to show for it.”

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6 Audit Office (2010) NSW Transport Services Overview, 2010, p. 14. Figures are in $AU. A former NSW Transport Minister from the 1970s told the author in 2011 that he was astonished that such ‘lost sums’ did not attract greater public ire.
In the rail authorities case, however, apart from the Clearways project (explained below), most projects were unconnected, separated from each other, and unable to be described as the development of ROs capable of exercise and creating new options for future work. In contrast to the RTA’s ambition to execute major infrastructure provision section by section, de-megatising the overall scheme, many of the rail projects in Sydney were poorly thought through, too complicated, too expensive, and therefore prone to failure. 8

NSW Transport Snapshot

Figure 34 below sets out a summary of NSW public transport services, including rail.

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With public transport, rail in terms of movement of passengers and in assets under management, easily eclipses the bus network. Though the latter moves two thirds of the passengers of rail, it does so with 1 per cent of the public sector assets under management.\(^9\)

Noticeable too in the summary associated with this Figure is the lack of reference to ‘cost recovery from users’ with respect to the road network – an issue discussed at the end of Chapter 4 of the Thesis.

Most of the discussion in the Thesis is about roads versus rail MUTPs. But it might be useful to briefly pause to note the recent Sydney light rail experience. There, from 1997 to 2012, the initiatives were driven by the private sector, though with significant funding support from government at the beginning and in key stages of project and network development. The private owners (mostly Australian superannuation funds), right up to selling their business to the NSW Government in 2012, sought to pursue and exercise options to extend the network, first to Lillyfield (with Keating Government ‘Better Cities’ funding), then to Dulwich Hill in the inner west (announced in 2010, and completed in mid-2014), and into the Sydney CBD (the ultimate route and completion of which is still uncertain.)\(^{10}\)

Constant Changes in Management and Structure

The rail network in the greater metropolitan area of Sydney underwent regular structural and organisation change in the two decades under consideration. A map showing the contemporary network is at Figure 35.

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\(^9\) The comparison between rail and bus requires acknowledgement that with the latter the passenger numbers in Figure 34 refer to both public and private bus services; whereas the assets under management only refer to assets owned by the government. The value of the bus corridor network, including bus lanes, in this table does not estimate the value of the corridor. Yet the graph calls attention to the merit of one transport mode over another, including in terms of cost, viability, and passenger utility – a subject for a whole new thesis!

\(^{10}\) The author was an independent, non-executive director of Metro Transport Sydney (MTS) which managed and operated the light rail and monorail services in Sydney. At the time of writing the construction of the CBD extension of the light rail from the Haymarket into the city along George Street is now underway, but whether it goes all the way to Circular Quay is still uncertain.
Until 1972, the railways in NSW were operated by the NSW government Railways Department, then replaced by the NSW Public Transport Commission (PTC), which was also responsible for bus and ferry services. In 1980, the PTC was broken into the State Rail Authority (SRA), responsible for rail services, and the Urban Transit Authority responsible for bus and ferry services. The UTA later became the State Transit Authority (STA). In 1996, the SRA was broken into separate business units - State Rail, Rail Services Australia (RSA), FreightCorp, and the Rail Access Corporation.
The RSA was later merged with the RAC, and a single, more powerful infrastructure owner and maintenance operator called the Rail Infrastructure Corporation (RIC) was formed.

In 2001 the ‘above track’ operations were separated from track ownership and maintenance operations, with the latter moving to RIC, which became the “owner and maintainer of the NSW rail network,” and a newly formed SRA as the operator. The separation of ‘infrastructure’ from ‘operations’, including the duplication of operational responsibilities between authorities, was criticised for causing rail delays and accidents. The NSW Transport Minister of the day privately agreed with this criticism. Indeed, the then NSW Transport Minister Scully put forward a Minute to Cabinet in June 2000 arguing for the need to re-create a single body, which he proposed to call Rail NSW. Scully argued that the splitting of the SRA into the new agencies meant a loss of corporate knowledge and expertise - with skilled staff either leaving the industry or being spread too thinly across the various entities. The agency that drove the trains, State Rail, had no ability to adequately provide “safe, on-time running” because it lacked control of “the infrastructure and [other] operational requirements.” The entity in charge of setting down the tracks, the RAC, was focused on “competitive tendering of rail track maintenance, the pursuit of efficiencies and cost savings in infrastructure.” The body set up to maintain the rolling stock and some track work, RSA, had become “preoccupied with protecting itself against any loss of business [from competitive tendering], pursuing alternative work interstate and overseas.” Each of the agencies, according to the Minister, cared for their own well-being “to the subsequent detriment of rail passenger operations.” Worse, he claimed that the lack of integration between agencies meant that the RSA had an “insufficient storage of spare parts” and was failing to give due “attention to properly carrying out routine and preventive maintenance.” Hence, “[n]one of the three rail agency chief executives has ultimate authority,” the minute declared tellingly. “Only one of the organisations - State Rail - is subject to the control of the portfolio minister.” The other agencies, RAC and RSA – then merged into RIC, were

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11 These were changes promulgated by the Carr government’s first Transport Minister, Brian Langton.
12 This became a theme of reports on several rail crashes. See, Goodsir, Darren (2002) ‘Bungling Down the Line Led to Rail Accident’, *Sydney Morning Herald*, 1 August.
13 Notes of conversation in 2001 between the author and the then NSW Minister for Transport.
14 Mr Scully’s views, including his leaked Cabinet minute, are quoted in, Goodsir, Darren, & Kerr, Joseph (2003) ‘Rail’s Red Alert’, *Sydney Morning Herald*, April 12.
under the control of the NSW Treasurer. Scully was defeated in Cabinet, despite the conclusion in his Minute that “[t]he disaggregation of the SRA has simply not worked and has failed to properly address safety and reliability.”

In 2004, under a new Transport Minister, Michael Costa, railways in Sydney became a vertically operated system again with the creation of Railcorp, a fusion of State Rail and the urban sections of the RIC. The Minister wanted a structure where one authority controlled the reliability of track performance for its passenger services. RIC ceded ‘ownership’ of the greater metropolitan rail network to a newly-created body, Rail Corporation New South Wales (Railcorp) reporting directly to the NSW Minister for Transport, and operating passenger trains under the Cityrail brand. Long distance trains were run under the Countrylink brand. Railcorp was established as a statutory State owned corporation on 1 January 2004 under the Transport Administration Amendment (Rail Agencies) Act 2003.

Railcorp underwent a further restructure in June 2013 by transferring its functions as operator and maintainer of rail passenger services to two new government agencies, such that CityRail was rebranded as Sydney Trains while CountryLink was rebranded as NSW Trains. Since 1 July 2013, Sydney Trains has provided train services throughout the greater Sydney metropolitan area.

One other public sector rail authority, referred to later in the Thesis, is Sydney Metro. Established as a statutory body under the Transport Administration Act 1988 on 27 January 2009, its principal activities were to develop safe and reliable metro heavy rail systems as well as hold, manage, and maintain metro rail infrastructure facilities. By ‘metro rail’, the government had in mind a new network of fast trains modelled on the Paris Metro, a single decker rolling fleet and other features. The NSW government cancelled all metro projects in February 2010, however, and thereafter Sydney Metro wound-up, but not until protracted and expensive negotiations with contractors and professional service providers.

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15 Ibid.
16 The definition of a metro train network was never completely spelt out. Indeed, Sydney’s train system could never be anything like the Paris Metro. The lack of density in Sydney along any route being one such factor.
The rail authorities were handicapped by a series of structural and managerial changes – separating track, infrastructure, and operational roles – which caused wasted management time to be internally focused. Having unscrambled in 1996-2003 the old SRA egg into parts, the yolk and albumen were re-joined in the form of Railcorp in 2004. A more powerful Transport Department (since 2011 called Transport for NSW), and a Co-ordinator General of Transport since 2001, were charged with ‘big picture’ thinking, with Railcorp responsible for operating the network. Along with a decade of chopping and changing of management models and personnel, this compartmentalisation of rail experience from strategic planning limited creativity. This is relevant to the theme explicated throughout this Thesis, namely that a TRO fits with a management system of project conception and development, guided by the expertise of managers. Where the experience of the latter is weak, where management structures are overly complicated and dysfunctional, then a TRO might seem to be of remote relevance.

Additionally, the experience with the airport rail line, and the contract between the SRA and the Airport Link Company (ALC), discussed below, soured expectations about the value of private sector involvement in the rail network. The mindset developed in government that the so-called risk transfer to the private sector was a ‘poison-coated boomerang’. Once the operator went into financial difficulty, the risks returned to government, arguably in the circumstances of the ALC arrangements to a magnified extent. A complicated, poorly drafted contract between the private sector party and the government was at the heart of the problem. Related to this was the shedding of expertise within the leadership and senior ranks of the rail authorities.

NSW Treasury formed a cautious perspective on PPPs in the NSW rail sector. Treasury concluded, strongly influenced by the airport rail link experience, that because of the gap in expertise between the government agencies and the private sector, the former would almost always be outsmarted. Hence the thinking was best to avoid PPPs as much as possible, especially where there was complicated

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18 The procurement of rolling stock was the largest involvement of the private sector in the NSW rail network. This was closely supervised by the NSW Treasury.

19 Notes of conversation, between the author and NSW Treasury officials, in 2008-2010.
funding or inter-operational interfacing between Railcorp and a newly added part of the network, such as exemplified with the ARL, as discussed below.

The NSW government released the State Plan – A New Direction for NSW - in November 2006. A priority was to increase the public transport system’s share of peak hour journeys undertaken in Sydney.20 This was a common theme of a host of government public transport planning reports over several decades.21 Figure 36 highlights most of them.

<table>
<thead>
<tr>
<th>Name of Strategy</th>
<th>Date Released</th>
<th>Premier</th>
<th>Transport Minister</th>
<th>Roads Minister</th>
<th>Planning Minister</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Plan: A New Direction for NSW</td>
<td>November 2006</td>
<td>Morris Iemma</td>
<td>John Watkins</td>
<td>Eric Roozendaal</td>
<td>Frank Sartor</td>
</tr>
<tr>
<td>SydneyLink</td>
<td>March 2008</td>
<td>Morris Iemma</td>
<td>John Watkins</td>
<td>Eric Roozendaal</td>
<td>Frank Sartor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport Blueprint</td>
<td>December 2009 (unreleased)</td>
<td>Nathan Rees</td>
<td>David Campbell</td>
<td>David Campbell</td>
<td>Kristina Keneally</td>
</tr>
<tr>
<td>State Plan</td>
<td>March 2010</td>
<td>Kristina Keneally</td>
<td>David Campbell</td>
<td>David Campbell</td>
<td>Tony Kelly</td>
</tr>
<tr>
<td>First Things First</td>
<td>October 2012</td>
<td>Barry O’Farrell</td>
<td>Gladys Berejiklian</td>
<td>Duncan Gay</td>
<td>Brad Hazzard</td>
</tr>
<tr>
<td>Long Term Transport Master Plan</td>
<td>December 2012</td>
<td>Barry O’Farrell</td>
<td>Gladys Berejiklian</td>
<td>Duncan Gay</td>
<td>Brad Hazzard</td>
</tr>
</tbody>
</table>

*Source: Author’s research including relevant government reports.*

Relevant to the rapid movement of ministerial appointments as shown in Figure 36 is the positioning of and the responding changes to the transport bureaucracies. Part of the reason for the influence and power of the roads lobby is that the RTA leadership did not change significantly over this period and so retained the corporate capital that was so lacking in public transport, as the bodies responsible for policy – the State Rail Authority, CityRail, and the NSW Department of Transport, together with their ministerial masters were chopped and changed with corresponding changes in public policy “plans” and public “strategy” documents over the period.
Policy Context of the Sydney Public Transport Environment

With public transport mega projects between 2004 and 2010, the stop-start approach of the NSW government, as projects were announced and then abandoned in quick succession, pointed to major flaws in decision-making. This has caused a high level of cynicism amongst the public about dysfunctional processes to solve the main challenges facing current and potential Sydney public transport users.

Figure 37: The City Rail Sectors

Whereas the hapless, hopeless politician is usually portrayed as the devil, there are deeper problems at the heart of matters. The policy and practical framework relevant to a potential, successful MUTP is the issue.

Traditionally, public transport infrastructure in NSW is funded by the State government - with some limited private sector involvement, such as financing leases (such as with rolling stock), as well as design-and-construct arrangements (under set contracts), and sometimes alliencing arrangements - which, at a stretch, can be described as a public private partnership. Douglas and Brooker note: “there is no Commonwealth operating subsidy support for public transport. Three-quarters of public transport revenue support is paid by the NSW Government with one quarter of the operating cost of bus, rail and ferry service paid through fares.”

Sources of funding could and do include: 1) Budget appropriations as capital works payments – derived from consolidated revenue. 2) Budget appropriation to fund operational expenses – also derived from consolidated revenue. 3) Borrowings by government. 4) Public Private Partnerships in various guises. 5) Leasing arrangements, such as is typical with rolling stock leases – nowadays usually directly arranged between the rolling stock provider and financiers. 6) Fares and other charges. 7) Direct subsidies (such as school concessions) – derived from consolidated revenue. 8) Rarely, such as in Honesuckle in Newcastle, Special Purpose Vehicles (SPVs) have been created - involving a mix of funding sources, including user charges, debt financing, and subsidies – for the funding of infrastructure. Generally SPVs, however, have not been significant for rail transport in Australia. And, 9) Development charges or levies such as applied in the growth centres in south-west and north-west Sydney. For example, in 2010 new development was charged $AU23,000 per lot to fund infrastructure in those areas; this was enacted to help fund new rail links to Leppington and elsewhere in the south west new release areas of Sydney.

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23 In 2015 equivalent dollars this was $AU25, 809. Development charges for rezoning of land, however, in the period 2010-2015 fluctuated considerably, subject to varying charges in different parts of south-west Sydney, a topic too complicated to explore here.
The Sydney rail network is complex and it is worth examining why. Railcorp provides 2,300 train services daily which carry almost a million passengers among 302 stations. To achieve this, Railcorp operates a fleet of more than 1,500 carriages over more than 2,000 km of track. As Figure 37 above highlights, the Sydney rail network consists of four major lines radiating out from the Sydney CBD to the north, south, west and southwest: the Illawarra line from Redfern south to Sutherland and on to Wollongong and the South Coast; the Main Southern Line, from Lidcombe, through Regents Park and Cabramatta and southern NSW; the Main Western Line, from Central through Strathfield and west to Penrith and western NSW; and, the Main Northern Line, from Strathfield north to Hornsby and on to northern NSW.

Other passenger lines branch from or interconnect with the four mainlines - the Airport Line, an underground line linking the airport to the city; the Bankstown Line, from Sydenham to Lidcombe via Bankstown; the Carlingford Line, from Clyde to Carlingford; the City Circle, a mostly underground loop in central Sydney; the Cronulla Line, from Sutherland to Cronulla; the East Hills Line, from Tempe to Glenfield via East Hills.; the Eastern Suburbs Line, a mostly underground line from Central to Bondi Junction now intricately linked to the Illawarra line; the North Shore Line, from Central to Hornsby via the Harbour Bridge; the Old Main South Line, from Granville to Cabramatta via Fairfield; the Olympic Park Line, a balloon loop line between Lidcombe and Olympic Park; and the Richmond Line, from Blacktown to Richmond.

Since the 1980s State Rail has attempted to operate CityRail services in three discrete rail network ‘sectors’, so as to minimise the impact of any service disruptions in any one sector on the rest of the metropolitan rail system: Sector 1 (Illawarra), extending from the Bondi Junction terminus of the Eastern Suburbs Railway to Bomaderry; Sector 2 (south), covering the south-western suburbs of Sydney; and, Sector 3 (northwest), covering the western and northern suburbs of Sydney, the Blue Mountains, the Central Coast, Newcastle and the Hunter.

The Eastern Suburbs Rail line, opened in 1979, enabled train services from Cronulla and the Illawarra to avoid the City Circle loop entirely. Planned in the 1960s, with contracts issued to the Snowy Mountains’ Authority in 1967, the project was marred by delays, industrial relations disputes, and tunnelling challenges. The route was scaled back in 1976, with new track and stations at Martin Place in the City, Kings
Cross, Edgecliff, and Bondi Junction.\textsuperscript{25} The original route to Woollahra and the University of NSW (UNSW) did not proceed. Part of the 1976 review called for new platforms at Redfern, Central, and Town Hall so as to enable a discrete sector of the network to be created.\textsuperscript{26} With that work completed in 1981, together with new above-ground track from Erskinville, the rail authorities were able to take the RO of increasing throughput from Sectors 2 and 3 by freeing up capacity such that trains previously looped through the CBD circle were directed into a discrete sector.

While Sector 1 is largely discrete, the growth in patronage (and hence train services) from the late 1990s to date has led to considerable interaction between Sector 2 and Sector 3 services along the Main Western line corridor between Granville and the CBD. Even in the case of Sector 1, rapid growth in patronage on the Illawarra line has forced some diversions of Sector 1 train services onto the City Circle, which was previously reserved for Sector 2.\textsuperscript{27}

This problem reflects the fact that in the 50 years from 1950-2000 there were almost no track amplifications on the metropolitan rail network. This means all types of services - fast and slow, and to and from a wide variety of locations via a wide variety of routes - are forced to share the same overcrowded tracks, with few if any overtaking opportunities, and with major congestion at the routes’ various junctions.

\textbf{A Culture of Secrecy}

Sydney public transport planning critically turns on considering the potential options. Douglas and Brooker (2013) note that within Railcorp preliminary research, specific route alignment, economic feasibility, and preliminary environment assessments are undertaken. “These documents which are frequently known as ‘options reports’ are primarily undertaken on a technical basis and rarely include

\textsuperscript{25} The author remembers the career advice of his school counsellor in 1972 to study at the UNSW, as there was due to be a station built at Kensington, alongside UNSW. But that was dropped in 1976 with the Eastern Suburbs line only extending to Bondi Junction.


\textsuperscript{27} The information and insights here rely on conversations from 2008 to 2012 between the author and the former head of operations for Railcorp, and former executive in charge of the Railcorp clearways project.
Such studies remain confidential. A theme outlined in earlier Chapters is that good transport planning and the environment in which TRO would thrive requires transparency and comprehensive information flow. Alas, a culture of secrecy is a problem which consistently results in the wrong questions being asked. Decision-making processes, broadly of the muddling through and ‘drift and stab’ approach described in Chapter 1, should be improved by public airing and debate on policy priorities – and thereby with wider inputs deciding on those projects worthy of support. This ought to reduce the chances of over-investment and poor investment in public infrastructure. Yet government is generally reluctant to publicly air its thinking and reluctant to encourage debate on priorities. For example, the handling of the Christie Report, Long-term Strategic Plan for Rail - Greater Sydney Metropolitan Region, is instructive. This report delivered in June 2001 for the Transport Minister by the then Co-ordinator-General of Rail, was deemed as ‘confidential’ by the government. It did not surface until a leaked copy was extensively reported in the Sydney Morning Herald in a series of articles on 25 to 27 February 2002. The report pressed for a huge expansion of Sydney’s railways, arguing that travel around the metropolis would become very awkward otherwise. (Environmental arguments, such as the impact on air pollution and safety, were also advanced). The government’s public response to the publication was to welcome the report. But government media briefings suggested that the Report was a mere ‘shopping list’ of possible projects. Shorn of public knowledge of its contents and the context in which reforms were advanced, the debate about this list was necessarily limited. Following pressure from the cross-bench of the Legislative Council, the report was officially released in May 2002.

In contrast, the Parry Report (2003) on NSW Rail Operations was published by IPART and publicly released for comment. A more recent case was the Boston Consulting Group (BCG) report titled the Customer Service Improvement Program.

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29 The ‘drift and stab’ model of public policy decision-making is where policy preferences are not clearly specified, the processes of organisation not well understood, with people drifting in and out of decision-making roles.
(2008) on reforming Railcorp operations. Although delivered in April 2008, the government resisted its release ‘explaining’ that if the priorities and programmes recommended in that report were more widely known, then decision-making would be complicated by a swarm of lobbyists and companies seeking to gain an inside edge.\textsuperscript{32} The Report, however, was publicly released by IPART late in 2008.\textsuperscript{33}

The Main Problems Were Well Known

It is important to distinguish between the operational challenges facing NSW public transport and the larger strategic issues. Some of the ongoing operational barriers that militate against an effective Cityrail service operating include the lack of investment in signalling and the communications system for the network; the inability to substantially change Railcorp’s operating procedures (something explored and advocated in detail in the 2008 BCG Report to government); the unnecessary maintenance and life-cycle costs of so many different models of rollingstock operating on the network; the inability to restructure the fare system to allow for the introduction of a travel card for use across all transport modes (T-card style);\textsuperscript{34} and, the lack of effective interchange design, which requires they integrate well between transport modes, facilitating continuous movement of passengers and should “no longer be considered merely as passageways for commuters”.\textsuperscript{35} Interchange design requires transfers to be easy, comfortable, short, and assist in enabling attractive use of public transport by commuters. (In this context, Chatswood and North Sydney are both poor examples of design).\textsuperscript{36}

\textsuperscript{33} The then head of IPART thought it was ridiculous that such important reports – the Parry and BCG reports – were secret. IPART unilaterally released them as part of a public rail fare inquiry review it was conducting. This information is based on private communication in 2008 between the author and that official.
On the BCG report, the government cherry-picked the easier things, pruning the ranks of senior management, talking tough on train graffiti, and implementing an organisational restructure. The NSW Audit Office noted late in 2011 that nearly four years on from receiving the BCG report, that RailCorp was cautiously soldiering on, noting that “[s]ince June 2010, RailCorp has made progress with implementation of initiatives” including the delivery of improved on time running management information. Rather vaguely the comment was made that: “Work is continuing on the implementation of initiatives which focus on ... the remaining BCG recommendations.”

Hasten slowly, slowly does it, seemed to be the motto.

More significant were the strategic challenges. The Christie report attested that: “... all types of services - fast and slow, and to and from a wide variety of locations via a wide variety of routes - are forced to share the same overcrowded tracks, with few if any overtaking opportunities and with major congestion at the routes’ numerous junctions. The system is rapidly approaching gridlock.” In this period, this was manifest in the extreme day-to-day sensitivity of CityRail services to even the most minor of disruptive incidents. This was among the main problems to be solved. Ironically, CityRail responded to the requirements of on-time running and problems associated with capacity constraints through innovations in redefining the problem. The method they chose was to slow down the trains and introduce more waiting time to the extent that journeys were longer than a couple of decades earlier. CityRail were able to fashion targets that allowed a response so obviously not in the passenger interest.

Foremost with the Sydney rail network was the evidence pointing to severe capacity constraints. Across the rail network throughput is limited due to out-of-date signalling, bespoke rolling stock, and sub optimal rail alignments; poor transport connections to stations is another problem. There are few park and ride carparks anywhere on the Railcorp network. A former Premier who rode a train from Toongabbie in 2008 was reported to have noted this message from commuters: it is

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hard to get to stations. Carparking space, for example, exists at Penrith, Seven Hills, and Blacktown; but there are poor bus connections. These are typical across the Railcorp network – with major exceptions, such as Chatswood and Parramatta where there has been significant investment by government to improve the efficiency of interchanges; near peak-hour capacity at Town Hall and Wynyard stations; tangled lines leading into the City - a major reason supporting the Clearways project; and, structural and safety issues with the Goulburn Street carpark. This also adds to delays due to trains slowing down on approach, and departure of this past-its-use-by-date, and potentially unsafe construction, at the beginning of the underground network to the city.

The Christie Report surveyed the many factors affecting passenger rail system capacity on any particular section of the rail network and hence CityRail’s ability to meet rapidly increasing patronage demand, including the number of passengers able to be carried on each train. For many years the growth in patronage was successfully handled by introducing double deck trains - the equivalent of cramming more people into each car on the road - but the relief afforded by this measure now has been almost totally absorbed. The major constraint is the total number of CityRail trains, which is failing to keep pace with the growth in patronage demand; and the number of tracks. This is a severe constraint, because outside of sector 1, the Illawarra to Bondi Junction sector, in the period from 1965-2005 there had been almost no track amplifications - the equivalent of converting two-lane roads into multiple lane roads - on the metropolitan rail network; as earlier noted, the need for CityRail to accommodate three types of demand on the one network: i) relatively long-distance intercity and outer suburban demand, ii) short-haul suburban demand, and iii) ‘inner city distribution’ demand. This necessitates a mix of station stopping patterns, with ‘fast’ (‘express’ and ‘limited stop’) services sharing the tracks used by slower trains, some

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40 Conversation between the author and the Premier at the time.
41 See Davies, Anne, & Moore, Matthew (2007) ‘Cover-up: Rail Crash Risks Compared to Granville’, Sydney Morning Herald, 21 March. This article refers to alleged attempts by the rail authorities to suppress reports by structural engineers Cardno MBK and Sinclair Knight Merz concerning the safety of this carpark. The author understands that the main concern is that the pylons supporting the structure could be fatally weakened should a rail crash tip carriages onto the structure. Hence all trains entering and egressing the Sydney underground slow at the approach.
42 Sophisticated signalling systems are immensely important to the throughput and sequencing of trains. In London, for example, because of advanced signalling, trains with the same destination are frequently run at 2 minute intervals to cope with peak hour load.
stopping at all stations. Because there are limited (if any) overtaking opportunities, this significantly reduces the capacity of many key lines; the long train ‘dwell’ times required at the busiest stations, including the main CBD underground stations, as passengers leave trains, and others wait on overcrowded platforms to board; the large number of ‘flat’ (i.e., non-grade-separated) junctions, many of which necessitate complex, ‘conflicting’ train movements (i.e., trains cannot enter until other trains crossing or merging with their path have either passed through the junction or have been held back from entering the junction themselves). The congestion at these junctions substantially reduces the capacity of all lines feeding into the junctions. Further, there is the limit of the signalling system to permit trains to travel closer together, thereby providing greater service frequencies, even in those sections of the rail network where this would otherwise not be ruled out by the necessary mixing of service patterns, junction merging and crossing requirements, and long station dwell times. High-quality engineering and operations management are key to meeting all the requirements of a successful railway—quality of service, reliable and safe performance, and maximum possible use of capacity. With automation, as the railway is a socio-technical system, with human factors never peripheral, the contribution of signalling technology is at a systems level rather than providing point solutions to particular equipment, interface, workplace, or job problems.43

Christie observed that: “In some cases the different services are able to be segregated from each other on four or six track sections of the network, allowing the faster services to overtake. In most cases, however, the almost total absence of track amplifications and junction grade separations in the last 50 years means this option is not available, and complex and disruption-sensitive timetabling is required.”44 He goes on to comment that as the number of trains has increased, the operational robustness of timetables, with complex mixes of types of services, has declined. This argument is similar to the points made by Professor Tom Parry who, in his 2003 Report, identified a number of causes for the then reduced level of reliability, safety, and service quality found on CityRail services. Those causes included the range of services – complicating scheduling, and timetabling provided on the CityRail network; the ‘entanglement’ of

the operating sectors; poor route and timetable decisions; complex stopping patterns; complex crew-rostering practices; and the need to improve management of ‘closedowns’.

Professor Parry put forward various recommendations in favour of improving operations which need not concern us here. To overcome operational impediments he especially advocated the need for Clearways.

Both reports call attention to the need to separate tracks (sectorisation), with Christie especially arguing for new pathways into the CBD (e.g., new track through the western part of the CBD), and across the harbour. The Christie Report’s main focus was on the transport tasks most suited to the movement of large numbers of people at comparatively high speeds. In doing so, however, Christie expressly recognised that in many situations other public transport modes, including road and ‘transitway’ buses and light rail, might be more suitable, especially where relatively small numbers of people are involved. This implicitly acknowledges that transport capacity and modes should be staged, with the RO of shifting to a new mode if demand warrants it.

In the case of several of the possible new longer-term rail corridors in suburban Sydney, Christie said that other modes should probably be used at the outset, with rail adopted for a corridor only if and when the much higher speeds and capacities of heavy rail become important, or when constraints such as road congestion prevent buses from fulfilling their transport tasks. In short, transitways and other ‘feeder’ bus services serve a vital role in combination with heavy rail. Christie stated in his Letter to the Minister, accompanying his Report, that “[p]robably the most important single aspect of the Long-Term Strategic Plan for Rail, however, is its clear identification of the seriousness of the looming problem of severe capacity constraints on the metropolitan rail network.” A detailed program of changes for essential capacity-enhancing works, including the physical separation of different types of CityRail services, was advocated. As Christie recognised, there is some tension between sectorisation on its own, without the development of new capacity, including new

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lines. That is to say, improvements in efficiency are ideally matched by improvements in capacity.

Christie persuasively argued for a new rail route through the inner city and the CBD. “In essence”, he said, “the situation now is analogous to that before the Eastern Suburbs Railway was built in the 1970s. By providing a new route through the inner city and CBD, the Eastern Suburbs Railway provided vital relief for the City Circle and the North Shore line through the CBD, but this capacity relief will shortly be completely used up, even with all the capacity augmentations proposed for the next ten years, and another additional route through the CBD will once again be required.” Even though Christie commented that initial investigations into the new route were then underway, and that a relatively early decision would need to be made by the government, the evidence appears to be that no-one in Railcorp and/or the government was seized with a sense of urgency to address and deal with this challenge, until the metro ‘solution’, discussed below.

Christie’s report (2001) advocated a series of significant and incremental changes that can be viewed as the generation of a number of ROs and the creation of paths that would generate new options. Unfortunately his recommendations were deferred as new Premiers and Ministers toyed with the metro concept. As immediately discussed below, the hasty, opaque decision-making contributed to three lost years of muddling (not even muddling through!)

**Action for Transport 2010**

Action for Transport 2010 was a glossy document launched in 1998 in the lead up to the Sydney Olympics. Seeking to articulate the transport infrastructure Sydney needed in the post Olympics period, the plan was trumpeted as Sydney’s first integrated transport system. Launched by Minister Carl Scully, NSW Minister for Roads and Transport from 1997 to 2003, the plan promised 25 large new road and public transport projects, including “a fully funded rail blueprint [that] will deliver...”

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46 Ibid., p. iv; see also his discussion at pp. 50-52.
"eight new rail lines by 2010..." The improvements to road and public transport systems were touted as improving the productivity of Sydney, reducing pollution, and continuing jobs growth. Figure 38 below lists and examines the 25 projects promised in the plan, and shows those that were carried out and which were not.

Figure 38: Projects Arising from Action for Transport 2010

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sydney Airport Link</td>
<td>PPP rail project</td>
<td>Built. Patronage significantly below projections. Receiver appointed and original investors' interests sold cheaply. Messy and expensive process.</td>
</tr>
<tr>
<td>Bondi Beach Rail Link</td>
<td>Extension of the Eastern Suburb Railway</td>
<td>Cancelled</td>
</tr>
<tr>
<td>Parramatta-Chatswood Rail Link.</td>
<td>A Link between the Western, Northern and North Shore Line.</td>
<td>Epping to Chatswood line completed. New underground platforms built at Parramatta (currently not used). Planning for the rest of line abandoned by Transport Minister Costa in 2003.</td>
</tr>
<tr>
<td>Epping-Castle Hill Line</td>
<td>A new Line servicing the North-west metropolitan area.</td>
<td>Not built.</td>
</tr>
<tr>
<td>Strathfield-Hurstville Line</td>
<td>First incarnation was the Hurstville-Bankstown line proposed. Later modified to link Hurstville with Strathfield, connecting the Eastern line (South and South East Sydney) with the Southern Line (South Western and Inner West), the Western Line (Western Sydney), and the North Shore line.</td>
<td>Cancelled.</td>
</tr>
<tr>
<td>Liverpool Y Link</td>
<td>Creating a 'Y' shaped link near Granville station, linking South Western Sydney with Western Sydney using existing train tracks.</td>
<td>Completed 2013.</td>
</tr>
<tr>
<td>High Speed Rail to Newcastle</td>
<td>$AU800m ($AU1275.96m in 2015 figures) high speed rail link from Hornsby to Newcastle. First stage to be completed by 2007 with further work to Newcastle by 2010.</td>
<td>Cancelled.</td>
</tr>
<tr>
<td>High Speed Rail to Wollongong</td>
<td>$AU287m ($AU457.75m in 2015 figures) high speed rail link from Sutherland to Wollongong by 2010</td>
<td>Cancelled.</td>
</tr>
<tr>
<td>Buses</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Road Project</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blacktown-Wetherill Park T-way</td>
<td>Not built.</td>
</tr>
<tr>
<td>Parramatta-Blacktown T-way</td>
<td>Not built.</td>
</tr>
<tr>
<td>Penrith-St Marys T-way</td>
<td>Not built.</td>
</tr>
<tr>
<td>Parramatta-Strathfield T-way</td>
<td>Not built.</td>
</tr>
</tbody>
</table>

**Roads**

<table>
<thead>
<tr>
<th>Road Project</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Distributor</td>
<td>PPP road project linking the airport To the city.</td>
<td>Opened in December 1999.</td>
</tr>
<tr>
<td>M5 East</td>
<td>An eastward extension of the M5</td>
<td>Opened in 2001.</td>
</tr>
<tr>
<td>M2 to Gore Hill Motorway</td>
<td>Extending the M2 to link up with the Gore Hill Motorway</td>
<td>Completed.</td>
</tr>
<tr>
<td>City West Link</td>
<td>An alternate route for traffic going in and out of the CBD from the western suburbs.</td>
<td>Opened in 2000.</td>
</tr>
<tr>
<td>M7 (Western Sydney orbital)</td>
<td>PPP road project in western Sydney</td>
<td>Opened in 2005</td>
</tr>
<tr>
<td>Cross City Tunnel</td>
<td>PPP underground road project project under the CBD connecting western Sydney ANZAC Bridge traffic to the eastern suburbs and vice versa.</td>
<td>Opened in 2005. Receiver appointed and original investors’ interests sold.</td>
</tr>
<tr>
<td>Parramatta Road Upgrade</td>
<td>Not complete. Superseded by the West Connex project since 2012.</td>
<td></td>
</tr>
<tr>
<td>Princes Highway Tidal Flow Scheme</td>
<td></td>
<td>Completed.</td>
</tr>
<tr>
<td>Victoria Road Upgrade</td>
<td>Numerous small upgrades for Victoria Road</td>
<td>Bus lanes completed.</td>
</tr>
<tr>
<td>New Transport Management Centre</td>
<td></td>
<td>Complete.</td>
</tr>
</tbody>
</table>

*Source: Author’s private research and McKell Institute (2014)*
Many of the projects were allocated funding (at least for design and further feasibility studies). In spite of the plan being trumpeted as “fully funded”, the projects were not. Many were outside the four-year forward estimates and therefore subject to future budget assessment. In the main, it was an aspirational document. One critic since lamented:

...a decade ago, the then transport minister Carl Scully released what has entered city folklore as a wonderful plan, woefully executed. Action for Transport 2010 was an ‘integrated transport plan’ for NSW, now integrated only into the National Library’s online archive, Pandora. It offered Sydney a ‘detailed, planned, affordable construction plan’, then failed to build it.

In NSW, turmoil in transport leadership created confusion and discontinuity, compounding negative impacts. In the period from 1998 to 2011, constant changes in Premiers and Ministers, related institutional restructuring of departments, and associated changes in transport plans and projects, was the only constant! Negative impacts of discontinuity included delays to projects, waste of scarce resources, loss of stakeholder trust and confidence, and loss of professional and corporate knowledge. In the worst example of project delays, the North-west rail Link, planned in 1998 for completion in 2010, was re-planned in 2010 for completion in 2024 after being accelerated, cancelled, replaced, and reinstated. The South West Rail Link planned in 2005 for completion in 2012 was in 2010 re-planned for 2016. The decision to abandon the CBD Metro rail project less than 18 months after its announcement and return to a heavy rail project wasted over half a billion of scarce funds. Could the various options chosen by the government – such as accelerated, cancelled, replaced, and reinstated - be comparable to how TRO is explicated earlier? Yes they can. But the lack of detailed planning, the poor management of the projects, points to the argument that TRO goes together with effective project management. It is not an alternative. Risk and its management, particularly with MUTPs, can be better managed with TRO. It is ancillary or complementary to effective project management.

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50 Scully, Carl (1998c) *Eight Major Rail Projects for Sydney*, press release by the Hon Carl Scully, Minister for Transport, 23 November. This media release was issued on the same day as that referenced in the immediately above footnote.


Conflict over funding for transport within government had associated flow-on impacts on ministers, institutions, plans, and projects. The inability of premiers to generate funds through electricity privatisation, private sector involvement or from the federal government each contributed to their downfall.\textsuperscript{53} There was conflict over funding for transport within government, including the source of funds - whether from infrastructure levies, electricity privatisation, industrial relations reform, toll roads, private sector involvement and/or a combination of the above. The many stakeholders in transport often had conflicting views on appropriate funding sources. Each potential source of funds for transport generated conflict. In addition, the government was not able to harness demonstrated community support for public transport improvements to generate funding to deliver public transport. Partly this was because there was a lack of public debate about needs and necessary projects. Premiers and ministers were in the habit of suddenly announcing new projects out of the blue, frequently in contra-distinction with the official, stated public transport priorities of the day.

A stated commitment to improve public transport was repeated in a range of strategic planning documents from 1998 to 2010. But this was insufficient to deliver improved public transport. The oft-stated government commitment to integrated transport and land use plans was not sufficient. The government was not able to deliver on its policy, and planning goals for public transport. Identifying long-term funding sources is clearly essential to ensure the goals for public transport articulated in strategic plans are delivered. Many decisions were made by premiers interested, but weakly determined, to leave a public transport legacy.\textsuperscript{54} Competence and an understanding of how to translate ideas into reality were lacking. The legacy became that of delay, waste, and cynicism.\textsuperscript{55}

\textsuperscript{53} Premier Iemma resigned in early September 2008 after a bitter dispute in the NSW ALP over his plans to attempt to privatise certain electricity assets so as to provide funding for social and public transport infrastructure.

\textsuperscript{54} Carr’s MREP was suddenly announced on 15 June 2005 before he resigned as Premier on 3 August 2005. In seeking election, his successor Morris Iemma was highly critical of the attention his predecessor gave to major public transport planning. Iemma’s electoral slogan in the lead-up to the March 2005 state election obliquely referenced transport and the initiatives he embarked on: “more to do but on the right track.”

\textsuperscript{55} In part, the last few paragraphs rely on: Daniels, Rhonda (2011) \textit{The Impact of Discontinuity in Governance: How Transport Planning Went Off the Rails in Sydney}, ITLS Working Paper, University of Sydney, December, p. 12.
One project that attracted a great deal of attention within government, and about which a number of myths and storylines formed relevant to our analysis, is the experience with various case studies, beginning with the airport rail link (ARL), to which we now turn.

5.2 The Case Studies

The Airport Rail Link

Airport Link Company (ALC) operates the Green Square, Mascot, Airport Domestic, and Airport International Train Stations located in the 9km Airport Line tunnel, 23m below the earth’s surface. This tunnel links Sydney Airport with Central Station, the Sydney CBD and, through the City Rail network, to over 300 train stations in Greater Sydney and beyond. Unfortunately, due to various legal disputes over the years, and commercial-in-confidence agreements between the NSW government and the private sector parties, some of the details of the project remain opaque to this day. From the information publicly available, Figure 39 below summarises the project.

**Figure 39: Airport Rail Link Summary**

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Contract Term</th>
<th>Opened</th>
<th>Handback</th>
<th>Private Partners</th>
<th>Toll</th>
<th>Contract Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line from central station to the domestic and international airports, then to Wolli Creek and Bankstown line. New stations at Green Square, Mascot, Domestic and International airport.</td>
<td>9km</td>
<td>1995-2030</td>
<td>20 May 2000</td>
<td>2030</td>
<td>Transfield consortium, D&amp;C on track, PPP in building the stations</td>
<td>Station usage fees are charged as part of the train fare</td>
<td>$AU900m (estimated capital cost at the time the contract completed or $AU1378.20m in 2015 figures)</td>
</tr>
</tbody>
</table>

*Source: Author’s research, including the CP2 website, accessed May 2014.*
From 1995 to 2000 the Airport Line stations and the tunnel were constructed. The project created 3,000 jobs in the construction stage and opened in readiness for the 2000 Sydney Olympics. The completed project was named Airport Rail Link (ARL, originally called the New Southern Railway), the largest single transport infrastructure project associated with the Sydney Olympics.

The Airport Line stations, from the international and domestic airport terminals to the city, were operated under a concession to a private company, ALC, as part of a PPP. This gave them the right to charge a Station usage fee on top of the normal fare. Opening on 21 May 2000, three months ahead of the Sydney Olympic Games, the project cost the State government around $AU700m ($AU1072.0m in 2015 figures), and the ALC over $AU200m ($AU306.3m in 2015 figures). The latter built the stations at the airport terminals, Mascot, and Green Square with the then SRA responsible for tunnelling and the track. ALC’s involvement was predicated on passenger estimates and train reliability guarantees that ultimately proved to be too optimistic. In 2000 on its bankers’ initiative, ALC went into receivership, exposing the government to costs of around $AU800m ($AU1225.07m in 2015 figures). The business was put up for sale in early 2006 and bought at a hefty discount by Hastings and CP2, representing a consortium of superannuation fund investors.

The unsolicited proposal to build a rail link from Kingsford-Smith to the CBD originally came from the consortium of CRI, Qantas, and Westpac in 1990. The NSW Transport minister of the time, based on advice from the SRA, informed the consortium that it was necessary to go out to open tender but that their proposal would be evaluated. Against the advice of the SRA Board, the minister announced in 1992 in Parliament that it would be built at no cost to government, as that was what the consortium had said in private (and perhaps was the only time it was

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57 The sum was undisclosed.
58 Formed in 1981 and called Custom Resources International, the business was renamed and known by its initials and became prominent in infrastructure projects before going into administration in 2008 and liquidation after that.
60 Personal knowledge of the author.
said). After the SRA’s evaluation, however, it was clear that the proposal had ignored or downplayed implications for the rest of the network, potentially during construction and, under the timetabling proposed, causing chaos on the Illawarra line. Also at this moment of conception, the project only served the Domestic air terminal.

The SRA issued the necessary request for tenders but only received minimal interest. Transfield worked with the original bidders, but again their proposal met resistance within the bureaucracy. Transfield later came up with a more considered proposal that broadly reflected what was ultimately constructed. But the cost now put the project beyond the PPP bracket. The whole project slumbered for a while until the Federal government began construction of the Third Runway at Kingsford Smith airport at Mascot. To offset some of the criticism, plus allay fears of airport road congestion with the Olympics, the then Director General of the NSW Department of Transport allocated payments from the Commonwealth (for the clearing of Botany Bay for the new runway) to the construction of the rail tunnel. An agreement was then made that Transfield and its new partner Bouygues would build the tunnel under a D&C contract while supplying the four stations (Green Square, Mascot, Domestic and International) as a PPP contract. The decision on Wolli Creek station was deferred by the SRA until after contract signing in February 1995. In March 1995 there was a change of government. The new minister had expressed his opposition to the project on numerous occasions - however the deal was signed and went ahead.

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The airport stations and line were developed as a PPP arrangement between the NSW government and a consortium of private sector investors operating as ALC. A station usage fee is charged when entering or exiting the barriers at the Domestic or International Airport stations, and this is the main source of revenue for ALC. As at the end of 2015, the NSW government had bought from the concession holder the access fees for Green Square and Mascot stations. The station access fee cost from the airport stations being $AU13.40 for an adult single trip, in addition to the Sydney Trains ticket fare of $AU4.00 (a total of $AU17.40).62

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62 NSW Legislative Council (2014) Removing or Reducing Station Access Fees at Sydney Airport, Report no. 29/General Purpose Standing Committee No. 3, Parliament of NSW, p. x. Note that the station access fee is capped at $AU25.00 per week for Adult and $22.50 for Gold Senior/Pensioner, Concession and Child/Youth Opal card holders, a “saving” for regular users. See: https://www.opal.com.au/en/opal-fares/airport_station_access_fee, accessed December 2015.
In September 1995 the estimated cost of constructing the line and stations was $AU673m ($AU1104.54m in 2015 figures), with the public sector component around $AU542m ($AU889.54m in 2015 numbers) and the private sector component $AU131m ($AU215.00m in 2015 figures). But as already noted, the total costs were over 25 per cent higher on construction and blew out further, as discussed below.

The privately built components of the line comprise four underground stations at Green Square, Mascot, Domestic Airport, and the International Airport. Separate, but built at the same time by the SRA, was a new station at Wolli Creek connected to the ARL. The SRA signed the initial Airport Line contract with ALC in 1995.

ALC went into receivership six months after the service opened in May 2000, blaming the then $AU10 fare and unreliable train service for turning off passengers. The receivers, McGrath Nicol Limited, relied on a government guarantee on the service standard (including passenger throughput) to negotiate a

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63 NSW Treasury (1995), New Southern Railway Stations Agreement.
64 From first presentation in 1992, hitherto there was unanimity of the independent directors of the SRA to oppose the type of PPP that was ultimately signed-off. The author was a director of the SRA from 1989 to 1992. It is not known if the then minister directed the SRA Board to accept the contract or if the SRA Board acquiesced to the project.
commercial settlement. The ticket vending machines were not modified to include ARL stations until 12 months after the line’s opening (six years after the contract signing) even though they had been modified during this period to include the new Olympic Park station. No timetable was implemented to specifically include the ARL until September 2005 - five and a half years after the commencement of operations! Until this point, the ARL service was predominantly the original East Hills trains that had run via Sydenham, with the then timetable fudged to accommodate the slightly longer run time. Some additional trains were also introduced in an attempt to deliver the level and quality of service agreed in the original PPP contract. This was a botched service agreement which cost the government $AU96m ($AU124.93m in 2015 figures) in penalty payments from 2000 to 2005.

It was not all one way. The consortium attempted to re-classify several station costs as tunnel costs, thereby increasing the cost of the D&C contract to the benefit of the PPP. The increased costs were accommodated by either allowing variation orders or by cutting out some seemingly unnecessary features. This included eliminating one electrical substation (saving $AU5m or $AU6.51m in 2015 figures) and not building two stub tunnels, which would have permitted the line to connect across the harbour to St Leonards. The substation omission cut capacity from 20 trains per hour to 12. It subsequently became necessary to install this item at a cost of $AU50m ($AU65.07m in 2015 figures).66 When the SRA later investigated the possibility of rebuilding the stub tunnels to permit a new cross town line it was discovered that the ARL would have to be closed for a minimum of six months to do it – not an option.67

In 2005, Transfield-Bouygues recognised they were not station operators and offered to sell their ARL station operation. Under the terms of the contract the government was given first refusal and a price of $AU150m ($AU195.21m in 2015 figures). The NSW Treasury declined, arguing that to do so would send the ‘wrong signals’.68

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66 This information came to the author from a then senior executive in the SRA.
67 It might be asked whether ROs need always to be ‘right’. RO theory might be a good way to freshly think through a problem. But their particular exercise might be flawed in conception or implementation. The story told about the electrical substation could be considered as an application of TRO. In the quest and experimentation to reduce costs, considered narrowly by the construction consortium, other options (capacity, potential expansion of the network) were constrained or poorly assessed. This point, however, is to highlight the oft-stated argument of the Thesis, that TRO complements, is ancillary to, effective project management.
68 This information came to the author from a then senior executive in NSW Treasury.
As at 2006, although passenger figures were not freely available because they were considered commercial-in-confidence, the patronage was said to be growing. In October 2005, the government estimated it carried 14,000 people a day, well below the forecast 48,000, a massive over-estimate. It has more than doubled since.

Airport Link emerged to become an important part of Sydney’s rail network. By July 2013 over 73 million passengers had used the airport line stations. The Airport Line stations are growing in patronage and during calendar year 2013 ARL accommodated more than 11 million passengers (more than 30,000 people on average per day, still below the original forecast) - being the Airport Line’s most successful year yet.

Hastings and CP2, infrastructure investors, recognised the opportunity to capitalise on potential patronage growth. CP2, on its website, commented: “Airport Link is a good example of the CP2 process in action. We are now very active in the ongoing management of this critical part of the city’s infrastructure, working closely with senior management and government stakeholders to continually enhance the value of this asset.” As Figure 41 illustrates, from CP2’s website, patronage steadily improved, though never to the level of the original forecast.

After opening, ARL was an uneconomic investment and failed to meet initial expectations. Since acquiring a 51 per cent share in ALC out of administration, CP2 saw significant, enhanced value with the asset. Identification of the key value drivers revealed strategic enhancement opportunities not appreciated by other investors. Key amongst these were: modal share expansion potential; the asset’s critical nature to the continued economic growth of Sydney; a long term concession agreement with a highly attractive revenue mechanism, providing a resilient underlying return; and the ability to increase value through concession re-negotiations and operational enhancements. This referred to the ALC’s view on potential increased passenger numbers due to the expansion of urban development at Mascot and Wolli Creek, and

70 CP2 (2011) Case Study Airport Rail Link, from CPS website. CP2 were originally called Capital Partners, but after a restructure was re-branded CP2.
73 Ibid.
expanded use of the line with increased flight passenger travel numbers to and from the domestic and international airports. Additionally, negotiations between the receivers and the authorities led to RailCorp signing the Restated Stations Agreement with ALC in October 2005.\(^75\)

**Figure 42: Map Showing the Airport Rail Link**


What is now the Airport and East Hills railway line is made up of two separate lines, the East Hills Line, originally constructed in 1931, and ARL. Figure 40 below highlights the ARL route.

The research associated with this Thesis is relevant to the development of this project, the applicability of a TRO, and to an evaluation of what went wrong. Understanding the latter is essential given how frequently the ARL is cited as a disastrous rail PPP. For some time, however, publicly available information was hard to come by as bankers and administrators of the ARL were involved in litigation with the NSW government.

There were three main reasons why the ARL was a bad experience for the parties involved. First, the project was rushed through. The government of the day, in preparation for the Sydney Olympics, wanted a rail connection from the airport terminals to the city. Although the then SRA Board rejected in 1992 a proposal from a consortium of sponsors, Transfield and others,\(^76\) the project was later approved by the Transport Minister in 1994.\(^77\) The minister and the NSW government decided

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\(^75\) The author has not seen or been able to locate a copy of this Agreement, and it is assumed to be commercial-in-confidence.

\(^76\) This statement is based on personal knowledge of the author, who in 1992 was an independent, non-executive Director of the SRA Board.

\(^77\) It is not clear from the public record if, in 1994, the SRA Board signed-off on the ARL and the terms of the PPP agreement.
not to exercise the RO of ‘wait and see’ and obtain more information on technical issues, including patronage risk and potential urban development, with appropriate density around rail stations. Second, the contract between the government and the private sector party was poorly drafted. Instead of a project which curtailed and/or capped government risk, it increased them. The ALC consortium negotiated to build the stations, with the SRA building the rail track and tunnelling under a D&C contract. The price of the SRA component easily outweighed that of the PPP party. But the latter were guaranteed a minimum patronage level, thereby capping part of their risk. Even this was too low to cover the repayment schedule negotiated with the lenders by the PPP project equity providers. They were over-geared. Third, the urban development around the new stations was very slow – demonstrating disconnect between the rhetoric by the authorities associated with integrated transport planning and its actuality. In 2014, twenty years after the project was first announced, fourteen years after the project opened, land use approvals were finally realising new development within a square kilometer of Green Square Station. Partly this was due to inertia and conflict between, at first South Sydney Council and the NSW government, then with the City of Sydney (after forcible merger in 2004 with South Sydney Council), and the government, including the latter’s Redfern Waterloo Authority (existed 2005-2012). Mascot’s development was speedier and relationships between the Botany Council and the NSW government healthier, but Council planning was slow with major urban development only realised after 2005. Development is on-going, years after the station’s opening. Building up density takes time. Where TOD is a ‘hoped for’ outcome, rather than systematically integrated in the overall planning, project conceptualisation and realisation, lags are typical.

One positive consequence of the development of the ARL was the enhancement of the East Hills Line, with new track capacity linking the line to the airport and the city, with a new station, Wolli Creek, opened in 2000. Unfortunately at first, Wolli Creek was built with only one set of platforms, instead of two, resulting in an irregular service to the station from Illawarra line trains when the original passenger forecasts had predicted that the Illawarra would provide 35% of the ARL patronage. This is a common fault in that predicted patronage is contingent, based on a level and type of service that is not delivered. The actual service provided needs to be consistent with that intimated in the original demand forecasting phase. This
interchange station enables trains from both the East Hills line and the Illawarra line to utilise the station platforms, with passengers from the latter line able to connect for trains on the ARL. Wolli Creek, a former industrial site, now rehabilitated, has attracted intensive residential tower development, which is still on-going (at the time of writing). The area has become a residential hub for many workers at the airport. Though not part of the original ALC PPP, effectively the rail authorities decided to capitalise on the ARL by building the Wolli Creek tracks and station platforms, providing alternatives for a) East Hill line trains to go through the airport line; b) still retain the option for some trains to avoid the ARL; c) ensure Cronulla/Illawarra line passengers could exit and platform hop at Wolli Creek to catch the ARL train to the domestic or international airports; and, d) provide capacity for increased services, with ten to fourteen trains per hour each way, with additional trains in peak hours.

Unfortunately, some of the wrong lessons were drawn from the ARL experience, such that rail PPPs were regarded within government as a likely disaster. What was mostly at fault, however, was that contract terms concerning the ALC were poorly drafted with the terms both leaving most risk with government and exposing the government for damages for failing to perform. The successful pursuit of such damages extended the government’s exposure, even beyond the cost of the private sector’s original investment in the project. Second, there was poor integrated planning between the new transport infrastructure and land use. Local authorities were in no hurry to get planning underway and no one was cracking the whip, notwithstanding NSW government strategic urban planning policy to intensify land use around new transport infrastructure nodes.

Also, ironically, the government compounded the risks of the ARL project by approving the Eastern Distributor motorway – a project signed off, built, and opened within the period of project design and construction of the ARL. With the Eastern Distributor opening six months ahead of the rail link, and providing an alternative, (initially) fast option to travel from the city to the airport terminals, and vice versa, this new mode undercut the patronage feasibility of the ARL.

The ARL experience shows that, despite some progress, land use and transport decisions remain poorly coordinated in Sydney with major rail projects. They
therefore end up imposing costs on each other. Inefficient land use decisions create pressures for the transport investment. The surprise with the ARL, especially in the light of the contract terms, is that targeted transport investment did not in a timely fashion prompt the efficient use of land supporting the patronage required for the project. Indeed, the evidence points to systematic failure by government in managing integrated urban and transport planning in Sydney.

**Epping to Chatswood Rail Link (ECRL)**

One other rail MUTP from *Action for Transport 2010* was partially completed - the Epping to Chatswood rail line (ECRL), a portion of the much larger promised Parramatta to Chatswood link which remains unfunded and unrealised. With the latter, in 2012, the Gillard Federal government offered to fund 50% of the capital cost with the rest being matched by the State government. Under this scenario, NSW was required to find $AU750m ($AU803.0m in 2015 equivalent figures) to secure a long desired new piece of infrastructure. While politics certainly played a major part, a major factor was the recurrent costs which would have to be borne by NSW. There was no agreement on how this should be funded. NSW feared that patronage would be significantly below cost recovery. The O’Farrell government rejected the Commonwealth’s offer and, following the 2013 election, the Abbott government shelved the proposal.78 The background to the project is this. In 1990 management consultants Booz-Allen Hamilton, as part of their strategic consulting arrangements with the SRA, undertook some passenger growth modelling work for the government. The outcome was the recommendation to increase CBD capacity by constructing a new line along the western side of the CBD next to Darling Harbour. The SRA set up a working group to evaluate a number of supporting studies one of which was to look at possible alternatives. Civil engineers Ove Arup was contracted to do this work showing that one way to overcome congestion was to construct a line from Epping to Chatswood. That meant that some Northern line trains could be diverted, thereby creating extra capacity on the western lines. The idea was ‘kicked around’ for a while, with the dream of extending on to the north-west, but this

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appeared to be over when the M2 was built which precluded, by agreement, any rail extensions to the area for a period of time.

The Parramatta-Epping line was then put forward within the minister’s office. Originally an idea was a line from Parramatta to the Central Coast. There was no data to support the need for such a line. There was reasonable passenger flow from the Central Coast to Parramatta LGA (which includes a large part of Epping). At Epping, Central Coast passengers catch buses to North Ryde/Macquarie. The analysis of the flow had been superficial. Given the terrain, building a line direct from Parramatta to the Central Coast was virtually impossible, except at great expense. After the 1995 election the government was confronted by its election promise. Within the SRA, a Parramatta-Epping extension to the mooted Epping-Chatswood line was ‘sold’ as an alternative route to the CBD. This then was promoted by the government as a ‘solution’ to western Sydney’s transport problems.

As has become traditional in NSW rail planning, a mixture of town planners, computer programmers, short-term train operators, and politicians ignored what the passengers wanted - a fast, frequent, all-day service to the CBD. What they got was a slower, circuitous alignment with a variable quality service.79

The Epping-Chatswood project was announced in 1994 (during the Parramatta by-election), tenders were awarded in 2000 and the line opened in early 2009. Original costs were estimated at $AU800m (in September 1994 or $AU1380.41m in 2015 figures), whereas final construction costs were estimated at $AU2.3b (in June 2009 or $AU2.66b in 2015 figures). Although the Parramatta to Chatswood line was announced by the Fahey government in 1994, and reaffirmed by Labor prior to the election of the Carr Labor government in 1995, the progression of the Parramatta to Epping project was put on hold soon after the 1995 elections. This was so as to review route options and to consider the option of Epping to Chatswood as the first stage of the project. This was sensible in the sense that more time was required to cost the work and consider whether it might be done in stages. Effectively, by deciding on stage one, Epping to Chatswood, the government decided to create a RO as to whether to later extend the line from Epping to Parramatta. Figure 43 above

79 This insight and those of the previous few paragraphs relies on observations by a senior, former SRA official in the period.
highlights the ECRL route. In July 1998 the then Transport Minister, Carl Scully, announced in principle support for the building of a $AU1.4b ($AU2.23b in 2015 figures) line from Parramatta to Epping. Closer costing showed that instead of $AU800m number, referenced above) for the Epping to Chatswood part, a higher figure would be required, thus the $AU1.4b figure was stated as available to fund the Epping to Chatswood section “first”. Costs went up largely because the government had decided to tunnel under the Lane Cove River (instead of a bridge across). A consequence of this decision (which was largely motivated by political and environmental concerns) was that tunnelling had to be much deeper than originally anticipated.80 This was justified on the basis that the link, ultimately to Parramatta, would free up to 4 train movements per hour on the western line. But in 2003, the then Minister for Transport, Michael Costa, killed off the link from Epping to Parramatta, claiming that only 12,000 passengers per day would use it.81 He therefore decided not to exercise the option to go to Parramatta.

The ECRL is a model of engineering achievement. But it is also an example of what can go wrong. The Transport Infrastructure Development Corporation (TIDC) took

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80 See: Parramatta Rail Link (2003), PRL West Options, Report to the Minister, August.
over the project, with all of its technical complexities. The project took 15 years from thought to finish. Costs ballooned. Construction was over 7 years. The estimated projected final cost of the ECRL project in the 2003-04 budget papers was $AU1.6b (or $AU2.18m 2015 prices), however this did not include post 2000 escalation costs for the project, which meant that the final cost of the project was revised to $AU2.3b (excluding interest costs on borrowings) in July 2006 (or $AU2.66b in 2015 figures). This increase included rises in construction sector costs above budgeted increases ($AU160m or $AU200.23m in 2015 figures), settlement of a claim for noise mitigation works above forecast costs ($AU28.0m, $AU35.04 in 2015), increased scope of works, other modifications, and commissioning costs ($AU53.0m, $AU66.32m in 2015). To 30 June 2006, 66 per cent of the projected cost had been expended, at $AU1.5b ($AU1.87b in 2015). RailCorp agreed to acquire from TIDC the Parramatta Transport Interchange in 2006 and the ECRL in 2008 on completion.82

Figure 44: Epping to Chatswood Link Summary

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Contract Term</th>
<th>Opened</th>
<th>Handback</th>
<th>Private Partners</th>
<th>Toll</th>
<th>Contract Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line from Chatswood to Epping. New stations at North Ryde, Macquarie Park, Macquarie University, and new platforms at Chatswood and Epping.</td>
<td>13km</td>
<td>After many years of planning, construction began in November 2002</td>
<td>23 February 2009</td>
<td>Not Applicable. Owned by NSW government</td>
<td>D&amp;C contract</td>
<td>Fares as part of CityRail fare schedule.</td>
<td>Original estimate $AU800m or $AU1380.41m in 2015 figures; final cost $AU2.3b (estimated capital cost at the time of completion of the project or $AU2.66b in 2015 figures)</td>
</tr>
</tbody>
</table>

Source: Private research, including NSW Treasury & Audit Office documents.

A deed of release and amendment was executed on 25 August 2006 to settle a contract dispute between TIDC and one of its major contractors. This dispute was primarily over the quantum and value of additional floating slab track installed over

what was specified in the contract. The detail of the amount in dispute was not disclosed as it was deemed by both parties as commercial-in-confidence information. The ECRL’s cost blowouts are depressingly familiar in that they corroborate Flyvbjerg’s analysis of rail MUTPs. There has to be a better way. There have been enough lessons learnt from other projects to effectively deliver an equal or better product whilst, where possible, still shifting risk and delivery responsibility to the private sector.

Figure 44 above summarises some of the key features of the rail line.

Much of what was wrong and needs to be done is known. The Christie Report (2001), the 89-page overview of the ‘Long-term Strategic Plan for Rail’, discussed below, is particularly apposite. What was badly lacking is the mechanism to drive cost effective solutions to the design and effective delivery of a rail MUTP. Almost everything was wrong – with poor planning, secretive, dysfunctional processes, and repeated, expensive mistakes. This is a reminder that “[s]tatements about ‘high quality public transport’, ‘best practice’, and ‘success examples’ can only be meaningful in relation to a defined purpose.” Because of capacity constraints and critical under investment, CityRail has not matched infrastructure development with need. Nowhere is this more acute than in western Sydney, where the transport problems are arguably worse for more people than anywhere else in metropolitan Australia. One major consequence of the Christie report was renewed attention to de-complicating – simplifying - the Sydney rail network. This led to a series of projects which collectively constitutes a MUTP. That experience the Thesis will now address.

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The Clearways Project

The Christie Report noted that within each of the three main operational sectors of CityRail there is a complex mix of ‘fast’ (‘express’ and ‘limited stop’) services - generally those travelling longer distances, including intercity services - and slower trains with a variety of station stopping patterns, including trains which stop at all stations on their routes. This mixture of services reflects the need for CityRail to accommodate three types of demand on the one network: i) relatively long-distance intercity and outer suburban demand, ii) short-haul suburban demand, and iii) ‘inner city distribution’ demand. As then configured, the system was approaching gridlock, because of the finite limit on how many trains could reliably and safely use each track and, even more significantly, on how closely they could follow each other through multiple congested junctions and/or wait their turn.

The greatest limitation on current CityRail network train frequencies are: (1) the available train paths; and, (2) the onload/offload capacity at the CBD stations. Since most services pass through the CBD, there is a major constraint to increasing total network capacity until CBD capacity is improved. On mode capacity, Vuchic (2007) notes that “all major transit modes have optimal domains of application”, suggesting that

...there can never be a single “optimal” mode for all urban transportation.
Conditions and requirements for urban travel vary so much that in most cities except very small ones the optimal (often referred to as “balanced”) transportation system should consist of several complementary modes coordinated in a single multimodal system.

So the consideration of the required commuter transport needs consideration of the mode that best matches current and potential demand.

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87 Ibid., p. 80. For a discussion on various transport nodes see also Vuchic at pp. 67-80.
Figure 45: Overview of Operating Constraints with Sydney Rail circa 2001

Source: Adapted from: Christie, Ron (2001) Long-term Strategic Plan for Rail, Greater Sydney Metropolitan Region, report to the NSW Government, Office of the Coordinator General of Rail, June, p. 10. This map was utilised in the debate about the need for the Clearways project.

The carrying capacity of a given transit mode, represented by passengers per hour, can be expressed by multiplying the number of vehicle sets (trains) that could pass by a particular stop in one hour (the frequency) by the number of vehicles per train and the number of passengers that could be carried by each vehicle. Matching speed and
capacity is complicated as the factors influencing capacity include: 1. number of carriages; 2. seating/standing arrangements; 3. technology and design; 4. supporting technologies such as signaling; and, 5. profile and length of carriages. Very generally capacities are about: LRV 50-300 passengers; Metro 200-1500 (Hong Kong & Tokyo); Heavy Rail (commuter) 250-1500. These are passengers per train, rather than passengers per hour; in the latter case a metro can be higher.88 The numbers are meant as a general guide only as the magnitude of the difference in capacities amongst the different modes. For timetabling purposes, in Sydney, it is generally accepted that the maximum capacity for many sections of the CityRail network is 20 trains per hour. This is actually low by world standards (where 25 to 30 plus trains per hour are common).89 The main reason for this is the dwell time necessary at key stations such as Town Hall; the dwell time is based on the time needed to detrain and entrain passengers from double-deck rolling stock. This stock, with its upper and lower saloons is limited to only 2 sets of doors, while the 2+3 seating arrangements severely constrains the access, and egress of passengers. This capacity limit is nearly reached already on one CBD line (North Shore line in the AM peak) and it is anticipated that other lines could reach their maximums over the next decade. This puts a limit on the ability to increase frequencies by providing additional services. The Clearways strategy is aimed at improving reliability and adding to schedule capacity to the network. With one significant exception, discussed below, without faster journeys and new rail corridors such reforms would have little impact on altering the attractiveness of public transport versus the private car. Railcorp’s clearways project’s core objective is to de-complicate the network and increase reliability, not to reduce journey times. The improvements in reliability on the existing Railcorp model potentially do little to decrease journey times. Over time this could reduce potential patronage and revenue take for Railcorp, because more travellers would elect to travel by car if journey times are uncompetitive. An important means to reduce journey times is to increase frequency. Essentially this means reducing the wait times at stations, even if the real journey is unaltered. Unfortunately, in Sydney’s situation, the potential for frequency is limited by

88 Email correspondence between the author and Barry Garnham, retired former head of operations at NSW Railcorp, October 2014. See also: MacKechnie, Christopher (2014) ‘What is the Capacity of Different Modes of Transit?’, on-line public transport website, not dated, circa 2014.
89 These views are derived from conversations with the author, and a former head of operations of Railcorp.
rollingstock design and the capacity throughput in the CBD.\textsuperscript{90}

Yet frequency also increases patronage substantially; therefore a new alignment through the CBD is needed, as Christie and others have observed.\textsuperscript{91} Without new capacity, new lines, and a new CBD rail corridor, the Railcorp service will continue to operate on congested lines, even if more ‘reliably’. The Clearways Program aims to separate the existing fourteen metropolitan rail routes into five independent clearways, thus reducing the sharing of critical infrastructure and train paths.\textsuperscript{92} The Program aimed to improve the capacity and reliability of CityRail’s Sydney suburban network through 15 key projects, including building additional track, platforms, turnbacks, and train crossing loops totalling $AU1.5b (in 2008 or $AU1.76b in 2015), delivered by TIDC on behalf of RailCorp. Potentially, in time, as parts of the network are untangled and discrete, independent corridors are created, then options for discrete operating networks are created.\textsuperscript{93}

There were two distinct timetables for completion of the Clearways Program, those projects to be delivered by 2008, and those expected for delivery by 2010 (since extended to 2015). Effectively, as the Clearways Program was developed, there was the generation of ROs, what might be characterised as key priorities and the follow-up projects also aimed at simplifying the network. The key projects and projected completion dates estimated in 2008 are set out in Figure 46, below.

\textsuperscript{91} In June 2015, the NSW government committed to create an under the harbour rail connection that would connect to the Bankstown line with an independent corridor tunnel from Sydenham to the city then under the harbour to Chatswood, then connecting to the ECRL and from there the NWRL. See, http://www.transport.nsw.gov.au/media-releases/world-comes-get-board-sydney-metro, accessed June 2015.
\textsuperscript{92} Audit Office of NSW, \textit{Rail Corporation of New South Wales, 2005}, p. 178.
\textsuperscript{93} This was the subject of a media story in early 2015 speculating that the NSW Liberal National Coalition government in NSW was contemplating privatising certain operations. See: Saulwick, Jacob (2015b) ‘Secret Rail Plan for Sydney Would Create Massive and Costly Upheaval to Existing Network’, \textit{Sydney Morning Herald}, 6 March.
With new investment in ‘fixing’ the existing rail corridors, many more operational changes became possible. This is not to underestimate the impact of strategic operational changes that could also improve throughput in the system. For example, through the combination of a new CBD corridor, and the scheduling of certain south west Sydney-origin trains over the Sydney Harbour Bridge, throughput could be significantly improved to and from the south west. This could avoid the current scheduling problems associated with the routing of trains from the south west of Sydney (such as East Hills, Liverpool, and Campbelltown services) through the city circle.

As shown in Figure 47, below, as at 2013, the major NSW rail projects were:

<table>
<thead>
<tr>
<th>Key Projects</th>
<th>Scheduled completion date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Eastern Suburbs &amp; Illawarra</strong></td>
<td></td>
</tr>
<tr>
<td>Bondi Junction Turnback</td>
<td>Completed April 2006</td>
</tr>
<tr>
<td>Cronulla branch line duplication</td>
<td>2008</td>
</tr>
<tr>
<td><strong>2 Bankstown</strong></td>
<td></td>
</tr>
<tr>
<td>Lidcombe turnback and platform</td>
<td>2008</td>
</tr>
<tr>
<td>Liverpool turnback and platform</td>
<td>2010</td>
</tr>
<tr>
<td>Sydenham to Erskinville extra tracks</td>
<td>**</td>
</tr>
<tr>
<td><strong>3 Campbelltown express</strong></td>
<td></td>
</tr>
<tr>
<td>Kingsgrove to Revesby quadruplication</td>
<td>2010</td>
</tr>
<tr>
<td>Macarthur fourth platform</td>
<td>2010</td>
</tr>
<tr>
<td><strong>4 Airport &amp; South</strong></td>
<td></td>
</tr>
<tr>
<td>Macdonaldtown turnback</td>
<td>Completed May 2005</td>
</tr>
<tr>
<td>Homebush turnback</td>
<td>2008</td>
</tr>
<tr>
<td>Revesby turnback</td>
<td>2008</td>
</tr>
<tr>
<td>Macdonaldtown stabling</td>
<td>2007</td>
</tr>
<tr>
<td><strong>5 North West</strong></td>
<td></td>
</tr>
<tr>
<td>Berowra Platform</td>
<td>2006</td>
</tr>
<tr>
<td>Hornsby Platform</td>
<td>2008</td>
</tr>
<tr>
<td>Quakers Hill to Schofields Duplication</td>
<td>2010</td>
</tr>
<tr>
<td>Carlingford line passing loop</td>
<td>2010</td>
</tr>
</tbody>
</table>

** The feasibility of the Sydenham to Erskinville six tracks project was being studied as part of the Metropolitan Rail Program. Scheduled completion date has not been determined and funding is yet to be allocated to the construction phase of this project.

The table above highlights that the costs of the Clearways Program increased to nearly \$AU2.02b (or \$AU2.11b in 2015 figures); together with signalling and train technology modifications (covered in Automatic Train Protection), \$AU3.0b (\$AU3.13 in 2015 figures) was proposed to be spent (and had been mostly spent) on improving the rail network’s capacity, including removing capacity constraints.

Some of the projects specified in Figure 47 are further discussed later in the Chapter, but for the moment, the Thesis concentrates on the Clearways and related projects.

The breakdown of scheduling capacity, as train numbers increased beyond the capacities of any one sector was one of the factors contributing to the increased sensitivity of CityRail peak services to disruptions. The Christie Report urged that the restoration and strengthening of ‘sectorisation’ operational approaches – or clearways - was critical. But the Report argued that this required both increases in the inherent capacity of the rail infrastructure - the equivalent of road widening programs - and the physical separation of the tracks, and routes used by trains operating on different existing and new operational sectors. Better scheduling, and configuration of trains could obviate some of the problems. At the beginning of the 21st century, in Sydney

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**Figure 47: Major Rail Projects (2013)**

<table>
<thead>
<tr>
<th>Project</th>
<th>Forecast completion year</th>
<th>Original updated Project Cost $AU’000</th>
<th>Latest revised Project Cost $’000</th>
<th>Total Spend to 30 June 2013 $’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>North West Rail Link</td>
<td>2019</td>
<td>8,279,000</td>
<td>8,279,000</td>
<td>723,000</td>
</tr>
<tr>
<td>South West Rail Link*</td>
<td>2015</td>
<td>2,122,000</td>
<td>2,022,255</td>
<td>1,242,049</td>
</tr>
<tr>
<td>Rail Clearways Program</td>
<td>2014</td>
<td>1,887,000</td>
<td>2,019,505</td>
<td>1,950,608</td>
</tr>
<tr>
<td>Northern Sydney Freight Corridor</td>
<td>2017</td>
<td>1,000,000</td>
<td>1,000,000</td>
<td>146,309</td>
</tr>
<tr>
<td>Automatic Train Protection</td>
<td>2020</td>
<td>988,000</td>
<td>988,000</td>
<td>106,947</td>
</tr>
<tr>
<td>Waratah rolling stock – Enabling and ancillary work</td>
<td>2014</td>
<td>790,013</td>
<td>794,013</td>
<td>576,267</td>
</tr>
</tbody>
</table>

* The updated project cost includes an additional \$AU762 million in approved scope charges.

Source: Adapted from: NSW Auditor-General’s Report to Parliament (2013), Vol. 8, *Transport Overview*, pp. 41-42, based on information provided by Transport for NSW and RailCorp.
nearly all time delays and cancellations on CityRail were caused by switch and crossing failures. So sectorisation or the clearways strategy became critical to improving the efficiency of the CityRail network. Potentially some congestion constraints of the south-western lines could be lifted through routing some services to the north shore, rather than the city circle. This is discussed later herein. The Rail Clearways Program is untangling the CityRail network to reduce rail congestion, allowing for simpler timetables, and more reliable and frequent services for commuters. The program is aimed at increasing the capacity of the network to meet patronage growth from suburban and intercity communities, provide reliable public transport, and improve the capacity of Sydney’s metropolitan rail network. The program involves the construction of additional tracks, platforms, turnbacks and stabling facilities. When completed, those works remove bottlenecks and junctions, and significantly reduce the sharing of critical infrastructure and train paths across rail lines. It would mean that an incident on one part of the network would have a limited effect on other services. Because the network is complex even small improvements can cost a disproportionate amount of funding (and one of the arguments for a separate alignments such as the proposed Metro was that capacity would not suffer from the issues of complexity).

By 2011, the TCA completed numerous projects, including the Berowra Station Platform 3, Bondi Junction Turnback, Cronulla Line Duplication, Homebush Turnback, Hornsby Station Platform 5, and Stabling, Lidcombe Turnback, Macdonald Stabling, Macarthur Station Upgrade, and Interchange Project, and the Revesby Turnback. The issues in the network are difficult: it is clearly congested. The Clearways program certainly fits the TRO. In redesigning rail alignments, the program is responding to the need to de-complicate the network.

The South West Rail Link

The South West Rail Link is a response to predicted population growth in south-west Sydney and passenger growth on the metropolitan rail network. The link supports new communities in south-west Sydney, providing new rail services to the outer

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metropolitan area, additional services on the East Hills Line, and stabling to support the Airport and East Hills Line, Main South Line, Bankstown Line, and Inner West Line. When completed, such services should encourage a reduction in use of private cars as the main mode of transport to and from communities in south-west Sydney.

The South West Rail Link is made up of three major packages of work: the Glenfield Transport Interchange; the Glenfield to Leppington Rail Line; and ancillary projects, including the Auburn Stabling, and Airport Line power upgrade.95 The project comprises a 11.4 km twin track extension from Glenfield to Leppington with two new stations at Edmondson Park and Leppington, an upgrade of Glenfield station, new car parking, and a train stabling facility. As we saw in Figure 47, project costs were estimated at around $AU2.02b (or $AU2.11b in 2015 figures). In 2012/13, work was progressed ahead of schedule, with expenditure of $AU537m ($AU561.55m in 2015) against the budget of $AU397m ($AU415.15m in 2015). The government announced the project would open 12 months earlier than originally planned in February 2015.96

5.3 Abandoned Projects

North-west Sydney

When the North-west Metro was ‘announced’ by Premier Iemma in March 2008, the cost of the North-west Metro was estimated at $AU12b ($AU14.28b in 2015 figures) – that is almost half the value of the whole of the then existing rail network, according to Railcorp’s books. Patronage, fully ramped up on this metro line, was estimated at 40m passenger journeys per year. At a conservative, commercial capital service charge of 10%, at the time of the announcement, the Government should expect a return of $AU1.2b ($AU1.43b equivalent in 2015) per year. Assuming the patronage estimates were accurate (an ambitious assumption), the economic cost per passenger journey therefore would be around $AU30 ($AU35.71 in 2015). Yet even this figure, in 2008 terms for simplicity, of around $AU30 does not include the cost of opex and depreciation. A ‘back of the envelope’ calculation suggests that if, instead, there is the assumption of a total cost of, say, $AU45 per passenger journey, together with the

95 Ibid., p. 21.
optimistic assumption that the external benefits are equivalent to $2/3$ of the total cost, then that leaves an average fare per trip of $AU15.

NSW Treasury did not believe the North-west Metro patronage forecasts. The UK expert hired by Treasury in early 2007 argued that the low density through the proposed route, lack of key population centres, and the frequent, slow stopping service (e.g., too many stations) meant that patronage would only be a fraction of the predicted 40m passenger journeys.\(^\text{97}\)

It is reasonable to factor in the risk that the subsidy per journey, if the project was built, would be of the order of $AU40, $AU50 or higher. This was Treasury’s main concern. As both heavy rail and metro rail ‘solutions’ are expensive, caution should be adopted before embarking on any project. Consideration should be given to all factors affecting cost and delivery of any solution to the problem to be addressed. Specifically on transport, the answer is about the most cost-effective solution, which invariably tends to be about using existing networks and gateways better, as well as building new expensive networks, or extensions from existing networks. It involves rigorous cost benefit analysis (CBA) and project appraisal. Priority deserves to be given to projects with the highest Benefit Cost Ratio (BCR). From a whole of government perspective, this cost effective approach applies equally to planning and transport interaction. Significant up front effort is required to identify trade-offs and synergies between the spending plans of the planning and transport departments. This should help deliver a more cost effective pattern of growth. This needs to be enforced from the top, because agency incentives often use other agency demands merely as a lever for additional funding.

Some of this points to the need for better, integrated planning around stations – so as to generate patronage. Yet the ARL and ECRL experience does not inspire confidence. Importantly, heavy-rail investment, particularly where achieving patronage forecasts depends on urban development alongside new stations, takes a long time to come to fruition. Therefore it is prudent to consider transitional strategies that deliver accessibility benefits far earlier, and then increment as appropriate, to the more

\(^{97}\) This statement is based on discussion between the author and the Principal Advisor, Private Projects Branch, NSW Treasury.
expensive heavy rail, if and when it is required. One possible way of achieving this would be through strategic sequencing of the right-of-way (including over and underpasses, tunnels etc.), with lower cost but with service-effective activity above the right-of-way, such as a high frequency bus service that can serve the extensive origin-destination traffic with direct services and those with minimal but efficient interchanges.

The experience from the Brisbane Busway system provides a useful reference point. This illustrates the way in which an integrated bus service, on its own right-of-way, was designed to light rail standards but operated initially as a bus transitway. It has proven so successful that government has decided to extend it.98 The reason is simple – it delivers very high capacity and does it at a much lower cost (capital, operational, and maintenance) than light rail or heavy rail.

Challenges of North-west Sydney

The north-west (NW) Sector of the Sydney Metropolitan Area has been subject to various transport reviews, most recently by the O’Farrell government.99 As the project was an election commitment, the usual or preferred CBA was not undertaken, at least to the satisfaction of IA.100

In 1998 the north-west Rail Link (NWRL) was announced in the State government’s Action for Transport 2010 plan as “essential” and due for completion in 2010. Later, in 2005, the project was re-announced as part of the Metropolitan Rail Expansion Program (MREP). This heavy rail addition to the Railcorp network never happened.

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100 Saulwick, Jacob, & Nicholls, Sean (2012) ‘Infrastructure Chief Blasts Lack of Detail over $8.5b Rail Link’, Sydney Morning Herald, 8 May.
The project languished on the drawing boards in 2006. In that year, the ‘Moving On’ report said that

The next step to be undertaken in the planning process is reservation of the land corridor for the NWRL, which is a time-consuming process. However, despite repeated calls from officials for sites to be bought as early as 1998, the State government... failed to acquire land. As a consequence, acquiring land to build the future Rail Link will be more costly, with land prices having tripled... Therefore, to ensure the necessary land is available for the construction of the NWRL, immediate action is required.101

Instead, in March 2008 the government committed to a 38km underground north-west Metro tunnel. According to the government’s then website,102 metro rail was the favoured mass-transit system of many of the world’s great cities. Each metro system was promoted as individually designed to meet the needs of its discrete network. By the use of Euro style metro trains, Sydney’s metro system would be tailored to meet

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needs and would revolutionise Sydney’s heavy rail network; high frequency services would make timetables unnecessary. With a metro train every few minutes waiting times would be kept to a minimum. More doors would mean that passengers could get on and off faster, delays at stations would be reduced and overall travel times much quicker; by operating independently of other modes of transport, energy efficient Metro would run predominantly on underground routes that would feature new, passenger friendly stations. Another reason is that disability access can be provided at the outset whereas the program of providing this at old stations is very expensive. The Metro could add substantial capacity to existing transport modes, reducing traffic congestion, and passenger crowding. As some metro lines around the world can reliably move more than 40,000 people in an hour, while CityRail lines are limited to a maximum of about 15,000 people per hour, there is the potential to massively increase capacity.\textsuperscript{103} Those, at least, were the arguments put forward at the time. Such transport systems, however, arguably only work where there is significant density along the corridor.\textsuperscript{104}

The proposed 38km north-west Metro route was from Rouse Hill, through the Hills district, to Epping, then Top Ryde to the city. A change of Premier in October 2008 led to the project being formally shelved. Ministers of the Rees’ government concluded that the project was unaffordable. The sister, Inner West Metro, between Parramatta and the city, was expected to cost an additional $AU6b to $AU8b (in 2008 or $AU7.4b to $AU9.52m in 2015 figures). In combination, therefore, those two metro lines were likely to cost up to $AU20b ($AU23.8b in 2015 terms) - 80\% of the value of the then network. Despite the flurry of activity (announcement under then Premier Iemma, cancellation under Premier Rees), the feasibility studies were yet to be completed. At the time of the announcement basic feasibility work had not started.

Is metro rail or something similar ‘the solution’? Whereas it is true that fast and punctual operations at the highest possible speed of service are a key factor. “The

\textsuperscript{103} See earlier discussion in this Chapter of the Thesis on the carrying capacity of different transit modes.

operational speed determines both the cost efficiency and the attractiveness of the public transport system. A high quality system cannot make many compromises on this aspect of the service," it is also interesting to consider the policy and political dynamics. The Metro was an issue in the by-election in Ryde lost by the Labor government in October 2008. The proposed north-west Metro went through this previously marginal electorate and, if built, might have eased traffic along Victoria Road. Hence the protest signs on the Iron Cove Bridge: “No Second Bridge, Metro Way to Go.” Partly due to incessant publicity, including in 2008 expensive television advertising by the NSW government for the north-west Metro, public expectations were high that the metro should be built. The previous Premier, Morris Iemma, saw the metro projects as his legacy. By putting this technology/mode solution forward, without the justifying density and potential patronage, it might truly be said that Premier Iemma was ahead of his time. At least he put more efficient public transport and rail services on the agenda. He tried to do something. Because, over the years, land had not been reserved for an above-ground transport corridor in the north-west, this meant that any rail network there would necessarily be expensive. It is highly arguable that far from being a cynical political response to pressures, or a deceptive attempt to fob off an illusory solution on an unknowing public, the metro rail solution was the well-meaning product of a powerful myth. It is a classic case of technology defining the solution, rather than the reverse. Arguably, however, the best possible extension of heavy rail, even a metro line, would be through the west of Sydney, along the western line where employment and population are densest. According to Hensher (2000):

Expanding public transport rail services far into suburban areas in contexts where we are losing the dense corridors linked to a major destination is precisely what has the least market potential. Improving bus services however may have a more appealing role. Investing in new rail systems as an isolated strategy is a very expensive way of attacking the general problem. The results where this has been undertaken in urban areas with a dominating automobility have been disappointing – low ridership, and debilitating subsidies.106

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Though not written with the north-west Metro in mind, Hensher’s formulation looks presciently apposite. This is an argument about considering what works best in which context. Additionally, as noted by the HiTrans researchers, “[w]hen the aim is to compete with the motorcar for travel in urban regions two crucial qualities of the system are: short waiting times between departures; and an integrated network of services between all areas of significant transport demand. A system with-out these two qualities can never be a real competitor to the car as the main mode of transport.”

An alternative to the north-west metro was to step up transport links from the north-west to the city. First, with sophisticated buses and/or transitways; then, perhaps, light rail, then heavy rail. This might unfold over a ten to twenty year plus scenario. As density and commuter numbers increase, then the next stage becomes more feasible. If a bus rapid transit corridor was built, the tunnelling provides important options depending on the preferred transport mode, and contributes well to the overall conclusion. The crucial issue is to get a corridor that can deliver accessibility and then find the relevant transport capability (i.e., right capacity per hour) given cost per km. In sum, in order to ensure that the north-west Sector of Sydney (the Hills District) is served by improved public transport that delivers maximum net social benefit per dollar of taxpayers’ investment (i.e., value for money), the following emphasis should be given to the development of improved public transport services: 1. That the provision of improved bus services, as either main line or feeder services, not be restricted to serving existing or future rail systems (metro, heavy and/or light rail). 2. That an integrated bus network system be an alternative to new rail in part at least to both provide more direct and efficient services as well as to take pressure off the existing and future rail system, given anticipated growth in demand for public transport in the NW sector. 3. Serving the needs of the entire population of the north-west sector must be emphasised to ensure that any focus on investment in radially-focused public transport does not restrict the financial capability to deliver effective outcomes for the large number of actual and potential users of public transport who have regional and cross regional travel needs to be served. 4. A mix of services that includes: (i) direct CBD services, using articulated buses, bus priority along routes

(including the M2) and in the CBD and a combination of re-routing and through-routing strategies in the CBD; (ii) high frequency feeder services to Epping rail and to the Hills Centre if the rail link was built; and (iii) an enhanced high frequency north-west transitway service to Parramatta. 5. That a focus on the higher frequency service mix noted above would provide a system-wide increase in service capacity that can start to benefit radial and cross-regional trip activity. Finally 6, that a Bus Rapid Transit be developed for the corridor being reserved for heavy rail beyond the Hills Centre to Rouse Hill (and possibly from Epping to the Hills Centre) as a transition investment that could bring forward a public transport system capable of handling up to 20,000 trips per hour one-way, built to light rail standards, with incremental investment up to heavy rail being able to be made in the future should demand grow, where needs are not met by advanced bus rapid transit systems. Thus, under this thinking complementing existing bus services, the first step would be to lay the foundation for a dedicated bus transitway or corridor from Rouse Hill to Epping station. Commuters from Epping would then catch a train to the city. Leighton Contractors estimated in 2008 that the cost of this connection, from Rouse Hill to the M2 to Epping, a distance of 21km, would be around $AU700m ($AU811.75m in 2015 figures), not including the cost of buses, estimated at another $AU100m ($AU115.96m in 2015 terms), though more likely fundable through leasing arrangements.109

After the defeat of the NSW Labor government in March 2011, the new Liberal National coalition government committed to the NWRL, a project whose costs had ballooned four-times since estimates were made just five years before. Douglas and Brooker (2013) note that the 2006 the economic valuation concluded that a heavy rail costing $AU1.9b (in 2006 or $AU2.13b in 2015 figures) produced the highest BCR of 1.4. A cheaper bus transitway costing $AU600m ($AU750.87 in 2015 equivalent) and a $AU1.4b ($AU1.75b in 2015) light rail option were rejected with lower BCRs of 1.08 and 0.85 respectively.110 A former head of strategic rail planning


at Railcorp described the Minister’s determination to proceed with NWRL “without detailed public discussion truly heroic.”

As a growing proportion of all Sydney travel activity is regional and cross-regional, there is a contrast with existing public transport infrastructure (especially rail) being predominantly radial (towards the CBD), with a focus on buses as a feeder service to rail stations. This rigid structure does not meet commuter needs. The plans adopted from 2005 to incrementally introduce cross-regional direct bus services under the strategic corridors plan rollout, creating competition between bus and rail, an initiative to both improve service levels (reducing transport interchanges) - and spreading the load across a much over-stretched public transport system - was a thoughtful complement to ‘heavier’ rail modes. Evidence from the introduction of metrobuses shows that those services which provide connections across the radial lines have built up considerable patronage. Pressures to construct a heavy rail corridor to serve a relatively limited amount of the north-west sector residents, however, raises some fundamental questions about whether this is a desirable strategy. It is not only very expensive (in absolute terms and in terms of net social benefit) but also potentially cuts off funds that might be better invested in lower cost but more effective technologies that could provide greater service coverage for all north-west residents. Buses connect to Epping Station already – with a flyover from the M2 taking buses to Epping station. Direct city buses are required, however, due to lack of train capacity or frequency at Epping. The rail-bus terminal at Epping needs to be increased in size and be well designed. To make this proposed north-west busway operate efficiently, there should be choice for commuters to either keep going on the bus towards the city or to catch the train from Epping. So as to make this choice appealing, there should be an increase of frequency of services on the rail network; the Epping-Chatswood-City line helps to improve overall network capacity and efficiency, allowing for more frequent services from Epping.

On the scenarios outlined here, the idea is that a new north-west transit way is an efficient public transport corridor, with the potential for later light rail, and heavy rail conversion. The corridor therefore provides ROs for potential exercise in the future. This does not exclude considering the feasibility of a rail link from Rouse Hill to Epping. A new bus route from Rouse Hill to Epping, connecting to the M2 and running along the busway in the middle of the M2, could be built within two to three years. But there is a need for more than this, as the M2 is already congested, and buses disgorging at morning peaks in the CBD are close to capacity. Inescapably, new dedicated transit lane tunnels and more, and better, interchanges are required.

The Proposed CBD Metro

Following a meeting with Infrastructure Australia, on 24 October 2008, the then NSW Premier Nathan Rees publicly released his vision to ease congestion and improve public transport in NSW. This centred on a CBD Metro “to allow for future metro projects to Western and North-western Sydney.”113 At an estimated cost of $AU4b ($AU4.63b in 2015 figures), the proposal envisaged construction beginning in 2010 with completion expected four to five years thereafter. Figure 47 below shows the proposed line, from Central Station to Rozelle, with stations at Town Hall, Martin Place, Barangaroo/Wynyard, and Pyrmont.

The then Premier stated that:

This project will ease rail congestion straight away and is the first step towards a metro line for both Western and North-western Sydney. The simple fact is that the worst congestion on our rail line starts when you get to the CBD. People converge on Central from all over Sydney – six lines meet at this station. But we only have three lines to take them through, so obviously this causes a bottleneck, putting pressure on Town Hall and Wynyard. This is the first step in extending the metro to the West and the North-west. It is the future of transport in NSW.114

Figure 49: Map of the then Proposed CBD Metro


Figure 50: Map of the then Inner West Metro Investigation Area; also Showing North-west Metro

The proposal attempted to also deal with bus congestion in the City and on the Anzac Bridge. By creating a bus interchange at Rozelle, north-west buses would terminate at Rozelle, without crossing the Anzac Bridge and clogging traffic when disgorging on York Street in the CBD. Commuters would then travel to the City from the Rozelle interchange. The project calculated that the M4 East road extension (now called West Connex) might be unnecessary. With hectares of government surplus land at White Bay/Rozelle, significant density might be encouraged in that locality. Potentially there were many good things with the proposal. The CBD corridor proposed – from Central to Town Hall, Martin Place, and then to Barangaroo – tackled the need identified by Christie and others that a new CBD link is crucial to increase capacity, reliability, and the efficiency of the CityRail network. (Note that Railcorp has long had two reserved underground rail corridors into the city from Central. One is along the western CBD, under Sussex Street to Wynyard, which can easily be adapted to Barangaroo. The other CBD corridor is under Pitt Street. This was proposed to be used by the CBD Metro. Thus the western CBD alignment remains available to potential, other services). But the expense of twice dipping under the harbour from Barangaroo to Rozelle was likely to be prohibitively expensive. The Epping/Chatswood rail link’s most expensive decision was going under the Lane Cove River. As a general rule, water is the enemy of rail! Although over-engineering should not be automatically assumed, it was likely that deep tunnelling, steep grades, and waterproofing were likely to massively add to costs.

The staff of the then NSW Co-ordinator General of Transport, previously working on the north-west Metro, were immediately reassigned to work on this new metro ‘solution’. The then Premier’s comments about keeping the north-west metro option alive, as if the CBD Metro was “a first step”, was a proto-attempt to see the project in the sense of creating options for further extensions. But unfortunately, sitting on its own, the inner city metro was conceived ab initio - alone. The rest of the network needed to fit with the metro, rather than the metro fitting with an existing rail system. The project was as if half a loaf is better than none. But perhaps the correct analogy was probably that the idea was ‘half baked’. The project, as it then stood, was disconnected from the rest of the rail network. Because the proposed CBD Metro began at Central – or at White Bay/Rozelle - there would have been a massive interchange problem. This was so at both ends. It was ambitious to assume that
patronage would be strong. The CBD Metro, on its own, required commuters to change over from rail services terminating at Central then on to the metro at one end, or use of the large bus exchange at the other.

Clearly, the project needed to be assessed against alternatives, on a CBA. The then Premier’s ‘back of the envelope’ calculations needed to be backed up, and scrutinised in detail.

5.4 Choosing Between Projects

Choosing between competing rail options raises complicated questions associated with the comparison of benefits with costs. As demonstrated in earlier Chapters, there are a number of mechanisms available to transport planners to assess proposals. In the absence of funding constraints, the best value-for-money projects are those with the highest NPV. Where there is a budget constraint, the ratio of NPV to the expenditure falling within the constraint is used. In practice, the ratio of NPV to expenditure is expressed as a BCR. This formulation has been used extensively in the field of transport cost-benefit appraisals. The NPV is evaluated over the service life of the project. As noted in Chapter 2 of this Thesis, a potential shortcoming of BCRs is that, by definition, they ignore non-monetised impacts. Attempts have been made to overcome this limitation by combining BCRs with information about those impacts that cannot be expressed in monetary terms, such as the UK’s New Approach to Appraisal (NATA) framework.115 A complication with BCRs concerns the precise definitions of benefits and costs. These can vary depending on the funding agency. Without getting into too much technical detail, NATA is a framework used to appraise transport projects and proposals in the United Kingdom. It is a multi-criteria decision analysis based tool that builds on already well-established CBA and environmental impact assessment techniques, such as those contained in the Highways Agency’s Design Manual for Roads and Bridges (DMRB), for assessing transport projects and proposals. Since 2009, part of the guidance includes taking account of carbon emissions. The DEFRA CO2 valuations were incorporated into the NATA guidance and software tools. The NATA framework also utilises methods to capture the value

of more reliable journeys, providing guidance to capture the impacts upon travel time variability of transport investment. Both the Eddington Study and the NATA consultation emphasised the importance of reliability to travellers.\textsuperscript{116}

In assessing projects, Eddington commented in his UK Report ‘The Case for Action’ (2006) that conventional BCR refers to the welfare measure conventionally used as part of the appraisal framework. He states that:

In my view, while the conventional BCR is the most certain measure of welfare, it is incomplete in a way which makes it difficult to compare projects. The value for money measure (the vfm BCR) is the most complete ‘single measure’ of transport’s welfare consequences, though it is more uncertain than the conventional BCR because the evidence base is relatively new, and some of the effects are inherently hard to monetise.\textsuperscript{117}

IA was alive to such issues and challenges, publishing in September 2008 its Prioritisation Methodology for the assessment of projects.\textsuperscript{118} This document outlined the key steps required to determine consideration and evaluation of initiatives for the Infrastructure Priority List. It included detailed advice on carrying out profiling and economic appraisals of initiatives. Proponents were required to outline a logical, evidence-driven, robust methodology. The Audit framework consists of seven steps:

IA stated that its methodology was to provide an integrated framework that harmonises the information and data resulting in a balanced range of initiatives, using cost benefit analysis (CBA) as the primary tool for prioritising initiatives. The aim of the methodology was to be logical and well defined - as it is systems focused, and based on and conforming to IA’s aims, objectives, strategic priorities, and principles; clear and transparent - as it promotes the open sharing of information; evidence driven - as it uses quality and suitable data and consistent tools; and robust - as it is comprehensive by looking though multi-lenses to solving a complex problem. This declaration - adding some science to the process of project selection -

\textsuperscript{116} UK Highways Agency (2009) \textit{Design Manual for Roads and Bridges}, UK.
\textsuperscript{117} Eddington, Rod (2006), Op. Cit.
\textsuperscript{118} Infrastructure Australia (IA) (2008a) \textit{Prioritisation Methodology for the Assessment of Projects}. 
was welcome. So was the commitment to transparency and sharing of information by IA. This openness is something sorely lacking in most past rail and public transport assessments in NSW. The appraisal phase of the IA’s prioritisation methodology adopts ‘monetised’ cost benefit analysis as its core tool. This is complemented by ‘non-monetised’ effects. Together a picture of the wider economic, environmental, and social merits of each initiative can be profiled. As noted in the TfNSW 2013 guidelines, economic impact analysis can be used as a complementary set of information with which to assess projects alongside CBA and BCR.119

The profiling phase of the IA’s prioritisation methodology assesses the compatibility of the range of initiatives to IA’s strategic priorities. A picture of the potential national productivity value of initiatives can be determined while producing a balanced view of them together with their linkages and dependencies to other initiatives. The appraisal phase is interested in both the overall efficiency of an initiative as well as its equity and distributional impacts. Efficiency is determined by comparing the benefits and costs of an initiative - specifically addressing the question: “When all the benefits and costs are combined, will the initiative deliver net benefits (benefits in excess of costs)?” On the other hand, the issue of equity and distributional effects is concerned with who bears the benefits and costs. Although CBA is the primary appraisal tool by which IA assesses the net benefit of an initiative, in the IA’s methodology, as benefit and cost are monetised as much as possible, estimates of wider economic benefits and costs (WEBs) are included as relevant.

5.5 Chapter Conclusion

Decision makers face weighty decisions in considering major projects including the overwhelming evidence that MUTPs run over in costs and under-estimate their complexity. Understanding recent Sydney rail transport experience through case studies of decision-making requires a combination of factual evidence and the knowledge of the details of particular projects. This Chapter’s case studies achieve

that objective. There is a considerable mismatch between forecasts/expectations and outcomes. Allport notes that transport planning is drastically affected by poor management such that “[m]anagement autonomy is undermined. The consequence of poor success is often over-design and under-use of assets, poor performance, ever larger financial crises and calls for change and ‘instant solutions’. This is hugely distracting to management, and precludes necessary focus on the medium/long term.”¹²⁰ The approach of TRO is the opposite of seeking instant outcomes. The emphasis inherent in exercising ROs is to make sober judgements, based on facts and well researched information, weighing alternatives and considering the best course. This seems particularly apposite to the NSW public transport mentality where Cohen et. al.’s idea of the ‘drift and stab’ model of non-strategic exercise of options by government is relevant.¹²¹ Morris’ and Hough’s definition of the three criteria of success: project functionality, project management, and contractors’ commercial performance suggest that the ARL is an example where all three failed.¹²²

As a general rule, in the assessment of the relevance of a particular theory to project actualisation it is desirable to assess projects that happened rather than projects that never materialised. Hence this Thesis focus is on real projects - with roads, particularly the Sydney orbital; with rail, particularly the Airport Rail Link, the Clearways project, and the ECRL. As we have seen in earlier Chapters, extensive time and cost overruns are typical in mega projects.

What is interesting about the Sydney experience is how certain agencies, like the RTA, capitalised on moments of opportunity. In contrast, Railcorp was forever fixated on correcting the existing network, über cautious about new extensions to the existing network, and only weakly involved with ambitious and ultimately abandoned, metro rail projects. By 1990 the Roads Authority had established an influential and experienced road planning function, this cannot be said of the rail system. As time went on the RTA became sophisticated in lobbying government in the context of new freeway investment, congested roads, frustrated drivers and slow-

moving traffic. All were significant incentive to politicians to support major road projects.

Areas for future research should include work required to expand on the hypotheses and preliminary work underpinning this Thesis. Project risk management operates in a complex and dynamic environment that is constantly confronted with various risks;\textsuperscript{123} it is turbulent,\textsuperscript{124} and in competition for scarce resources ‘messy’.\textsuperscript{125} Both the road and rail experience suggests that the popularity of BOOT and BOO schemes. The supposed transfer of risk to the private sector may begin to wane. The experiences in the 1990s in using the skills and expertise of the private sector in developing and implementing infrastructure projects\textsuperscript{126} may not be replicated like that in the future. With ARL and the more recent Sydney tollroads (CCT, LCT), all the typical characteristics of delusional and optimistic over-estimation were present.\textsuperscript{127} The research illuminates Sturup’s idea of the AoG of MUTP being the amalgam of rationality, knowledge, and technology which defines the character of the MUTP. The RTA might be said to exemplify the rational comprehensive model characterised by separation of analysis, decision-making, and implementation, and by rigorous technical analysis leading to an organised, optimised solution. Its leadership illustrates how superior, entrepreneurial bureaucratic skills in competition with other (public) transport agencies can triumph.\textsuperscript{128} But that is a word to use with caution with MUTPs. Stone’s (2008) research yields the contention that new transit routes are the result of political contention over transport policies and that therefore political factors are crucial in the rebuilding of mass transit.\textsuperscript{129}

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Even if so, the execution of a strategy is vital to the sustainability of mass transit projects and whether new ones are attempted. Hence the significance of risk management, transparency, learning from experience, and applying lessons to future projects. This is the context in which the TRO fits. It does so partly a) with the recent Sydney rail experience, in contrast to the roads experience where the TRO is clearly applicable in the development of the Sydney orbital, as discussed in the preceding Chapter; b) in assessing the part that TRO did, did not, could not, or might have played in the planning of Sydney’s public transport, particularly the rail component, the announcement/abandonment, propose/discard characteristics of decision-making makes the assessment particularly complicated. Yet what is clearly apparent is that the Clearways project, the expertise gained by management, has inspired confidence to do more – not only additional Clearways projects, but also major rail transport planning; c) related to this, the ERL experience has stimulated the rail and public transport bureaucracies to consider extensions – of which the NWRL is clearly relevant. Arguably, however, as outlined in this Chapter, the alternatives to heavy rail in north-west Sydney were not adequately thought through. Although the discussion on this point in this Chapter concentrates on announced projects, the discussion diverges, as it must, into other public transport (PT) modes and land use aspects, thus underscoring that the issues are not just about the engineering challenges of major rail projects. In PT terms, it does not need to be a binary formula – heavy rail or nothing. Scaling up public transport through a series of steps, real options concerning bus transit, even light rail, were alternatives.

It might be instructively noted the successful managing of those aspects with a metro extension in the Rotterdam Region in the Netherlands. The literature identifies the causes for overruns and the question thus becomes what prevented these causes from occurring in this instance? The answer in Rotterdam’s case seems to be a strict focus on reducing complexity, or in other words keeping it simple. Therefore, the conclusion highlights the need to reduce complexity as it affects the planning of mega infrastructure projects.\textsuperscript{130}

Even though this Chapter has underscored particular failures, the Sydney metro projects from 2008 onwards in particular, there has developed in project development in the Sydney state rail bureaucracy that, in turn, has stimulated the conceptualisation of other projects, as outlined. The continued absence of transparency, however, complicates the picture – in fact the lack of knowledge eclipses efforts to apply the TRO. But for the production of NSW Audit findings, extensively utilised in the research unperpinning this Chapter, there would be relatively scant, detailed and official documentation on the major projects referenced herein.

The ARL experience was a shambles from start to finish – and then some. But here the problem was more with the political masters. This project had a chilling, if not crippling, effect on further project development. The erratic, ‘drift and stab’ perspective and actions of the politicians mitigated against sensible outcomes.

What is consistently argued for in this Thesis is that the TRO is best employed in the context of management of information and project development that is open, is in important ways democratic (or at least is open to debate and discussion) and involves experienced practitioners ‘who have done it before’ and are capable of, in an environment conducive to, learning from experience. Real options, their conception, development, and exercise sits within a context of a system of project management.
6. Conclusion

The arguments from the preceding Chapters can now be drawn together to establish the case that a TRO can be of significant, practical assistance in the planning and delivery of MUTPs in the context of excellence in project and risk management. The achievement of the Thesis is in building on Flyvbjerg’s theories – deepening and extending their analysis – by drawing together arguments from project and risk management, which fit well with a TRO.

The guiding rationale of the Thesis is to evaluate the utility of the TRO in deciding on and progressing MUTPs. As noted at p. 46 and confirmed through the empirical evidence considered in Chapters 4 and 5, this matter can be conceptualised into two parts: (1) Was some version of TRO applied (or was evident) in the cases studied?, and (2) Did its application/non-application result in better or worse outcomes?

This Thesis suggests herein that strategic focus should be directed to all manner of possible transport ‘solutions’ and not limited by any particular preference for a specific technology (i.e., light rail, heavy rail, bus rapid transit, conventional bus, and increased road capacity for cars).¹ Extensive economic appraisal needs to give a complete definition to the range of alternatives that may best reveal the subset that can truly deliver the greatest amount of accessibility per dollar of expenditure for current and future residents of a transport corridor. Thinking through particular alternatives requires that there is the need to generate various options and guidelines as to the grounds whereby one option, or another, might be exercised. In terms of financing, generally government debt financing is the primary means for funding infrastructure (in general it is the most cost effective in terms of borrowing) but, where the risk can be transferred properly, a PPP type approach is a viable alternative. Potentially this

could be shared with the private sector taking on equity financing, with the government sourcing debt (at a 'lower cost of capital'); but this has rarely occurred. There are many variants and combinations in capital financing.

The Christie Report suggested investment in improved rail operational safety, reliability and efficiency, in particular sectorisation of CityRail services, and enhancing this approach by developing separate new ‘sectors’ through the combination of new lines, and extra tracks on existing lines, so that increasingly CityRail trains would operate on much simpler, much more segregated, and much more robust ‘end to end’ service patterns; the associated ability to simplify the ‘mixing’ of fast and slow CityRail services on the major rail corridors; the ability to create new ‘turnback’ facilities, thereby removing obstructions to through services and increasing line capacity; the potential of new computerised signalling control systems in parts of the metropolitan area to improve both operational efficiency (for example, through automatic route setting and the ability to precisely monitor all train movements), and infrastructure and train maintenance efficiency (through automatic logging and reporting of asset conditions and failures); the ability of emerging communications-based ‘in cab’ signalling technologies to improve both rail safety (through Automatic Train Protection systems which would prevent over speeding and the passing of signals ‘at danger’3 and the capacity of the rail network (through ‘moving block’ and similar systems which could permit trains to travel closer together with reduced ‘headways’); and, the introduction of new technologies and facilities improving both the reliability and performance of the CityRail fleet and the cost-effectiveness of rail infrastructure and operations, such as upgraded infrastructure and train maintenance capabilities and systems, alternating current electric traction and, in the longer term, more efficient types of wheel-on-rail rolling stock, and should the technology and cost effectiveness improve, potentially magnetic levitation and associated technologies.

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2 But see the discussion a few pages on.
3 Automatic Train Protection (ATP) systems refers to a form of train protection system installed in some trains to help prevent collisions or derailments through a driver's failure to observe a signal or speed restriction. Where fitted, ATP is designed to provide messages and audible warnings to alert train drivers to the actions they should take to correct a deteriorating situation. The system applies the train brakes if the driver fails to respond to these warnings. An outline of the Sydney system is at: http://www.transport.nsw.gov.au/projects-automatic-train-protection, accessed June 2014.
Adding capacity to the network and adding new services are difficult to achieve without new funding sources. Although it is sometimes asserted that government can always do it ‘cheaper and better’ because its cost of debt is lower, this glosses over reality. A joint article (2000) by John Pierce, then Secretary of the NSW Treasury, and Ian Little, the then Secretary of the Victorian Department of Treasury and Finance, pointed out:

But why would a government seek to use private-sector finance to build infrastructure, when it can borrow at lower interest rates by issuing government bonds? It’s a myth that governments have access to ‘cheaper’ finance to undertake projects: a government’s ability to borrow more cheaply is purely a function of its capacity to levy taxes to repay borrowings. But, when it comes to raising finance for a project, it’s the risk of the individual project that determines the real cost of finance... The difference between the private and the public sectors is that private-sector capital markets explicitly price in the risk of a project into the sources of finances. In the public sector, taxpayers implicitly subsidise the cost of a project by bearing the risk of cost overruns, time delays or performance failures, which are not priced into the government borrowing rate.4

Underpinning that assumption is to allude to the modern theory of corporate finance, which focuses on information imperfections in capital markets.5 The same factors that mean firms are typically capital rationed, and that investment and financing decisions are interdependent, apply in a public finance context. Thus, in practice, investors in state government debt may have considerable difficulty in assessing the quality of the state’s balance sheet and the likelihood of the state being able to increase taxes in the event of financial difficulties. As a result, state governments, like corporations, may face the risk of ‘debt overhang’, and the effective interest rate on bonds may be subject to discontinuous (and at times sudden) increases. To that extent, governments face tighter constraints in raising funds than nominal interest rates suggest. Moreover, given those constraints, it may be desirable for governments to act as if they faced a ceiling on acceptable debt levels, which in turn constrains the size of their balance sheet. The extent of the risk-rate mark-up should be related to the option value associated with differing investment,

which in turn relates to the extent to which updated cost and demand information might alter the scale and timing of efficient investment.

Without Commonwealth assistance and financing from the private sector, the NSW public transport sector faces a dire period ahead. The federal government, however, has shown recent interest across Australia in considering and funding major new, metropolitan public transport projects. In early 2008, an advisory body, Infrastructure Australia, was formed, chaired by Sir Rod Eddington, who had headed several reviews on policy, priorities, and funding options for public transport for both the UK government (2006) and the Victorian State government (2008). Mr Michael Deegan, a former Secretary of the NSW Ministry of Transport, was the first Coordinator General of Infrastructure Australia (IA), whose functions are set out in the *Infrastructure Australia Act 2008* which include the responsibility of a) developing lists (known as Infrastructure Priority Lists) that prioritise Australia’s infrastructure needs; b) reviewing and providing advice on proposals to facilitate the harmonisation of policies, and laws, relating to development of, and investment in, infrastructure; and, c) evaluating proposals for investment in, or enhancements to, nationally significant infrastructure. In the six years since IA has operated there was always tension between the ideal of a robust, independent body and real politics, between pressure on IA merely accepting whatever was put forward by the States as “their preferred projects” and the IA’s role in rigorously assessing projects, including competing projects, on a merit basis. It was encouraging, early in its existence, that IA published guidelines that required it to systematically consider CBA. In 2009, the Federal government allocated $AU20m to the NSW government for the funding of feasibility assessments of western Sydney rail transport projects. The NSW government, under the then Premier, on the advice of the Office of the NSW Coordinator General, allocated those funds to an evaluation of the two then announced Sydney metro projects (i.e., the north-west and west Metro).

Even significant federal funds for new projects are not enough to finance the needs of Sydney’s and NSW’s public transport needs. Arguably the problem is also due to the

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uncreative approach of government in ensuring that the private sector invests and takes on risk and is significantly exposed to failure of a public transport project. Of course government needs to ensure that projects meet real needs and are properly costed. And in so doing avoid some of the mistakes of the past. The TRO is a means to that objective – together with effective project management that learns from experience. This fundamentally requires transparency. Where mega funding is required anything less is grossly irresponsible.

Figure 51: The TRO and the Sydney Case Studies

<table>
<thead>
<tr>
<th>Project</th>
<th>Was Some Version of TRO Applied or in Evidence?</th>
<th>Complications</th>
<th>How Did Application or Non-Application Affect Outcomes?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney Orbital</td>
<td>Broadly conceived, the Sydney Orbital in its various projects was a master stroke of conception by the then NSW senior road bureaucrats in the late 1980s. Piece by piece the orbital was constructed.</td>
<td>Each project was different, each with their self-generated rationale. Gradually the RTA grew more skilled in extracting economic value and shift of risk from the public to the private sector. Several failures, including the Cross City Tunnel and the Lane Cove Tunnel led to the private and public sectors better understanding risk and the potential for extreme ‘optimism bias’ in business cases.</td>
<td>Not only did the RTA have a plan, they implemented in stages, exercising each component (the M4, M5, etc.) depending on the financing options and perspective of the Roads Minister and Cabinet of the day. Permissive as to whether long-dated concessions, limited PPPs or directly developed by government, the exercise of oreal options was relentless over a decade in realising the original ambition.</td>
</tr>
<tr>
<td>ARL</td>
<td>The TRO was not considered in the conceptualisation of this project, as the idea was to provide a faster, less congested service from the international and domestic airports to the city, built on time for the Olympics in 2000.</td>
<td>Contractual flaws in the conception, design, and responsibilities of different parts of the project were manifest. These in combination have had a negative impact on government’s appetite for more rail PPPs. The private sector remains a concessionaire.</td>
<td>Ultimately, through additions to the ‘pure’ ARL section, through augmentation of existing track, new signalling, and new lines through Wolli Creek, Tempe and Sydenham, greater throughput, flexibility and efficiency was achieved with the East Hills Lines and certain Illawarra line services.</td>
</tr>
<tr>
<td>ERL</td>
<td>The ERL was initially considered as the first stage of a</td>
<td>Cost and time blowouts led to the project costing double and twice as long to build.</td>
<td>Increased capacity of transport capacity from Epping to new stations to Chatswood assisted in creating the option to go north, connecting to the</td>
</tr>
</tbody>
</table>
The hypothesis explored and demonstrated in the Thesis is that the road bureaucrats in NSW developed a plan, the Sydney orbital road in the late 1980s, and gradually implemented their vision in the ensuing decades. They exercised real options in piecing together the network with the F3 and M5 East funded and built by government, the M4, M2, M7, etc. in partnership with the private sector, sometimes with significant government subsidy.

With heavy rail, the story is more complicated. There appears to have been a consensus within government that rail was an expensive black hole and the less done to extend its network the better. The carving apart in the late 1990s onwards of the rail bureaucracy (an almost endless process of separating and then joining operational and project development responsibilities) meant that developing new initiatives, let alone real options, was gravely curtailed. Based on the empirical evidence considered

<table>
<thead>
<tr>
<th>Source: Derived from the analysis considered in the Thesis.</th>
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| Clearways | Effectively the TROs was implicitly applied to the Clearways Project as the intention was to create options for existing and new networks. | Cost and time blowouts meant considerable delays in declogging the network. | As lines became more efficient and less complicated – “clearer” – with fewer overlaps with other lines, there was the ability to increase throughput and to set up discrete lines. Over time, this is likely to create the option for entirely discrete portions of the Sydney rail network. |

| link ultimately to go from Epping to Chatswood. The abandonment of this “stage 2”, however, was not the end of the matter. Both Premiers Iemma and O’Farrell championed a link from Epping to the North West | In the earliest conceptualisation of the project the route alignment and detail over one key section (whether to tunnel under the Lane cover river or to bridge that obstacle) had not been decided. Eventually, the more expensive and deeper tunnelling decision led to most of the time and cost overruns. | northwest through new alignments going from Epping to Chatswood to the city. In rail, the option to extend ECRL to Parramatta via Carlingford was arguably an example of the exercise of a RO. Based on the government doing further research and deciding that passenger numbers and cost of going through a difficult terrain, from Epping through to Carlingford and then to Parramatta, did not economically “stack up” meant that the project was not proceeded with. As noted, government decided to reprioritise and utilise the existing network, including the relatively new ECRL, to go north west, hence NWRL. |
in the case study Chapters Figure 51, above, captures the main conclusions concerning the TRO as applied to the case studies.

From this brief outline of what the empirical work has uncovered, it is clear that the TRO operates in the context of people and processes. Option theory focuses on the choices and decisions, which are a part in the complex process of policy-making. Options always are embedded in real conditions and in trajectories over time. One of the problems in complex projects is that the options at hand do not always provide opportunities for major change or to adapt to new conditions. Processes of policy making may be ‘funnelled’, making the real options spaces smaller than adaptability would require. In other words, one may deal with the stream of options at hand, but simultaneously the process should be guided by more strategic reflection and action that enables to organise more redundancy of objectives, information, and organisation creating in this way the space to recombine options and act in adaptive ways. TRO can only be a useful tool subject to the expertise, competence, and qualities of the systems and processes within an organisation. So it can never be useful or operate outside of a system of management of change, innovation, and creative opportunism in the imagining and delivery of major projects.

To spur change programs and capture potential savings, governments must move beyond a project-by-project view and upgrade systems for planning, operating, and delivering infrastructure. A well-functioning system entails close co-ordination between the authorities responsible for different asset classes, clear separation of political and technical responsibilities, and clarity about the roles of (and effective engagement between) the public and private sectors. Other requirements include improved stakeholder management, better operational and financial information to guide decisions, and upgraded capabilities across the infrastructure value chain.

In this context, as noted in Chapter 1, the PC has rather tentatively referred to real option theory. In its report on Public Infrastructure, the PC comments on the usefulness of keeping appropriate options open “to rescale a project... when a reassessment of the scope of the project suggests that the risk of failure ha[s]

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significantly increased.”

Referring to its work in 2011 on urban water policy, the PC states: “Analysis of these sorts of situations can be undertaken using the ‘real options’ approach. The real options approach to investment under uncertainty has been developed over the past 20 or 30 years and applied in a wide range of contexts.” In its urban water policy report, the PC observes: “there is evidence to suggest that better application of the ‘real options’ or adaptive approach to planning and delivering augmentation of supply would have reduced the cost of supply of augmentation, lowered prices to consumers, and avoided the need for restrictions in most cases.”

Adaptive management (AM), also called adaptive resource management (ARM), is a structured, iterative process of robust decision-making in the face of uncertainty. AM seeks to identify uncertainties, and then to establish methodologies to test hypotheses concerning those uncertainties. This is a real options methodology.

The process allows for new information to be identified and evaluated, with a determination then made whether to adjust strategy or goals in the light of such information. That is, there is a decision to defer, reject, or implement an option. Applying this concept to complex management strategies requires answers to several critical questions. What new information should compel an adjustment to the strategy? What threshold should trigger this adjustment? Who decides, when and how, to make adjustments? What are the definitions and thresholds of acceptable results? The exercise of decisions requires information and is dependent upon a continually evolving understanding of cause-and-effect relationships. Planning for and adapting to surprise provides an actionary rather than a reactionary basis for more informed decisions. With a TRO, decision-making occurs in steps, each one constituting an exercised option.

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10 Ibid. Surprisingly, there is virtually nothing else stated on real options in the PC *Public Infrastructure* (2014) report other than a few references to the PC’s *Australia’s Urban Water Sector* Report.
An indication of one sort of option-exercise is stated in the PC 2011 Water report: “The Commission’s modelling indicates that applying a real options approach could reduce the cost of supply for Melbourne and Perth collectively, by about $1.1 billion over a 10 year period, compared with traditional approaches to planning and investment.”\textsuperscript{14} The potential for deferring, adapting, continuing, or delaying certain projects is always subject to new information.

The real options approach necessitates costs in order to keep options open. For example, in the case of urban water, investments might be made to get potential projects 'shovel ready'\textsuperscript{15} or expenditures incurred on higher-priced water sources that do not involve large sunk costs (for example, pre-purchasing water from irrigators and storing it, if the risk of a sustained drought is emerging). Such investments would be considered efficient if the costs are more than offset by the benefits of increased flexibility to proceed with a project when required (with a shorter lead time) or to defer.

Under traditional engineer-driven planning approaches, a supply augmentation such as investment in large desalination capacity, is undertaken to cover all future supply risks ('drought proofing' supply). In contrast, the PC notes that the National Water Commission and the Water Services Association of Australia have endorsed the real options approach to planning and investment.\textsuperscript{16} In other words, decision-making should be dynamic, flexible, and open to change in the light of new information.

This raises the question of what is meant by the PC in proposing a real options approach. In the case of urban water supply, the PC’s proposition appears to be this: making supply augmentation decisions efficiently requires a sophisticated approach to dealing with uncertainty. Australia’s weather patterns and impacts of climate change mean that there is significant uncertainty about future water supply, as well as uncertainty about future demand. The PC observes that there is a value in being

\textsuperscript{15} The phrase refers to projects that have been well-researched and requiring financing. Out of the mouths of politicians and proponents, however, the question how 'ready' always requires exacting, critical examination. Roig-Franzia, Manuel (2009) 'Obama Brings “Shovel Ready” Talk into the Mainstream', \textit{The Washington Post}, January 8.
able to delay major investment decisions until more information becomes available - by not committing to investments earlier than necessary. Some actions enable decisions to be delayed in ways that do not threaten water security. For example, through preparatory work, in reducing lead times in bringing on-stream supply augmentation. In some cases this value can be large and worth funding.17 The PC argues that “[w]here a major supply augmentation can be safely deferred for a year or two the subsequent pattern of rainfall can result in it not being needed for a decade or more, which provides a major cost saving.”18 This is just one kind of decision that might be taken – namely, the decision to defer. To do so rationally requires reliable information, consistent data, expertise, and an openness to reset course. This mentality is frequently missing with MUTP development and the absence diminishes the ability to apply the TRO.

Extending the water analogy further, the PC favourably cites an observation by Borison et. al. that, “[r]eal options [are] now being applied by managers in both the public and private sectors as a way of thinking, a specialized analytic tool for evaluating complex investments, and an organizational process for guiding strategy.”19 The PC went on to recommend “adopting a real options approach to investment,” proposing that “[t]he National Water Commission and/or Water Services Association of Australia should provide ongoing support to utilities to build capacity and expertise in adopting a real options approach, determining a framework for calculating the marginal opportunity cost of water, and devising a range of retail tariff offerings.”20 This highlights an insight that management expertise is required for the capable exercise of decision-making under a real options approach. This Thesis concurs, hence the focus on risk management.

One achievement of the Thesis is to show that real options are no pie-in-the-sky concept. They sometimes are – and should always be – in a decision-maker’s toolkit. The following examples of real options provide investors with flexibility and ability to

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18 Ibid.
respond in real time to unfolding events. Such options, grouped here to indicate whether they are available to a sponsor or investor pre- and post- contract award are not mutually exclusive and can operate in sequence. Figure 52 adds insight to that point.

**Figure 52: MUTPs and the Exercise of Real Options (ROs)**

<table>
<thead>
<tr>
<th>Real Option Type</th>
<th>Description</th>
<th>Transport Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deferral or waiting option</td>
<td>Management can wait before making the investment based on need for further information and/or to see how the market unfolds.</td>
<td>Projects in demanding geophysical environments can be treated in this way. The particular route adopted by ECRL (a tunnel rather than a bridge over the Lane Cove River) is an example.</td>
</tr>
<tr>
<td>Staging or time-to-build option</td>
<td>When a management decision takes time or is done in stages, management can default if market prospects prove worse than expected.</td>
<td>The case for staging in the light of market conditions is compelling for all MUTPs. The gradual roll-out of the Sydney orbital road projects is an instance of this RO type.</td>
</tr>
<tr>
<td>Expand or extend option</td>
<td>If a project turns out well, there may be grounds for management to expand the project scale or extend the project.</td>
<td>The Sydney orbital is an example of this. In rail, the extension of ECRL to Parramatta via Carlingford was a potential example, but not proceeded with. In the end, government decided to utilise the existing network, including the relatively new ECRL, to go north west, hence NWRL.</td>
</tr>
<tr>
<td>Contract or abandon option</td>
<td>If the market prospects are worse than expected, managers can contract or abandon a project for salvage.</td>
<td>The Metros were abandoned but as we saw demonstrated in the Thesis little was salvaged.</td>
</tr>
<tr>
<td>Switching option</td>
<td>Management can select among the best of several alternatives, e.g., inputs, outputs or locations, under the prevalent market conditions.</td>
<td>Choosing between rapid bus transit, light rail and heavy rail are examples where this option could be potentially applied in public transport. Decision-making would be tied to changes in patronage demand and technology improvements.</td>
</tr>
<tr>
<td>Compound option</td>
<td>If investment takes place in stages, the first project can be valued in view of the future growth options it creates.</td>
<td>Seen as a network, each augmentation adds to the value of the system as a whole. This is part of the experience with the unfolding of the Sydney orbital. In the longer term the Clearways project might ultimately be seen in this light.</td>
</tr>
</tbody>
</table>

*Source: Adapted from Figure 3 and applied to projects considered in the Thesis.*
In the period of due diligence of a project (in the pre-contract award phase), there are the options to defer or pause before committing to the investment. For example, in order to obtain new information on likely construction costs, environment, and physical constraints, etc. There is also the option to stage the implementation of the investment/project (acquire incrementally). MUTPs can be broken down into stages, and it is generally desirable to do so. Finally, there is the option to invest in flexibility and/or to upgrade in the future at a much lower cost.

In the post-contract award phase, there is the option to abandon the investment proposal, or exit the project during delivery. This should always be on the table. But it rarely ever is. The exercise of this option, of course, should be in the light of new information, arising even after construction has begun. There is also the option to change the scale of the investment (expand or contract) and the option to change the scope of the investment (different mix of deliverables). Finally, there is the option to switch inputs or processes during delivery.

ROs are exercised in real time, either before or during project delivery, as events unfold and further information becomes available. In response to the additional information, decisions can be made that create additional value for the project sponsor - usually government with MUTPs. That value is in the flexibility to respond to changing circumstances.

Governments, as purchaser of infrastructure-related services, have a distinct interest in value for money (in other words, achieving the best deal they can on behalf of the community). For example, procurement practices that engender competition can improve efficiency by pushing firms to find cost savings or quality improvements. Evidently, in order to maximise the effectiveness of projects, PPPs, where appropriate, need to be well managed throughout every phase from establishment of the project deed, through operation, and finally to hand-back. These skills are often lacking within government bureaucracies, particularly as noted in the Thesis with rail compared to the road sector in Sydney in recent decades.

Accessible information and public, credible analysis of MUTPs has been a major failure in NSW and, indeed, across Australia, particularly with public transport projects. There is strong merit in the University of Wollongong Smart Infrastructure Centre proposal
that all public project evaluations should be made fully public and, when they are, released in a form that would facilitate third party analysis.\footnote{Bowditch, Garry, et. al. (2014) \textit{Green Paper, Infrastructure Imperatives for Australia}, Smart Infrastructure Facility, University of Wollongong; see the earlier reference in the Thesis at p. 38.} Where evaluations are poorly, or rarely, updated in the course of a project’s progress, this means too little attention is paid to the desirability of terminating or postponing projects should costs rise or expected demand fall. Nowhere in Australia does government have in place adequate processes for \textit{ex post} review of cost-benefit studies, with the result that the scope to effectively learn from experience is forgone. The result of poor quality project evaluation is that planners rarely take proper account of uncertainty. As a consequence, project designs embody too few termination and postponement options. Not enough emphasis is placed on the desirability of adopting incremental approaches in the presence of uncertainty, as those approaches allow decision-makers to ‘wait and see’ about cost and demand conditions. When cost blowouts occur, as they have on any number of major projects, the projects continue, even though scaling them back may have been more efficient. An objection to this argument might be the example of the NWRL. There the ‘waiting’ saw project cost balloon from $AU1.9B to $AU8.0B. But this is not a fair comparison because, as noted in Chapter 5, the government sold off reserved tracks of land that would have served a mostly above-ground link. The tunnelling now required for NWRL explains most of the hefty cost increases.

With MUTPs, the Thesis addresses the quandary of how to plan rationally. Lindblom (1959) suggests that scientific planning is a myth.\footnote{Lindblom, Charles E. (1959) ‘The Science of Muddling Through’, \textit{Public Administration Review}, Vol. 19, No. 2, pp. 79-88.} It is usually a question of ‘drift and stab’. Flyvbjerg and others (2014b) highlight the prevalence of over-optimism, excessive mistakes, and large cost over-runs in realising MUTPs.\footnote{Flyvbjerg, Bent (2014b) ‘Projects, Power, and Politics: A Conversation with Bent Flyvbjerg’, interview conducted by Jesper Pagh and Malene Freudendal-Pedersen, \textit{Twentyfirst}, No. 3, 14 May, pp. 62-75.} With reference to Sydney’s experience, the Thesis demonstrates that the local roads authority, the NSW Roads and Traffic Authority, in the mid-1980s came up with a plan for an orbital network, which was patiently and relentlessly pursued through the generation of options to complete parts of the network, road link by road link. The experience can
be described as the exercise of real options in conceiving, developing, and completing that ‘network’.

In contrast, due to the disastrous experience with the PPP for the airport rail link, a negative mindset enveloped thinking within the public sector rail and related bureaucracies concerning PPPs and deriving value for money from private sector involvement. All subsequent rail projects have been conceived and developed along traditional D&C lines. The Thesis argues that the lessons with the ARL are mainly with poor project conception (which limited the rail authorities options, particularly once the project got into difficulties) and poor contract drafting which meant that risk and compensation costs for government ballooned, far beyond the initial investment of the private party to the ARL PPP. These problems were later compounded by poor thinking through of options by the government to take back control of the project.

Ironically, the project costs for all of the post ARL rail projects, along the ‘safer’ process of D&C, have significantly exceeded their budgets. For example, the ECRL, the South West Rail Link, and the Clearways project.

The last two projects can be seen as the development of infrastructure that created real options. The extension of the ECRL from Epping to Parramatta has been considered and rejected – by governments of different political persuasion over the past decade. But more recently, the idea of the NWRL was put forward to extend the line from Epping to Rouse Hill. This project is underway now.

Government has clearly learnt some lessons, on paper at least, concerning poor land transport integration with new infrastructure. The reason for this poor experience is part of the lessons with the ARL and the ECRL. Hence, in many of the pronouncements concerning the NWRL, increased density around rail stations seems to be prominent. Clearly there is the need with new rail links to demonstrate proper integration with land-use planning, including by assessing options to meet transport needs by increasing the efficiency by which nearby land is used.

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24 The NWRL, however, is to be operated by the private sector.
The Thesis has briefly examined the scope to avoid or postpone undertaking major projects by instead undertaking more targeted ‘de-bottlenecking’ projects and to consider alternative modes – such as bus transitways and light rail. With the Clearways project, this has proven to be a much more expensive task than originally envisaged in the Christie Report (2001), but in time it should improve overall network efficiency by creating options to simplify a complicated, interlocking network of rail lines. Implicitly, the Thesis argues for extra capacity – new lines – as well as remedying the existing network problems.

As the ability to think through, create, and utilise ROs is related to management expertise and learned experience, great attention has been paid to this in the Thesis. Thinking about the exercise of real options seems to have come naturally to the leadership of the RTA, compared to the rail authorities in Sydney.

In seeking to fill a gap in the MUTP literature, the Thesis dwells on the proposal by Flyvbjerg that risk should be apportioned to the party best able to handle it and that private parties, where involved, should have ‘skin in the game’. There are several issues to consider here. First, the concept of risk is multi-faceted, complicated, and under-explored in Flyvbjerg’s analysis. Therefore, fleshing out Flyvbjerg’s case is merited by referring to project management and risk – thus linking to the earlier point about leadership, experience, and expertise. Second, with the GFC has come fresh difficulties in financing projects, therefore requiring in many cases greater government involvement in funding, especially where the price for equity and debt, despite current historically low interest rates, becoming relatively more expensive. An addition to the risk premium can arise from the government changing its mind and dropping projects. This increased financing risk is likely to be an additional pressure on project sponsors to consider and counter optimism bias. In turn, this will force careful examination, where efficient, to provide options to terminate, postpone, or re-dimension projects in the face of adverse cost and demand shocks, and to ensure MUTPs are more rigorously assessed and priced.

25 Low interest rates is merely the headline story. Lenders for infrastructure projects price a margin for risk, which has gone up. Long dated loans, say beyond 10 years, since the GFC, have also attracted steeper margins.
The last point, raising the question of rigorous assessment, suggests that all of Sydney’s MUTPs should be subject to proper quality control. Preferably, for consistency across Australia, this should be by way of the IA Cost-Benefit Appraisal guidelines, or an improvement on that model, and by means of full ex post review, including during the course of the project. A considerable problem exists in breaking down secretive, non-market friendly behaviour by governments in the development and procurement of projects. Christie commented in his reports (2001 & 2010) on the desirability of government ‘putting out there’ its thinking on potential projects and priorities, so as to stimulate the private sector to prepare responses to expressions of interest for major projects and, perhaps, come up with initiatives of their own.

Hence the merit of the proposition that such information needs to be transparent. To be also useful this requires that all evaluations and the data on which they are based are fully disclosed to the public. Preferably, each year, the relevant authority should report on the projected net benefits of both the projects that it has decided to undertake, and of those evaluated but are not proceeding.26

With respect to the debate on road versus rail in transport provision, it is noteworthy that for roads there are no direct user charges (excepting on a small number of toll roads). Thus, there is a lack of transparency in the pricing of road use, as both the Productivity Commission (2014) and the Henry tax review (2010) have emphasised. This places public transport at a disadvantage, even if for public transport generally charges are far below long run costs. In combination, where prices cannot guide efficient usage and investment decisions, then the burden of financing infrastructure expansion falls on current and future taxpayers.

There is merit in both the road and rail entities having the scope to seek private funding for all, or part, of ‘their’ network subject to requirements of transparency (and probity). The entity must be satisfied that any private funding would promote

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26 This should be an independent body – potentially GAMUT Mark 2.
the long-term interests of end-users. This, however, should be subject to mandating periodic, fully public assessment of the efficiency and effectiveness with which the entity discharges its responsibilities, as set out in the statement of objectives of a transport project.

**TRO in Overview**

Chapter 1 noted that traditional approaches to project valuation are based on discounted cash flows (DCF) analysis which provides measures of net present value (NPV) and internal rate of return (IRR). A problem with DCF-based approaches is that cash flows cannot be estimated precisely in an uncertain decision-making environment. The other one is that the values of managerial flexibilities in investment projects cannot be exactly revealed through DCF analysis. There is value in the flexibilities embedded in a potential project. Irreversibility is not required to give value to the option of delay during which time further information might be collected to assist a sponsor – and/or the investor - value the investment. If an investment project is irreversible at any stage during its life – that is, the investor can undo the expenditure of resources and recover them if market conditions turn out to be worse than anticipated – then an option to delay start-up has no value. If delay adds nothing to the information of the investor about the cash flows of the project, then again the option to delay has no value. The existence of the opportunity to delay, however, gives an investment the possibility of containing the equivalent of a financial call option - that is, the right but not the obligation for some specified period of time to pay an exercise price and in return receive an asset with value. The exercise of an option is not necessarily an irreversible investment, although there may be sunk costs. In some cases, the option cannot be retrieved once sold nor can the funding paid in exercising it. A real investment opportunity for a sponsor is an option to spend funds now or in the future in return for an asset of value (the project). In part because the future value of the asset is uncertain, the option when to invest is valuable.

Because delaying a major investment decision until more information becomes available can lead to a better decision-making, it is generally preferable not to commit
to investments earlier than necessary. Similarly, taking actions that enable decisions to be considered and unrushed, such as by doing preparatory work to reduce the lead time for building infrastructure, can be worth investigating. It is not just a matter of delay or merely buying time. Better information can be vital for the exercise of many subsequent options associated with a project. A particularly important and common form of embedded option is the opportunity for an investor to delay the commitment of resources in order to allow the gathering of more information about the project’s cash flows and costs to construct.\(^2^7\)

It is useful to keep appropriate options to rescale a project when a re-assessment of the scope of the project suggests that the risks of failure have significantly increased. Expended resources are a sunk cost and strictly should not influence future decisions (the exercise of options) going forward. Although abandoning a project shortly before contracts are signed may have some political difficulties (of the ‘egg on the face’ kind) - where this is desirable, given new information, such a decision can be worthwhile, even where it requires compensation to be paid to shortlisted bidders. Notwithstanding the merit of this, as a practical matter, there are also significant reputational, management, governance, and accounting issues for both government and private entities associated with writing off large sunk infrastructure investments. Even so, this effectively occurred with the Sydney Metro projects. One lesson here is how the early implementation of a project might nonetheless be able to retain or salvage value should it ultimately be abandoned. This clearly was not anticipated in the development of the Metro projects.

Every project involves some degree of risk, but that risk can be controlled with careful analysis. One of the key responsibilities of a project manager is to anticipate project risks and then to devise the means for controlling those risks before they can get out of hand. This is where the risk management process comes in. Risk is a complex notion and it is very difficult to capture all major aspects of project risk. The complexity of projects has increased risk exposure. Project risk management operates in a dynamic environment that is constantly confronted with various risks. It is therefore imperative that project managers should consider all possible risk

factors affecting a given project. Furthermore, they should take corrective actions to control and manage the identified risks. An effective risk management approach can provide a framework for project managers, which enables them to identify and assess potential risk factors and to then take the necessary actions in order to achieve the desired objectives of a given project. Risk management can be a challenging process because it requires anticipating future events. Instead of only trying to look into the future, we can also manage risk by looking at the past. By examining prior project experiences, an insight into risk probabilities can be obtained. If an event can be anticipated, then there should be scope to weigh up the consequences and control of the outcome.

All novel projects are risky and all MUTPs are novel in some way. Once a project has started, even experienced project managers can make ineffective choices. Hence, the need for project risk analysis and project risk management tools, in order to help with decision-making. The skills of project proponents and managers in addressing such risks, and ensuring efficient project delivery, goes hand in hand with a theory of real options. Flyvbjerg’s statement that risk should be borne by the parties best able to handle them is a simple claim that belies a host of methodological complexities and choices concerning how best to measure, monitor, and control risks with MUTPs.

The argument in Chapter 5 concerning the Sydney metro projects was critical of decision making, primarily because the decision-making was sub-optimal. The CBD Metro could only work once other lines were added to its narrow focus. It was a crab without claws and just as useless. This Metro did not fit at all with any of the rest of the network and added to its complications, thereby eliminating or frustrating the potential to exercise potential options on the existing network or even a new network. Analysis of these sorts of situations can be undertaken using ROs. As discussed, the ROs approach to investment under uncertainty has been developed over the past 20 or 30 years and applied in a wide range of contexts.

To recap the arguments developed in the Thesis, the primary concern has been with exploring the theoretical potential of a TRO in an area of urban and transport planning that has been vexed in recent decades. The analysis here addresses Flyvbjerg’s findings that MUTPs are notoriously troubled by dramatic cost overruns and optimism
bias. Flyvbjerg’s research features prominently in the analysis, particularly as his extensive empirical and theoretical critique of MUTP planning dominates the academic literature. His recommendation is that there should be more responsibility and risk management taken on by those parties best able to handle them, with realignment of interest between the sponsorship and the delivery of projects. Thus, understanding how to do better requires evaluation of project management, the acquisition of expertise, learning from experience, and risk management. The accomplishment of the Thesis, with reference to Sydney’s experience, is to continue the dialogue initiated by Flyvbjerg into areas of MUTP management. If urban and transport planning only shyly or rarely strays into the field of management, this is to the disadvantage of both disciplines. For MUTPs are amongst the most vexed of management challenges. Clearly, ‘solutions’ for failures in MUTP project execution that do not venture into the world of risk and project delivery management merely point to potential solutions. What is required is systematic consideration of best practice and learning from – and remembering - experience.

In Chapter 1, it was noted that a TRO, though a relatively new concept, is extensively explored in the academic literature, mainly in the context of business management of complicated projects. Interestingly, the PC in its recent analysis of both urban water and public infrastructure projects generally has recommended a ROs approach to project conception and management. The Thesis sketches how this might be applicable in the context of road and rail projects in Sydney, suggesting that in the rollout of the Sydney road orbital there was the exercise of ROs and that this stood in contrast to the Sydney rail experience.

Chapter 2 referenced the literature concerning mega transport projects, particularly highlighting work done by Flyvbjerg and others in explaining why, so often, MUTPs go wrong. Ideas are introduced into the analysis of principal and agency risk, cost benefit analysis and project management, attempting to link all those elements into a coherent proposition, namely, that a TRO is not a tool able to be utilised separate from a system of mega project management. In the broadest sense, it is how projects are managed that is important. A TRO fits in that context and not on its own. The Chapter also explores the origin and controversy-laden history of CBA with MUTPs. Chapter 3 further develops the argument about ROs, referencing a TRO in the context of other theories seeking to interpret MUTPs. The hypothesis about the
valuable potential of a TRO is not contradicted by the competing theories that are discussed. Indeed, the argument put forward here complements and extends previous analysis, including Flyvbjerg’s theories.

Chapter 4 puts to the test the Thesis’s theories by evaluating Sydney road MUTPs, pointing to the strong evidence that the exercise of real options in the conception of the Sydney orbital is a fruitful means of explaining that experience. We also see that in some of Transurban’s own development as a private company that certain ROs were obtained, became valuable, and were exercised. The Sydney orbital has become a reference point for future road MUTPs, both fitting into a storyline of extending the roadlink and in the context of having created options for expansion of that ‘network’. In passing, we note that the under-pricing and lack of transparency concerning road costs is poor public policy, distorting planning for project funding allocation, including public transport projects competing with road projects. Significantly, we see that expertise in project and risk management is crucial to the successful project delivery, including in the ability to acquire, manage, and exercise real options.

With rail projects in Sydney, Chapter 5 discusses why the experience has been markedly different to the roads experience. The conclusion is that constant political and management disruption has handicapped project conception and delivery. Hence, without the kind of management systems and expertise required, a TRO is of limited utility. Even so, there are some projects, particularly the Clearways project, that create real options for the future.

Some projects, however, such as the now abandoned Metro projects, were so incompatible with the existing network that it is clear that they were likely to complicate, rather than enhance the operations of the network. The analysis is supportive of the Christie Report (2001) recommendations on improving both rail operations and in extending the network. On the latter, the Chapter critiques the Airport Rail Link experience, including the storylines and urban myths of what went wrong. The finding is that the original PPP concept, the contract arrangements and complications associated with loosely worded government guarantees, immensely increased risk and ultimately the expense to government of the project. Also, urban development around new stations considerably lagged what was projected would happen (undermining potential patronage) – a theme also relevant to the ECRL.
Integrated transport and urban planning in Sydney leaves a lot to be desired. The evidence points to new transport infrastructure creating ROs for land use, intensifying development around stations for example. Property can be conceived as a network asset – its value and utility turns on what happens around it. Where new infrastructure is built, there is at least the prima facie case for assessing potential, consequent land use change. This is the argument around the theory of transport-oriented development (TOD). It is surprising, particularly because of the plethora of NSW government official planning guidance documents which advocate TOD that the experience with ARL and ECRL was so fraught and delayed. But with respect to the Thesis, the main conclusion reached in this Chapter is that management and systems of management are crucial to the effective imagination and project delivery of rail MUTPs. It is only in that context that a TRO can be useful.

Instancing the various MUTPs examined in the Thesis and comparing them to common ROs is already described in Figure 52, above.

One of the issues with rail planning in Sydney is that the government is responsible for the provision of the infrastructure and also responsible for the delivery of the service using the infrastructure. Consequently the travelling public generally under-appreciates enhancement to existing infrastructure. Their overriding concern is changes to the services they use. Given that in many cases neither the rolling stock has changed nor the stations, especially the central city stations, then new investment rarely generates the lift in popularity that many politicians would like to see.

As stated in the Thesis, relevant to Sydney there have been many transport planning documents over the decades, nearly all of which have been abandoned at some point and, from a rail point of view, rarely implemented. From a rail planning perspective the main absence has been an overall plan of how Sydney should develop, in particular how public transport, especially rail, would help to achieve community objectives and needs. The current, unspoken programme of concentrating the vast majority of employment on the eastern edge of Sydney while providing the vast majority of new housing in western Sydney is fundamentally unsustainable. The rising cost of commercial development in the CBD and North Sydney, plus the rising cost of inner-city housing caused by segments of the population escaping the long journey times required from western Sydney, increases the cost of doing business in the CBD. There
are other cities that provide many of the benefits that Sydney does but at a lower cost. Therefore current transport planning practice undermines the long-term sustainability of Sydney. Unfortunately, the road programme supports this scenario, as do many of the rail plans – of which the Christie Report is the most prominent. Ease of access is maximised to the CBD while other freeways provide an orbital function avoiding the congested area. What the road plan does not provide is a system whereby there is an ease of movement between other CBD’s within the Sydney region (Parramatta, Liverpool, Penrith, Campbelltown, Hurstville, etc.), or between the northern beaches and western and southwestern Sydney. The Christie Report (2001) does include a number of potentially interesting projects proposing an ungrasped opportunity to challenge what types of services should reshape Greater Sydney.

The NSW Labor government issued a document called City of Cities (2005), but it failed to develop a transport plan which would support the objective of interconnecting population and employment nodes across Sydney, rather than the current, concentrated links to the CBD. Without this overall conceptualisation of how to ‘rebalance Sydney’, to show how Sydney should look in the future, it is difficult if not impossible to determine the most efficient investment options for improving transport. For example, there is much talk of a second harbour crossing, with very little thought it is assumed that a second harbour crossing would be near to the first harbour crossing. The current harbour crossing has a maximum capacity of 24,000 passengers per hour in each direction by rail. Upgrading train technology to even late twentieth century standards would increase capacity to 40,000 passengers per hour. So the question should be “why build another crossing where you already have substantial capacity and where the increase is only going to be marginal?” Perhaps a second crossing would be better placed between the Domain and Cremornerne, with the line continuing to Warringah Mall. This would substantially reduce road traffic on Military Road and congestion on the Harbour Bridge and tunnels. How such a project might be assessed returns to an earlier theme – the need for systematic, transparent, rigorous public evaluations of projects. Yet most MUTPs are developed in secrecy

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29 Some of my thinking here has been influenced by exchanges with the late, former senior rail bureaucrat Barry Garnham, mentioned in the Introduction to this Thesis.
and when they see the light of day there is the game of doing the minimum in public consultation and transparency.

Chapter 6 therefore flows logically from the earlier Chapters. The key to the TRO is risk and project management - hence the preoccupation in the Thesis to relate MUTP analysis with such considerations. In a multi-disciplinary fashion, the Thesis has built on past prescriptions and analysis of MUTPs, particularly Flyvbjerg’s, and provided a fresh theoretical perspective on how a TRO can be of practical value in improving decision-making.

There are many potential areas of research arising from this analysis that are worth noting. First, the Sydney experience invites comparison with other cities in Australia, and internationally, that can be explored with respect to a TRO. Second, within Sydney, as noted in Chapter 5, the bus network, and its development is worth assessing in the light of our analysis. We saw in Figure 34 on page 193 that the number of annual bus passenger journeys in NSW was around two thirds of rail, so the numbers of people moved is massive. A TRO could be of value to the development bus services, corridors, and extended networks. This is a potential, interesting research project and could be extended to consider the appropriate mode in meeting transport needs on a systematic basis, in parts of Sydney. Third, further research might delve deeply into the empirical evidence, including interviews with project managers, bureaucrats, and politicians involved in Sydney and wider MUTP planning. Case studies, building on the analysis offered here, could also be undertaken.

Is the lack of a quantifiable benchmark and the lack of measurement of the value of a RO a fatal theoretical weakness? No. Certainly, as Chapter 1 noted, finance theory urges putting a price on everything. The Thesis, however, has resisted this prescription, though further research and particular case studies might yield alternative, quantifiable examples that monetise particular ROs. But this, as explained in Chapter 2 in particular, is a controversial area.

For the purpose of this Thesis, the theoretical case is established that the TRO is of practical assistance to MUTP planning. In *Objective Knowledge* (1972), a book referenced in Chapter 3, Popper suggested that theories are like searchlights, illuminating evidence, providing perspective, and a rationale for analysis. A TRO is such a theory, but its utility is enhanced and may not be valuable without project
management skills and managers capable of its realisation. As every road and railway project and network is a socio-technical system, with human factors at its core, the contribution of a TRO must be at a management systems level rather than as an isolated tool. This is the proposition that informs this Thesis, filling a gap in the academic literature, and extending, through the consideration of a TRO, transport and urban planning to project management of MUTPs.
Appendices
Appendix 1: Competing Methodologies in Avoiding Risk

For ease of reference, the principal systematic methodologies of project risk management, referenced in Chapter 3, are now summarised.

**Critical Path Method**

The Critical Path Method (CPM) or Critical Path Analysis is a common tool in construction and project management. CPM is a mathematically based algorithm for scheduling a set of project activities. Commonly used with infrastructure, building construction, software development, research projects, product development, engineering, and plant maintenance, among others, any project with interdependent activities can apply this method of scheduling. The core insight is that as Kelly (1961) notes, a schedule ‘network’ represents the project strategy. Network analysis procedures originated from the traditional Gantt chart. When the results of a CPM analysis are fitted to a calendar time, the project plan becomes a schedule. CPM relies on the insight that projects are made up of a number of individual activities. Some of those require other activities to finish before they can start. Therefore the project becomes a complex web of activities. CPM yields insight on how long a complex project will take to complete, which activities are critical, meaning those activities that might hold up other activities that have the potential to cause the whole project to take longer. By obtaining information about the cost of each activity, and how much it costs to speed up each, then insight on the options are generated concerning the least costly way to speed up a project. CPM is overwhelmingly the standard approach for considering the effects of delays on a

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The CPM identifies the longest path in the network, called the critical path, by calculating activities by time parameters. Without mitigating action, any delay in an activity on the critical path would delay the entire project. The paths that are not critical can be delayed, if they have scheduling flexibility, without necessarily delaying the project.

The CPM models activities and their dependency. Sometimes it is not possible to start some activities until others are finished. These activities need to be sequenced, usually with each stage being completed before the next stage can begin. Since real projects do not work this way (there is over-lapping of tasks, rather than neat sequencing), the CPM is just the beginning of project schedule management. Large projects, including MUTPs, become much more complicated than the simple schema as outlined. That is because multiples of thousands of overlapping activities need to be attempted and scheduled.

Some key reservations about the standard CPM include that it is based on single-point estimates and therefore gives a false notion that the future can be predicted precisely. One common misconception is that since estimates are based on most likely estimates, things will even out by the law of averages. In almost all cases, the CPM completion date is not the most likely. Second, the activities on the critical path may not be the most likely to delay the project. Due to deviations from the plan, tasks not on the critical path can end up on the critical path. The use of the CPM can therefore direct management’s attention to activities not likely to delay the project. The duration of each task is an estimate subject to uncertainty. The critical path may vary and single tasks may or may not be on the critical path when randomness is accounted for. Third, project duration is probabilistic and therefore predictions of

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completion dates should be accompanied by probabilities. The duration indicated by the CPM is simply an addition, a calculation, of the most likely estimates, which is only accurate if everything goes according to plan. The CPM date is rarely a good approximation of the most likely date. Even with a single path project, the CPM date is almost always far too optimistic. Fourth, the CPM does not account for path convergence and therefore tends to underestimate the duration of the project. For example, if three parallel activities all have an estimated duration of 10 days, the CPM calculated duration would be 10 days. If any one of the activities, however, is delayed this estimation will not hold. The likelihood of meeting the predicted merge date is the product of the probabilities of each of the joining paths. Fifth, the project duration calculated by the CPM is accurate only if everything goes according to plan. This is rare in real projects. Sixth, in many cases the completion dates the CPM produces can be unrealistically optimistic and highly likely to be overrun, even if the schedule logic and duration estimates are accurately implemented. Seven, the CPM completion date is not even the most likely project completion date, in almost all cases. Finally, the path identified as the ‘critical path’ using traditional CPM techniques may not be the one that is most likely to delay the project and which needs concentrated management attention.5

PERT

Developed in the late 1950s for the U.S. Navy’s Polaris project which employed thousands of contractors, the Program Evaluation and Review Technique (PERT) is a variation on Critical Path Analysis and its limitations.6 PERT attempts to master uncertainty through factoring uncertainty in activity estimation. A PERT chart is a project management tool used to schedule, organise, and coordinate tasks within a project. For each activity, PERT gives three estimations: optimistic, most likely, and pessimistic times – and identifies the minimum time needed to complete the total project. The idea is to make it possible to schedule a project while not knowing

precisely the details and durations of all the activities.

There have always been doubts about the theoretical assumptions of PERT and its practicality. The assumption of independence between activities, and the assumption that all estimates come with a Beta distribution, is not practical. More importantly PERT assumes that the probability distribution of the project completion time is the same as that of the critical path. The possibility that the critical path identified may not end up being the critical path is ignored. Hence, PERT consistently underestimates the expected project completion time and produces overly optimistic estimates for the project duration.

Monte Carlo Simulation Tools

Monte Carlo simulation (MCS)\(^7\) is a problem solving technique used to approximate the probability of certain outcomes by running multiple trial runs, called simulations, using random variables. In doing so, MCS can be used to overcome some challenges associated with CPM and PERT.

First proposed for project scheduling in the early 1960s, the technique became dominant in 1980s when sufficient computer power became available. Each simulation is generated by randomly pulling a sample value for each input variable. These input sample values are then used to calculate the results, i.e., total project duration, total project cost, project finish time. The duration of each activity is estimated by shortest, most likely, and longest duration and also the shape of the distribution (normal, Beta, etc.). Then critical path calculation is repeated. A sufficient number of runs provide a probability distribution for the possible results (i.e., time, cost).\(^8\) MCS allows a manager to evaluate a project under unlimited, alternative scenarios.\(^9\) MCS can provide a sensitivity analysis by measuring the correlation between the project inputs (task duration, finish time, etc.) and the

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\(^7\) Monte Carlo simulation is named after the city in Monaco, where the primary attractions are casinos that have games of chance. Gambling games, like roulette, dice, and slot machines, exhibit random behaviour.


project outputs (project duration, cost etc.). This gives an indication of how much
the duration of each task affects completion of other tasks and also the tasks that are
most likely to cause delay on a project.

The classic Monte Carlo simulation method has a number of limitations. The serious
flaw in traditional MCS is the assumption of statistical independence for individual
activities, which share risk factors in common with other activities.\textsuperscript{10} MCS tools
assume that the marginal distribution of uncertainty for individual activities in the
project completely define the multivariate distribution for project schedule. Van
Dorp and Duffey (1999) demonstrated that failure to model such dependence during
MCS can result in the underestimation of total uncertainty in project schedule.
Statistical distributions of project inputs such as task durations should be obtained
based on reliable historical data. In most large, novel projects this information is not
available and so using the MCS may not improve estimations.\textsuperscript{11}

Risk Register Approach

A standard tool for project risk management is the risk register. Under this schema,
a project team thinks through the risks for their project, then decides which factors
are relevant at what rating, and then proceed to state the specific risks they suspect
could affect the project. They develop a risk register. Transparency is important
with MUTPs, particularly where some organisations store their risks in undisclosed
forms of registers. Typically, the register is a list of the risk factors of project failure
compiled based on the experiences from past projects. A risk register usually is
generated from the use of a questionnaire or a risk list and reflecting on past
experience. The questionnaire might consist of a set of questions that ask about the
current state of the project. The questions directly indicate the existing risk factors
and also guide towards some potential risk factors. The risk factors are identified
usually by negative answers. Williams states that a risk register has two main roles:
first, to serve as a repository of knowledge, and, second, to begin analysis and plans

\textsuperscript{10} Van Dorp, J.R., & Duffey, M.R. (1999) ‘Statistical Dependence in Risk Analysis for Project Networks
\textsuperscript{11} Ibid.
that flow from it. As such, the risk register should be used to keep log of the risks characteristic of a project. A common mistake among many organisations is that they need to manage a defined list of risks. Some risks are volatile. Some others are unpredictable. If, in the creation of a risk register, there is created the impression that risks are static, this is a mistake. Just as business conditions change all the time and decisions have to be made every day, new risks emerge and old risks change all the time. Seen in this light, risk registers are an Aide Memoire to management to capably manage risks for value creation and in setting and modifying strategy, in monitoring and managing performance, and in daily decision-making across the project. Chapman and Ward (2000) state that to enable the documentation of the sources of the risk and their responses, as well as their classification, “the risk register identify phase involves compiling a list, a log or register.” Ward (1999) states that “the purpose of the summary risk register is to help the project team review project risks on a regular basis throughout the project.” The risk register is used as a formal method of identifying, quantifying, and categorising the risks, as well as providing the means of developing a cost-effective method of controlling them.

Publicly available risk registers are particularly useful in practice because of their accessibility and comprehensiveness. Some risk registers currently available derive information from: The Risk Assessment Checklist - a general questionnaire proposed by Thomsett (1992) to assess risk in the very early stages of a project. The questionnaire is supplemented with a method to assess the overall level of project risk, which evaluates each answer with a given number of points. The total number of points is then compared against a predefined scale, which assigns a risk level (high, medium or low) to a given range of points.

There are many examples of the items or type of information which could be stored in the register. The general consensus being that the risk register should contain a description of the risk, its impact, and probability. Risk is decomposed into two components: a) probability of the risk; and, b) impact the risk can cause. Risk is then quantified as the measure: \( \text{risk} = \text{probability} \times \text{impact} \). A risk register involves a dose of subjectivity especially where the current state of a project is being assessed. Depending on who is doing the assessment, optimism bias can creep in. A common technique to reduce the subjectivity in a risk register is by gathering answers from different sources, comparing responses, and debating the efficacy of each, before reaching a conclusion.

**Fault Tree Analysis**

Fault tree analysis was developed by Bell Telephone Laboratories in 1962 for the US Air Force for use with the Minuteman system.\(^{16}\) The methodology was later adopted and extensively applied by the Boeing Company. This is a graphical technique that provides a systematic description of the combinations of possible occurrences in a system which can result in a system failure.\(^{17}\) A fault tree is a logical diagram which shows the relation between system failure - that is, a specific undesirable event in a system and failures of the components of the system. The undesirable event constitutes the top event of a tree and the different component failures constitute the basic event of the tree. By use of this analysis, a list can be generated of possible combinations of component failures/basic events which would ensure the top event occurs; identification of critical components/events; and the (un)reliability of the system - the probability of the top event occurring. Fault tree analysis is a top-down method of analysing an undesirable event to determine all the ways that the event can happen, based on the behaviour of the components and interfaces.

The most serious outcome is selected as the Top Event. From there a fault tree is constructed by relating the sequences of events with AND and OR logical gate which

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individually, or in combination, could lead to the Top Event. Probabilities are assigned to each event and at an OR gate the probabilities must be added to give the probability of the next event, whereas at an AND gate, the probabilities are multiplied. Therefore it is possible to identify the failures that have the greatest influence on the End Event. Advantages of fault tree analysis are that it: provides insight into the system behaviour; provides a graphic aid for management; identifies failures deductively; handles complex systems more easily; provides options for management and others to perform either qualitative or quantitative reliability analysis; and allows concentration on one particular failure at a time.

In contrast, some of the disadvantages include: the independence assumption between the causes; a time consuming approach which introduces the possibility of error; a costly method; it considers components in either a working or failed state; and more specifically, the components’ partial failure states are difficult to handle, difficult to use for large projects, and the end results are difficult to check.

Cognitive Mapping Methodologies

Broadly considered, cognitive mapping methods supply a researcher with a tool for constructing a collective map of a group involved in a business relationship. With respect to a MUTP, the collective cognitive map of a group presents a hierarchy of aspirations, strategic issues, problems, and strategic options. Such methodologies have been applied in research in a project context to study disruption and delays in projects. Williams (1994)\textsuperscript{18} proposes using causal mapping and system dynamics to model complex projects; Williams \textit{et al.} (2003) used causal mapping to explore risks in projects;\textsuperscript{19} Maytorena \textit{et al.} (2004) employed causal mapping to explore the process of risk identification in projects.\textsuperscript{20} In a broader management science context, cognitive mapping methods can be combined with other methodologies such as

Multiple Criteria Decision Analysis (MCDM), where the overall goal is to determine a preference ordering among a number of available options.\textsuperscript{21}

The cognitive mapping methodology is built on the premise that all individuals gain an understanding of the world they inhabit through developing a set of beliefs, assumptions, and a knowledge base that is used to make sense of the world around them. The decision makers use ‘personal models’ when making decisions and it is through the dissection of their explanations using cognitive mapping techniques that researchers are able to gain greater insight into the perceived complexities of the issues.

Cognitive mapping techniques are used to identify an individual’s beliefs about a particular domain and to depict these diagrammatically. Swan (1997) in her review of cognitive mapping as a management research tool highlights that the product of these mapping techniques, although typically referred to as cognitive maps, are not cognitive maps in the “psychological sense.”\textsuperscript{22} It is not “an internal mental representation” but a visual representation of an individual’s subjective data that helps in the understanding and analysis of specific elements of an individual’s thoughts rather than thinking.\textsuperscript{23} Kelly’s Personal Construct Theory (1995), an interactive decision-support tool used to capture and analyse complex problems for decision-making, has been influential in providing a basis for understanding how individuals make sense of their experiences.\textsuperscript{24} In some cognitive mapping techniques highlights why different managers respond to information differently and reach varying conclusions on the right option to pursue.

Decision Tree Analysis

A decision tree visually maps out, organises and analyses potential decisions, a tree-like graphical diagram of options and their possible consequences, including chance

\textsuperscript{23} Ibid.
event outcomes, resource costs, utility and uncertainty consequences.25 Basically, there are two node types: Rectangle represents the decision to be made. The branches from decision nodes are the alternative choices. The manager can implement only one alternative. A circle represents chance node. The branches from chance nodes have some element of uncertainty as to whether or not they will occur.26

The core of the decision tree is aggregating the payoff values, and their associated probabilities into a single quantity that can be compared with each other. This is particularly important with a TRO as Brealey, Myers, and Allen (2008) note: “notice that sensitivity analysis and Monte Carlo simulation do not recognize the opportunity to modify projects.”27 But decision tree analysis encourages thinking about the flexibility and options associated with decision-making. The aggregation procedure is repeated until the decision maker can identify the action to be chosen at the initial node, and the subsequent decision nodes. The most commonly used method for the decision tree is the expected monetary value (EMV), which maximises the expected payoff as the evaluation criteria. If the monetary value is replaced with utility, which measures the decision maker’s preference in an interval scale, the EMV decision rule would become the maximising expected utility (EU). The utility analysis is a powerful framework for decisions involving risk, but it has some limitations. It cannot include the portfolio effect of the decision maker’s attitude, as the decision maker’s attitude changes dynamically.28 Another limitation is the famous Allais paradox,29 where people sometimes violate the basic assumptions on which the utility approach is based. So in most cases it is usual to use only the EMV rule. This might not produce the best result, however, since the EMV rule does not consider the decision maker’s attitude. Yager (2002) pointed out

the shortcomings of the EMV rule such as the use of the expected values that associate a neutral attitude to the decision maker.\textsuperscript{30}

Theory of Constraints

The Theory of Constraints (TOC) was coined by Goldratt (1994), who argued that processes, organisations, etc., are vulnerable because the weakest person or part can damage or break, or at least adversely affect the outcome.\textsuperscript{31} Thus, like the old saying that ‘a chain is no stronger than its weakest link’, this means a focus on what could go wrong and anticipating problems. The TOC analytic approach contends that any manageable system is limited in achieving its goals by a small number of significant constraints and that there is always at least one constraint. Hence the TOC process seeks to identify the constraint and restructure the rest of the organisation around it. Every system has at least one constraint limiting what it strives for. Constraints determine the output of a system whether they are acknowledged or not. Therefore it is in a manager’s best interest to identify and reduce the system constraints within the organisation. The TOC is both descriptive and prescriptive in nature; it not only describes the cause of system constraints, but implicitly provides guidance on how to resolve them. This is because by encouraging identification of weaknesses and constraints, relevant risks can be monitored and addressed.

After searching for, then strengthening in response to a constraint, the system is stronger. Yet the system does not become infinitely stronger. The constraint simply migrates to a different component of the system. Some other link is now the weakest and all the other links are non-constraints (not weighing on the system).\textsuperscript{32} It follows that watchful excellence in project management is imperative.


Final Note

Primarily concerning the latter, this Appendix addresses the kinds of competing, advanced management tools available to assist in managing this task.
Appendix 2: A Note on Western Fast Rail

As mentioned in the Preface to the Thesis, from 2002 to 2010 the author was deeply involved as Chairman of the consortium proposing the Western FastRail (WFR)\(^1\) link from the Sydney CBD along the western rail corridor to Penrith.\(^2\) Although objectivity might be challenged, this matter is appropriately referenced here because some of the tests and methodologies advocated in the Thesis can be explicated by reference to this since abandoned project. The purpose of this summary is to relate them to the themes addressed in the Thesis.

The proposal centred on two privately funded 26 km underground tunnels (going either way) that would link from Parramatta to the City with limited stops, building two new lines from Penrith (or Emu Plains) to St Mary’s and then either sharing of services (as proposed in 2005) or two new tracks from St Mary’s to Westmead (as proposed in 2007). A distinct line would then be operational with 11 minute journeys to Parramatta, 18 to Blacktown, 28 minutes to Penrith. Standard, international rolling stock would operate on the network. For a $AU8 (in June 2007 or $AU9.80 in 2015 figures) return toll on top of the normal fare, trains travelling at 160 km/h could carry up to 16,000 commuters an hour. Figure 53 illustrates the concept.

![Figure 53: The WFR Project](image)

Source: WFR website, accessed July 2014

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\(^1\) From 2002 to 2004 the Consortium called itself the Penrith Fast Rail Consortium (PFRC).

There were 10 stations proposed for WFR at Wynyard, Metro West (linked to Town Hall), Central, possibly Olympic Park, Parramatta, Seven Hills, Blacktown, Mount Druitt, St Marys, and Penrith. The then NSW Sustainability Commissioner, Professor Peter Newman, publicly stated in 2005 that a fast train link was critical to the ailing Sydney heavy rail transport network. He commented that “I am desperate to get this one up, and all the Government has to do is say ‘yes’.” But this was not to be.

![Image](image.png)

**Figure 54: Map of the FastRail Proposal in Context of Western Sydney**

WFR was initiated by a consortium led by the author as Chair, Leighton Contractors, the investment bank ABN AMRO, and a number of other consultants, including former employees of Railcorp. Put to the NSW government under its unsolicited proposals guidelines (which were meant to encourage innovative proposals from the private sector), the proposal went through several iterations. The project was prompted by the desire of consortium members to provide a PPP concessionaire model, including the raising of the capital required to meet new rail demand in

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3 The relatively isolated Olympic Park station is presently a ‘balloon loop’ from Lidcombe on the western line. Generally passengers have to alight from Lidcombe to join the Olympic Park service. WFR proposed to directly link Olympic Park to Parramatta and beyond, as well as to the CBD.

western Sydney. The congestion on Sydney’s westbound trains and roads, the growing importance of Parramatta and potentially Blacktown and Penrith as business centres, higher petrol prices, opposition to tolled roads, and environmental concerns, were all factors in favour of the project. The project aimed to stimulate employment in western Sydney, based on the proposition that “[a]ccessibility is generally a determinant in the location of firms. New transport infrastructure that improves accessibility is often an incentive for new business activity.” Should further employment growth be spurred in western Sydney through faster, more reliable and frequent services, then the ‘pendulum effect’ could be sustained. A pendulum line is where the line runs between several major population centres, so that passengers continue to board after the inner city has been reached, so that the capacity of the line is far better used on the sections of the line.

At the time WFR was formulated in detail, co-inciding with the release of the NSW State Infrastructure Plan in 2002, it was obvious that the cupboard was bare for new funding of major rail projects. All that was referred to in that Plan for new additions to the heavy rail network was funding for ‘investigations’ of high speed rail links from Sydney to Newcastle, from Wollongong to Sydney and, with respect to the heavy rail option, from Parramatta to Epping. (Ultimately, all three projects were never proceeded with). This stood in marked contrast with the road experience where private sector funding and involvement was fostered by the RTA. Indeed, commenting on the road and public transport experience in Sydney, Christie et. al. lamented that: “In particular, there has been a heavy investment in radial freeways and tollroads as governments sought to meet the increasing demand for cars to access the CBD and other centres. More recently circumferential projects such as the Eastern Distributor and the M7 tollway have complemented this radial road network. These road-based ‘solutions’ have been at the expense of opportunities to

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6 Ibid., pp. 120-121.
8 See: Parramatta Rail Link (2003), PRL West Options, Report to the Minister, August.
significantly expand the rail network to serve the new urban areas and change the bus system to meet the needs of new areas.”  

With Western FastRail (WFR), Leighton Contractors proposed a real risk transfer of delivery and operation at considerable savings to government. Yet because of the way government was structured to deal with unsolicited transport projects, this proposal proved too hard to assess.

At the outset, the government insisted in 2002 that if any public campaign was launched by the consortium, then the project would be rejected. Naturally, there was the need to consider what would be the interface between WFR and the rest of the network, the complications that might entail, other impacts, and whether the project represented value for money. The consortium argued that the train link would eliminate the need of around 18 million car trips per year, reducing between 34,000 and 45,000 tonnes of greenhouse gas emissions being put into the atmosphere.

**Figure 55: Map Showing FastRail and Network of Northwest Busways**

Source: Leighton and FastRail Consortium.

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10 Opinion of the author.
In 2007 the consortium estimated that the costs would be $AU3.2b ($AU3.92b in 2015 figures) including rolling stock plus the cost of the St Mary’s to Westmead leg of the journey (then estimated by Sinclair Knight Merz (SKM) at $AU700m or $AU858.03m in 2015 numbers). Part of the WEB of the project was the proposition that high speed services would stimulate employment growth in areas like Blacktown and Penrith. Pollution in Sydney would be substantially cut by more people using rail. With Government support (facilitation, sharing of tracks or building of new lines from St Mary’s) the consortium proposed that the project needed to be put to the open market.

The Government guidelines on unsolicited projects\(^\text{11}\) required that the Head of the NSW Premier’s Department form an independent view of the merits of a proposal and should it pass that ‘worth a look’ test, then a review would be undertaken and a Preliminary Assessment made. In February 2007, Dr Gelattly, then Head of Premier’s Department, wrote to the Chairman of the WFR consortium stating that he had formed the view that the project merited the government’s consideration.\(^\text{12}\) He proposed that over a six month period a government working party chaired by him and consisting of all the relevant government agencies would meet and assess the proposal.

A senior executive from Leighton Contractors was nominated as the point of contact between WFR and the government. In response to requests for information, WFR obtained new reports by transport engineers SKM on the cost of the tunnel from Parramatta to the City, a further SKM report on patronage, and surveys from public communications firm URM gauging public support for the project and the likely fares. These were submitted in late 2007.

After Dr Gellatly retired in May 2007, however, the Consortium had little direct contact with the government working party. Over a nine month period there was no feedback other than verbal assurances from the then Transport Co-ordinator General that WFR was being examined.


\(^{12}\) i.e., the Chair of WFR Consortium was the author.
In the lead up to the 2007 federal elections, the Leader of the Opposition, Kevin Rudd, promised to support the project and provide part funding for the state government. In March and April 2008, however, Premier Morris Iemma announced several competing projects, discussed in Chapter 5, namely the proposed $AU12b ($AU14.28b in 2015 figures) north-west metro line and the examination of West Metro (then estimated as costing between $AU5b to $AU9b or, in 2015 numbers, $AU5.95b to $AU10.71b). The inner west metro, like WFR, proposed an underground tunnel from Parramatta to the CBD.

On 24 June 2008 the NSW Transport Co-Ordinator General, who was also in charge of the metro projects, at a meeting convened by him, advised the Consortium that in his view the WFR figures for construction costs were under-estimated. The consortium asked for details backing this opinion and a Preliminary Assessment, as required under government guidelines, so that those statements could be tested. This request was subsequently put in writing.

At a meeting on 13 August 2008 with Treasury, the government representatives told the consortium that with the concentration on metro projects, WFR had fallen through the cracks. And that although the WFR consortium might feel aggrieved at the delays, there would after all be a formal review and response provided on WFR’s costings. This meant that one of the complaints of the consortium would be addressed. Despite spending to that point $AU6.0m ($AU7.04m in 2015 figures) on the project, mostly at the behest of government representatives requesting ‘studies’, meaningful feedback was lacking. But the promised formal review of the WFR proposal never occurred.

Inspired by leaks in sections of the rail bureaucracy and elsewhere in the government, a major story appeared in the *Sydney Morning Herald* in August 2008 attacking the project, complaining that the WFR proponents would not take ‘no’ for an answer and stood to make a fortune should the project win government support.

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13 Hildebrand, Joe (2006) ‘Rudd’s Road and Rail Cash’, *Daily Telegraph*, 19 December. A few years later, in a personal conversation with the author, the Prime Minister’s Chief Economic Advisor said that Mr Rudd’s office was urged to lend such support by the office of the then NSW Premier.

14 The ‘inner west metro’ was the way WFR described the West Metro project.

A few weeks later in September 2008 the Premier and several ministers had resigned (over an unrelated internal ALP wrangle over electricity privatisation), and with changes in the ministry, the consortium decided to ‘park’ the WFR idea. A formal request for the often promised Project Assessment was once more made to the new Premier. But this was never responded to. (This Premier was to last just over a year in office).

Prior to ‘the line going dead’ in August 2008, the Treasury representatives and the NSW Infrastructure Co-ordinator pointed to the ARL experience, the cost blowouts with the Epping Chatswood line (all discussed in Chapter 5 above) as evidence that private sector interaction with the rail network was fraught with risk, and that underestimated costs were par for the course with rail projects. Understandably, in part, the government feared that should trumpets blare, the project get announced and should the private party need funding support beyond what was projected, the government would be left holding the baby. Though such concerns were understandable, as initial whiteboard analysis, this merely suggested that the proposition needed rigorous assessment. But this appeared to never have been thoroughly carried out. Whatever was done occurred in secret and never publicly released.

Government representatives argued that the WFR cost estimates should include costs for land already in Government ownership and contingencies needed for a government delivered project, not a private sector delivered project. In 2008 Leighton Contractors offered if selected to underwrite costs on an agreed route. Appropriately negotiated this could have been a tight transfer of risk to the private sector.

Doing something for “far western Sydney”, as the rest of Sydney calls the suburbs where most people live, is a matter of priority and choice. Clearly WFR competed with the West Metro and because two underground tunnels would never be built

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Morning Herald, 25 August; Easson, Michael (2008) ‘SMH Botched its Reporting on Sydney’s Western FastRail’, Crickey, 26 August; Hildebrand, Joe (2008) ‘Iemma Government’s High-speed Western Sydney Rail Link Dumped’, Daily Telegraph, 11 August. Besser saw WFR members as possessed by a persistent faith in the merits of their proposal and a determination not to give up despite numerous rejections. Actually the government never did formally reject the proposal. The author had received no fees, was under no contract, and volunteered his time to the consortium in the hope that he would ultimately serve on the Board as Chairman or as a Director.
from Parramatta to the city, one project would have to give. The WFR consortium argued that the inner west, from Parramatta inwards, was an area of Sydney comparatively well treated by heavy rail and excellent government bus services. As far western Sydney was not so lucky, the priority should be for that region.

In February 2010 the West Metro project was formally cancelled by a new Premier and in its stead the CBD relief line (an underground corridor in the CBD) and the Western Express were simultaneously announced.16 These were similar to the Western FastRail proposal, in conceptualising a new tunnel under the CBD, and the need for capacity expansion on the western corridor. But the route for the Western Express was unclear (whether, for example, it would be a mix of above ground and tunnel track, and in what sections). IA agreed to fund a $AU20m feasibility study.

At this time, prior to most of the work with the Clearways Program, there were about 60 slight twists and turns in the existing above ground Railcorp track from Parramatta to the City. Speeds were necessarily limited by the existing, tortuous route, complicated signalling, and tired infrastructure. If the proposed Western Express route from Parramatta to the city was delivered through a dedicated tunnel, this would leave Penrith commuters with the existing above ground track, with little improvement in speed, unless they changed over at Parramatta.

The consortium complained to various Premiers of the day about the Co-ordinator-General's office being in charge of both championing the proposed metro networks, then the Western Express, and also in assessing WFR. But this fell on deaf ears.

Perhaps the most significant observation from this experience is to lament that there is no independent process for assessing ex-ante or post-ante infrastructure projects on an agreed common basis. Infrastructure Australia, in its earlier days, indicated that this was a task it would measure up to. But a combination of political factors, resources, and prioritisation meant that this never occurred.

The NSW government never followed its own guidelines on assessing unsolicited projects. The culture of secrecy, lack of transparency, and poor administration

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combined to kill Western FastRail - at least for the moment. But if the project ever had merit it is because it would meet a need.17 The final Chapter on this project is still to be written.

17 Saulwick, Jacob (2015a) ‘Crisis Looms for Sydney Train Commuters’, *Sydney Morning Herald*, 16 February. This article specifically references over-crowding and capacity limits of the Sydney western line.
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