

# **Architectural Practice in City-Shaping Infrastructure Projects**

An Embedded Study of the Sydney Metro

by **Michael Macy Kahn**

Thesis submitted as part of the Industry Doctorate Program  
in collaboration with Cox Architecture in fulfilment of the  
requirements for the degree of

**Doctor of Philosophy in Architecture**

under the supervision of Professor Charles Rice, PhD and  
Professor Anthony Burke

University of Technology Sydney  
Faculty of Design, Architecture and Building

September 2021

## **Certificate of Authorship/Originality**

I, Michael Macy Kahn, declare that this thesis is submitted in fulfilment of the requirements for the award of PhD in Architecture, in the Faculty of Design, Architecture and Building, School of Architecture at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

Production Note:  
**Signature:** Signature removed prior to publication.

Date: 13 September 2021

## Dedication

*To my family, who lovingly supported my decision to move half-way around the world.*

*For three years I have had the privilege to live, work, and research on the lands of the  
Gadigal People of the Eora Nation.*

*I have also had the opportunity to explore the vast continent of Australia and  
experience its unparalleled natural beauty—from the dramatic cliffs overlooking the  
Pacific, to the vibrant reefs ringing the coast, to the striking forms of the red centre  
which glow with the setting sun. Through the years I have spent time on Country  
cared for by Traditional Custodians for countless generations—the Eora, the Yuggera,  
the Woiworung and Boonwurrung, the Pitjantjatjara and Yankuntjatjara, the Wajuk,  
and so many more.*

*For the distinct privilege of these experiences, in a place so spectacular, I  
acknowledge the Traditional Custodians and their unending connection to Country in  
this great Aboriginal Land.*

*Sovereignty was never ceded.*

*Always was, always will be.*

## Abstract

Architects are increasingly involved in the realisation of large-scale city-shaping infrastructure projects, exemplified by mega-transport projects in urban areas around the globe. This growing engagement by the profession has led to a widening fissure between the existing conceptualisation of architectural practice and the actions and roles of architects in these decidedly functional project types. This research explores the role of architects in the development of design for large-scale infrastructure, establishing the key contributions of the profession to the realisation of the modern expectations of urban public projects. These roles—advocates for human-centric ambitions, coordinators of multi-disciplinary inputs, and managers of data—are not foreign to the profession, but reveal unique elements of architectural knowledge developed through the design and delivery process in the context of contemporary, corporate practice.

I conducted the research in an embedded mode as an architect involved in the design of a station for the Sydney Metro, a new underground railway project being designed and constructed while the research was undertaken. This hybridised participant-observation approach provided an opportunity to explore architectural design using auto-ethnographic and sociological methods, as well as theoretically informed thematic analysis. By leveraging methods from both within architectural practice and from other disciplines, the research establishes a new means of understanding architectural activities and contributions within the framework of existing linear interpretations of the architectural process—from conceptual design, through development and, finally, documentation.

The research makes an original contribution to knowledge of the role of architect and architecture in shaping large-scale public infrastructure investment, focusing on management of data-centric elements of design and the production of deliverables. The research outcomes underscore the heterogenous roles of contemporary large-scale practice and the place of architecture in shaping key urban nodes as prominent people spaces in the polycentric city. The project also offers a new method of conducting research embedded within architectural practice and, more broadly, other professional practice.

## Prologue

On 31 March 2018, I departed Atlanta, bound for Los Angeles and onward across the Pacific to the sunburnt shores of Australia. Some had thought the announcement of my decision to decamp from the United States, where I was well settled in architectural practice and journalism, was an April Fool's joke. Yet, through the miracle of the international dateline, I skipped ahead that year, touching down in the Harbour City on 2 April. The arrival in Sydney, while the start of something new, was hardly a new experience. Rather, the event marked a return to where I had studied abroad in 2012. Few were particularly surprised by the move—my fascination with Australia had only grown over the years as I returned between 2013 and 2015 to travel and visit friends under the guise of participation in the annual conferences of the Society of Architectural Historians of Australia and New Zealand (SAHANZ). Through the travel and conferences, I met some fantastic Australian architectural academics.

Following my 2012 semester abroad, I returned to New Orleans for the final year of my Masters, dedicating my thesis study to the redevelopment of a rail gulch in the heart of Sydney—a great way to combine my undying love of trains and my newfound antipodean obsession. While I dabbled in academic writing (enough to net annual invites back to Australia), my career aspirations upon my post-university return to Atlanta—the city I was raised—were decidedly professionally oriented. After I received my architectural license in 2015 and started a position at a large firm in Atlanta, the prospect of returning to anything resembling research seemed farfetched. However, in 2017, one of those aforementioned Australian academics forwarded me an email about an opportunity to work as an architect on high-profile rail projects in Sydney, with the added benefit of undertaking a PhD in the process. Ever the pragmatist, I was sceptical of how research and theory might have any relevance to the practical concerns of the architectural office. With five years of work experience, I was very content to never think of theory again. However, the promise of applied research in a practical setting convinced me the endeavour was worthwhile—the trains and Australian locale did not hurt either. Three years later, my understanding of the importance of theory and analysis of practice have transformed my understanding of architecture. I look forward to continuing this hybridisation moving forward.

## Acknowledgements

First, a debt of gratitude goes to Charles Rice at UTS as an omnipresent adviser, guiding me through the process, addressing relentless questions, and humouring a few token puns throughout this dissertation—he really kept things on track. Additionally, much thanks to Anthony Burke at UTS and David Holm at COX for their foresight in creating this opportunity, provision of support, and overall investment in the development of knowledge along the journey without a clear destination.

Given my unique role as embedded researcher, I did not have a traditional cohort. Rather, I was fortunate to assemble my own expert PhD panel from the three amazing Australian academics in my life: the trio of doctors Ashley Paine, Alex Brown, and Soph Maalsen. Thank you for answering the never-ending stream of questions and generally being there to reassure and encourage me along the way. Special thanks (or blame) to Ashley for telling me about this opportunity in the first place. You three are absolutely astounding, and I am very humbled to call you my friends.

Thanks to my Australian friends and family—both those I have known for years who supported my move back and those whom I have picked up along the way ... Brant, Ian, Amanda, Candice, Beck, Mon, Stu, Jeff, Janene, Paul; you all played a part in this, be it chats over a beer or inclusion in Christmas dinner.

Meanwhile, on the other side of the world, while it has been a trying few years, thank you to Mom, Dad, and Jason for supporting my relocation. Also, thanks to the friends and family who have made great efforts to stay in touch—amazing how distance has brought us closer together.

Finally, this research would have been literally impossible without my three years at COX. Much thanks to Architects A-Z and everyone else at the firm with whom I had the pleasure of working on Metro, WSA, PLR, and the various side projects throughout my time in the studio. Special thanks to Diana, Ashley, Leo (albeit as a ZHA interloper), and Architects R and Y for comradery and cheerfulness both in the studio and remotely in 2020.

Overall, it took a diverse array of people to turn this research into reality—for all those that assisted me along the way, I cannot thank you enough. It has been quite an adventure and, rest assured, I do not expect you to sit down and read this.

## Table of Contents

List of Figures	viii
List of Acronyms	x
Preface	xi
Introduction – Architects Aboard the Sydney Metro	1
Chapter 1 – Unpacking Transport Development in Sydney	7
<i>Metro Sydney and the Sydney Metro</i> <i>Metro Sydney: Polycentricity, Global Motives, and “Design Excellence”</i> <i>Sydney Metro: Mega-Projects, Politics, and Procurement</i> <i>Concluding Remarks: A Place for Architecture</i>	
Chapter 2 – Research Through Participation	53
<i>A Regular Day in the Studio</i> <i>Research of Architecture, In Architecture, But Not Through Architecture</i> <i>Inherent Tensions and the Emergence of Themes</i> <i>Methods of Presentation</i>	
Chapter 3 – The Human Elements	85
<i>Nothing Sells an Idea Quite Like an Octopus</i> <i>Transport Spaces, Urban Spaces, People Spaces</i> <i>Advocacy and Ambition: Knowledge Expressed Through Sketch</i> <i>Selling the Experience</i> <i>Concluding Remarks: Qualitative Ambitions as Expertise</i>	
Chapter 4 – External Pressures	130
<i>The Really, Really Big Box Arrives</i> <i>Architecture, a Methodical Process</i> <i>The Station Needs Skin</i> <i>The Non-Human Actors Act</i> <i>Concluding Remarks: Architects Depend on Non-Human Actors</i>	
Chapter 5 – Data Management	178
<i>Room Number Bingo</i> <i>Behind the Doors Marked “Do Not Enter”</i> <i>Managing and Demonstrating Knowledge</i> <i>The Four Ds of Data</i> <i>Concluding Remarks: Data as Design</i>	
Conclusion – A Journey with Many Destinations	221
<i>Architectural Knowledge and Actions in Support of Infrastructure</i> <i>Theory and Methodological Contributions</i> <i>The Next Steps</i>	
Epilogue	235
Bibliography	239
Appendices	253
<i>Appendix A – Sydney Metro City Station Design Profiles</i> <i>Appendix B – Metro System Construction 1950-1979</i>	

## List of Figures

### Introduction

Figure 0.01 An Architect Aboard the Sydney Metro  
*Photograph: Author, 2021*

### Chapter 1

Figure 1.01 Sydney Harbour from the Sydney Harbour Bridge  
*Photograph: Author, 2020*

Figure 1.02 *Three Cities* plan  
*Diagram: Greater Sydney Commission, 2016*  
*Source: <https://www.greater.sydney/metropolis-of-three-cities>*

Figure 1.03 Sydney commuting patterns  
*Diagram: Greater Sydney Commission, 2016*  
*Source: <https://www.greater.sydney/metropolis-of-three-cities>*

Figure 1.04 Rose Hill Packet Route, 1789  
*Drawing: Author, 2019*

Figure 1.05 Sydney to Parramatta Railway Route, 1855  
*Drawing: Author, 2019*

Figure 1.06 Sydney Railway Network, 1906  
*Drawing: Author, 2019*

Figure 1.07 Wynyard Railway Station Refreshment Room  
*Photograph: Unknown, 1946*  
*Source: [https://www.records.nsw.gov.au/image/17420\\_a014\\_a014000105](https://www.records.nsw.gov.au/image/17420_a014_a014000105)*

Figure 1.08 Sydney Metro Alignment with construction of Northwest portion and Epping to Chatswood Rail Link identified  
*Diagram: Sydney Metro, 2016; callout by Author*  
*Source: Sydney Metro City & Southwest, Final Business Case Summary, October 2016*

Figure 1.09 City & Southwest Procurement for City Tunnelling, Excavation, and Station Works  
*Diagram: Sydney Metro, 2020*  
*Source: Project Summary, City & Southwest OTS2 PPP, 3 March 2020*

Figure 1.10 Sydney Metro lines proposal  
*Diagram: Sydney Metro, 2020*  
*Source: Sydney Metro Annual Report 2019-20, October 2020*

### Chapter 2

Figure 2.01 An office view  
*Photograph: Author, 2019*



### **Chapter 3**

Figure 3.01 The “octopus sketch”  
*Sketch:* Architect F, 2018  
*Source:* Sketch produced by Cox Architecture

Figure 3.02 Metro station opportunity spaces  
*Diagram:* Author, 2020

### **Chapter 4**

Figure 4.01 Collage of the unboxing of the cavern lining panels  
*Photographs:* Author, 2019

Figure 4.02 Detail of early design model for the primary station concourse  
*Photograph:* Author, 2019  
*Source:* Model developed by Cox Architecture

Figure 4.03 Team meeting to review panel development  
*Photograph:* Author, 2019

Figure 4.04 Studio project review charette  
*Photograph:* Author, 2020

Figure 4.05 Collage of 3D printed panel models and team meeting to review panel development  
*Photograph:* Author, 2019  
*Source:* Models developed by Cox Architecture

### **Chapter 5**

Figure 5.01 Room schedule excerpt  
*Screen capture:* Author, 2020  
*Source:* Document produced by Cox Architecture

Figure 5.02 Station ventilation diagram and annotated key  
*Sketch:* Author, 2020  
*Source:* Document produced by Cox Architecture

Figure 5.03 Station and OSD sectional floor number and coding diagrams  
*Screen captures:* Author, 2019 & 2020  
*Source:* Documents produced by Cox Architecture

### **Conclusion**

Figure 6.01 Longitudinal section through station south concourse  
*PDF Revit Output:* Cox Architecture, 2020  
*Source:* Document produced by Cox Architecture

## List of Acronyms

AEO	Authorised Engineering Organisation
ANT	Actor Network Theory
BIM	building information modelling
BOH	back-of-house
CAD	computer-aided design
CBD	Central Business District
CCTV	closed circuit television
CNU	Congress for New Urbanism
CoS	City of Sydney
CPTED	crime prevention through environmental design
DRP	Design Review Panel
ESR	Eastern Suburbs Railway
FOH	front-of-house
GDP	Gross Domestic Product
IDP	Industry Doctorate Program
ISD	integrated station development
KIF	Knowledge Intensive Firm
LGA	Local Government Area
LIRR	Long Island Rail Road
MTP	mega transport project
NJTRO	New Jersey Transit Rail Operations
NSW	New South Wales
OMA	Office of Metropolitan Architecture
OOO	object-oriented ontology
PPP	public-private partnership
RER	<i>Réseau Express Régional</i>
RIBA	Royal Institute of British Architects
RVTM	Requirement Verification Matrix
SATP	<i>Sydney Area Transportation Plan (1971)</i>
SEPTA	Southeastern Pennsylvania Transportation Authority
SNCB	<i>Société nationale des chemins de fer belges</i>
SRPOP	<i>Sydney Region Outline Plan (1968)</i>
SSD	State Significant Development
SWTC	Scope of Works and Technical Criteria
TES	trackway exhaust system
TfNSW	Transport for New South Wales
TOD	transit-oriented development
TVS	tunnel ventilation system
UTS	University of Technology Sydney
VT	vertical transport
WSA	Western Sydney (Nancy-Bird Walton) International Airport
ZHA	Zaha Hadid Architects

## Preface

This PhD research was undertaken as part of the University of Technology Sydney (UTS) Industry Doctorate Program (IDP). The IDP facilitates industry partner collaboration with academic research to expand and advance research with practical pertinence to partner organisations.<sup>1</sup> The unique arrangement allowed me, a registered architect already engaged in practice, to take on a dual role as both an industry member and researcher. For this research, the industry partner was the Sydney studio of Cox Architecture (COX). COX is one of Australia’s largest architecture firms in terms of both workforce and output. Headquartered in Sydney, the firm operates studios in major cities across the country and is engaged in projects around the world.<sup>2</sup> Central to the firm’s practice is the ethos of “supporting the public life of ... cities.”<sup>3</sup>

When the work and research was undertaken, the COX Sydney studio was broadly divided into “clusters”, with each notionally focused on a specific sector or type of work; each cluster was overseen by a director with background specific to that type of work. The largest cluster during the research, and the one in which the research was conducted, was Cluster 5, which was predominately engaged in public transport facility design. When the research began, the cluster had approximately 15-20 dedicated employees, but grew to more than 70 following the successful tendering for multiple projects, including two stations for the Sydney Metro City & Southwest line (anticipated 2024), the Parramatta Light Rail line (PLR) (anticipated 2023), and the new Western Sydney (Nancy-Bird Walton) International Airport (WSA) (anticipated 2026).<sup>4</sup> Each Metro project had a dedicated team of about a dozen staff at various levels of seniority, though across the years of the project the size of the team would expand and contract with deadlines as members flowed between transport projects, assisted other clusters, or left the firm. Overall, the Sydney studio had between 120 and 200 employees during the three-year research period.

- 
1. Graduate Research School, *The Industry Doctorate Program*, (University of Technology Sydney, 2018), <https://www.uts.edu.au/sites/default/files/article/downloads/Industry-Doctorate-Program-%28IDP%29-brochure.pdf>.
  2. “Studio” is the preferred means of identifying COX offices, which, as Dana Cuff points out, ties into a pedagogical and socially constructed conceptualisation of *how* architecture firms operate. As this is the term used by the firm, it is adopted and used through this dissertation as well. Dana Cuff, *Architecture: The Story of Practice* (Cambridge, MA: MIT Press, 1991).
  3. Cox Architecture, “Practice,” accessed 6 December 2020, <https://www.coxarchitecture.com.au/practice>.
  4. Cox Architecture was a design partner with London-based Zaha Hadid Architects (ZHA) for the airport project.

Generally, the cluster director was responsible for high-level oversight on all projects across the cluster. Specific projects were administered by project leads at an Associate and Senior Associate level who largely focused on ensuring technical accuracy, on time delivery, and client engagement, though the cluster director often participated in both formal and informal meetings about project development and was broadly across the trajectory of the work being completed. The overarching aesthetic design outcomes were the product of work between the cluster director and the design director for the Sydney studio, who took a particular interest in the high-profile transport projects. While a strong hierarchy existed within Cluster 5, both the cluster director and the studio design director were omnipresent in projects around major submissions to ensure the integrity of the design.<sup>5</sup>

The structure of the research undertaken included direct, immersive engagement in the professional practice, with my part-time employment as an active team member, engaged in the day-to-day production works of an architect on various projects. Given the focus of the research on transport facilities, the work undertaken was generally related to transport projects, including nearly a year of involvement in the design process for a new station of the Sydney Metro line at Victoria Cross in North Sydney. Additional long-term Metro involvement included time on the design team for a second new station on the same line at Pitt Street in the Sydney Central Business District (CBD), and retrofit works for an existing railway station to be updated to serve Metro trains at Sydenham. Outside of Metro, long-term involvement included PLR—a new light rail system in the Sydney region—and services related to WSA. All projects were procured through public tendering, with COX forming part of a larger team including engineers, contractors, landscape architects, urban designers and various specialty consultants.

---

5. While collaboration across the studio and on project development indicated a relatively “flat” or “democratic” structure where all levels of staff regularly sat at a table together to collaborate on design development, the reality for those responsible for production was defined by a “silent hierarchy” that was discussed openly at the lower levels of the firm. This structure shaped the design outcomes as they developed, with the design and project leaders effecting their “vision” for the project outcomes on the outputs, rather than a more organic means of design stemming from inputs as they were introduced. This will be seen in Chapter 4. Andrew D. Brown, Martin Korberger, Stewart Clegg and Chris Carter, “‘Invisible Walls’ and ‘Silent Hierarchies’: A Case Study of Power Relations in an Architecture Firm,” *Human Relations* 63, no. 4 (2010), <https://doi-org.ezproxy.lib.uts.edu.au/10.1177/0018726709339862>; Robert Schmidt and Andy Dainty, “The Influence of Practice Culture on Designed Artefacts,” *Architectural Research Quarterly* 19, no. 4 (2015), doi:10.1017/S1359135516000051.

While the work and research focused on public projects presently under construction and countless images and visualisations were created through the design process, this dissertation includes very limited use of imagery. Primarily, this is a result of the complicated contractual arrangements present in the multi-party team structures, resulting in hesitancy by multiple parties to permit images to be used outside of official release channels. Notably, this condition affords the reader the opportunity to focus on the process being interrogated, decoupling the research from a singular project and permitting the outcomes to be more easily understood in a non-specific form.

Throughout the research engagement, I spent time outside of the studio in various academic pursuits. I held regular meetings with the academics advising the research and composed and presented conference papers on different aspects of the project. Overall, the hybridised role of practitioner and researcher offered a unique format for exploring the active architectural process from the inside, generating both challenges and benefits. This dissertation is the direct output of the prolonged period of embedded research and is constructed around the experiences, observations, and analysis that emerged from the arrangement. Its outcomes make an original contribution to knowledge related directly to the role of architecture in shaping these types of large-scale projects and, while derived from involvement in transport typologies, are applicable to the activities of architects engaged in the design of various types of mega-projects. Further, this work contributes to the growing discourse on the role of academic research in professional practice (and vice versa). This has been an emerging issue in schools of architecture and design professions more broadly, with the topic featuring strongly in two conferences in which I participated during this research.<sup>6</sup> Finally, this work builds on previous research undertaken to analyse the profession of architecture and explores new means of engaging in such research in the future.

---

6. The Australia & New Zealand Association of Planning Schools (ANZAPS), "ANZAPS 2019: The Role of Research and the Researcher in City Making," accessed 6 December 2020, <https://anzaps.net/anzaps-2019/>; Australian Institute of Traffic Planning and Management (AITPM), "2019 National Traffic and Transport Conference," (Adelaide, 30 July-2 August 2019).