UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Architectural Practice in City-Shaping Infrastructure Projects

An Embedded Study of the Sydney Metro

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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

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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.

Signature: Production Note:
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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.

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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	*Réseau Express Régional*
RIBA	Royal Institute of British Architects
RVTM	Requirement Verification Matrix
SATP	*Sydney Area Transportation Plan* (1971)
SEPTA	Southeastern Pennsylvania Transportation Authority
SNCB	*Société nationale des chemins de fer belges*
SROP	*Sydney Region Outline Plan* (1968)
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.[1] 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.[2] Central to the firm's practice is the ethos of "supporting the public life of … cities."[3]

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).[4] 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.[5]

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.[6] 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).

Introduction

Architects Aboard the Sydney Metro

Figure 0.01 – Aboard a very quiet Sydney Metro train on a rainy Sunday during the COVID-19 pandemic.

The Sydney Metro (see Figure 0.01) is being developed to reshape the way people move to, through, and around the Greater Sydney region. Billed as the "biggest public transport project" ever undertaken in Australia, the rail system—encompassing tunnels, viaducts, stations, and various operational facilities—is envisioned as far more than a utilitarian intervention meant to transform urban movement.[1] Rather, where the project interfaces with the public domain—at stations throughout the region—the ambition is to create facilities that provide customers not just with transport options, but with an experience that is easy, enjoyable, and seamlessly integrated into the urban context.[2] To achieve this ambition, large and diverse teams are assembled to design the facilities. Despite the decidedly engineering focus of much of the infrastructure, architects are included in these teams to provide input and expertise in realising the designs. Six architecture firms are responsible for architectural design contributions to the seven new stations being developed as part of the City & Southwest line, which is slated for completion in 2024.[3]

The stations, as the public interface between the urban realm and the Metro network, are designed not only to serve as portals between the city and the system, but as embodiments of the civic ambitions and functional aspirations of the Sydney region. Architecture serves to mediate the uncomfortable contradiction between the engineered design elements and the largely human-oriented, qualitative ambitions of the project. Architectural contributions to the design process must simultaneously work within the context of an engineering-intensive project while fulfilling the aspirational intent of the design as it relates to the experience of station users and the broader urban public.

The aim of the present study was to construct an understanding of the role of the architect and the architectural profession in the design of these city-shaping mega transport projects (MTPs). This dissertation is the result of a three-year embedded research project, undertaken by a practising

1. NSW Government, "Sydney Metro," Sydney Metro, accessed 6 December 2020, https://www.sydneymetro.info/.
2. NSW Government, "Stations," Sydney Metro, accessed 6 December 2020, https://www.sydneymetro.info/stations.
3. The seven new stations of the line are located between Chatswood (the present terminus of the Northwest Metro line) and Sydenham (where the City & Southwest Metro line will tie into the existing rail network and run on the existing rail right-of-way through converted stations). While the works at Martin Place and Central are adding new platforms to existing railway stations, the scale of the intervention at both is commensurate with wholly new station works and is only unique in relation to their interchange provisions. For an overview of the seven stations and the six architects involved, see Appendix A.

architect who has been directly involved in the design of two Sydney Metro stations, as well as other large-scale transport facilities. The research outputs were enhanced by the author's experience as a member of the architectural team, which afforded him practical first-hand access to the evolving and varied roles of architecture. The work allowed for the definition, exploration, and refinement of concepts uncovered and explored as the multi-year project progressed, based on primary data that included interviews with other architects and project team members. This introduction outlines the impetus behind the industry-based research, framing it as a modern academic and practical enterprise that fuses research and real-world outcomes.

Sydney is a dynamic and growing urban centre, whose ambitions for design excellence and placemaking are embedded in the design parameters of the new Metro stations, as well as in the systemic approach to urban development in general. This emphasis is part of a wider global phenomenon that has seen increased interest in the development of large-scale public infrastructure projects to improve the city environment, particularly transport-oriented projects. Chapter 1 introduces these issues and contextualises the transport project typology in Sydney within broader global patterns. The chapter also examines the political, social, and cultural context of transport development in the Sydney region, which tangibly manifest and indirectly influence the design process of the Sydney Metro.

The research is grounded in established literature on the analysis of architectural practice, including the works of Dana Cuff and Jeremy Till.[4] The work of these author-practitioners establishes a baseline for understanding the operations of architectural studios, the influence of pedagogy on practice, how drawings are developed and deployed, and how projects are executed from inception to construction. The present study examined and, in some cases, reframed these elements of practice within the context of architectural engagement with the large-scale transport project, using ethnographic methods to construct themes from practice to further the analysis. The ethnographic approach draws on Bruno Latour's application of social science methods to laboratory work at the Salk Institute, to transportation in *Aramis, or, the Love of Technology*, and finally, to architecture

4. Dana Cuff, *Architecture: The Story of Practice* (Cambridge, MA: MIT Press, 1991); Jeremy Till, *Architecture Depends* (Cambridge, MA: MIT Press, 2009).

with Albena Yaneva in "Give me a Gun and I will Make All Buildings Move".[5] Yaneva further developed and explored the approach in three books, two of which played a key role in defining the methods used in this dissertation to capture the range of inputs that define the architect's role in design.[6] Chapter 2 frames this study in relation to the literature, including the methodological literature on participant-observation as an ethnographic method of data collection. As such, the chapter locates the research within the context of existing knowledge and identifies gaps and shortcomings that are elaborated in subsequent chapters.

The method and theoretical framework established in Chapter 2 is leveraged in the three main chapters of the dissertation—Chapters 3-5—which apply specific methods to unpack and analyse the architect's contributions and role in the design process. Each chapter explores different aspects of the architect's role as initially defined through the ethnographic method: (1) generator of and advocate for the human-centric ambitions of the station; (2) consolidator and mediator of competing ambitions and parameters; and (3) compiler and manager of data. Each chapter is framed by empirical evidence in the form of an example from the project in which the author was heavily involved, bolstered by interviews with architects who have worked on similar projects in major cities around the world.

Chapter 3 examines the human-centric ambitions role of the architect, leveraging the sketch as a framework for intent generation and communication that constitutes a major contribution of architectural knowledge in the design process. The architect is established as the primary advocate for qualitative components of the design, in line with ambitions of the government client for transport facilities and a heightened public awareness of the impact of place on the experience of the city. The chapter frames the sketch as not only communicating a vision of space, but as a medium for formalising design intent to the architectural team, the larger design team, the client, and the broader community (as filtered through the client). Finally, it explores how that intent is

5. Bruno Latour, *Laboratory Life: The Social Construction of Scientific Facts*, ed. Steve Woolgar (Beverly Hills: Sage Publications, 1979); Bruno Latour, *Aramis, or, the Love of Technology* (Cambridge, MA: Harvard University Press, 1996); Bruno Latour and Albena Yaneva, "Give me a Gun and I will Make All Buildings Move: An ANT's View of Architecture," in *Explorations in Architecture: Teaching, Design, Research*, ed. R. Gesier (Basel: Birkhäuser, 2008).

6. Albena Yaneva, *Mapping Controversies in Architecture* (Burlington: Ashgate Pub. Co., 2012); Albena Yaneva, *The Making of a Building: A Pragmatist Approach to Architecture* (Oxford: Peter Lang, 2009); Albena Yaneva, *Made by the Office for Metropolitan Architecture: An Ethnography of Design* (Rotterdam: Uitgeverij 010, 2009).

carried through the design process, influencing the development arc of the project. The analysis of the content of sketches, their inherent vagueness, and the preservation of intent through the maturation of the design is analysed against the conceptualisation of architectural drawings by Robin Evans, Juhani Pallasmaa, and Bernard Tschumi.[7]

Chapter 4 examines the role of the architect within the larger design team as it relates to the filtering and incorporation of inputs from disparate disciplines into a single, tangible output. Ideas of architectural intent established in the previous chapter are framed within the complex web of inputs that drive the practicalities of the design forward to create a network of interrelated actors. The architect's role as mediator between seemingly incongruous parameters and ambitions, as well as advocate for the intent against this inundation, is explored as a component of architectural knowledge. The shifting nature of the inputs as new elements of the design are defined and refined is examined within the architect's role of capturing the status of these interactions as the design evolves. The analysis is framed around the various non-human actors produced by architects and leveraged to develop the design. Actor-Network Theory (ANT), adapted from the approach developed by Latour and applied to architecture by Yaneva, affords autonomy to the non-human actors as they facilitate the architects in their work.[8]

Chapter 5 brings together the roles of intent advocate and mediator to reveal the generative role of the architect as a distiller of qualitative information into quantitative representation. The breadth of architectural outputs, beyond drawings and other image-based media, encompasses a body of written and quantitative data that is necessitated by the requirement for assurances and coordination in a transport facility building type. The architect's role of ensuring compliance not only with the brief and statutory regulations, but also with "best practice" is defined by the work of individual architects in the studio as they attempt to generate a cohesive series of outputs that embodies the intents established in Chapter 3 and the inputs explored in Chapter 4. Ultimately, the

7. Robin Evans, *Translations from Drawings to Buildings and Other essays*, ed. Richard Difford and Robin Middleton (London: Architectural Association, 1997); Juhani Pallasmaa, *The Thinking Hand: Existential and Embodied Wisdom in Architecture* (Chichester, UK: Wiley, 2009); Bernard Tschumi, "Operative Drawing," in *The Activist Drawing: Retracing Situationist Architectures from Constant's New Babylon to Beyond*, ed. Catherine de Zegher and Mark Wigley (New York: Drawing Center, 2001).

8. Latour, *Laboratory Life: The Social Construction of Scientific Facts*; Yaneva, *The Making of a Building*; Yaneva, *Made by the Office of Metropolitan Architecture*.

cyclical nature of information flows and the push for production of “final” documentation are seen to round out the bulk of the architectural work. The chapter explores the friction between the self-identity of architects and the data management role they fulfill, building on the tensions explored by Sumati Ahuja, Natalia Nikolova, and Stewart Clegg.[9]

In summary, the dissertation frames the role of the architect and architecture in the design of mega transport projects through prolonged, embedded research. Ethnographic methods were used to establish key themes revealed through the work, supplemented by interviews with project participants and practitioners engaged in similar projects in other cities. An in-depth portrayal of architectural contributions was generated by examining discrete moments in the design process that exemplify the central themes identified in the analysis, and by tracing the development of the production of those elements. This research represents an original contribution to existing knowledge of architectural production on large-scale projects. It also demonstrates how a hybridised method of researching professional practice through prolonged, embedded active participation can both broaden the academic understanding of practice and provide critical self-reflectivity for practice.

9. Sumati Ahuja, “Professional Identity and Status: An Ethnography of Architects in Professional Service Firms” (PhD diss., University of Technology Sydney, 2018); Sumati Ahuja, Natalia Nikolova, and Stewart Clegg, "Paradoxical Identity: The Changing Nature of Architectural Work and Its Relation to Architect’s Identity," *Journal of Professions and Organization* (2017), https://doi.org/10.1093/jpo/jow013.

Chapter 1
Unpacking Transport Development in Sydney

Figure 1.01 - The stereotypical view of Sydney, with ferries passing the Opera House as they make their way to Circular Quay, seen from the Harbour Bridge.

Metro Sydney and the Sydney Metro

Around the world, the mention of "Sydney" is likely to conjure images of the city's eponymous harbour, flanked by J.J.C Bradfield's soaring Sydney Harbour Bridge (1932) and Jørn Utzon's iconic Opera House (1973), criss-crossed by a flurry of ferries in distinctive yellow and green livery, under a clear blue sky (see Figure 1.01).[1] So too do visions of sweeping beaches, such as Bondi and Manly, crowded with surfers and sun worshipers, come to mind. These images are a testament to a distinct "brand" that makes Sydney instantly recognisable globally, placing it among cities with much larger populations and commercial outputs.[2] Unsurprisingly, however, Sydney is much more than the sum of stereotyped scenery. The relatively diminutive City of Sydney (CoS)—just 26 square kilometres—lends its identity to a vast, politically fragmented region encompassing dense urbanity, sprawling suburbia, and rural hinterlands far from the gleaming white sand beaches and office towers crowding the harbour.[3] Of course, this is not atypical for global urban agglomerations, with one foundational city standing in to represent a diverse, expansive region, administered through complex inter-jurisdictional relationships. However, unlike many global economic centres of other developed countries with equally strong brand identities—such as London, New York, Tokyo, and Beijing—Australia's commercial hub contains a notably small population but has the aspirations of cities many times her size.[4] With a population under five million, the City has hosted prestigious international events and solidified a reputation as a global financial hub, affording the city a position within the global psyche, among other great cities of the world.

1. The designer of the Bridge is a contentious subject, debated by participants who contributed to its realisation. It is accepted that Bradfield, the chief engineer of the project, originated the design, but that Sir Ralph Freedman, based on Bradfield's work, produced the final iteration. G. Peter Webber, "The Nature of the City," in *The Design of Sydney: Three Decades of Change in the City Centre*, ed. G. Peter Webber (Sydney: Law Book, 1988), 1; Colin O'Connor, *Spanning Two Centuries: Historic Bridges of Australia* (St. Lucia, QLD: University of Queensland Press, 1985), 40. So too, Utzon's claim to authorship of the Opera House is problematic; the form would not have been possible without engineer Ove Arup and Utzon never resigned over cost overruns and schedule delays, leaving the project (and the country) six years before the building was completed. Albena Yaneva, *Mapping Controversies in Architecture* (Burlington: Ashgate Pub. Co., 2012).
2. Global City Lab, "2019 Global Top 500 Cities," accessed 7 December 2020, http://globalcitylab.com/news/us-news.html; Hans Mommaas, "City Branding: The Necessity of Socio-Cultural Goals," in *City Branding: Image Building & Building Image*, ed. Véreonique Patteeuw (Rotterdam: Nai Publishers, 2012).
3. City of Sydney, "Areas of Service," accessed 7 December 2020, https://www.cityofsydney.nsw.gov.au/areas-of-service.
4. Sydney does not make the 2018 UN-compiled list of 81 urban areas with populations in excess of five million and is 99 on the list of 100 most populous urban areas around the globe, based on 2020 population estimates. United Nations, *World Urbanization Prospects 2018*.Department of Economic and Social Affairs Population Division, United Nations (New York, 2019), https://population.un.org/wup/Publications/Files/WUP2018-Highlights.pdf; Demographia, *Demographia World Urban Areas*, 16th ed. (June 2020), http://www.demographia.com/db-worldua.pdf.

National Importance, State Intervention, and Lack of Local Autonomy

Despite the diminutive size of the City proper relative to its sprawling metropolitan reaches, its anchor as a commercial hub is indisputable. With a resident population of under 250,000—just five percent of the metropolitan population—the CoS draws more than a half million commuters each workday. Its supremacy within the region and importance both at the State and National level is clear, accounting for more than 30 percent of the region's gross domestic product (GDP), a staggering seven percent of Australia's GDP.[5] With State and National interests so intertwined with the City's prosperity, and considering the interjurisdictional relationships necessary to ensure cohesion within the region, it is no surprise that the State Government exercises a noticeable amount of control over local issues. The Sydney region is located entirely within the State of New South Wales (NSW)—one of six states and two territories of Australia. NSW is subdivided into Local Government Areas (LGAs). The creation, reconfiguration, and dissolution of LGAs are overseen by the State Government, which has exercised this power quite regularly since Australian Federation in 1901, often at the displeasure of the City of Sydney Council.[6] The City of Sydney's present boundaries date to 2003, while many of the more than two dozen LGAs that make up the region only date to 2016 when the State amalgamated smaller councils to decrease fragmentation through "joint organisations". This involved uniting small local councils into cooperative single LGAs to promote "regional strategic planning".[7] Generally, LGAs are empowered to establish rules around development in their local jurisdictions, with the caveat that the State may intervene in the case of any "State Significant Development" (SSD), superseding all local planning controls.[8] This fraught and fractured state of local development governance has left a legacy of State intervention and a politicised planning and transport policy.

5. City of Sydney, "The City at a Glance," updated 9 April 2020, https://www.cityofsydney.nsw.gov.au/guides/city-at-a-glance.
6. City of Sydney, "Changing Boundaries," accessed 7 December 2020, https://www.cityofsydney.nsw.gov.au/history/history-city-sydney-council.
7. Sydney, "The City at a Glance."; Parliament of New South Wales, *Local Government (Council Amalgamations) Proclamation 2016*, 12 May 2016.
8. Parliament of New South Wales, "Levels of Government in Australia," accessed 7 December 2020, https://www.parliament.nsw.gov.au/about/Pages/Levels-of-Government-in-Australia.aspx; Parliament of New South Wales, *Local Government Act 1993 No 30*, 8 June 1993; NSW Government, "State Significant Development," Department of Planning, Industry and Environment, accessed 15 December 2020, https://www.planningportal.nsw.gov.au/major-projects/assessment/state-significant-development/ssd-projects.

Planning and Transport Policy in Action

Two areas in which the State exercises city-shaping control at the regional and local levels are planning and transport. The region is criss-crossed by a rail network serving more than 150 stations, with the earliest segments dating back to 1855. Prior to the onset of the Covid-19 pandemic, the network carried more than 400 million passengers per year, making rail travel the most used form of public transport by Sydneysiders. In addition to the rail system, the region is also served by a robust network of buses, eight ferry routes serving three dozen wharves across the harbour, three light rail lines (with a fourth under construction), and the first segment of a new rapid transit line known as the Sydney Metro (Metro), which together carried an additional 400 million passengers annually.[9] Overall, public transport accommodated nearly 25 percent of commuters across the entire region.[10]

The entire transport network in Sydney is overseen by the State Government through a complex arrangement of public and privatised asset and operations management.[11] As a testament to the State's interest in easing movement around the region, an astounding $55.6 billion was spent on road and transport projects in the 2019-2020 fiscal year, with the Treasury noting investment of $93 billion in the Metro projects underway at the time.[12] The Metro is intended to develop into an independent system complementing the existing comprehensive suburban commuter rail network. It is part of the Government's strategy to provide new connections within the region and improve existing connections by establishing direct and faster corridors between major urban centres. Coupled with land use and regional planning, investment in mega transport projects (MTPs) such as the Sydney Metro is conceived as a way to unite a sprawling, polycentric metropolis.

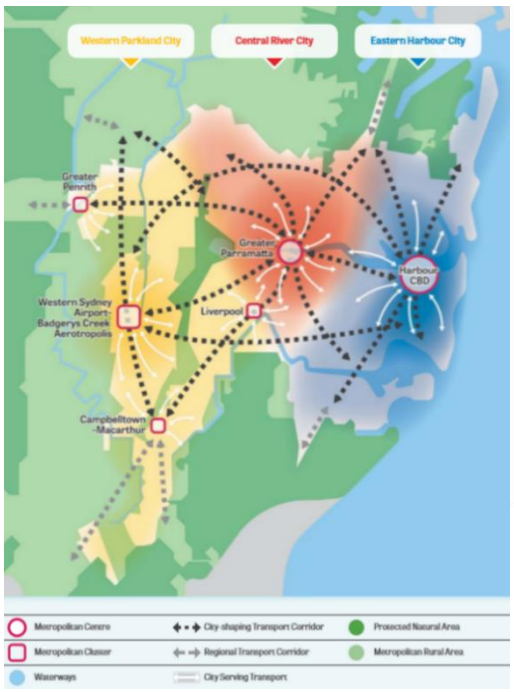
9. Tom Rabe and Pallavi Singhal, "Public transport growth surges past NSW government predictions," *Sydney Morning Herald*, 18 February 2020, https://www.smh.com.au/national/nsw/public-transport-growth-surges-past-nsw-government-predictions-20200218-p54208.html."
10. Numbers reflect pre-pandemic conditions and encompass the entire region, including outlying areas with limited public transport. In CoS, 35 percent of workers took transport daily, with another 27 percent walking or biking; only 24 percent of workers in the city drove, and that number likely represents people commuting out of the city. "City of Sydney: Method of Travel to Work," ID Community, accessed 1 March 2021, https://profile.id.com.au/sydney/travel-to-work.
11. Sydney Trains owns and operates the suburban railway network and is fully controlled by TfNSW, itself an agency of the State Government; bus, ferry, and light rail services are coordinated by TfNSW, but operations are contracted out to a mix of private and publicly owned organisations; similarly, Sydney Metro is overseen by TfNSW, but trains are owned and operations are controlled by a private contractor, Metro Trains Sydney.
12. NSW Government, "NSW Budget 2019-20: Building a Better NSW," updated 18 June 2019, accessed 15 December 2020, https://www.treasury.nsw.gov.au/news/nsw-budget-2019-20-building-better-nsw.

Recently, Sydney has adopted a strategy of concentrating the densest development in distinct nodes—both existing and new—and uniting them through transport connections.[13] In this way, Sydney is unremarkable, and is simply following the example of numerous other global metropolitan areas.[14] The ethos is captured by the Greater Sydney Commission (a State Government-funded organisation that oversees region-wide planning) in its plan *A Metropolis of Three Cities* (*Three Cities* plan), which was produced in 2018 to guide the development of the region through 2056.[15] The central premise of the plan is to encourage increased density around three urban nodes, spread east to west across the region (see Figure 1.02), with Sydney (the Eastern Harbour City), Parramatta (the Central River City), and a new city, Bradfield, centred on the Western Sydney Airport, which is currently under development (the Western Parkland City).[16] The centres are proposed to be connected by a "city-shaping transport corridor", comprising existing rail infrastructure and new "mass transit" offerings.[17] While the plan is relatively new, it is both reinforced by and reinforces patterns of movement undertaken daily by commuters accessing existing distinct employment nodes (see Figure 1.03). Further, the ambitions and intent of the plan are factors in the planning and development of recent MTPs in the region, including the Sydney Metro and new highway systems.

In short, the *Three Cities* plan, which both echoes present development patterns and shapes policy that is driving planning in the region for the coming decades, embodies the idea of metro Sydney as a polycentric urban area, and the Sydney Metro is both of the time and supportive of these ambitions. However, neither the polycentrism of metro Sydney nor the push for transport to reinforce this urban form are new. To understand how Sydney finds itself in the present situation, this chapter first explores the evolution of urban form and transport patterns in the city that have

13. NSW Government, *Greater Sydney Region Plan – a Metropolis of Three Cities – Connecting People*, (March 2018), https://gsc-public-1.s3-ap-southeast-2.amazonaws.com/s3fs-public/greater-sydney-region-plan-0618_0.pdf.
14. Kyle Miller, "Polycentric Development and the Future of Regions," *The American Planning Association*, 15 December, 2020, https://planning.org/blog/9203550/polycentric-development-and-the-future-of-regions/.
15. NSW Government, "Who We Are," accessed 15 December 2020, https://www.greater.sydney/who-we-are; NSW Government, *A Metropolis of Three Cities*.
16. The name is of particular note as it recognises the preeminent figure in public transport development in Sydney, J.J.C. Bradfield, who completed his PhD nearly a century ago, in which he outlined the development of Sydney's railway system and the construction of the Harbour Bridge. A section of this chapter is devoted to his role in shaping transport serving the region. NSW Government, "New city at Aerotropolis to be named Bradfield," news release, 16 March 2021, https://www.nsw.gov.au/media-releases/new-city-at-aerotropolis-to-be-named-bradfield.
17. NSW Government, *A Metropolis of Three Cities*, 87.

created it. It goes on to focus on the two decades of globalism, stemming from events around the turn of the millennium, which led to a planning and political climate that was conducive to government adoption of mega-projects, specifically MTPs and, hence, the Sydney Metro. Both concepts are contextualised within global terms, underscoring the relevance of the overall thesis.



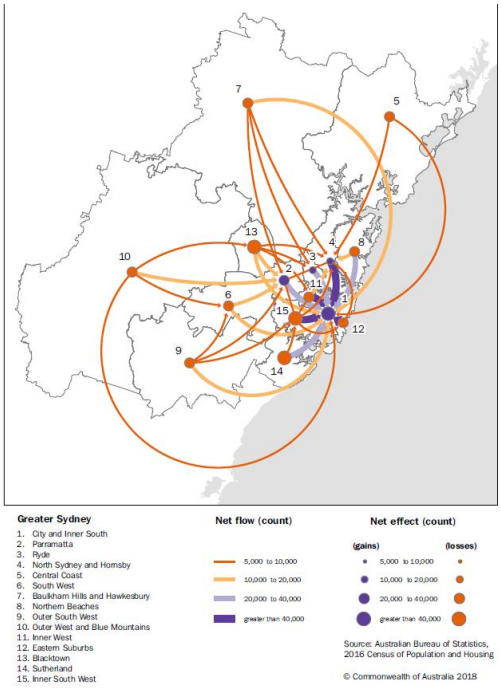


Figure 1.02 – (left) The *Three Cities* plan, proposed by the Greater Sydney Commission.
Figure 1.03 – (right) Commuting patterns the Sydney region highlight the trends that underpin the *Three Cities* plan.

Chapter Overview

This chapter establishes the local, urban, and regional design strategies that have shaped Sydney and its contemporary transport network, and which drive the development of large-scale transport infrastructure projects, of which the Sydney Metro is representative. The chapter explores the history of the city and its transport network through the lens of polycentrism, touching on the natural and geographic conditions, politics, adherence to global trends, and prevailing public domain strategies that have influenced the trajectory of the region. The chapter then delves into the background of the project which forms the basis of the research—the Sydney Metro—to contextualise its development within the larger discourse of mega-projects and MTPs, addressing procurement strategies, economics, and, again, politics, in these undertakings. It is within these contexts that the architect operates.

The role of factors such as history, nature, politics, and economics may at first seem outside the remit of the architect in the daily work of designing a transport station. While this is true, it is within the contexts shaped by these realities that the architect must work; the aggregation of decades of planning and ambitions, as well as modern procurement and technology, weighs on the process in various ways, as described in subsequent chapters. In addition, while modern metropolitan Sydney would be unrecognisable to the Aboriginal and European inhabitants from two centuries ago, the legacy of those who came before is legible in the patterns of development and is reflected in the design and placemaking that shape the contemporary construction of transportation infrastructure. Accordingly, an exploration of the bounds of metro Sydney is an excellent starting point for understanding the genesis of the Sydney Metro project and how it fits within both the context of the comprehensive transport planning ideas of the region, and the ambitions of regional, polycentric growth. Notably, Sydney has a well-documented legacy of transport development, coinciding with the polycentrism that has now been codified at the City level in *Sustainable Sydney 2030* and at the State level within the *Three Cities* plan.[18]

Design is also being driven by another layer of complexity overlying this comprehensive strategy. This is the codified requirement to instil "design excellence" in development within the City of Sydney through a number of competitive and review-based methods intended to enhance Sydney's global competitiveness.[19] While State-controlled transport projects, including the Sydney Metro, fall outside the jurisdiction of the City, the architects who work in the city have operated under the guidelines for more than two decades, and are influenced by these parameters.[20] The selection of architects through competitions also creates an environment of differentiation through design, which shapes the actions of architects and encourages them to look beyond the continent for design inspiration. The combination of these strategic (and decidedly policy-based) contexts

18. Council of the City of Sydney, *Sustainable Sydney 2030: the Vision* (Sydney: City of Sydney, 2009); NSW Government, *A Metropolis of Three Cities*.
19. Council of the City of Sydney, *Terms of Reference - City of Sydney Design Advisory Panel*, (Sydney, 2007), https://www.cityofsydney.nsw.gov.au/-/media/corporate/files/committees/design-advisory-panel---terms-of-reference.pdf; Council of the City of Sydney, *Competitive Design Policy*, (Sydney, 9 December 2013), https://www.cityofsydney.nsw.gov.au/-/media/corporate/files/2020-07-migrated/files_c-1/competitive-design-policy-adopted-09-december-2013.pdf; NSW Government, "Defining Design Excellence," accessed 15 December 2020, https://www.governmentarchitect.nsw.gov.au/review/defining-design-excellence.
20. Robert Freestone, Davison Gethin, and Richard Hu, Designing the Global City: Design Excellence, Competitions and the Remaking of Central Sydney (Singapore: Palgrave MacMillan, 2019).

creates a situation in which the architect for each of these projects is positioned not only as expert, but as a defender of the ideals of the profession—that design is inherently important—although these constitute only a limited number of the wider criteria that define the practice of architecture at State and National levels.[21] These political and aspirational conditions drive the architectural outcomes and, while unstable, anchor the work of the architect. This is explored in Chapters 3-5 using the methods outlined in Chapter 2.

To appreciate both the transformation of a European outpost into a major global city and the lineage of the decisions that shape transportation and design narratives in the city today, it is necessary to locate them in historical context before the research is described. Accordingly, the chapter presents a very general overview of the history of (public) transport in the Sydney region, as well as the complex concerns of design style in the city, identifies the issues that were explored in the research, and links the work executed in practice with common experiences and themes. As such, this chapter positions the Metro project within the context of urban-level design strategies (polycentrism) and transport development (mega-projects).

Metro Sydney: Polycentricity, Global Motives, and "Design Excellence"

The urbanised region that we today know as Sydney would not exist in its current form if it were not for transport—though not the transport that keeps today's Sydneysiders moving. The transport that defined the earliest years of the New South Wales colony was the result of the criminal justice system of late 18th century Britain, which saw petty thieves, fraudsters, forgers, and the like, undertake a circumglobal eight-month journey to a land previously little explored by Europeans—colonisation by design.[22] While the arrival of more than 700 British convicts and 300 officials in Sydney on the First Fleet in 1788 continues to shape the culture and society of Australia to this day, natural conditions largely dictated the earliest settlement patterns, even before the

21. Architects Accreditation Council of Australia, *The National Standard of Competency for Architects*, 2015 ed. (2018), http://competencystandardforarchitects.aaca.org.au/library/page/document/nsca-briefing.pdf.
22. Sydney's first architect, Francis Greenway, was transported for forgery and would go on to design several of Sydney's earliest notable buildings. Alasdair McGregor, *A Forger's Progress: the Life of Francis Greenway* (Sydney: NewSouth Publishing, 2014).

members of the First Fleet disembarked.[23] The British had every intention of establishing the colony in Botany Bay, an inlet south of today's Sydney Harbour, based on recommendations made by Captain James Cook following his 1770 voyage to Australia.[24] However, when Captain Arthur Phillip arrived in January 1788, he quickly made the decision to establish the colony at Port Jackson, deeming Sydney Cove (later Circular Quay), with its all-important access to a fresh water supply, superior to Botany Bay.[25] Thus, natural amenity dictated the location of what would develop into the Sydney CBD.[26] However, this would be only the first decision based on sustenance that would fundamentally shape the urban condition of the town, destined to spawn a metropolitan region.

Tracks to Tracks

Following the establishment of Sydney, then-Governor Phillip determined that the soil conditions at Circular Quay were inadequate for the agricultural cultivation required to support the population; thus, a party was dispatched to locate land suitable for agriculture.[27] A farm was established at the furthest inland point navigable on the harbour at a site named Rose Hill—later Parramatta—sowing the seeds for the founding of the region's second European centre, just months after the establishment of Sydney.[28] After a successful first growing season at the experimental farm, Rose Hill was established as the horticultural hub of the region, necessitating a reliable means of transporting bulk goods (and passengers) between the farm and the Sydney Cove centre of population and commerce.

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23. The land on which the present-day City of Sydney sits has been the traditional home of the Gadigal people of the Eora Nation for 60,000 years. The land was never ceded, but was taken by the British under the doctrine of *terra nullius.* This principle was applied across Australia, setting in motion the disenfranchisement and subjugation of the indigenous populations that persist today. Ian Hoskins, *Sydney Harbour: A History* (Sydney: University of New South Wales Press, 2009), 17 and 35; City of Sydney, "Aboriginal Histories," updated 20 October 2017, accessed 15 December 2020, https://www.cityofsydney.nsw.gov.au/history/aboriginal-histories.
24. Francis Gordon Clarke, *The History of Australia* (Westport, CT: Greenwood Press, 2002), 24.
25. A bit of irony is at play, as Botany Bay would eventually become the modern gateway to Sydney for international arrivals, with the establishment of the airport and commercial shipping port there. Hoskins, *Sydney Harbour*, 21-22.
26. The Tank Stream provided fresh water for the colony but presented an issue when it came to planning and developing the new town. Ultimately, the stream was channelised and ultimately placed beneath ground to allow the city to grow on top, with its residents unaware of the nature-cum-infrastructure below. Today, Tank Stream Lane, which roughly follows the course of the old stream, is the only indicator of its existence in the CBD. Hoskins, *Sydney Harbour*, 22.
27. B.H. Fletcher, "Phillip, Arthur (1738-1814)," vol. 2, *Australian Dictionary of Biography* (1967), http://adb.anu.edu.au/biography/phillip-arthur-2549.
28. Within a few years, the growing enclave took on an anglicised version of the Aboriginal name for the area—Parramatta—a bastardisation of either Buramada or Burramatta. Michael Duffy, *Man of Honour: John Macarthur, Duellist, Rebel, Founding Father* (Sydney: Macmillan, 2003), 81; "Parramatta," in *Britannica*. https://www.britannica.com/place/Parramatta.

Several over-land connections existed between Rose Hill and Sydney Cove, in the form of well-worn tracks used for millennia by the Aboriginal population, connecting sites of importance.[29] However, their narrowness, coupled with a lack of carts and draught animals to convey them, dictated the need for other means to transport large volumes of goods; the British turned to the riparian connection. In May 1789 the Rose Hill Packet—heralded as the first European-built vessel in Australia, though little more than a barge—was launched.[30] Weekly trips were made between the two settlements (see Figure 1.04), representing arguably the first public (i.e. convict) transport, with convict power required to navigate the vessel upstream over the course of four days.[31]

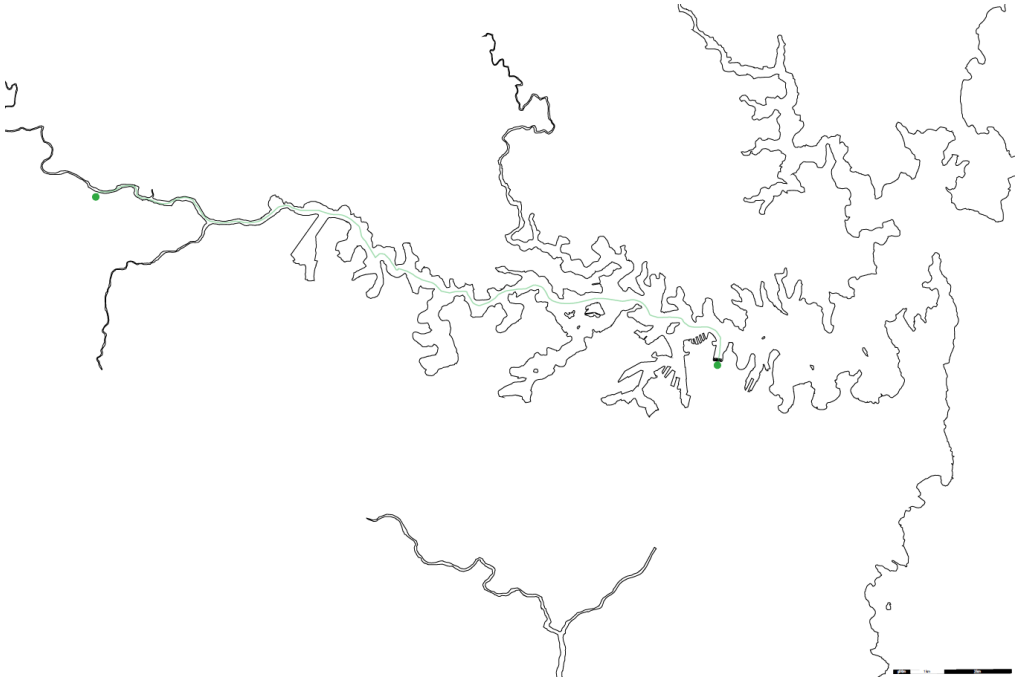

Figure 1.04 - The first public transport route in Sydney, the journey of the Rose Hill Packet between Circular Quay and Parramatta.

The ferry serviced the two settlements, which were separated by some 23 kilometres, as both grew and flourished according to the plans of Surveyor General Augustus Alt.[32] By 1791, the

29. Sue Daniel, "'Walking in Their Tracks': How Sydney's Aboriginal Paths Shaped the City," *Australian Broadcasting Corporation (ABC)*, 17 May 2018, https://www.abc.net.au/news/2018-05-17/curious-sydney-aboriginal-pathways/9676076.

30. Garry Wotherspoon, "Introduction," in *Sydney's Transport*, ed. Garry Wotherspoon (Sydney: Hale and Irremonger, 1983), 13-14.

31. A course still navigated by the region's modern ferry network today. R.J. Unstead, "From Bullock Dray to Tin Lizzie," *History Today* 18, no. 6 (1 June 1968), https://www.historytoday.com/archive/bullock-dray-tin-lizzie.

32. Parramatta took on the form of a regimented, orderly planned community, while Sydney's topography and the alignment of the Tank Stream (the impetus for establishing the colony), resulted in a more haphazard urban arrangement; both cities still reflect these influences today. Edward Higginbotham and Paul-Alan Johnson, *The Future of Parramatta's Past: An Archaeological Zoning Plan, 1788-1844*, Departing of Planning, NSW and The University of New South Wales (Sydney, 1989), https://www.higginbotham.com.au/pdf/AZP_Parramatta_Vol-1.pdf.

population of the rechristened town of Parramatta was far larger than that of Sydney, though their interdependence—Parramatta as breadbasket and Sydney as link to the outside world—united the success of both settlements, creating a single entity, with transport between the two centres vital to this polycentric arrangement.[33] The mutual reliance of the cities, and the need for reliable transport to assure their continued success, resonates centuries later and on a much larger scale with the establishment of transport between centres of a polycentric city as inherent to their function.[34] As such, the need for speed of conveyance between them increased and, by 1825, two coaches were operating daily between Sydney and Parramatta, roughly following the Aboriginal tracks, which had been transformed into the major thoroughfares known today as Parramatta Road, Broadway, and George Street.[35]

Around this time, though half a world away, another set of tracks was set to revolutionise the way the world moved. The Liverpool and Manchester Railway opened in 1830, linking the two English industrial centres via the first "modern" railway system.[36] Following the success of the railway, similar systems quickly spread across the country and mainland Europe, with the first continental railway opening in Belgium in 1835.[37] Notably, these early systems often linked either proximate, but distinctly self-reliant individual cities with one another, or were developed for purely industrial reasons, such as the movement of raw materials to factories. While the importation of the technology across the English Channel only took five years, it would take a bit longer to make its way across the oceans to Australia. Eventually, following Sydney's incorporation as a city in the 1840s, plans began to materialise for the construction of Australia's first railway.[38]

33. Higginbotham and Johnson, *The Future of Parramatta's Past*, 9.
34. Jerry B. Schneider, *Transit and the Polycentric City*, Urban Transport Program, Departments of Civil Engineering and Urban Planning, University of Washington, for U.S. Department of Transportation (1981).
35. Unstead, "From Bullock Dray to Tin Lizzie."
36. For a contemporary account of the development of the Liverpool and Manchester Railway, see Henry Booth, *An Account of the Liverpool and Manchester Railway*, 2nd ed. (Liverpool: Wales & Baines, 1831), https://www.google.com.au/books/edition/_/BlA4Z5QqpecC?hl=en&gbpv=0, Google Books.
37. For a comprehensive account of the development and proliferation of passenger railways across Europe and around the world, see Christian Wolmar, *The Iron Road* (London: DK Publishing, 2014).
38. No book offers a comprehensive history of Australian railways. For a brief overview of the development of railways in the country, see Australian Government, "History of Rail in Australia," Department of Infrastructure, Transport, Regional Development and Communications, updated 21 February 2020, accessed 15 December 2020, https://www.infrastructure.gov.au/rail/history.aspx.

Function Before Form

Given the continued importance of the Sydney-to-Parramatta link, it is no surprise that the first rail line in the colony was planned to run between the two centres.[39] However, the unique relationship of the cities—operating as a single unit—meant that the nature of the connection varied fundamentally from the early lines in other locations around the world. The rail link was not only an economic priority, ensuring speed and capacity, but also a factor in perpetuating the polycentric form of the Sydney region. While private enterprise attempted to construct a line, the investment ultimately proved too much, necessitating the Colonial Government (the precursor to the State Government, upon Federation in 1901) to step in, establishing State control of rail transport that persists to this day.[40] Even with, or perhaps because of, government backing, the construction of the termini was not feasible in the heart of the developed areas at either end of the line. This resulted in the stations being located in paddocks far from what would have been the core of the cities—a decision that would have long-term implications for urban development and transport infrastructure patterns.[41] When the line opened in September 1855 (see Figure 1.05), even though the stations had not yet been completed, the establishment of a fixed, reliable transport link was a major moment in the life of the city, with businesses closed and the city decorated for the occasion.[42] From its opening, the railway line not only carried passengers—more than 250,000 annually by 1870—but also served as the major means of transporting agricultural products from inland to the freight terminal at Darling Harbour for international export.[43]

The development of the rail network was vital for the economic strength of the Sydney region and allowed it to profit from the increasing importance of global trade for the colony.[44] Rapid expansion of the network in the years following its opening was overseen by Chief Engineer of the

39. Margaret Simpson, *On the Move: A History of Transport in Australia* (Sydney: Powerhouse Publishing, 2004), 24.
40. Hugh Stretton, *Ideas for Australian Cities*, 2nd (revised) ed. (Melbourne: Georgian House, 1975), 241.
41. Morton Herman, *The Architecture of Victorian Sydney*, 2nd ed. (Sydney: Angus and Robertson, 1964), 66.
42. "Opening of the Sydney and Parramatta Railway," *Empire* (Sydney), 27 September 1855, http://nla.gov.au/nla.news-article60169340.
43. Within months of initial completion, the line was quickly extended to meet the port at Darling Harbour, facilitating the movement of goods for export. NSW Government, "History of the NSW Railways," accessed 15 December 2020, https://www.transport.nsw.gov.au/projects/community-engagement/sydney-trains-community/culture-and-heritage/history-of-nsw-railways.
44. Simpson, *On the Move*, 23.

NSW Railways, John Whitton (1819-1898), who imported his railroad knowledge from prior experience in Britain.[45] However, while Whitton extended the rail network into the far reaches of the Sydney region—then merely rolling plains and pastoral holdings—the journey for those from the suburbs into the core of the city still meant disembarking in Cleveland paddock, and finding alternative transportation into the city nearly three kilometres away.

Figure 1.05 –Map of the first railway line in the Sydney region, showing (red square) where the service stopped short of the cities.

At the outset of rail development in Sydney, the infrastructural investment was viewed as a necessary commitment by the government to bolster the economic conditions of the region. Hence, the task of designing and building the railway was inherently political, as the government of the time was simply the only organisation with financial capacity for the undertaking.[46] With these decidedly pragmatic foundational ambitions, the function-before-form sentiment was underscored by completion of the Sydney terminus, which was described as not only rudimentary, but aesthetically unappealing.[47] Nonetheless, aesthetic considerations and passenger amenity could not be neglected,

45. The use of foreign expertise to oversee the rail expansion of transport in Sydney is a legacy that persists today, with much of the technology and oversight of projects executed by those who have worked on similar projects in Europe, leveraging technologies developed overseas.
46. Stuart Alan Sharp, "The Railway Stations of New South Wales – 1855-1980" (Master's thesis, University of Sydney, 1982), http://hdl.handle.net/2123/14984.
47. Angus MacKay, *Visit to Sydney and Cudgegong Diamond Mines* (Melbourne: George Robertson, 1870), 15 in Sharp, "The Railway Stations of New South Wales," 874.

as Sydney faced competition from Melbourne which, with its coffers boosted by the discovery of gold, was also building a rail network. In addition to stations being conceptualised in fiscal terms, as commercial spaces to serve the basic practical needs of the traveling public and their goods (along with the all-important collection of fares), rail spaces quickly took on a politically symbolic role, demonstrating the power of the government, the centrality of rail in generating commerce and strengthening the State's fiscal relevance within a global context, and the unification of the region as a single entity.[48] After the first line opened, numerous subsequent lines were devised under Whitton's leadership. Stations, at first rudimentary, quickly evolved into more substantial accommodations of stone and brick, with waiting rooms and other passenger amenities.[49] Ultimately, the proliferation of the station types developed by Whitton illustrated the power and reach of the rail system across not just the immediate Sydney region, but the entirety of NSW, which supported the city (through support of the colony), within the broader context of global urbanism.

New stations constructed through the Sydney region in the 1860s demonstrated this commitment to both function and form, but Sydney Terminal (1855) remained little more than a utilitarian shed in a field, hardly befitting its station.[50] In 1871, Whitton secured funding and developed the design for a handsome, if small, brick facility.[51] However, with land procurement closer to the city seen as both costly and politically untenable, the new terminal rose adjacent to the old one, thus not improving access for passengers into the city centre—a point of consternation for Whitton and the public.[52] Nonetheless, the opening of the second Sydney Terminal (1874) was heralded as a symbol of maturation from the economic austerity represented in the first terminal, and established a trajectory for transport facilities as places that demonstrated civic city (and colonial) pride within the urban realm. However, the Terminal's days were already numbered, with

48. The inherent politicisation of space, especially public space, is widely recognised, building off the concepts of Lefebvre. Henri Lefebvre, *The Production of Space* (Oxford, Blackwell, 1991).
49. Sharp, "The Railway Stations of New South Wales."
50. The sorry state of affairs is captured in a photo of the station from 1871. NSW Government, "The Paddocks: Terminus," Eveleigh Stories, accessed 3 December 2020, https://eveleighstories.com.au/stories/paddocks/terminus.
51. The description of the building in the 1871 call for tenders is incredible, detailing the materials and speaking to the desired qualitative outcomes of the project, yielding "a very light and effective appearance." "Railways and Public Works," *Sydney Morning Herald*, 14 June 1871, http://nla.gov.au/nla.news-article13240314.
52. Bob McKillop, "The Railways of Sydney: Shaping the City and Its Commerce," in *Dictionary of Sydney* (2016). https://dictionaryofsydney.org/entry/the_railways_of_sydney_shaping_the_city_and_its_commerce; "Railway Extension into the City," *Empire* (Sydney), 1 December 1874, http://nla.gov.au/nla.news-article61022693; "The Redfern Railway Station," *Sydney Morning Herald*, 19 June 1877, http://nla.gov.au/nla.news-article13395636.

the location and small scale limiting its ability to provide an effective service to the rapidly expanding city. After Whitton's death, options for the construction of a "Central Station", modelled after the grand central stations of late 19th century Europe, were explored and construction began in 1901.

The work done in the half century between the opening of the first railway line and the opening of Central Station (1906) cemented the importance of the steel rails linking Sydney, suburbs throughout the region, and even locations further afield (see Figure 1.06).[53] The long-distance train network acted as a feeder system, serving suburban passengers on their journey into Sydney. The region's success was therefore inextricably linked with the success of the new state and vice versa, solidifying the NSW Government's role in the provision of transport for the capital and the interdependence of Sydney with the other developed centres of the region, even as Sydney usurped them in size.

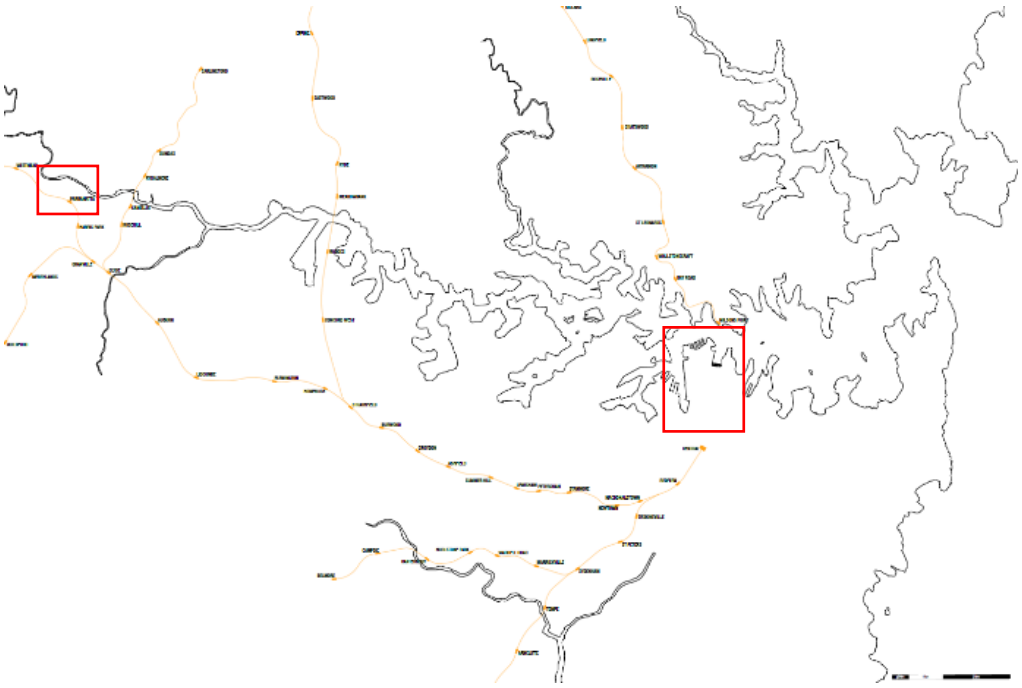

Figure 1.06 - The extent of rail service in the Sydney region by 1906, with the opening of the new Central Station, still outside the core of Sydney.

Despite the style displayed by Central Station and local stations developed from the 1880s onward, rapid expansion of the rail network and the station infrastructure that accompanied it was still largely driven by functional considerations. With the State's economic supremacy both

53. Paul McGillick, *Sydney Architecture: the Making of a Global City*, ed. Patrick Bingham-Hall (Singapore: Periplus, 2005), 73.

figuratively and literally riding on the rails, the dominant interest was in creating an effective system to unite the region for the movement of goods and people for commercial purposes; the economy was the driver of rail development, and the State served as conductor. This, coupled with other factors, drove the design of stations within Sydney for the first decades of rail development. In a comprehensively review of the design of rail stations in the State from 1855 to 1980, Stuart Sharp characterised them as products of their "environment", by which he meant "the amalgam of social, economic, political and other factors", thus emphasising the varying impact of "human considerations" along with the more tangible drivers of design such as engineering, materials, and physical constraints.[54] This evolution in conceptualisation of the impact of the railway and infrastructure led to a reframed view of the design of the stations.

Similarly, Ian Bentley contextualised transport investment not only in economic terms, but also in relation to considerations of prestige, noting that "double economic and ideological attraction" led to the growth of government support for transport infrastructure throughout the world in the late 19th and early 20th centuries.[55] The reconstruction of Sydney's main markets (1908), proximate to Central Station, is no coincidence.[56] The concentration of hotels (for accommodation and libation), entertainment, shopping, and numerous public services around Central was a testament to the role of the station as the gateway to the city from the rural areas of the region, with amenities for those visiting the city for business, recreation, commerce, and entertainment.[57] Ironically, while Carmen Hass-Klau attributes the decline of street life in the city to the adoption of transport, it is clear that it was often transport that facilitated the liveliness of city streets, with suburbanites able to journey into the city for entertainment and commerce.[58] While these characteristics indicate a transition toward a more monocentric urban arrangement during this period, the role of Parramatta as a major hub for the west endured.

54. Sharp, "The Railway Stations of New South Wales."
55. Ian Bentley, *Urban Transformations: Power, People & Urban Design* (London: Routledge, 1999), 102-03.
56. While several factors influenced the decision to consolidate the city's market operations in the neighbourhood following Federation, the construction of Central Station is among them. NSW Government, "Market City (Façade-Former Paddy's Market)," accessed 15 December 2020, https://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=4500356.
57. Shirley Fitzgerald, "Haymarket," in *Dictionary of Sydney* (2009). http://dictionaryofsydney.org/entry/haymarket.
58. Carmen Hass-Klau, Streets as Living Spaces: Helping Public Places Play Their Proper Role (London: Landor Publishing, 1999), 24.

It is also important to note that three trends, which would persist in the design of the railways, were initiated in the first half-century of construction:

1. The design of both the network itself and the stations that served it was predominantly undertaken by engineers. However, this did not necessarily mean that the process was entirely calculated along functional lines, with no aesthetic influences. While the emphasis was definitively on the functional parameters overseen by engineers, in line with the prioritising of the economic aspects of the railway, there simply were no architects to do the job. The first architectural degree was offered in Sydney in 1919, and registration of architecture as a profession followed in 1921.[59]
2. Generally, the design work was not attributable to any single engineer, as designs were the product of a bureaucratic machine, churning out stations and line at a high volume to keep up with demand for expansion. Attribution of design authorship rested with the engineer overseeing the operations of the railway, such as in the case of Whitton or, later, Bradfield.
3. The expertise needed to realise the designs was often provided not by Australians, but by imported talent. Wotherspoon, with some exasperation, noted that the government was not keen to take action on transport infrastructure without consulting experts from abroad, characterising the refusal to accept recommendations by Australians until they had been confirmed by non-Australians as a "time-honoured tradition."[60]

Style as Import

The man most closely associated with the design of Sydney's urban railways, drawing the network into the core of the CBD, was educated and worked in this context. In 1913, civil engineer John Jacob "Job" Crew (J.J.C.) Bradfield (1867-1943) was appointed Chief Engineer for Metropolitan Railway Construction.[61] Over the next two decades, Bradfield led the modernisation of Sydney's

59. Design and Planning The University of Sydney School of Architecture, "History of the School," accessed 15 December 2020, https://www.sydney.edu.au/architecture/about/history.html; Parliament of NSW, *The Architects Act 1921*, 28 November 1921.
60. Wotherspoon, "Introduction," 21.
61. Peter Spearritt, "Bradfield, John Job Crew (1867–1943)," in *Australian Dictionary of Biography* (National Centre of Biography: Australian National University, 1979). http://adb.anu.edu.au/biography/bradfield-john-job-crew-5331/text9011.

railways, including electrification of the existing suburban network, design and construction of the Harbour Bridge, and development of the City Railway.[62] The City Railway—operating today as the "City Circle"—is an eight-kilometre line serving four underground and two elevated stations in the heart of Sydney's commercial district.[63] The realised railway was a small component of a grand plan to link Central Station in the city's south and the rail terminal at Milsons Point on the Harbour's North Shore via the urbanised core, negating the need to transfer to ferry or tram to reach the CBD on a journey from the suburbs.

Interestingly, the tasking of the effort to one strong design lead for a range of tasks—including rolling stock, bridges, and stations—echoed the design of the Vienna *Stadtbahn* some 15 years prior. Overseen by architect Otto Wagner (1841-1918), the works epitomised the notion of *gesamtkunstwerk*, with careful attention paid to the integration of the stations and infrastructure into the adjacent urban context and the overall aesthetics and experience of the stations.[64] While engineers are rarely known for architectural proclivities, Bradfield's interest in aesthetics and town planning greatly shaped his work on the City Railway and its integration into the heart of the CBD, not unlike Wagner's. Bradfield's interests were fuelled by the curriculum at the University of Sydney, where he undertook undergraduate and master's studies under noted architect and urbanist Sir John Sulman (1849-1934).[65] Bradfield placed high value on aesthetics and the impact of infrastructure on the visual appeal and liveability of the city, the quality of the customer experience, and the long-term success of the stations.[66] His dedication to the creation of new, beautiful buildings and public spaces led him to declare "the aesthetic treatment of all above-ground portions of the City Railway has been carefully considered… [and] the various structures will be in architectural

62. Bradfield documented his work on the railway and Harbour Bridge and presented it as a dissertation, earning him the University of Sydney's first doctorate in engineering. J.J.C. Bradfield, "The City and Suburban Electric Railways and the Sydney Harbour Bridge" (PhD diss., University of Sydney, 1924).
63. A bit of a misnomer as trains cannot traverse the full circle, but proceed inward and outward at either the southern end, via Central Station, or the northern end, via the Harbour Bridge.
64. David Patrick Frisby, "Metropolitan Architecture and Modernity: Otto Wagner in Context" (Master's thesis University of Glasgow, 1998), 155, https://www-proquest-com.ezproxy.lib.uts.edu.au/docview/2162849856?accountid=17095.
65. Bradfield did not visit Vienna during his travels, but Sulman was familiar with the city. John Sulman, *An Introduction to the Study of Town Planning in Australia* (Sydney: Government Printer, 1921), 113.
66. For a more comprehensive understanding of Bradfield's architectural inclinations, see Michael Kahn, "Around the World in Eight Kilometres: Tracking Sydney's 'City Circle' International Railway Ties," *Proceedings of the Society of Architectural Historians, Australia and New Zealand* 36, *Distance Looks Back* (Sydney: SAHANZ, 2020), 230-41.

harmony with their surroundings," clearly indicating that his interests extended beyond the functional, representing a maturation of the drivers behind Sydney's rail infrastructure.[67]

Ultimately, the urban fabric of Sydney today and, of course, the train stations owe much to Bradfield; while not necessarily contributing any skyline-altering architecture (save for the bridge), his works shaped the skyline by providing infrastructure necessary to sustain Sydney's growth. Bradfield's work inextricably linked the design and development of transport infrastructure with the form of the city. Tasked by the Minister of Railways to seek out information related to the construction of rail transport in major urban areas, Bradfield travelled abroad in early 1914, in what would be the first of multiple trips.[68] His six-month itinerary included Chicago, New York, Boston, Philadelphia, London, Paris, and Hamburg. Even in the early days of World War I, the details of his journey were popular fodder among Sydneysiders, with anticipation building for what a modern rail line serving the city core could mean for the region. Grand visions of the system rivalling the London Underground were proposed, as Bradfield drew up plans for the electrically powered underground circle linking Central Station with the city, with a line emerging at Circular Quay to traverse the harbour on a bridge.

The following year, Bradfield presented his findings in a report to the State Parliament, and the railway proposal was accepted in mid-1915.[69] While the emphasis of his travel abroad had been to examine technical aspects of railways, he noted that, despite modern trappings of power, signalling, and equipment, the systems he encountered were only as successful as the design of means of handling patronage.[70] To ease the passenger journey within stations, Bradfield devised utilitarian interiors, in deference to their purpose, and embellished them with classical flourishes and materials aimed at passenger convenience and comfort. Station walls were uniformly finished with cream tiles that were durable and easy to clean, capped in distinct coloured tiles unique to each

67. J.J.C. Bradfield, "The Transit Problems of Greater Sydney," (Australian Town Planning Exhibition, Art Gallery, Education Building, Bridge Street, Sydney, 19 December 1917), lecture, 25.
68. "R.M.S. Tahiti, for San Francisco," *The Sydney Morning Herald*, 21 March 1914, http://nla.gov.au/nla.news-article15485776.
69. J.J.C. Bradfield, *Report on the Proposed Electric Railways for the City of Sydney* (Sydney: William Applegate Gullick, 1916).
70. Bradfield, Report on the Proposed Electric Railways for the City of Sydney, 11.

station to permit instant identification of a destination from an arriving train.[71] The colours were also applied to roundel signage, co-opted from the London Underground, to create a tangible parallel to the system Sydneysiders had grown to admire, and aspired to emulate, through years of media coverage of Bradfield's experiences abroad.[72] The intrinsic importance of the stations in the economic life of the city was further underscored by the opulence and amenity provided within the stations in the heart of the city. At Wynyard Station (1931), grand dining rooms and meeting spaces accommodated those travelling into the city to conduct business (see Figure 1.07). Rail infrastructure was tied to effective commerce and modernity, with Bradfield's railway serving as a tangible manifestation of a period in Sydney's design history defined by the importation of international understanding of urban form and the role of transportation in shaping the city.

Figure 1.07 - One of the grand dining spaces constructed as part of Wynyard Station.

Ideas of style and functionality from Europe and the United States shaped the system and in turn the city, giving Sydney greenspace and classical edifices scattered through the CBD. Bradfield's borrowing of technological innovation, especially from London and New York, yielded station configurations that have served an ever-expanding number of commuters for nine decades, and

71. Removed during unsympathetic renovations throughout the years, these motifs have been reinstalled in stations that have undergone recent renovations—red at Museum, green at St. James, blue at Wynyard, and yellow at Town Hall.
72. For the global proliferation of the Roundel, see David Lawrence, *A Logo for London: the London Transport Bar and Circle* (London: Laurence King Publishing, 2013).

which are ingrained in their daily movement. The opening of the City Railway introduced Sydneysiders to a form of transport they had read about for decades in newspaper accounts, both before and during Bradfield's exploratory sojourns abroad. The stations, a fusion of utility and restrained aesthetic classicism, captivated Sydneysiders, embodying the global aspirations and antecedents of a decade of intensive investment in transport infrastructure that would not be challenged for nearly a century.

In permitting Bradfield to work in this broad way, the Government acknowledged that the development of the urban transportation system in Sydney was not only economically important, but a means of positioning Sydney, as a polycentric region, in a larger global context. Design style carried import, with the Government tying the success of public space—itself tied to economic vibrancy—with the effective layout of urban areas and connections to transportation.[73] No longer was the city (or State) building parks and large civic gathering spaces—the railway and its environs became the expression of civic identity. However, after Bradfield retired upon the opening of the western leg of the City Railway and Harbour Bridge in 1932, enthusiasm for rail investment became a victim of the economic depression, and all interest in pursuing additional work evaporated with the outbreak of WWII.

Austerity to Automobiles

Post-war, Australia, much like America, saw itself on the cusp of a population boom.[74] The beneficiary of new technologies and policies, but without the need for reconstruction efforts such as those in devastated cities of Europe and the Pacific, Australian cities—chiefly Sydney—began to explore what the modern Australian city would be. In 1948, the State Labor Government produced the first comprehensive regional plan, the County of Cumberland planning scheme (Cumberland Plan), which called for investment in both railway and roadway expansion to allow for the growth of low-density suburban housing far from the core of the city, though none of the proposed rail

73. Bentley, Urban Transformations: Power, People & Urban Design, 103-04.

74. Robert Freestone and Christine Garnaut, "Beginnings: The Evolution of Metropolitan Planning to the Late Twentieth Century," in *Planning Metropolitan Australia*, ed. Robert Freestone and Stephen Hamnett (London: Routledge, 2018).

development was to be realised.[75] Planning was underpinned by a perception that the inner city, dominated by heavy industry and ageing housing stock, did not provide a quality lifestyle for those who resided there. The creation of new suburbs was seen as an opportunity to rectify the problem, giving residents access to greenspace untainted by pollution from industry. This was to be made possible, of course, by private automobiles.[76] With the proliferation of automobile ownership, the trajectory for the subsequent decades of growth in Sydney was set, and the focus of development spread beyond the traditional cores of Parramatta and Sydney.[77] As in the United States, this was facilitated by the availability of cheap land, cheap automobiles, and a policy that embraced the expansion of road networks. In the 1950s, the drive toward auto-centric urban development—no longer tethered to the tentacle-like reaches of the rail map that had defined Sydney's growth in the preceding century—introduced what Glaeser called "modern sprawl" and what Boyd would lambast in *The Australian Ugliness.*[78] The patterns mimicked those seen in the United States at a regional scale, but directly impacted the urban conditions of the Sydney CBD through the construction of numerous large-scale car parks and the widening of roadways to accommodate the demand for private transport on a scale previously unseen in the city.[79]

The embrace of automobile-centric development patterns within the city was underscored by the contentious completion of the City Circle railway only after the agreement to top Circular Quay Station (1956) with the four-lane Cahill Expressway (1958).[80] Notably, the hybrid station-expressway was the only rail station built in the city between 1931 and 1979. Finally, removal of the eastern set of tracks on the Harbour Bridge, intended for Bradfield's never realised Northern

75. Denis Winston, Sydney's Great Experiment: the Progress of the Cumberland County Plan (Sydney: Angus and Robertson, 1957), 53.
76. Peter Spearritt and Christina DeMarco, *Planning Sydney's Future* (Sydney: Allen & Unwin, 1988), 11-18.
77. Margaret Simpson, "The 1950s Australian Dream – Holdens, Victas and Mixmasters," updated 22 August 2018, accessed 16 December 2020, https://maas.museum/inside-the-collection/2018/08/22/the-1950s-australian-dream-holdens-victas-and-mixmasters/.
78. Edward Glaeser, *Triumph of the City* (London: Penguin Books, 2011); Robin Boyd, *The Australian Ugliness*, 3rd ed. (Melbourne: Text Publishing Company, 2012).
79. The development of the Domain Parking Station in the late 1950s was intended to be a model of drive-to urbanism, with a ring of carparks proposed at the edge of the urban core. Similarly, plans were drawn up to replace some of Sydney's grandest buildings—among them the Queen Victoria Building (which is directly linked to Town Hall Train Station)—with large multi-storey car parks. In the ultimate snub to public transport, when platforms 1 and 2 at Wynyard were removed following the removal of the tracks on the Harbour Bridge, the space was converted to a large underground car park.
80. Webber, "The Nature of the City," 17.

Beaches railway, in favour of two additional vehicle lanes, reinforced the transport trajectory for the coming decades, thus linking Sydney with the global trend of removing rail in favour of road lanes.[81]

Ultimately, the Cumberland Plan met with staunch resistance and was superseded by the newly elected Liberal government's *Sydney Region Outline Plan* (*SROP*) in 1968.[82] The politicisation of planning policy, with leadership changes serving as a bellwether for the adoption of new strategies, was a harbinger for the future. Governments would go on to further their agendas, framed with supportive data by bureaucrats and designers, in increasingly complex plans.[83] The *SROP* heavily emphasised dense development at rail stations (notably naming Parramatta the "second CBD"), leveraging existing infrastructure and benefitting from the introduction of world-first double-deck carriages to increase passenger capacity.[84] The emphasis on density around transport hubs, fostering walkability and transport interconnectedness, predated the idea of transit-oriented development (TOD) introduced by Peter Calthorpe in the 1980s. While decidedly transit-oriented, with density tied to transport nodes, the development defined in the *SROP* differed from Calthorpe's conception of greenfield projects that focused on a rigid intentionality and delineation of land use.[85] In the decades since the emergence of the term, however, "TOD" has been applied more liberally to transit-adjacent projects around the world, aligning well with the intentions enshrined in the *SROP*.[86] In contrast to the emphasis on development around existing transport facilities, however, the *SROP* encouraged expansion of the region's road network. The plan proposed, among other things, a

81. The tracks were never used for trains, as Bradfield's northern beaches line was never built, but had instead been used by tram services from Milsons Point to Wynyard. The destruction of the tram network in the early 1960s, itself an incredibly politically fraught occurrence, underscored that transport policy and infrastructure were inextricably linked with political ambitions. Of course, this still holds true more than half a century later. William D. Middleton, *Metropolitan Railways: Rapid Transit in America* (Bloomington: Indiana University Press, 2002), 115.

82. Henry Wardlaw, "Reality Strikes the County of Cumberland," in *Sydney – Planning or Politics: Town Planning for Sydney Region since 1945*, ed. Jonathan Falk and John Toon (Sydney: Planning Research Centre, University of Sydney, 2003); Peter Williams, "Governance, Property Rights and Planning in Peri-Urban Areas: Greater Sydney Case Study," in *Conflict and Change in Australia's Peri-Urban Landscapes*, ed. Melissa Kennedy, Andrew Butt, and Marco Amati (Farnham: Ashgate, 2016).

83. Stretton, Ideas for Australian Cities, 280.

84. Bill Hynes, "Parramatta – Sydney's Second Cbd?," in *Sydney – Planning or Politics: Town Planning for Sydney Region since 1945*, ed. Jonathan Falk and John Toon (Sydney: Planning Research Centre, University of Sydney, 2003); Simpson, *On the Move*, 44.

85. Peter Calthorpe, The Next American Metropolis: Ecology, Community, and the American Dream (New York: Princeton Architectural Press, 1993).

86. Antoine Decoville and Olivier Klein, "Polycentrism and the Accessibility of Public Facilities to the Population. The Example of the Grand Duchy of Luxembourg and Belval," *European planning studies* 28, no. 4 (2020), https://doi.org/10.1080/09654313.2019.1670141.

gridded network of roadways to further decrease the centralisation of Sydney on the CBD, instead diffusing density across the region. In 1971 another State study, the *Sydney Area Transportation Plan (SATP)*, bolstered by the participation of overseas experts, focused almost exclusively on expanding road networks.[87] However, the *SATP* and *SROP* were both abandoned with a change in government less than a decade later without being fully realised.

In contrast to the State emphasis on expanding road transport and encouraging suburban growth at the regional level, the City of Sydney simultaneously undertook a series of initiatives to reinvigorate the CBD. Numerous proposals for wide-scale pedestrianisation around the CBD were developed to ameliorate the impacts of slum clearance, road widening, and car park construction.[88] These plans coincided with a resurgence of global interest in encouraging walkability in urban cores. Advocates proposed the development of people spaces to bring life back to city centres that had been decimated by car-oriented infrastructure. These were modelled after European examples of walkable city centres predating the automobile (and the destruction wrought by the War).[89] Pedestrianisation plans tied into transport hubs in the city. Notable among these was the east-west corridor of Martin Place—the "civic heart" of the city—as the street was remade in preparation for the opening of the Eastern Suburbs Railway (ESR) in 1979.[90]

The railway line, a far shorter version of a line proposed more than a century prior and included in Bradfield's grand plans, marked the first major investment in rail in the city since the City Railway.[91] However, while its completion was celebrated and the line was an immediate success, its realisation was not to be a sign of renewed railway interest on the part of the State. Rather, it was

87. Brian Watters, "A Retrospective on the Sydney Area Transportation Study (SATS)," in *Sydney – Planning or Politics: Town Planning for Sydney Region since 1945*, ed. Jonathan Falk and John Toon (Sydney: Planning Research Centre, University of Sydney, 2003).

88. Urban Systems Corporation, *Wynyard Pedestrian Network*, vol. Action Plan No 3 (The Council of the City of Sydney, September, 1971). MSJ Keys Young Planners, *The City of Sydney Pedestrian Network*, Action Plan Number 6 (The Council of the City of Sydney, September, 1974); Terry Purcell and Ross Thorne, *Studies for Pedestrian Use in the City of Sydney* (Sydney: Architectural Psychology Research Unit, University of Sydney, 1976).

89. Kent A. Robertson, Pedestrian Malls and Skywalks: Traffic Separation Strategies in American Downtowns (Aldershot, UK: Avebury, 1994).

90. Andrew Briger, "The Politics of Planning: The 1971 City of Sydney Strategic Plan," in *The Design of Sydney: Three Decades of Change in the City Centre*, ed. G. Peter Webber (Sydney: Law Book, 1988), 38. "A City's Heart Builds on a Sense of Place," *The Sydney Morning Herald*, 1 October 2007, https://www.smh.com.au/national/a-citys-heart-builds-on-a-sense-of-place-20071001-gdr8gj.html.

91. Martin Riordan, "The Politics of Concrete: the Eastern Suburbs Railway," in *Sydney's Transport*, ed. Garry Wotherspoon (Sydney: Hale and Iremonger, 1983).

the result of subsequent administrations using the project as a campaign promise, starting work, and then funding a report to justify stopping the work, with some pressure applied from constituents who resided outside the city.[92] When the line opened, its four modern stations were generally well-liked; the truncation of the line did not necessarily demonstrate a lack of public interest, but a lack of political support in transport investment. This was due in no small part to the tensions that arose over expenditure on State-controlled railways to service purely residential suburbs and tourist beaches with no direct economic benefit to those who lived outside the city.[93] Ultimately, the influences of politics, changing technologies, social norms, and any other environmental factors do not matter as much as the results. In 1946-1947, nearly 87 percent of Sydneysiders travelled by public transport, with just 12.8 percent of trips undertaken by car. By 1981, however, that metric had reversed, with public transport journeys accounting for just 13.4 percent of all daily trips.[94] Without investment in transport, Sydney drifted away from a polycentric arrangement, becoming a sprawling mass with a monocentric CBD.

While transport investment—a major expense—was not politically viable, investment in the urban realm of Sydney was more generally accepted. In the decade following the opening of the ESR, the State Government focused on a series of urban renewal projects unrelated to the provision of transport.[95] Major thoroughfares in the city were reconfigured to accommodate pedestrians and de-emphasise cars around existing transport hubs, bolstering the city-led initiative that had started a decade earlier.[96] The investment around transport hubs was less an endorsement of transport viability for the city and more the product of an emphasis on development that would boost the lucrative tourist industry by enhancing the cityscape. In a position paper produced by the NSW government in 1984, the main emphasis was on creating new hubs to leverage the existing transport offerings, with unused transport capacity cited as a key to accommodating the densification around

92. Ian Collins, "The 'Country Interest' and the Eastern Suburbs Railway, 1875-1932," in *Sydney's Transport*, ed. Garry Wotherspoon (Sydney: Hale and Iremonger, 1983). The stop-and-go history of construction is succinctly examined in "The Long Track to Completion," *The Sydney Morning Herald*, 21 June 1979, https://smharchives.smedia.com.au/.
93. Riordan, "The Politics of Concrete: the Eastern Suburbs Railway."
94. Spearritt and DeMarco, *Planning Sydney's Future*, 50.
95. One element of transport was constructed during this time—the Sydney Monorail. Constructed by a private company, the single-track 3.6-kilometre loop linked tourist destinations around Darling Harbour. In its two-and-a-half-decade life it carried fewer passengers than the Sydney Train network does in as many months.
96. Chris Johnson, *Shaping Sydney: Public Architecture and Civic Decorum* (Sydney: Hale & Iremonger, 1999), 97; Briger, "The Politics of Planning: The 1971 City of Sydney Strategic Plan."

transport hubs. The report also expressly stated that there was little need to enhance or increase public transport offerings, since usage had declined due to decades of suburban flight and diffusion of workplaces and shopping centres around the region—itself the result of government policy encouraging reduction in urban core concentration.[97]

In place of urban vibrancy through residential inhabitation and commercial concentration, tourism was seen as a major driver for Australia's economy and urban growth.[98] In preparation for the Australian Bicentennial in 1988, the State adopted a top-down approach to transform the city to welcome international visitors; the reimagination of the Darling Harbour waterfront—for two centuries the industrial port of Sydney—as a tourist precinct became a signal project.[99] While these strategies mimicked Calthorpe's new urbanist TOD ideas, the emphasis in these initiatives was less on connection to transport than on the provision of recreational and cultural spaces.[100] Ultimately, in the lead-up to 1988, the Labor government replaced the *SROP* with *Sydney into Its Third Century: Metropolitan Strategy for the Sydney Region*—a plan devoid of public transport, and which codified the government's favouring of automobile infrastructure.[101] Ironically, before the Bicentennial celebrations were underway and *Sydney into Its Third Century* began to circulate, NSW voters replaced the Labor government.[102]

Sydney as the Global City

Following the Bicentennial, Sydney sought opportunities to attract global attention (and investment) as the millennium was ending, bolstering tourism offerings and refashioning the old industrial waterfront precincts beyond Darling Harbour as entertainment destinations, complete

97. *Planning Issues in the Sydney Region: Urban Consolidation*, (Sydney: Department of Planning and the Environment, 1984); Spearritt and DeMarco, *Planning Sydney's Future*, 11-18.
98. Spearritt and DeMarco, *Planning Sydney's Future*, 108.
99. C. Michael Hall, "The Politics of Decision Making and Top-Down Planning: Darling Harbour, Sydney," (Tourism and Services Management, Victoria University of Wellington1998), http://www.academia.edu/download/11767/Urban_tourism.pdf.
100. Ian Carlton, "Histories of Transit-Oriented Development: Perspectives on the Development of the TOD Concept," (IURD working paper 2009-02, Institute of Urban and Regional Development, University of California, Berkeley, Fall 2009), https://escholarship.org/uc/item/7wm9t8r6.
101. State Government of NSW, *Sydney into Its Third Century: Metropolitan Strategy for the Sydney Region* (Sydney: Department of Planning, 1988).
102. For a more complete analysis of the alphabet soup of planning policies, see Richard Hu, "Shaping a Global Sydney: the City of Sydney's Planning Transformation in the 1980s and 1990s," *Planning perspectives* 27, no. 3 (2012), https://doi.org/10.1080/02665433.2012.681139.

with museums, an aquarium, and a convention centre. These efforts were rewarded in September 1993, when Sydney was announced as the host city for the 2000 Summer Olympics. In the run-up to this event, which was foreseen as generating "the biggest continuous demand for passenger transport ever experienced in Australia", investment in transport increased as Sydney prepared itself for the international stage.[103] For the first time since 1979, a new train line serving the city—linking the CBD to the airport—was constructed, while another line extended to the newly constructed Olympic Park. The rail investment of the 1990s represented just a small portion of investment in the overall transport network; this period also witnessed the introduction of the city's first light rail service, the commissioning of two classes of ferries to serve the Parramatta River, and the reorganisation of bus services in the region. In this time, investment in transport was not only discussed in the context of benefits to the economy and potential ecological sustainability. For the first time, the concept of social sustainability and access to the city for all entered the discussion.[104]

Not only did the transport investment represent a policy shift, but the procurement methods used for the airport line would usher in a new strategy for developing and operating transport as the State sought to limit liability and the cost of funding projects with eye-watering price tags. In embracing the public-private partnership (PPP) model, Australia joined a global shift toward sharing risk—and reward—with the private sector, reframing the value of infrastructure investment in the process.[105] The importance of such a project in representing Sydney to the international public echoes the ambitions a century earlier during Federation, with investment focusing on ensuring Sydney's status and, again, with the country's reputation placed in the hands of foreigners.[106] However, the privatisation of the airport line (which would ultimately be an economic failure) set in

103. *Olympic Transport Actionplan for Business*, (Sydney: Olympic Roads and Transport Authority, 1999).

104. Brian Elton, "Building Sustainable Communities: Planning for Social Sustainability," in *Talking About Sydney: Population, Community and Culture in Contemporary Sydney*, ed. Robert Freestone, Caroline Butler-Bowdon, and Bill Randolph (Sydney: UNSW Press, 2006), 87; John Blair, Deo Prasad, and Robert Freestone, "Master Planned Communities and Sustainability in Sydney," in *Talking About Sydney: Population, Community and Culture in Contemporary Sydney*, ed. Robert Freestone, Caroline Butler-Bowdon, and Bill Randolph (Sydney: UNSW Press, 2006), 112.

105. Martijn Van Den Hurk and Matti Siemiatycki, "Public–Private Partnerships and the Design Process: Consequences for Architects and City Building," *International Journal of Urban and Regional Research* 42, no. 4 (2018), https://doi.org/10.1111/1468-2427.12629.

106. "City to Airport Link," *News of the Area (NOTA)* (Hawks Nest and Tea Gardens, NSW), 17 February 1995, http://nla.gov.au/nla.news-article258469700.

motion a new trajectory for transport development in the new millennium.[107] Aside from the adoption of PPP, the two rail projects illustrated diverging attitudes towards the design of infrastructure, exemplifying two conceptualisations of rail—one as expressive of civic ambitions and achievements, and one as merely a monetizable utilitarian means of movement. On one track, the Olympic Park Station, designed by Sydney architectural firm Hassell, was a grand gesture to anchor the games and welcome visitors to the precinct, evoking the heritage of rail design tracing back to "the great glass and iron railway stations of the 19th Century". On the other track, the stations that visitors encountered after leaving the airport were little more than underground platforms with the most basic of passenger provisions.[108] The contrast between public infrastructure as a testament to the city and as a testament to corporate financial return was—and remains—stark.

Simultaneously, the City of Sydney developed an ambitious, unprecedented plan to elevate the aesthetic and urban contributions of new projects on the skyline and streetscapes of the city.[109] To assist in this endeavour, Sydney developed a codified mechanism for "design excellence", requiring developments to be subjected to some form of objective analysis of the quality of design. The entire scheme, applied to no fewer than 45 projects from 2000 through 2017, was analysed by Freestone, Davison, and Hu in 2019, who presented a compelling case for the effectiveness of the policy.[110] A by-product of this has been that in the two decades since the inception of the regulation, there has been a notable uptick in internationally recognised practitioners—"starchitects"—associated with buildings in Sydney.[111] The participation of international firms often included local firms as part of a team, and/or the establishment of local outposts of the starchitect's office, staffed by local talent. The trend reflected the brand power of foreign architects in the relatively insular

107. From its opening, the airport line did not meet targeted patronage goals and, within five years, the State Government was required to subsidise the private investment. Ultimately, Airport Link Company Pty Ltd became insolvent and the line was sold to Australian bank Westpac in 2006. Today, dense development at the two stations on the line has led to a dramatic increase in ridership, with passenger numbers at the stations serving the residential precincts far outpacing use by airport patrons. The ownership of the stations is to pass to the railway in 2030. NSW Government, State Rail Authority of New South Wales: 1999-2000 Annual Report, (2000). Joshua Newman and Malcolm Bird, "British Columbia's Fast Ferries and Sydney's Airport Link: Partisan Barriers to Learning from Policy Failure," *Policy and Politics* 45, no. 1 (2017), https://doi.org/10.1332/030557316X14748942689774.

108. Robert Powell, *Hassell: Poetic Pragmatism*, ed. Patrick Bingham-Hall (Sydney: Pesaro, 2003), 61.

109. Freestone, Gethin, and Hu, *Designing the Global City*.

110. Freestone, Gethin, and Hu, *Designing the Global City*.

111. Donald McNeill, "Office Buildings and the Signature Architect: Piano and Foster in Sydney," *Environment and Planning A* 39, no. 2 (February 2007), https://doi.org/10.1068/a3720.

market of Sydney and mimicked the pattern of importing talent to participate in large projects in Sydney, as seen in the development of rail over the previous 150 years.[112] The pairing of local and internationally acclaimed architects not only established a precedent for the arrangement, but opened a pipeline through which international practitioners continue to relocate to Australia to practice with local firms.

Design excellence and an enhanced urban environment were not limited to the development of single buildings. In the first decade of the new millennium, the City of Sydney produced sweeping plans, published as *Sustainable Sydney 2030: The Vision*.[113] The plans laid out ten strategic directions, the first of which was to make Sydney "a globally competitive and innovative City," further reinforcing the commercial impetus for the urban planning strategies of the 21st century.[114] Another related to the integration of transport in the city, linking the quality of the city with the quality of infrastructure serving it and acknowledging the importance of regional connectivity.[115] Other principles related to perceived quality of life metrics including liveliness, engagement, vibrancy, culture, and creativity—all non-quantifiable targets related to the human experience of the city.[116] In another instance of the leveraging of international expertise, the City of Sydney engaged architect Jahn Gehl, who had created designs for numerous global cities in the preceding decades, to craft a vision for Sydney's future development.[117] In the City's own report, Gehl alluded to the fickle nature of planning for urban change, writing, "in Sydney, it seems to me, you sometimes say 'this is too hard, it can't be done.'"[118]

At the wider regional level, the establishment of the Greater Sydney Commission (as discussed in the opening of this chapter) in 2015, catalysed the movement toward the latest iteration of planning, pivoting decisively back toward a polycentric strategy. The empowerment of a single entity, outside the direct influence of State-level politics, to advise cross jurisdictionally, led to

112. Donald McNeill, "In Search of the Global Architect: the Case of Norman Foster (and Partners)," *International Journal of Urban and Regional Research* 29, no. 3 (September 2005), https://doi.org/10.1111/j.1468-2427.2005.00602.x.
113. City of Sydney, *Sustainable Sydney 2030: the Vision*.
114. City of Sydney, *Sustainable Sydney 2030*, 68.
115. City of Sydney, *Sustainable Sydney 2030*, 82.
116. City of Sydney, *Sustainable Sydney 2030*, 92-109.
117. Jan Gehl, *Life between Buildings: Using Public Space*, trans. Jo Koch, 5th ed. (Copenhagen: The Danish Architectural Press, 2001).
118. City of Sydney, *Sustainable Sydney 2030*, 17.

the *Three Cities* plan being drafted and adopted. The engagement of private partners in the planning process further cemented the plans and galvanised broad support, perhaps tinged with scepticism about eventual adoption, given the government's lack of commitment to enacting previous plans. With the approval and, ultimately, the commencement of work on the new Western Sydney Airport (WSA), some legitimacy was lent to the idea of the new Western Parklands City. Overall, the ambition to allow for all metro Sydney residents to live in a "30 minute city" by reducing sprawl and creating distinct urban nodes within the region underscored a definitive embracing of the polycentric nature of Sydney.[119]

All of these factors align with what Hamnett and Freestone described as a trend for Australian State governments to craft policy and "pursu[e] strategies intended to make their capital city-regions more sustainable, particularly through encouraging more compact urban forms and reduced car dependency."[120] By streamlining the development of transport through the perceived reduction of risk, and encouraging "design excellence", which not only rewarded environmental sustainability but also encouraged economic investment through "high-quality design … [that is] widely regarded as a key contributor to the competitive advantage of global cities", Sydney established a direction for transport and design policy that embraced the inherent polycentrism of the regional form and furthered an agenda of economic prosperity and enhanced notoriety through globalisation.[121]

Sydney Metro: Mega-Projects, Politics, and Procurement

It was from this environment that a push toward new, innovative transportation ideas began to emerge. As Sydney settled into the 21st century, policy, ambition, and technology began to coalesce in various proposals for rapid transit offerings in the city. This would ultimately become the push for the Sydney Metro. The realisation of this investment in Sydney echoed patterns seen around the world in the preceding decades. The delayed adoption of technologies and planning

119. Jennifer Harris and Nikki Robinson, "Visions of Lattes and Polycentric Cities: the Greater Sydney Commission Draft District Plans," *Mondaq Business Briefing*, 28 December 2016, https://www.mondaq.com/australia/construction-planning/556010/visions-of-lattes-and-polycentric-cities-the-greater-sydney-commission-draft-district-plans.
120. Stephen Hamnett and Robert Freestone, *Planning Metropolitan Australia* (London: Routledge, 2018), 4.
121. Freestone, Gethin, and Hu, *Designing the Global City*.

ideas first tested abroad harked back to the initial importation of railway technology in 1855 and of urban rail transport in the 1920s. The idea of rapid transit was hardly new; European and American cities had widely adopting these systems in the 1960s and 1970s, and Asian cities pushed technological boundaries with their systems in the 1980s and 1990s.[122] The trans-global construction of new systems from scratch boomed in the second half of the twentieth century, as the mega-project—and specifically the mega transport project (MTP)—became common under multiple political systems.[123]

The delayed realisation of MTPs in Sydney was not a product of ignorance of global developments but, rather, a manifestation of the relative lack of need for the solutions adopted abroad. Mid-century Sydney had a limited population, inconsistent political dedication to a single planning idea (as outlined in the previous section), and constrained economic resources. As such, aside from the completion of the ESR line, transport capital investment was largely limited to piecemeal motorway construction until the opening of the Sydney Harbour Tunnel in 1992.[124] While other cities built rapid transit offerings, Sydney's political circumstances, comprehensive existing public transport coverage, commitment to one-off roadway projects, and the massive investment required to realise an entirely new system rather than simply upgrade existing infrastructure, all proved barriers.

As noted in the previous section, the conditions for a "great mega-project era" were created as global interest in the city increased in the lead up to the new millennium, giving rise to a renewal of interjurisdictional competition.[125] The embrace of MTPs in the 2000s mimicked patterns such as those seen in post-war America, which were fuelled by emergence from recession into a decade of

122. The United States adoption of rapid transit followed the construction of the interstate system; both were the result of large-scale federal investment in transport infrastructure furthering urban renewal and economic policy objectives as they shifted post-war into the 1970s. US Department of Transportation, "About FTA," accessed 16 December 2020, https://www.transit.dot.gov/about-fta.

123. Harry T. Dimitriou, "What Constitutes a 'Successful' Mega Transport Project?," *Planning Theory & Practice* 15, no. 3 (September 2014): 389-92, https://doi.org/10.1080/14649357.2014.935084.

124. Roads Australia, "Sydney's Freeway History," accessed 16 December 2020, https://roadsaustralia.weebly.com/sydneys-freeway-history.html.

125. Alan A. Altshuler and David Luberoff, *Mega-Projects: The Changing Politics of Urban Public Investment* (Washington, DC: Brookings Institution Press, 2003).

sustained prosperity.[126] Under the influences of globalisation, economic boom, suburban growth fuelled by population expansion, and the development of exurbs, Sydney—and Australia in general—doubled down on long-term planning, fuelling the rise of the MTP.[127] Fittingly, in its realisation of MTPs, Sydney has embraced a model which Altshuler and Luberoff have sought to establish as distinctly American in form, though not all aspects of this model have been realised in practice.[128]

Notably, the funding for MTP investment differed from the full government support seen in post-war America. NSW adopted PPPs under the decade-long Bob Carr premiership (1995-2005), thus providing the economic footing for the projects to be undertaken.[129] A number of factors combined to identify not only the functional outcomes of MTPs, but their aesthetic and societal benefits within the context of planning and design. These included the adoption of the new procurement strategy, which allowed for these mega-projects to be realised through the framework of private enterprise, the long-range planning vision associated with ideas of placemaking and sustainable urban renewal, and the emphasis on "experience services" to differentiate the city and create a distinct identity for Sydney in the global context.[130]

In the last two decades, Sydney has rushed to build MTPs—M5 East Tunnel (2001), Cross City Tunnel (2005), M7 Westlink (2005), Lane Cove Tunnel (2007), NorthConnex (2019), CBD and South East Light Rail (2019 and 2020), Sydney Metro (2019-ongoing), and WestConnex (2019-ongoing). During this period, there has been an increase in research on the phenomenon, including influences, implications, and impacts. The research has framed the projects as more than just massive

126. Jonathan Kearns and Philip Lowe, "Australia's Prosperous 2000s: Housing and the Mining Boom," Reserve Bank of Australia, Economic Research Department, 2011; Ellis Connolly and David Orsmond, "The Mining Industry: From Bust to Boom" in Hugo Gerard and Jonathan Kearns, ed. *The Australian Economy in the 2000s*, Conference Proceedings 15-16 August 2011, Sydney.

127. In the 2000s, international migration to Australia increased, supporting both the population boom and the uptick in global engagement. Freestone and Garnaut, "Beginnings"; Janet Phillips and Joanne Simon-Davies, "Migration to Australia: A Quick Guide to the Statistics," Parliament of Australia, accessed 16 December 2020, https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp1617/Quick_Guides/MigrationStatistics.

128. Altshuler and Luberoff, Mega-Projects: The Changing Politics of Urban Public Investment.

129. R. Richard Geddes, *The Road to Renewal Private Investment in U.S. Transportation Infrastructure* (Washington, DC: AEI Press, 2011), 107-14.

130. Raymond Bunker, Robert Freestone, and Bill Randolph, "Sydney: Growth, Globalization and Governance," in *Planning Metropolitan Australia*, ed. Stephen Hamnett and Robert Freestone (London: Routledge, 2018).

engineering feats, arguing that their realisation was the outcome of a broader process of engagement between public perception and the politics behind decisions.[131] The context of public engagement, interest in creation of public amenity, and interest in sustainability (environmental, economic, and social) defines the MTP process in Sydney today, and impacts on the design of urban transport infrastructure associated with the Sydney Metro.

What is Metro?

It is at this point that it is necessary to add some comments on train types and technology to clarify the shift in Sydney's transport strategy, which follows the lead of countless other cities on every inhabited continent. Between 1855 and 2019, Sydney's heavy rail-based transport offerings (excluding trams, light rail, and monorail, each of which is a different subset of rail) were almost exclusively provided by the State.[132] The electrified lines (undertaken as part of Bradfield's inter-war work), served as a commuter rail type of network, carrying not only suburban train traffic but also regional and national passenger rail and even freight rail within the city. This type of network is typical of many in Europe, America, and Asia.[133] These systems predominantly operate on networks originally served by steam locomotive-drawn trains and date to the inception of transport services in the regions they serve—just as Sydney's. Notably, many regions served by this type of heavy rail infrastructure are also served by rapid transit systems today.[134]

In contrast to commuter rail systems, rapid transit lines are typically purpose-built electric railways that do not share rights of way with longer-distance services or freight. While the first London Underground lines of 1863 were largely extensions of the mainline services, their role in

131. Nicholas Low and Sophie Sturup, "Leadership, Risk and Storylines: the Case of the Sydney Cross City Tunnel," *Planning Theory & Practice* 15, no. 3 (September 2014), https://doi.org/10.1080/14649357.2014.935084; George Kaparos and Pantoleon Skayannis, "Dealing with Context and Uncertainty in the Development of the Athens Metro Base Project," *Planning Theory and Practice* 15, no. 3 (September 2014), https://doi.org/10.1080/14649357.2014.935084; Yasunori Muromachi, Seiji Iwakura, and Kazuya Itaya, "What Constitutes a 'Successful' Mega Transport Project? Lessons from the Metropolitan Expressway in Tokyo," *Planning Theory & Practice* 15, no. 3 (September 2014), https://doi.org/10.1080/14649357.2014.935084.

132. Limited private lines were constructed over the decades, but either were incorporated into the State network or closed.

133. These include the Paris *Réseau Express Régional* (RER), Beligian *Société nationale des chemins de fer belges* (SNCB) serving Brussels, the lines of the London Overground, the Long Island Rail Road (LIRR) and New Jersey Transit Rail Operations (NJTRO) in the New York Region, Metra in Chicago, and Southeastern Pennsylvania Transportation Authority (SEPTA) regional rail services in Philadelphia, and the expansive Mumbai Suburban Railway.

134. Including all of the cities served in the footnote above.

connecting the terminal stations in the city represents the first instance of urban rail transport in the *rapid* sense, allowing Londoners to traverse across the capital below the crowded streets at a speed unfathomable before their introduction.[135] However, dedicated rapid transport in the modern sense emerged with the introduction of electric traction for underground use, first in London in 1890. The idea quickly proliferated, with the construction of "metro"—short for metropolitan—systems in continental Europe and America throughout the late 1800s and early 1900s. Following World War II, metro investment boomed, with 39 cities on four continents constructing systems between 1950 and 1979. The majority took on the moniker "metro" and the name has been adopted to signify this type of transport [Appendix B].[136]

Simultaneously, technological advances provided for eventual automation of metro systems, with London again leading the way in adopting the technology.[137] Continual development led to wider implementation by the 1980s—first in small-scale, closed systems such as airports and, starting later in the decade, in larger urban systems.[138] Mainstream adoption of driverless systems began in the 2000s, with cities in Asia leading the charge. Today, most new systems harness the technology, with other existing systems being retrofitted where technological and spatial constraints permit.[139] Automation has complemented design changes, including the adoption of platform screen

135. Christian Wolmar, *The Subterranean Railway: How the London Underground Was Built and How It Changed the City Forever* (London: Atlantic House, 2005).

136. Such systems were built in cities including Toronto, San Francisco, Atlanta, Sao Paolo, Beijing, and Lisbon.

137. H.G. Follenfant and D.S. Currie, "Informal Discussion. The Victoria Line - Its Contribution to Mass Transportation," *ICE Proceedings* 43, no. 4 (1969), https://doi.org/10.1680/iicep.1969.7329.

138. The Port Island Line in Kobe was the first fully autonomous urban metro system in the world, debuting in 1981. Two years later, Lille, France opened a light metro system utilising VAL technology, which played a role in Bruno Latour's ANT mapping of Aramis in Bruno Latour, *Aramis, or, the Love of Technology* (Cambridge, MA: Harvard University Press, 1996).

139. "First Driverless Glasgow Subway Train Delivered," *Railway Gazette International* 175, no. 6 (2019), https://link.gale.com/apps/doc/A590952380/ITOF?u=uts&sid=ITOF&xid=9677ea05; "Sydney Metro Receives First Driverless Train," *International Railway Journal* 57, no. 11 (2017), http://ezproxy.lib.uts.edu.au/login?url=https://www-proquest-com.ezproxy.lib.uts.edu.au/trade-journals/sydney-metro-receives-first-driverless-train/docview/1970623738/se-2?accountid=17095; "First Driverless Train for Shanghai Metro Line 14 Rolls out from CRRC," *International Railway Journal* 59, no. 10 (2019), http://ezproxy.lib.uts.edu.au/login?url=https://www-proquest-com.ezproxy.lib.uts.edu.au/trade-journals/first-driverless-train-shanghai-metro-line-14/docview/2310613902/se-2?accountid=17095; "More Ansaldobreda Trains for Copenhagen Metro," *International Railway Journal* 54, no. 11 (2014), http://ezproxy.lib.uts.edu.au/login?url=https://www-proquest-com.ezproxy.lib.uts.edu.au/trade-journals/more-ansaldobreda-trains-copenhagen-metro/docview/1630055688/se-2?accountid=17095; "Delhi Metro Gets First Driverless Trains from S Korea," *India Business Insight* (Bangalore), 21 June 2015, http://ezproxy.lib.uts.edu.au/login?url=https://www-proquest-com.ezproxy.lib.uts.edu.au/wire-feeds/delhi-metro-gets-first-driverless-train-s-korea/docview/1714551409/se-2?accountid=17095; Gérard Yelloz, "Siemens CBTC Solution in Barcelona-the First Driverless Metro in Spain" (13th International Conference on Automated People Movers and Transit Systems, Paris, 22-25 May 2011).

doors to separate passengers from arriving and departing trains, thus isolating passengers from the platform edge through the creation of a distinct platform zone, independent of the animation of train movement. Coupled with innovations such as real-time tracking of trains, digital ticketing, and the inclusion of climate control on trains and within stations, technology shifted the approach to the design of transport stations, and many older rapid transit systems have been modernised. However, early rapid transit systems and commuter rail systems—and the stations which they serve—have remained largely unchanged for decades or even longer, with legacy arrangements resulting in issues that often impacted safety, capacity, and universal accessibility. The problems involved in adapting ageing stations, often restricted by the cities that have matured around them, and legacy issues carried over from early technologies and rolling stock, have left limited opportunity for expansion or increased efficiency. To this day, trains stopping at many original London Underground stations cannot open all doors because platforms are too short, disabled access is limited in many systems around the world, and the now iconic expression "Mind the Gap" serves as a reminder of an ongoing safety concern.

While major cities around the world constructed rapid transit systems, often to supplement existing commuter rail infrastructure, no Australian city adopted such a strategy.[140] Aside from signalling upgrades and various other minor safety changes since its initial opening, Sydney's train network—the backbone of transport in the region—exemplifies the larger global conundrum of providing transport for modern cities based on the constraints established when the cities were much smaller and technologies more rudimentary. When Bradfield designed the City Circle in the 1920s, he anticipated population growth over the next century, creating stations that could accommodate the needs of a city of millions. His foresight allowed for the *laissez faire* approach of the State Government to the maintenance and improvement of the rail system in the 1950s-1990s, leaving stations neglected and, ultimately, unable to cope with the demands and safety considerations of 21st century Sydneysiders.[141]

140. A few non-political factors likely influenced this; Australian cities were already well served by transport systems compared to other cities with similar populations, and the populations did not require additional services.

141. Matt O'Sullivan, "Secret Reports Reveal Fire Risks on Sydney's Underground Rail Network, Old Trains," *Sydney Morning Herald*, 19 January 2018, https://www.smh.com.au/national/nsw/secret-reports-reveal-fire-risks-on-sydneys-underground-rail-network-old-trains-20180117-h0jgka.html.

With increasing passenger numbers in the city's stations, the persistent deferral of decisions about addressing the shortcomings of the system began to attract attention. Finally, work on upgrading Wynyard Station, the City Circle's second busiest station, started in 2014 in anticipation of increased use due to its proximity to the new business district immediately west of the CBD at Barangaroo. The upgrade involved decluttering the passenger areas of the station to accommodate movement. The architectural contract, awarded to Cox Architecture, was for services "to expand capacity, improve safety and efficiencies and update and improve the station's amenities."[142] Many access upgrades, still underway, were tied directly to private development around the station.[143] In the case of Town Hall, the busiest station on the network, options were more limited, with little chance of relief from redevelopment of adjacent sites. Ultimately, crowd control measures had to be enforced as increasing passenger numbers led to overcrowding as a stop-gap strategy to ensure the system can cope until a redundant line is provided as a means of relieving the congestion.[144]

Vying for Control of Transport

With increasing ridership on the Sydney Train network near the end of the century, the State explored options for easing the growing congestion in the city's stations. The first proposal for an additional train line to serve the city came in 1990 under the Greiner Liberal Government, with the vision of constructing a new rail corridor down the western side of the CBD.[145] Additional plans, including a line linking two existing rail corridors to the north of the city, were proposed; that project, the Epping to Chatswood Rail Link, was the city's first major rail development of the 2000s. Designed by Hassell Architects, who channelled many of the principles they had employed a decade earlier in the Olympic Park Station, the stations ushered in a new era of "world class" transport facilities featuring cavernous concourses and natural light—features never before seen in Sydney's suburban train stations.[146] Simultaneously, at the eastern end of that line, Cox Architecture was on the team awarded the redevelopment of Chatswood Station as the "Chatswood Transport

142. "Wynyard Station Upgrade - Architectural Technical Advisor," *MENA Report* (London), 5 November 2014.
143. "NSW: Wynyard Station Upgrade Planned," news release, 7 October 2010.
144. Matt O'Sullivan, "Town Hall Station Overcrowding to Force Staff to Slow Access at Peak," *The Sydney Morning Herald*, 8 October 2018, https://www.smh.com.au/national/nsw/town-hall-station-overcrowding-to-force-staff-to-slow-access-at-peak-20180921-p5056j.html.
145. "New Underground Planned of Sydney's West," *Network, the Railways of Australia Quarterly* 27, 4 (4 October 1990).
146. APOL, "Epping to Chatswood Rail Link," accessed 17 December 2020, https://apolsystems.com/project-ecrl.php.

Interchange".[147] While limited in scope—the link only included three new stations, new platforms and entry at Epping, and the upgrade at Chatswood—the line would play a vital role in the future plans for the city's transport networks. The project established design of stations as a major differentiator from network expansion *per se*, with the stations serving not just as infrastructure, but as statements about the Government's long-term commitment to the areas they served and as spaces for people to enjoy the commute, rather than merely pass through. The austerity of the Airport Link stations from a decade earlier was not to be repeated. Additionally, the project re-established Hassell as a dominant transport architect in Sydney, while the portfolio boost also enhanced COX's credibility in pursuing future opportunities. Finally, it anticipated incorporation into future line routings for rapid transit, with the design including modern safety and accessibility standards to permit conversion.

Meanwhile, over the next two decades, various studies would be undertaken, reports would be drafted, and plans would be unveiled for new transport links to the CBD, only to be criticised and revised, or scrapped altogether, by subsequent governments as the state oscillated between Liberal and Labor regimes. With each successive government routes would be proposed and timelines established, but no construction would take place. The political indecision that stymied the ESR construction for more than a century continued to play out. During the Carr, Iemma, Rees, and Keneally Labor administrations, no fewer than seven different plans, recommending at least ten different transport lines, were produced. It was during this time, in March 2008, that the idea of a rapid transit system for the city, instead of a new rail line to add to the existing network, was developed and revealed.[148] Almost as soon as plans for the "North West Metro" were unveiled, critics began to emerge, sceptical of the proposal.[149] Still, the government pressed ahead, with initial design undertaken by a consortium of the two transport-experienced Sydney firms—COX and

147. Cox Architecture, "Chatswood Transport Interchange," accessed 17 December 2020, https://www.coxarchitecture.com.au/project/chatswood-transport-interchange/.

148. "Sydney Plans Pioneering Metro," *International Railway Journal* 48, no. 5 (May 2008), http://ezproxy.lib.uts.edu.au/login?url=https://www-proquest-com.ezproxy.lib.uts.edu.au/trade-journals/sydney-plans-pioneering-metro/docview/212957091/se-2?accountid=17095.

149. Linton Besser, "Metro Will Be Too Fast to Get On," *The Sydney Morning Herald*, 31 March 2008, https://www.smh.com.au/national/metro-will-be-too-fast-to-get-on-20080331-gds7gn.html.

Hassell.[150] However, by the end of the year, the proposal to open the line by 2015 had been deferred, and after another year the project was cancelled.[151]

Along with successive State-led transport plans came a cavalcade of State-led planning programs, including the *City of Cities* plan (2005), the *Metropolitan Plan for Sydney 2036* (2010) and *A Plan for Growing Sydney* (2014).[152] While it was clear that transport was needed to achieve the desired outcomes, the decoupling of transport plans and definitive planning policy resulted in inconsistency and minimal action realising meaningful projects. Instead, projects were piecemealed, including the construction of the Epping to Chatswood Rail Link.[153] With the election of the O'Farrell Liberal government in 2011, the cycle repeated itself, with O'Farrell and his successor Baird devising at least four new rail plans—notably adopting the metro technology—in as many years. The first plan, announced the year of their election, was for a North West Rail Link (largely a facsimile of the Labor proposal in everything but name).[154] A tender for initial design of the line was awarded to a consortium including Cox Architecture and London-based Grimshaw Architects.[155] The next year, a contract was awarded for tunnelling on the system to begin, while initial plans continued to be developed for the stations.[156] Finally, in late 2014, a tender worth $3.7 billion was awarded as part of a PPP to deliver and operate the rail system, including the provision of architectural design services for the eight new stations on the line. With the contract, Hassell took over the design from COX for the Rail Link.[157] The Rail Link would finally move forward as Australia's first rapid transit line.

150. Cox Architecture, "Sydney CBD Metro and Sydney West Metro," accessed 17 December 2020, https://www.coxarchitecture.com.au/project/sydney-west-metro/.

151. "Sydney Metro Deferred," *Railway Gazette International* 164, no. 12 (2008), https://www-proquest-com.ezproxy.lib.uts.edu.au/scholarly-journals/sydney-metro-deferred/docview/36256596/se-2?accountid=17095; "New South Wales Scraps Sydney Metro," *Project Finance* (London), February 2010, https://search-proquest-com.ezproxy.lib.uts.edu.au/docview/211376102/citation/63DF198DF814F51PQ/1?accountid=17095.

152. NSW Government, *City of Cities: A Plan for Sydney's Future* (Sydney: Department of Planning – Metropolitan Strategy, December 2005); NSW Government, *Metropolitan Plan for Sydney 2036* (Sydney: Department of Planning, December 2010); NSW Government, *A Plan for Growing Sydney* (Sydney: Department of Planning & Environment, December 2014).

153. Bunker, Freestone, and Randolph, "Sydney: Growth, Globalization and Governance."

154. NSW Government, *Northwestraillink – Project Overview June 2012*, (June 2012), https://www.sydneymetro.info/sites/default/files/Project_overview.pdf%3Fext%3D.pdf.

155. "Aecom-Led Consortium Appointed to Design North West Rail Link," *Engineering Career*, 2 August 2011, http://www.engineeringcareer.net.au/archived-news/aecom-led-consortium-appointed-to-design-north-west-rail-link.

156. Northwest Sustainability Environmental and Planning, *Construction Compliance Report 11 (1 April to 30 September 2018)*, Rev. 1.0 ed., Sydney Metro (30 November 2018), https://www.sydneymetro.info/sites/default/files/document-library/Sydney_Metro_Northwest_Construction_Compliance_Report%2011-April_to_September_2018.pdf.

157. Australia & New Zealand Infrastructure Pipeline, "Sydney Metro Project Pipeline Status," accessed 17 December 2020, https://infrastructurepipeline.org/project/sydney-metro/.

The First Line—Public Transport, Public Input, Public Use

By 2015, plans for the North West Rail Link had been consolidated with a new harbour tunnel and extension of the line to the city's southwest. With funding secured and the failed Labor proposal of 2008 a distant memory, the line was rechristened "Sydney Metro Northwest".[158] The press release announcing the project called it "city-shaping", reinforcing the idea that the project was not envisioned simply as transport infrastructure but, rather, as a catalyst for urban transformation. Plans called for the line to be completed in 2019, providing rapid transit service along a 33-kilometre segment from Rouse Hill in the region's far northwest to Chatswood, incorporating the Epping to Chatswood Rail Link. In total, the line included eight new stations of the Northwest line to be designed by Hassell and the five existing stations of the Epping to Chatswood Rail Link, four of which were designed by Hassell; the repurposing of the existing Chatswood Station was designed by Cox Architecture (see Figure 1.08).

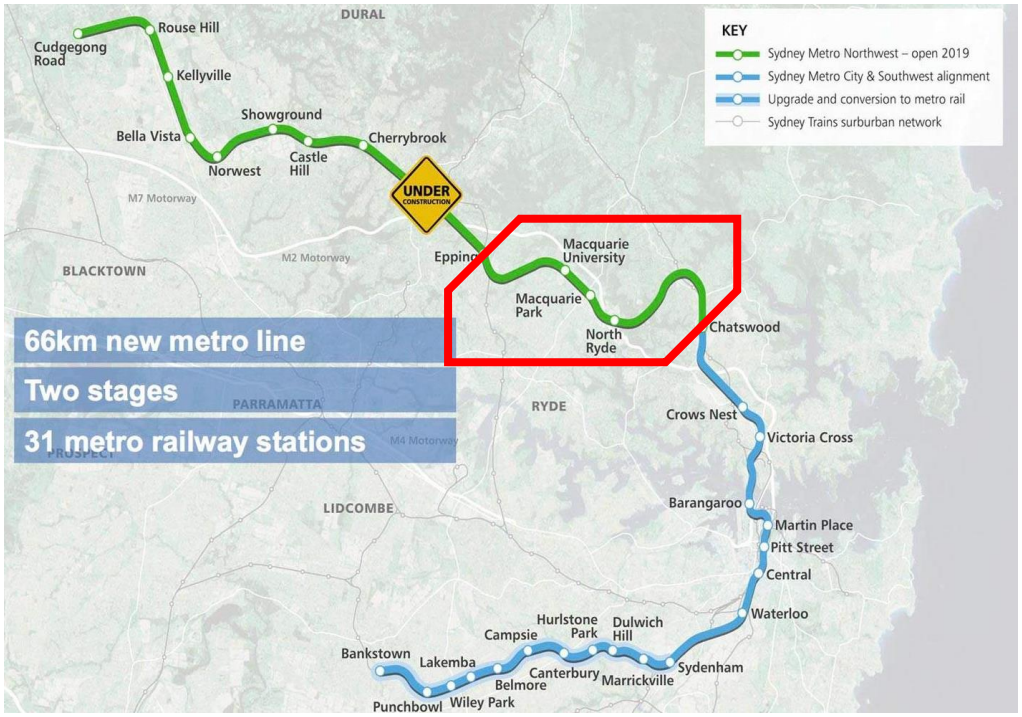

Figure 1.08 - The extent of the Sydney Metro Northwest and City & Southwest alignments. The existing Epping to Chatswood Rail Link is shown in red.

158. NSW Government, "Funding Secured: Sydney Metro to Be a Reality," news release, 4 June 2015, http://www.transport.nsw.gov.au/sites/default/files/b2b/releases/150604_Funding_secured_Sydney_metro_to_be_a_reality.pdf.

Central to the planning of the line and design of the stations was community involvement and stakeholder engagement, with regular consultations with future users and the general public.[159] Public input and adherence to existing planning principles established in prior studies formed the foundation for the design of the stations, including the initial planning for the line, which had been undertaken by the COX-Grimshaw team a decade earlier.[160] Hassell noted that the overall strategy for the stations was the creation of "places that make travel easier, safer and smarter—hallmarks of a world-class system," which "add colour and life to their communities, with fresh spaces like plazas, parks and paths set around the striking new stations, drawing people into their orbit."[161] The appointment of a single architect for the stations allowed for the development of a cohesive design language across the network, establishing "line-wide" elements to be deployed at each station.

The framework for public participation in the planning and design process, which located civic input at the core of the design ambitions, echoed a trend in the realisation of MTPs in Sydney.[162] With private sector involvement, and the government concerned with the political palatability of projects, advocating for the future users was a core tactic. Paraphrasing Robert Hughes, Chris Johnson notes in his introduction to *Shaping Sydney*, that "the civic realm is indeed made through political will."[163] By understanding public infrastructure as a natural extension of the public realm, the transport space became inextricably intertwined with political ambitions. Stations became not only infrastructural touchpoints, but public expressions of the values of the government and the larger society, providing amenity for the commuting masses of the city while also representing the city to visitors who use the infrastructure. Of course, this pattern was not confined to dictating the trajectory of the Sydney Metro, but is part of a larger global emphasis that is legible in recent public investment in grand architectural gestures in transport facilities, such as those in London, Bilbao, New York, Brussels, Singapore, and Copenhagen.[164]

159. NSW Government, *Submission Report Stage 2 – Stations, Rail Infrastructure and Systems*, TfNSW (March 2013), https://www.sydneymetro.info/sites/default/files/NWRL_EIS_II_SUBMISSIONS_CHAPTERS_1-6_1.pdf%3Fext%3D.pdf.
160. Hassell, *Urban Design and Corridor Landscape Plan*, NSW Government (2016), https://www.sydneymetro.info/sites/default/files/document-library/1.SM_NW_UDCLP-Introduction.pdf.
161. Hassell, "Metro North West," accessed 12 March 2020, https://hassellstudio.com/project/sydney-metro-north-west.
162. Countless reports for the Metro echo the strategy, stating "customers are at the centre of Sydney Metro."
163. Robert Hughes, *Barcelona* (London: Harper Collins, 1992); Johnson, *Shaping Sydney*, 13.
164. These include Norman Foster's London Canary Wharf station and Bilbao metro designs, Santiago Calatrava's World Trade Center PATH station, updated stations on the Brussels suburban rail network, including at Mechellen, numerous stations on the Singapore Metro, and the Danish minimalism seen in ARUP's new stations for the Copenhagen Metro.

This use of grand stations to signify public investment and the supremacy of a city is not, however, a new concept. The architectural expression of stations is not only the product of current design considerations. It also reflects the interest of the agency, government or private enterprise, in understanding the aims of the mega-project. If the goal is simply infrastructural—the movement of people between points—the result is the utilitarian stations of the London Underground, Chicago El, or New York Subway. This is very different in the case of entities that seek to illustrate commitment to civic ambition, such as—at the far extreme—the Stalinist designation of the Moscow Metro as a palace to the people. Of course, there are varying degrees of this, and the concept is illustrated across styles and time, reverberating from Otto Wagner in Vienna, to Bradfield in Sydney, to Harry Weese in Washington, DC, and up to the present day, with varying degrees of ostentatiousness.

Procurement: Economics First, Design Later

While physical works for the Northwest Metro were underway, planning for the continuation of the line was taking place. Beyond the first phase, plans called for the line to be extended into the city and then out toward the region's southwest as part of a single project to be completed in 2024. The city portion of the line would include two new stations in North Sydney (Crows Nest and Victoria Cross) and four CBD stations, including one at Barangaroo, an interchange with the ESR at Martin Place, a new station at Pitt Street to relieve congestion at nearby Town Hall train station, and new platforms at Central Station to allow Metro users to interchange to all suburban, regional, and national lines. The southwest portion would include one new station in the inner-city, the formerly industrial and now residential suburb of Waterloo, and involve the conversion of an existing suburban train line from Sydenham to Bankstown, necessitating the complete reconfiguration of stations along the line to accommodate the Metro trains.

Similar to the design of the Northwest stations, the City & Southwest procurement strategy initially hinged on the provision of services by a single consortium across the line. Once the route was decided, London-based Fosters + Partners in coordination with Sydney-based Architectus was selected to design the seven City stations, as part of a larger PPP group.[165] However, over the life of

165. Jessica Mairs, "Foster + Partners to Design Seven New Stations for Sydney Metro," *Dezeen*, 31 March 2017, https://www.dezeen.com/2017/03/31/norman-foster-partners-win-competition-design-seven-new-stations-sydney-metro-australia-news/.

the project, the procurement strategy changed dramatically due to a number of political and strategic factors, including the private development of integrated station developments (ISDs) to maximise commercial development, which was a central to the economic benefit of the PPP structure.[166] Construction of the CBD stations required costly compulsory resumption to provide both construction access and for future station entries. Upon completion of the stations, the land would be developable—an asset to the private sector with the added benefit of value uplift due to transport adjacency.[167] In order to capture the value uplift and offset high development costs, private development was identified as a mechanism for capturing the add.[168] The procurement strategies thus changed as the project developed, fostering private competition; the general idea behind the team bids was that the architectural representation of the proposal was important but, ultimately, the factor with the biggest weighting for the government decision makers was the promised economic benefit. This further politicised the development of the Sydney Metro, with the delivery of the stations being integrated with the development of property surrounding the stations to entice private developers to take on the public role of station construction. In one instance, which happens to be one of the stations examined in the embedded research, concerns over the impact of proposed high-rise development stemmed from a long-envisioned public open space on the station site, which was stymied by the plans for development. People were not opposed to the Metro but, rather, to the coupling of private development with public infrastructure. Despite the fact that all politics are local, procurement and the economic realities of uplift and return on investment for MTPs won out.[169]

166. NSW Government, *Project Summary City & Southwest OTS2 PPP*, Sydney Metro (3 March 2020), https://www.treasury.nsw.gov.au/sites/default/files/2020-03/Project%20Summary%20-%20OTS2%20PPP%20%28FINAL%20-%203%20March%202020%29.pdf.

167. Roderick B. Diaz, *Impacts of Rail Transit on Property Values* (McLean, VA: Booz·Allen & Hamilton Inc., 1999); Rohit Sharma and Peter Newman, "Does Urban Rail Increase Land Value in Emerging Cities? Value Uplift from Bangalore Metro," *Transportation research. Part A, Policy and practice* 117 (2018), https://doi.org/10.1016/j.tra.2018.08.020.

168. James McIntosh et al., "Framework for Land Value Capture from Investments in Transit in Car-Dependent Cities," *Journal of Transport and Land Use* 10, no. 1 (2017), https://doi.org/10.5198/jtlu.2015.531; A. Roukouni and F. Medda, "Evaluation of Value Capture Mechanisms as a Funding Source for Urban Transport: The Case of London's Crossrail," *Procedia – Social and Behavioral Sciences* 48 (2012), https://doi.org/10.1016/j.sbspro.2012.06.1210; Becky Loo et al., "Risking Multi-Billion Decisions on Underground Railways: Land Value Capture, Differential Rent and Financialization in London and Hong Kong," *Tunnelling and Underground Space Technology* 81 (2018), https://doi.org/10.1016/j.tust.2018.07.011.

169. Jacob Saulwick, "'This Is Not a Good Process': Sydney Metro's Dual Role Angers Locals," *The Sydney Morning Herald*, 12 July 2018, https://www.smh.com.au/national/nsw/space-metro-sunlight-north-sydney-committee-20180711-p4zqvv.html.

Indeed, the official strategies for the delivery of the project generally, and stations specifically, echoed the ambitions. Two "principal objectives" were established for Sydney Metro by the *Transport Administration Amendment (Sydney Metro) Act 2018*:

1) to deliver safe and reliable metro passenger services in an efficient, effective and financially responsible manner,
2) to facilitate and carry out the orderly development of land in the locality of metro stations, depots and stabling yards, and proposed metro stations, depots and stabling yards.

In addition to the principal objectives, other aims included "to maximise the net worth of the State's investment" and "to exhibit a sense of social responsibility by having regard to the interests of the community in which it operates."[170] Interestingly, the development of land came before the development of the Metro stations and supporting infrastructure within the parlance of the legislation. Therefore, the delivery of the design services for each station was re-tendered as part of the procurement of ISD outcomes, dispersing the architectural inputs, based on the initial proposal by the Fosters + Partners and Architectus team (see Figure 1.09), to multiple firms.[171]

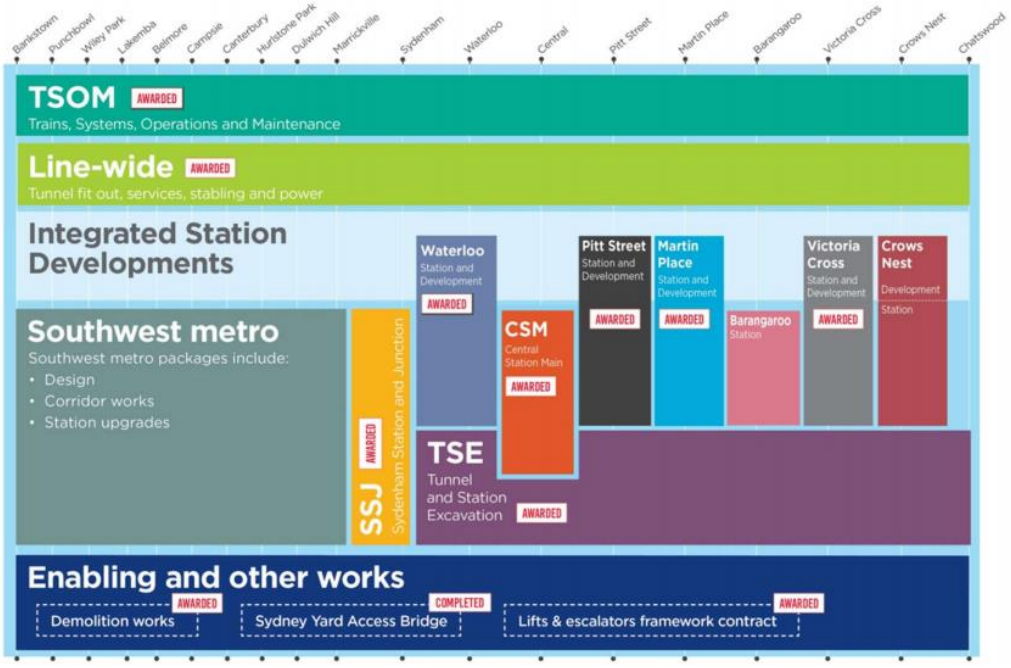

Figure 1.09 - Procurement strategies for the design and delivery of the City & Southwest Metro, including stations.

170. Parliament of NSW, *Transport Administration Amendment (Sydney Metro) Bill 2018*, 4, 23 May 2018.
171. NSW Government, *Project Summary City & Southwest OTS2 PPP*.

To mitigate the potential for private enterprise to run roughshod over the planning and design parameters established by the State, the Government—through the framework of the design excellence strategies—ensured their involvement through the planning undertaken by the private enterprise. The designs have been subject to comprehensive, constant, and iterative review, with the architectural outputs scrutinised by review panels. The processes mimic those established by the City of Sydney, which Freestone et al. posit are effective in elevating the standard of design. Whether this is empirically provable or not, the participation of local (and international) practitioners in this system carries on into the realisation of the Metro projects, requiring review by multiple parties, and the narrative of the customer (public) journey through the stations as a driving force behind the design.

MTPs Beget MTPs

Design minutia aside, the wider implications of the decisions about procurement and design strategy on the first line of the Metro—and their success—are influencing the strategies for future network realisation in line with the polycentric objectives of the region. By the time work is complete on the remainder of the first Metro line, work is slated to be underway on at least two other Metro lines in the city: Metro West, linking the Sydney and Parramatta CBDs via major residential centres, including the burgeoning Homebush area at Sydney Olympic Park; and Metro Greater West, linking the existing rail network with Western Sydney Airport, the major anchor of the planned new Bradfield aerotropolis (see Figure 1.10), which is currently under construction.[172] The integration of the Metro system with the *Three Cities* plan is driving continued reliance on MTPs to further the overall planning ambitions that are shaping the polycentric vision for Sydney's future.

Initial indications are that procurement strategies for future stations on the planned lines will mimic those undertaken as part of the City & Southwest line, indicating that these are perceived to have been successful in achieving the development and design outcomes.[173] The integral nature of the Metro project in realising the *Three Cities* plan—most notably the success of the Western

172. Sydney Metro, Sydney Metro Annual Report 2019-20, NSW Government (October 2020), https://www.sydneymetro.info/sites/default/files/document-library/Sydney_Metro_Annual_Report_2019-20.pdf.

173. Infrastructure Partnerships Australia, *Sydney Metro Briefing Wrap - Metro West Base Case Delivery Strategy Released*, (2018), http://infrastructure.org.au/wp-content/uploads/2018/12/THE-INFRASTRUCTURE-REPORT-%E2%80%93-Infrastructure-Partnerships-Australia-%E2%80%93-7-December.pdf.

Parkland City, which is being developed from greenfield pastoral lands—means that while the impact of the Metro decisions on the Sydney CBD are contextualised within more than two centuries of planning, the decisions that shape the new stations as part of the Western Parklands City will have a much stronger influence on the success of that urban node as it develops in subsequent generations. Once a decision is implemented in the context of a mega-project, it is by its very nature difficult to change. The coupling of this with the anchor role of the new airport—itself an MTP, designed by COX and London-based Zaha Hadid Architects—in the new Western Parkland City consolidates the role of MTPs in shaping inhabitation patterns in the Sydney region in perpetuity.

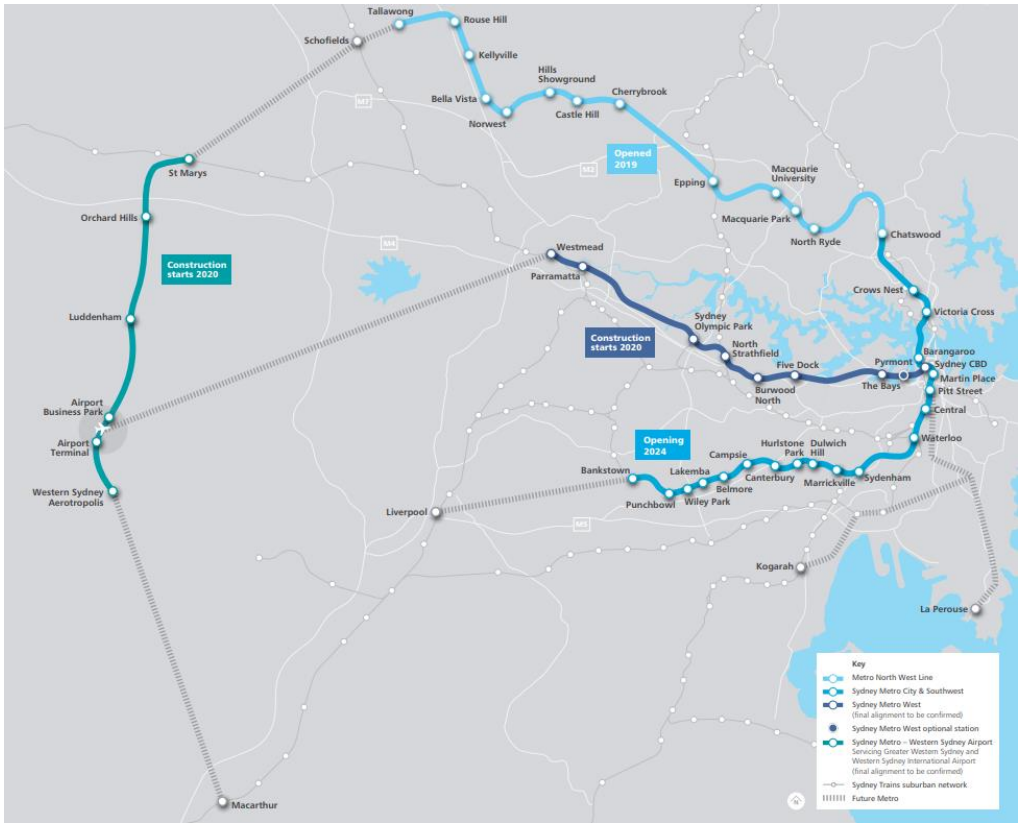

Figure 1.10 - The Sydney Metro lines realised, underway, and planned, as of 2020.

Despite the impact of the Covid-19 pandemic on transport ridership, the government has indicated that the plans for the new Metro lines will push ahead, anticipating a revival of demand in the coming years as life returns to normal. Therefore, this research seeks not only to document the phenomenon of the role of the architect, but also to offer insights that can inform the ongoing practices of architects and associated design professions in both Sydney and elsewhere as MTPs are realised in cities around the world.

Concluding Remarks: A Place for Architecture

The design and development of the Sydney Metro represents a major investment by the State Government not only in public transport, but also in public space and placemaking within the urban realm. The new system underscores the State's interest in facilitating movement to and through the region's densest nodes, supporting wider planning ambitions for a growing Sydney. Ambitions for the stations as public space are embedded within the procurement mechanisms for design and delivery of the stations, building on an evolving legacy of balancing economic and commercial concerns with growing interest in liveability of the city and a recently codified yet unquantifiable expectation of "design excellence". The complexity of designing mega-projects is not necessarily limited to technological constraints or the sheer size of the projects, but is tied up with elements of "civil society"—indicating the interconnectedness of intangible "public good" and social outcomes with the infrastructural solutions.[174]

The engagement of architects in the design of the stations of the Sydney Metro may seem obvious; the stations are buildings that require design inputs to be realised, and architects provide knowledge and expertise to advance the design. The Sydney Metro has provided work for a number of Sydney's largest architecture firms, engaging hundreds of architects in the design of stations. With two more lines planned, architectural involvement in the design of transport facilities in Sydney will only become more prevalent. This situation reflects a wider global trend as more cities emphasise the expansion of public transport offerings and contextualise them within ambitions of city-shaping potential. This thesis sheds light on an under-researched question: through the years of designing a single station, with its associated tasks of considering its qualitative ambitions, coordinating a vast array of inputs, and cogently presenting substantive information of the design, what is it that architects are doing?

174. Daniel W. Durrant, "The Role of Civil Society in Mega-Transport Project Decision-Making: the Case of the Proposed High Speed Rail Connection, High Speed Two (HS2)" (PhD diss., University College London, 2016), https://discovery.ucl.ac.uk/id/eprint/1493012/1/Durrant_Dan%20Durrant%20Thesis%20Final%20submission%20document%20docx.pdf.

Chapter 2
Research Through Participation

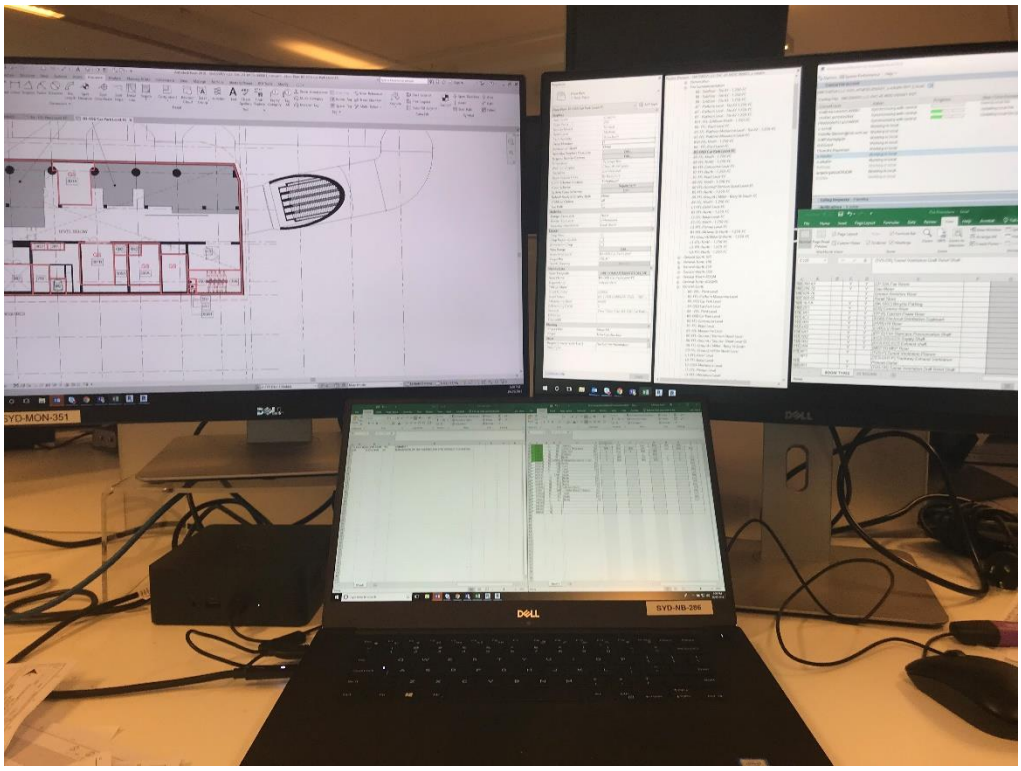

Figure 2.01 – The view of my architectural engagement changed daily, but, was always through screens.

A Regular Day in the Studio

The lift doors open into the midst of controlled chaos; I survey the scene as people rush around the studio. Ahead of me people congregate in the long kitchen against the opposite wall; to my left there's a group gathering outside Meeting Room A, clutching coffees and wearing forlorn looks as if they know they're in for a marathon meeting, I nod hello to Architect J in the thick of the throng; I turn to the right to find my desk for the day. It's 9:30am on a Monday—I am a bit of a late riser—maybe I should have left earlier; then again, there's no doubt I'll work far more than my contracted hours regardless of what time I arrive. Such is architecture. This week I am lucky enough to be sitting near a window (as a part-timer, I hot desk), near the rest of the project team—all the better to keep my eye on what's going on as I work on the Design Report, though also close enough to potentially be asked by Architect K for help with the room data sheets, or by Architect X for help in InDesign.

With just a few meetings in the diary and the next major deadline a few weeks away, I'm hoping for a quieter day in the studio. Being in the studio is definitely preferable to the office at the University—after all, there's tea in the studio kitchen. That's probably one reason why I find myself here most days, despite my part-time contract. Not that I usually mind: being in the studio, when deadlines permit, I am able to attend meetings which only tangentially impact my workflow; I also find time for casual conversations about the project with co-workers over afternoon tea in the central space. More often than not though, being around means working—if my desk is in a conspicuous place for the week, I find that I end up helping on tasks that need attention ASAP; if my desk is in a distant corner and no one from my team sees me I sometimes end up supporting other teams on deadlines. It's nice to know I can be of support outside the transport cluster on occasion. Every day offers variety.

The morning gets underway with a project "team leads" meeting. Architects C, D, J, M, P, and U gather around the small white table. We check in on what everyone is working on before the topic turns to an upcoming meeting with the contractor. I make notes in

my little notebook about what I need to get done this week to support the meeting. I jot "ENSURE WHAT WE ARE DOING HAS VALUE" in my uppercase architectural handwriting. The conversation moves to submission deadlines for drawings and virtual prototypes—I go back and double underline "HAS VALUE". I think to myself about what this "value" means to everyone at the table; something to consider later as I am brought back into the conversation. The topic turns to visualisations I've been waiting to move forward on: 'THE DESIGN IS "DONE"', I write. I go back and add the note "FINALISED"; I'm sceptical, as I had been told for weeks it would be done so I could press forward with documenting the specifics for the Report.[1] The "finalised" design is bound to change. Ultimately, it does. The note in my notebook becomes merely a testimony to the fluidity of design development in the architectural process.

As the topic again shifts away from the documents I am responsible for, I add some notes about the mood of the meeting and a few musings that I find interesting—while unrelated to my production work, they may come in handy for my research, to prod a future discussion in an interview; time will tell. Finally, we talk about next steps over the coming days and resourcing—the staff we will need—to meet the week's deadlines. We part ways and I head to my desk to check emails, send a few to consultants to chase up information, and open the files I will need for the morning. Then it's time for a quick tea before tucking into production, writing and editing, of the Design Report. I mine the server for drawings, I send more emails, I speak with the graphics department about standard formatting, I nag Architect M for more information about cladding details on the North Building—it seems they change by the hour. Later in the morning I send a message to Architect B about diagrams he's making: he says they'll be ready to check in the afternoon, or by this point, later this afternoon. It seems I have forgotten to eat lunch.

After lunch, scarfed down at my desk as I re-read a section of the Report, there's another meeting. This one is less formal, around the kitchen bench, some drawings

1. Meeting notes, 23 September 2019.

rolled out to review over an afternoon tea and biscuits someone has brought back from holidays. There's someone from the wayfinding team that I haven't met before. I jot down in my notebook to add her to the interview list and draw a little box around it so I remember to do it later. I don't. Beneath it I paraphrase an offhand comment: "IT GETS TO THE POINT WHERE YOU SPEND SO MUCH TIME DOING MANAGEMENT/DOCUMENTING DISCUSSIONS AND PROCESS, THAT WE DON'T HAVE TIME TO DESIGN AND DOCUMENT". Clearly the demands of the client are making Architect M a bit exasperated this week—and it's only Monday afternoon! "IF YOU THINK THIS IS A MESS, IT'S ACTUALLY PRETTY GOOD", Architect P chimes in, "OTHER CONTRACTORS ARE WORSE", and we all chuckle.[2] The fodder isn't important to my work; I would not have noted it if I didn't think it might be worth recalling down the road when I write the PhD. My notebooks are full of asides, crammed into the margins, between notes and sketches relevant to the production work being discussed. The notebooks give a sense of my job's duality. Production and observation, coexisting.

The sun sets around 6:00pm and slowly people start to drift away to the lifts. The cleaners come through the studio soon after, grabbing cups and plates to pack the dishwasher. The vacuums flip on—I hear them over my noise cancelling headphones. I do a bit more work and shut down for the evening. Tuesday morning, I have a meeting at the University with my advisor. But by afternoon I will be back in the studio—in time for afternoon tea and a chin wag, as Architect Y would say.

While largely based on the events of one day, the scene highlights the general working conditions under which the PhD research was undertaken over the course of three years. As an architect engaged in the process of architecture, I worked most days on the production of architectural deliverables—literally the mechanisms of representation produced by the firm to demonstrate the design through image, word, data set, model, digital file, or presentation.

Before I proceed, I will address three common terms that are used to describe the actions I performed in my daily role within the firm and which appear throughout the subsequent chapters. First, the word "architecture" within this dissertation refers to the processes and actions—drawing

2. Meeting notes, 23 September 2019.

among them, as Evans argued—in which architects engage through their work.[3] This stands in contrast to other forms of research and analysis in the field, which frame architecture as either the creative pursuits of the industry, or the physical manifestations of the process of developing a building as an output of the translation of architect's drawings into physical entities to be critiqued and considered.[4] Second, the word "design" has also been appropriated and largely lost its meaning in recent years; this thesis uses it in a general sense to represent the process undertaken by architects in the execution of a project—"a fundamental means of inquiry by which man [sic] realizes and gives shape to ideas"—and the derivatives of the process.[5] Finally, I use the term "deliverables" to demonstrate the wide variety and scope of items produced by architects as they execute their work in fulfilment of the requirements of the contract, thus *delivering* the knowledge contributions of the profession to the client.[6] This reflects its usage in the studio context.

Through my three years at the firm, I worked on a number of projects. More than a year of my time was spent on a single Metro station project, assisting through multiple phases (divided into two stints as we awaited confirmation of the successful tendering). Through both phases, much of my work focused on the production of the various Design Reports, which outlined the contributions across the architectural team, highlighted the coordination undertaken, and explained in text and images the overarching principles and, where necessary, specific unique elements of the design as developed. Outside of that, I picked up work where necessary, producing sets of drawings including the fire compartmentation plans and delineation plans for government filings, and supported

3. Evans proposed that architects do not make buildings but, rather, represent them through drawing so that they may be realised—a process; the idea still resonates. Robin Evans, "Translations from Drawings to Buildings," in *Translations from Drawings to Buildings and Other Essays*, ed. Richard Difford and Robin Middleton (London: Architectural Association, 1997); Naomi Stead, "Words and Pictures: Communication in Architectural Practice," in *Semi-Detached: Writing, Representation and Criticism in Architecture*, ed. Naomi Stead (Melbourne: Uro Media, 2012). The concept of architecture as a process, untethered from a physical entity is demonstrable, though contentious. Bruno Latour and Albena Yaneva, "Give Me a Gun and I Will Make All Buildings Move: An ANT's View of Architecture," in *Explorations in Architecture: Teaching, Design, Research*, ed. R. Gesier (Basel: Birkhäuser, 2008).

4. Architecture framed as a creative endeavour limits the study of the profession to just one aspect of a wide network, which includes a number of non-creative pursuits in the execution of architectural services. Dana Cuff, *Architecture: The Story of Practice* (Cambridge, MA: MIT Press, 1991), 57-108. Architects are, of course, just one participant in the realisation of the built environment. Jeremy Till, *Architecture Depends* (Cambridge, MA: MIT Press, 2009).

5. Gui Bonsiepe, "The Uneasy Relationship between Design and Design Research," in *Design Research Now: Essays and Selected Projects*, ed. Ralf Michel (Basel: Birkhäuser, 2007); Peter Rowe, *Design Thinking* (Cambridge, MA: MIT Press, 1987), 1.

6. The term "deliverables" is used within the practice to represent all contractually required outputs of the architecture firm, ranging from drawings to reports to data sets to digital files. It is an overarching characterisation of the broad range of items produced by architects to demonstrate through documentation the architectural process and the knowledge generated through it.

numerous endeavours relating to project organisation, including the facilitation of numbering and coding of over 500 rooms to allow for coordination and identification across the drawing sets.

Aside from the single Metro project, I was involved in numerous other projects—sometimes for a few days, sometimes for months. Most were transport related: another Metro station on the same line (six months), master planning for an existing train station being partially converted for Metro use (three months), a dozen ferry wharves (a few weeks), master planning (a few weeks) and specific architectural design (two months) for light rail lines, and a new airport (eight months). Sometimes I was involved in the early conceptual stages, while at other times I came in at the end to close out. The role of generating reports extended to the other projects as well; the architect getting a PhD is a prime candidate for writing up reports. The production of reports gave me a position from which I could observe the actions of many of the participants in the architectural process and liaise directly with them as I developed material to overview their work—an ideal position from which to conduct qualitative observation. Through it all, the studio proved a fruitful place for research—not necessarily limited to the work I did, but through reflection on the work I observed and undertook.

Chapter Outline

In the previous chapter I established the broad political, technological, cultural, and aesthetic context in which this research was undertaken. This chapter explores the methodological framework and theoretical guides employed in the research itself.

The first section introduces the studio environment as the context of my daily research activity. It also outlines the structure of the chapter and provides a brief introduction to architectural engagement in mega transport projects (MTPs) to frame the work undertaken in this research and its potential for application.

The second section explains the methodology of embedded research. It begins by briefly examining the idea of architectural research as a field. An argument is made for establishing the methods employed in embedded research, delimiting the bounds of participant observation, followed by an explanation of the application of the auto-ethnographic method in this research, leading to the three themes which form the core of the research exploration of the PhD.

The next section discusses the three key themes that emerged through the embedded research which are examined further through the application of theories best suited for analysis. The three sub-sections each ground the themes in practice, providing the reader a brief snapshot of the context that is used to frame Chapters 3-5 of the dissertation. The first focuses on architecture's role in the conceptualisation of place in the public domain and leverages the medium of drawing and discourse concerning representation in architecture. The second addresses architecture's role in mediating the various design inputs, both from within the profession and in a broader, cross-disciplinary way, drawing on actor-network theory (ANT) to frame the role. Finally, the last addresses the role of data management through the framing of architectural identity and the profession's distinctive knowledge.

Finally, a brief overview of the format of the dissertation in the context of the research methods and theories is provided.

Architectural Involvement and Research Engagement in MTPs

This research is founded on the presupposition that the nature of architectural work within the context of large-scale projects is both unique and worthy of study. This is supported by the emphasis of corporate firms on large-scale projects, typified by MTPs, as representing a definable subset of practice, with a unique package of architectural services and activities, and the "widespread acceptance that architecture is a key player in [Australia's] infrastructure investment."[7] Given the increasing prevalence of infrastructural projects, coupled with increased engagement by architects, it is timely to explore questions about the nature of the architectural role in the project type, including the potential for streamlining or improving the architectural process.[8] Despite the prevalence of these projects, the architectural role in realising these projects has been minimally investigated, even as the importance of architectural engagement is reinforced by the ongoing involvement of architects.[9]

7. Kim Crestani, "Australia's Urban Infrastructure – a Role for Architect Design Professionals," *Architecture Australia* 108, no. 5 (September-October 2019).
8. Even with the recent recession it is anticipated that government transport spending will be maintained—likely leveraged to generate jobs and bolster infrastructure. Geoff Hamner, "If Architecture Is the Canary in the Coal-Mine, the Outlook for Construction Is Appalling," *The Conversation*, 3 June 2020, https://theconversation.com/if-architecture-is-the-canary-in-the-coalmine-the-outlook-for-construction-is-appalling-141367.
9. Presently the three largest cities in Australia are constructing or expanding heavy rail lines, while in the last decade no fewer than six light rail systems have been developed or expanded in Australia—three in the Greater Sydney region (City & Southeast, Newcastle, and Parramatta). Architects are directly involved in the realisation of each project.

To this end, the research is grounded not in the built form, which is produced only at the end of architectural involvement in the design process and is reliant on the input of countless other industries and external forces, but examines the years of work undertaken specifically by architects in the realisation of projects. Accordingly, the research does not analyse the built result of the architectural outputs, nor the merits of the designs developed by the architects; this is not a critique of the processes or outputs of one firm or one project. Rather, the research frames the role of the architect as represented by the architectural process itself, the actions of which constitute the daily working life of architects and represent the professional contributions of the discipline. As the research was conducted while I was embedded at a large architecture firm and actively engaged in the architectural process of MTPs, I was afforded the opportunity to examine the architectural process from the inside. The research draws its conclusions from the practical application of theoretical ideas, leveraged to explore concepts identified through the project engagement. In short, this research examines the practice of architecture through the examination of the daily work of architects.

Research of Architecture, In Architecture, But Not Through Architecture

The primary objectives of this research were to explore the role of the profession and professionals engaged in the daily process of architecture and to present the results of my observations and analysis to contribute to an understanding *of* architecture. The methodology employed in this research was established through the structure that precipitated the endeavour—as an industry-supported doctorate, the research was always intended to have an embedded nature, that is, research conducted *in* architecture practice.[10] However, while this research addressed questions of architecture's role and was informed by work undertaken as an architect embedded in

10. This characterisation of research *of, in,* and *through* architecture is not to be confused with Christopher Frayling's tripartite division of design research *into, for,* and *through*. Frayling's characterisations relate more to the direct outcomes than to the methods employed in the research itself. When Frayling writes *for*, it denotes research undertaken in pursuit of artistic production; *into* is applied post-creation, exploring the output of the artistic process to provide critique, often with the lens of "traditional" research outcomes in mind; *through* is what is now understood as research by design. The characterisation put forward in this dissertation is less concerned with the outcomes of the research and more interested in differentiating the methods. Therefore, to avoid confusion, I have replaced Frayling's "into" with "of" and Frayling's "for" with "in". "For" may result from the types of research undertaken both "into" and "through," but is incongruous with the application. Christopher Frayling, "Research in Art and Design," (research paper, Royal College of Art, London, 1993); Jeremy Till, "Is Doing Architecture Doing Research?" (4th International Meeting on Architectural and Urbanism Research, Valencia University, 2012). Jeremy Till, "What Is Architectural Research?," (position paper written on behalf of the Royal Institute of British Architects (RIBA) Research Committee).

the production process, the research did not employ distinctly architectural methods that have defined research *through* architecture.[11] This methodology, of late characterised as "research by design" or "design research", has been fruitfully employed in many studies in the last decade to explore aspects of practice, largely focusing on specialised facets of practice, or the discrete development of architectural knowledge as it relates to practical applications.[12] The wide scope of this embedded research and its implications for practice and academia are evident in the work of RMIT University Practice Research.[13] However, it is precisely the fragmentation and specialisation of roles in architectural practice, noted by Marc Schnoonderbeek, that drives the need for different modes of analysis and understanding in research of broader architectural contexts such as this.[14] This aligns with Jeremy Till's argument that architectural research that only employs the tools of the architectural process, has marginalised research of architecture within the wider context of academic or "traditional" research.[15] Till and others argue that the growing chasm between "traditional" research and research developed purely "through" practice underscores the need for a hybrid model of research to address the "grey zone".[16] In this sense, the present study is research *of* architecture (clearly) and *in* architecture (through my active engagement as worker-researcher), but not *through* architecture (as it is not leveraging architectural methods to develop the research).

11. Yasser Megahed, "On Research by Design," *Architecture Research Quarterly (Arq)* 21, no. 4 (2017), https://doi.org/10.1017/S1359135518000179; Marc Schoonderbeek, "A Theory of 'Design by Research'; Mapping Experimentation in Architecture and Architectural Design," *Ardeth* 1, no. 1 (Fall 2017), https://doi.org/10.17454/ARDETH01.05.
12. Till, "Is Doing Architecture Doing Research?"; Murray Fraser, ed., *Design Research in Architecture: An Overview* (Farnham, UK: Ashgate, 2013); Frederik Nilsson and Halina Dunin-Woyseth, "Research by Design: Progress in Establishing Fieldspecific Research in Architecture and Design - an Update on Four National Scenes," *Reflections +15* (2011), http://publications.lib.chalmers.se/records/fulltext/139731/local_139731; Shannon Kennedy-Clark, "Reflection: Research by Design: Design-Based Research and the Higher Degree Research Student," *Journal of learning design* 8, no. 3 (2015), https://doi.org/10.5204/jld.v8i3.257.
13. Laurene Vaughan, *Practice Based Design Research* (New York: Bloomsbury Academic, 2017); RMIT University Practice Research, "Publications," accessed 19 February 2021, https://practice-research.com/publications. The work undertaken by Leon van Schaick at RMIT to facilitate practice-based research has fostered numerous industry-embedded outcomes, highlighted in his publication on spatial intelligence. Leon van Schaik, *Spatial Intelligence: New Futures for Architecture* (London: John Wiley & Sons, 2008). Of particular note, four PhDs undertaken (by Sarah Benton, Rory Hyde, Paul Nicholas, and Marcus White) between 2005 and 2008 and overseen by Mark Burry through an Australian Research Council Linkage grant highlighted the potential for relevant academic outcomes through practice-based research, though in relation to parametric design, exploring the digital realm of the architect and practice.
14. Schoonderbeek, "A Theory of 'Design by Research'."
15. Till, "Is Doing Architecture Doing Research?"; Jeremy Till, "Architectural Research: Three Myths and One Model," (2007), https://jeremytill.s3.amazonaws.com/uploads/post/attachment/34/2007_Three_Myths_and_One_Model.pdf.
16. Ken Friedman, "Theory Construction in Design Research: Criteria: Approaches, and Methods," *Design studies* 24, no. 6 (2003), https://doi.org/10.1016/S0142-694X(03)00039-5; Shane Murray, "Design Research: Translating Theory into Practice," in *Design Research in Architecture: An Overview*, ed. Murray Fraser (Farnham, UK: Ashgate, 2013); Esa Laaksonen, "The Grey Zone of Architecture," in *Research and Practice in Architecture*, ed. Esa Laaksonen, Tom Simmons, and Anni Vartola (Helsinki: Alvar Aalto Academy, 2001).

Various modes of enquiry and exploration were necessary to generate a comprehensive analysis of the role of the architect in architectural production in the present study, which was framed through the experience of the reflective practitioner and involved, both looking inside Reyner Banham's "black box" of architectural production and extending beyond design to a more holistic view of practice and architectural process.[17] The research leveraged the practice-based experience to identify key themes on which to focus, and then applied more "traditional" research methods to analyse the emergent themes. To this end, the primary method of participant-observation was supplemented with the collection of additional types of data only after key themes were developed based on engagement with the projects as an architect. The embedded nature of the research permitted the development of intimate familiarity with the processes of architectural production that would not have necessarily been readily perceptible to an outside observer. These emergent themes grew into the three chapters, each of which explores a facet identified from the primary method of embedded researcher-practitioner. This hybridised research approach, grounded in engagement within practice but filtered through appropriately rigorous methods from outside of practice, responded to Till's assertions that architecture must be subjected to research methods from outside of practice, as well as methods developed to address architecture's unique form and means of representation of specialised knowledge.[18]

The evolution of research *of* architectural practice and the proliferation of methods and theoretical frameworks for the conduct of such research are testament to the desire for a variety of outcome types, each of which is typically delivered through a particular method in isolation from others.[19] Because of this, it is important to state—in no uncertain terms—that this research, while conducted as a practitioner actively engaged in the architectural process and about architecture production, is research *of* and *in* practice, but not *through* practice—not "research by design". Instead, this research adopts a strategy best illustrated by Dana Cuff—that of an architectural

17. Rowe, *Design Thinking*; Cuff, *Architecture*; Till, *Architecture Depends*; Reyner Banham, "A Black Box: The Secret Profession of Architecture," in *A Critic Writes: Essays by Reyner Banham*, ed. Mary Banham (Berkeley: University of California Press, 1996).
18. Till, "Is Doing Architecture Doing Research?".
19. That is, research about representation often focuses on drawing, research on identity of architects leverages specific theories of identity in the professions; there is rarely crossover between modes of inquiry.

practitioner conducting research *of* architectural practice leveraging examples of experiences *in* architectural practice.[20]

While nearly three decades have passed since Cuff wrote of architectural practice, the work still stands as a robust account of the activities required of architects in practice based on observation of practice, informed by her own experiences as an architect and supplemented by interviews. It is not only an ethnography of practice at the dawn of a digital age, but a thoughtful analysis of what the profession can do to address the complexity and constraints that come with evolving roles of practice. The work explored a range of project and practice scales within the overall arc of professional life—from early education through the activities of office life—and how the ultimate results of the construction process (i.e. buildings) may be judged by the contributions of the architects. Hence, the account portrayed a profession grappling with a range of issues, but always within the context of projects that could be characterised as architecturally led, that is, where the architect was sought as expert, even when it was unclear exactly what that expertise was. This research leverages Cuff's work in form and mode of exploration, and supports some of its conclusions. However, it looks through the lens of a project type in which complexity and contingency more thoroughly define architecture's roles.[21]

Architectural Research

The distinctions among research of, in, and through architecture are important for understanding the methods employed in the generation of architectural research.[22] The idea of research *through* architecture—leveraging architectural methods such as drawing—has evolved within the practice of architecture. Of course, it is not uncommon for architects to engage in academic research and writing, with many of the most celebrated architects known not only for their built works, but for their contributions to pedagogy, often in the form of slick tomes.[23] These have

20. Cuff, *Architecture*.
21. Cuff, *Architecture*.
22. James C. Snyder, ed., *Architectural Research* (New York: Van Nostrand Reinhold Company, 1984); Esa Laaksonen, Tom Simmons, and Anni Vartola, eds., *Research and Practice in Architecture* (Helsinki: Alvar Aalto Academy, 2001); Murray, "Design Research: Translating Theory into Practice"; Ray Lucas, *Research Methods for Architecture* (London: Laurence King, 2016).
23. These include books such as Rem Koolhaas, *Delirious New York* (Oxford University Press: Oxford, 1978), Rem Koolhaas and Bruce Mau, *SMLXL* (The Monacelli Press: New York, 1997), and Bjarke Ingels' *Hot to Cold* (TASCHEN: Cologne, 2015).

their roots in the architectural treatises which, for more than two millennia, were the popular means by which practitioners engaged in design research to further aesthetic and technical knowledge within the profession.[24] A common theme in this form was a lack of self-reflection in the writing (research *of* practice), as well as a lack of applicability to specific project involvement (research *in* practice); instead, architects from Otto Wagner to Le Corbusier made statements about the profession based on general "truths" gleaned *through* practice.[25] These types of publications fall outside the realm of "traditional" research. Architectural theory, however, has evolved from the architectural treatise. Schoonderbeek attributes change in the role of research and writing to the growth of the field of architecture.[26] Illustrative of the expanding role of research *in* practice, many firms have research arms that explore materials, construction or production methods, technology, and design. Such "research through design" is largely undertaken for the purposes of firm differentiation and, ultimately, monetisation.[27]

Along with the evolution of research *through* practice into means, modes, and methods, another trend has also shaped the arc of architectural research *of* practice, namely, analysis of architectural practice by external researchers leveraging more "traditional" research methods. This trend emerged in the 1960s and 1970s, with research conducted by those outside of the profession seeking to understand the mechanics of the architectural (design) process.[28] The approach to exploring architecture in this way posited that the architectural process was rational and potentially formulaic, which aligned well with the functionalist tenets of the modern movement. Even within

24. Vitruvius's *De Architectura*, written some time between 30 and 15 BCE, established the treatise as the primary form of architectural research in practice, codifying a myriad of architectural elements that he deemed most suitable. Hanno-Walter Kruft et al., *A History of Architectural Theory: From Vitruvius to the Present* (New York: Princeton Architectural Press, 1994); Schoonderbeek, "A Theory of 'Design by Research'."

25. Otto Wagner, *Modern Architecture: A Guidebook for His Students to This Field of Art*, trans. Henry Francis Mallgrave (Santa Monica, CA: Getty Center for the History of Art and the Humanities, 1988); Le Corbusier, *Towards a New Architecture* (New York: Dover Publication, 1986).

26. Schoonderbeek, "A Theory of 'Design by Research'."

27. A theme in much of the research generated in this vein is its ability to further the interests of a firm or specific project, or to bring acknowledgement to a firm. By executing research in-house, therefore generating intellectual property within the confines of the firm structure, a firm can differentiate itself through product or method. Ralf Michel, "Introduction," in *Design Research Now: Essays and Selected Projects*, ed. Ralf Michel (Basel: Birkhäuser, 2007), 16; Till, "Is Doing Architecture Doing Research?". While firms increasingly leverage research in practice, the phenomenon is not new. Jonathan King, "Research in Practice: Generation, Use, and Communication," in *Architectural Research*, ed. James C. Snyder (New York: Van Nostrand Reinhold, 1984).

28. In 1971, a conference, notably opened by critic Reyner Banham, was held to understand the idea of "design participation" and the role of the design professional in the larger context of project realisation. Nigel Cross, ed., *Design Participation: Proceedings of the Design Research Society's Conference* (London: Academy Editions, 1972).

the profession, a rationalist approach to the actions of architecture (though not specifically architects) received attention at this time with Turin exploring a profession undergoing change in response to pressures that were compiled by the changing nature of buildings, functions of the profession, and contractual relationships.[29]

These works were based on the presupposition that design (as a facet of the architectural process) is an activity in its own right—a distinct skill or means of understanding that stood apart from other professional engagements.[30] The conceptualisation of design as an endeavour that leveraged unique skills and knowledge generated further reflection and interrogation of the activities surrounding architecture.[31] These ideas led to the conceptualisation of the design process as one of "synthesis"—a continual, iterative evaluation of various options that was "solution-focused."[32] Nigel Cross's research leveraged the ideas of professional design practice, citing observational studies undertaken by non-architects of the way architects, planners, and urban designers worked.[33] This decidedly scientific approach to the research of design and architecture, that is, as something that could be observed in order to gain understanding of specific patterns indicative of the profession, created the potential to explore architecture from a social science perspective as well as an architectural one.[34]

29. Turin's methodical analysis and diagramming of the flow of information within the design process was itself technical, framing the actions of design around relationships, though not in a social sense. The emphasis on process offered a compelling formula for analysing architectural outputs as something produced in an almost mechanical sense. While important and illuminating, the outcomes are identified by Turin himself as "oversimplified" and "rather crude", highlighting the integrated social role that accompanied the technical actions. D.A. Turin, "Building as a Process," *Building Research & Information* 31, no. 2 (2003), https://doi.org/10.1080/09613210302002.
30. This would mature into the ideas of "design thinking", with the foundations established in the inception of *Design Studies*. Bruce Archer, "The Three Rs," *Design Studies* 1, no. 1 (July 1979); Nigel Cross, "Designerly Ways of Knowing," *Design studies* 3, no. 4 (October 1982).
31. Two major workshops on the concept were held in 1991 and 1994. Nigel Cross, Henri Christiaans, and Kees Dorst, eds., *Analysing Design Activity* (Chicester, UK: John Wiley & Sons, 1996).
32. Nigel Cross, *Designerly Ways of Knowing* (London: Springer, 2006), 29.
33. Bryan R. Lawson, "Cognitive Strategies in Architectural Design," *Ergonomics* 22, no. 1 (1979), https://doi.org/10.1080/00140137908924589; Bryan R. Lawson, *How Designers Think* (London: Architectural Press, 1980). P.H. Levin, "Decision Making in Urban Design," in *Building Research Station Note EN51/66* (Garston, UK: Building Research Station, 1966), quoted in Cross, "Designerly Ways of Knowing."; Christopher Alexander, *Notes on the Synthesis of Form* (Cambridge, MA: Harvard University Press, 1964).
34. This also laid the groundwork for the self-reflexive works undertaken by architectural practitioners (noted in the previous section), which led to the emergence of the hybridised "pracademic" role through which the concerns of architectural practice were examined through more "traditional" research methods borrowed from outside of practice.

Adopting Anthropological Methods: Participant Observation in Architecture

Donald Schön's employment of social science-based analysis of "design practices" and other professional practices in 1983 represents the first instance of this form of critical analysis.[35] Through the use of practical examples (that is, examples observed from architectural practice), Schön argued for a self-reflective approach to understanding the social production of knowledge. In establishing the idea of the "reflective practitioner", the work created a platform from which practitioners could reflect on observations of practice to generate research *of* practice, from experience *in* practice.[36] This positioning of architectural practice and the production of architectural knowledge legitimised analysis of architecture through a social science-based frame.

It was from this perspective that hybrid practitioner-academics—*pracademics*—began to cast a critical eye on architectural practice to analyse the sociological factors that shape the architectural process. In the case of Peter Rowe, the analysis focused on "thinking" in the context of the architect's actions; for Dana Cuff, it was the trajectory of the development of the architectural practitioner's career through school and experience; and for Jeremy Till it was cross-disciplinary exchange.[37] To produce these accounts, they leveraged their professional experiences, supplemented by observations, interviews with other practitioners, and analysis of projects by other architects whom they felt embodied the ideas. While they were all practitioners, their research conspicuously eschewed examples of projects in which they were personally engaged, positioning themselves not as architects constructing accounts of practice but, rather, as informed observers generating ethnographies of architectural practice, or some aspect thereof, at arm's length. While their works benefitted from knowledge of the architectural process, such as familiarity with jargon and unique architectural processes, they did not draw specifically from the rich trove of experience in the sense of active engagement.[38]

35. Donald Schön, *The Reflective Practitioner* (London: Temple-Smith, 1983).
36. Coxe and Hayden would go on to leverage this means of exploring practice from the inside through interviews and in-depth analysis of firms to build a management consultancy group that catered exclusively to the design profession. Weld Coxe and Mary Hayden, "Architects and Power: Toward a New Architectural Practice." *Progressive Architecture* 74, no. 3 (March 1993).
37. Rowe, *Design Thinking*; Cuff, *Architecture*; Till, *Architecture Depends*.
38. Of course, their architectural experiences cannot be decoupled from their writing and research, and specific experiences of architectural practice likely informed the themes of their writing. However, with no tangible link to the

As a result, the value of having an architect conducting sociologically and anthropologically based research about architecture was limited, since their observations were removed from the actual daily activities of production—architecture in action. Their anthropological fieldwork was a journey into the field as a researcher (not a practitioner) to observe processes, armed with the benefit of inside knowledge of how activities are conducted in practice. The works can be understood as a form of informed anthropological research, undertaken by a researcher versed in the ways of those they are observing, but still removed from the active process of production— an observer—an observer of participants in the practice of architecture, rather than an active participant in the activities under observation. Where this research differed from traditional participant observation—and added value—was the nature of the researcher's participation in the activities of the architecture firm. In an anthropological study of cultures or organisations, the researcher's participation in activities is typically not "authentic" in the way it is for the actors under investigation but, rather, mimics their performance, which relegates the researcher to outsider.[39]

In contrast to this type of broad cross-sectional evaluation of architectural practice, anthropological methods have been used to analyse architectural process as it occurred, observed from within a project as it developed.[40] This approach is exemplified by longitudinal research conducted by sociologist and anthropologist Albena Yaneva. Notably, while Yaneva's research followed the protracted trajectory of a single project, it was differentiated from the work of Rowe, Cuff, and Till by her lack of professional experience in architectural practice. Yaneva engaged in a multi-year embedded research study at the Office of Metropolitan Architect (OMA) during the firm's engagement in the architectural design of the NEWhitney museum in New York City, focussing on the observation and review of architectural actions relating to the specific project.[41] The experience

architectural process as it unfolded, the books demonstrate broader applicability at the expense of specificity enhanced by intimate familiarity with the examples they cite.

39. Lucas, *Research Methods for Architecture*, 39. The idea of active participation verses a hybridised role invokes the concept of "going native" or "becoming the phenomena", thereby challenging the impartiality and, hence, the validity of the research within a positivist paradigm. Kathleen Musante DeWalt and Billie R. DeWalt, *Participant Observation: A Guide for Fieldworkers* (Lanham, MD: AltaMira Press, 2010), 28-33.

40. This permitted active tracking (rather than retroactive reflection) of what Pietroforte noted as the immense amount of information that is "searched, generated, and communicated" through the production of architecture. Roberto Pietroforte, "Communication and Governance in the Building Process," *Construction Management & Economics* 15, no. 1 (1997), https://doi.org/10.1080/014461997373123.

41. Albena Yaneva, *The Making of a Building: A Pragmatist Approach to Architecture* (Oxford: Peter Lang, 2009).

was combined with observation of additional projects, all within OMA, to create "an ethnography of design", which featured vignettes of the architectural process.[42] Yaneva's work applied similar methods to those adopted by Bruno Latour in his work at the Salk Institute, which explored scientific research using social science methods.[43] Latour's framing of scientific processes in social science methods established a model that could be used to examine the architectural process; the realisation of a complex architectural project—science or art aside—is just as reliant on human variables and social constructs as are scientific laboratory outputs.[44] Yaneva's work via intensive observation and, on occasion, limited participation in activities undertaken by architects in the execution of architectural processes, is standard practice for anthropologists engaged in participant observation.[45] However, this thesis proposes a new understanding of "participant-observation" and its application to architecture and, more broadly, to studies of other professional practices.[46] This construct of participant-observation requires a truly hybridised role as both architect (participant) and researcher (observer).

To participate in the activities of the architect in the production of work requires not just "participation" in the form of passive observation of a meeting or even active mimicking of the architect's actions, such as using a foam cutter on a scrap piece of foam, once the architect has cut the model they need.[47] Yaneva's actions while observing the participants in the design process potentially provided her with "tacit" knowledge of the actions themselves, which underpinned much of her analysis of buildings as "pragmatically knowable" products of design.[48] However, it could be

42. Albena Yaneva, *Made by the Office for Metropolitan Architecture: An Ethnography of Design* (Rotterdam: Uitgeverij 010, 2009).
43. Yaneva's use of the methods to analyse architectural process draws an interesting parallel between the hard sciences and architecture (itself often conceptualised as a blend of science and art). Bruno Latour, *Laboratory Life: The Social Construction of Scientific Facts*, ed. Steve Woolgar (Beverly Hills: Sage Publications, 1979).
44. Aside from this parallel, Latour's and Yaneva's research, separated by three decades, are united by the application of a single theoretical framework to analyse their findings—actor network theory (ANT). The use of ANT to analyse architecture was unique to Latour and Yaneva; it did not inform the engagement within architectural practice of the present study. However, ANT was used as a theoretical frame for a specific line of inquiry that emerged from the embedded research. This is further discussed in the context in which it is deployed to examine specific facets of the architectural process and role of the architect later in this chapter. Latour and Yaneva, "Give Me a Gun and I Will Make All Buildings Move".
45. Yaneva, *Made by the Office of Metropolitan Architecture*, 10. DeWalt and DeWalt, *Participant Observation: A Guide for Fieldworkers*, 12-13.
46. The use of the hyphenated term "participant-observation" speaks to the dual role of the researcher as both participant and observer.
47. Yaneva, *The Making of a Building*, 128-34; Yaneva, *Made by the Office of Metropolitan Architecture*, 51-63.
48. Yaneva, *The Making of a Building*, 7.

argued that this had the effect of romanticising architecture as a creative endeavour divorced from the encumbrances of producing deliverables to fulfil contractual obligations and advance the design. There is a clear difference in motivation for the action between a researcher cutting a piece of scrap foam to understand the mechanics of how a foam cutter may influence shape generation, and an architect cutting a piece of scrap foam to create a model for the purpose of exploring an idea or presenting that idea to a client. It is not the action, but the reason behind the action that drives the architectural process; this can only be explored by the one responsible for the action through self-reflection and criticality.

The latter form of participation is tied to the responsibility to deliver project-specific elements and integrated into the commercial actions of architectural production. In the present study, it included my long-term employment as an architect who was responsible for producing content through professional action. This served as a foil to the traditional understanding of participant observation as a qualitative research method.[49] Ultimately, the duality required reconciliation of my own actions, many of which had been taken for granted in my everyday work as an architect, with the criticality of a researcher questioning why something is so—hence the hybridisation.

Through her embedded research, Albena Yaneva established modes of analysis of architectural practice which examined not the outputs of the design process, but the means through which architects engage with the range of inputs which impact the trajectory of design—Jeremy Till's dependency.[50] By applying ANT to practice, Yaneva permitted those elements which impact design—from specific events and histories to physical models and properties of computer programs—to exercise influence and agency on the design process and its outputs. This means of understanding praxis incorporated not just the architect, but the standard modes of practice in the process of production, and ultimately underpinned an observable, if decidedly complex web of interconnected activities that comprises the architectural process and illustrate the roles the architects must take on in working collaboratively with the non-human actors.

49. DeWalt and DeWalt, *Participant Observation: A Guide for Fieldworkers*, 12-14.
50. For more information, see "Theme 2" in this chapter. Till, *Architecture Depends*.

Similarly, the present study leveraged anthropological methods employed in field work (though, as the research was based in an architecture firm, it is more accurately labelled *firm* work). These methods included (1) (participant) observation, some of which could be considered shadowing, (2) review of documents generated by the profession, (3) journaling, and (4) semi-structured interviews. These methods were combined to generate an auto-ethnography of architectural process as it unfolded, bolstered by my experiences acting as an architect and further corroborated by other anthropological methods as described in the next section. However, the engagement in architectural practice did not result in a finished work of research—this research is not merely the generation of an auto-ethnographic account. Rather, the "raw data" of the observation was then critically analysed and filtered, and key themes that emerged were further explored through theoretical lenses that were appropriate for each facet of practice, as described later in this chapter.

Good ethnography takes time, and the process of engaging in a long-term embedded research project enabled the consistent collection of observations through protracted participation; these data could be scrutinised to further hone the research.[51] The self-reflective approach adopted in this study allowed for the ultimate deconstruction of previously "known" facets of architectural practice, thereby opening the door to a more wide-ranging analysis.[52]

Leveraging Auto-Ethnographic Methods in Embedded Research

The documentation produced to advance this research was ethnographic in nature, that is, it comprised an account of the actions of architects in practice. Because it included reflection on participation, as well as observation, the resulting work can be understood as an auto-ethnography. While auto-ethnography is both process and product, it is important to note that the end goal of the project was not to generate an auto-ethnographic account of practice along the lines of Yaneva's

51. Jane B. Singer, "Ethnography," *Journalism and Mass Communication Quarterly* 86, no. 1 (Spring 2009), https://doi.org/10.1177/107769900908600112.

52. Although I was not trained in ethnography or other anthropological approaches, it was possible to hone the associated methods of data collection through action; as John van Maanen commented on the Chicago-style fieldwork of Robert Emerson from the 1980s, onward, "fieldwork was… something one learned best by doing." John Van Maanen, *Tales of the Field: On Writing Ethnography*, 2nd ed. (Chicago: Univesity of Chicago Press, 2011), 18; Robert M. Emerson, "Introduction," *Annals of the American Academy of Political and Social Science* 595 (2004): 8-13, https://journals-sagepub-com.ezproxy.lib.uts.edu.au/toc/anna/595/1.

own ethnography of architectural process.[53] Rather, the auto-ethnographic process—borrowed from the tool kit of anthropological methods—was leveraged to identify the themes that emerged from analysis and which could then be scrutinised. This mainly occurred in the first 18 months of research, as I spent time becoming acquainted with the practice as an architect and immersed in the project that would form a base for the study. The research involved not only reflection on the data collected (ostensibly snippets of auto-ethnography as output), but also self-reflection on actions undertaken within the context of practice. The documentation of observations and later reflection on that documentation defined the work as auto-ethnographic. It was facilitated by a maturing and evolving understanding of architectural production based on engagement in the process of actually doing the work and then reflecting on the work. This simultaneous engagement in actions of architectural production and observation of that production required a certain amount of siloing of my activity as either architectural practitioner or academic researcher. In my role as an architectural practitioner, like most architects, I was a worker, beholden to the management frameworks, expectations, and deadlines of the bureaucratic apparatus—the firm—that was responsible for developing and delivering the architectural contributions to the project.[54] It was with these professional eyes that I looked back on the work undertaken to understand the processes at play. As a reflective researcher, I was then required to question elements that a non-architect might not consider, framed by methods and theories external to the professional context.

The first step to successful participant-observation for this research was active engagement in the architectural process. Participant-observation, in the form of embedded research, formed the core of the research; active engagement in architectural practice and process was key to the identification of issues and areas that warranted further exploration. Without direct, constant engagement in practice, this research would not have been possible, as it was through this engagement that the concepts explored in the subsequent chapters emerged. The method included numerous types of observation, including observations of architects engaged in solo work, architects engaged in collaborative work with other architects, architects in formal meetings with other

53. Ellis Carolyn, E. Adams Tony, and P. Bochner Arthur, "Autoethnography: An Overview," *Forum: Qualitative Social Research | Sozialforschung* 12, no. 1 (2011).

54. Cuff, *Architecture*, 49-53; Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech, eds., *Industries of Architecture* (London: Routledge, 2016), 4-8.

architects, architects in both formal and informal interactions with external parties including clients and consultants, and even architects in casual social settings engaging in discussion about the work being undertaken. Often these observations were undertaken simultaneously with my work as a practitioner, for example, in meetings in which I was participating in in the context of the architectural process. Occasionally, however, I would participate in meetings that were not central to my work in practice (as noted in the opening anecdote); in these instances, the technique employed could be framed as pure shadowing.[55]

For the first 18 months of the three-year research project, qualitative data were amassed through these methods. This was somewhat complicated by the interconnectedness of engagement in daily professional practice on the project, which itself was forming the foundation of the research and which involved complex ethical considerations. While those in the firm with whom I worked were aware that I was engaged in research, the omnipresent possibility that the experiences were likely to inform my research outcomes was never at the fore, even though it was impossible to decouple the two tasks. Further, in my professional capacity, I engaged with many parties outside the firm in both large formal meetings and casual interactions; it was impractical within the work context to introduce my research at the outset of every engagement. Therefore, while these experiences shaped my research and illuminated lines of inquiry, they were only used to inform the overall trajectory—things that should be followed up or explored through other means. These complications were mitigated through a boundary established within my documentation—direct quotes were never taken in meetings with those from outside the firm while I was operating in a professional capacity. Aside from contextual discussions used to inform the anecdotes at the beginning of each section, direct content from internal meetings was also never used. Further, a system of anonymity was employed, with architects assigned a letter to represent them throughout the write-up of the research, both in the context of quotes and in the recounting of daily activities.

Within the scope of my daily work as an architect, I reviewed documentation (both written and drawn) produced within the firm and by external parties. Much in the same way as data gleaned through participant-observation, the document review served to both define lines of future inquiry

55. Kathy Charmaz, *Constructing Grounded Theory*, 2nd ed. (London: SAGE, 2014).

and frame the larger themes present in the research. This became more complicated as I worked within my professional capacity to generate or co-generate content for thousands of pages of reports, necessitating not just reflection on the documents and their meanings, but self-reflection about my engagement in that capacity. To record the observations and themes that emerged from the data as an observer to the activities and documents, I kept notes throughout the entire three-year process.

Throughout the study I kept two notebooks. The first was the one I kept with me in the office each day, from which the excerpts at the beginning of this and subsequent chapters have been extracted. This notebook was dedicated to documenting my work within the constructs of practice, and functioned in the same way as the notebook of any other practitioner who needed to record meeting minutes, tasks to be completed, and general reminders. However, among the production-related notes, I also included observations about the meetings and documents, as well as notations about things to explore further. The second notebook, however, was dedicated to research and can be characterised as journaling. This notebook travelled with me outside the office, to the University, to academic conferences, and even abroad as I travelled both for research and holidays. In it I would jot reflections, thoughts, or things to explore further. It is where I began to generate reflections and critical reviews of the data collected. Through this journaling, I cultivated ideas and drew parallels between the theories I was reading and discovering through engagement with other researchers and the work I was doing as an architect. This journaling—and reflection through the writing of conference papers—allowed for the emergence of themes in the practice work (participant-observation and document review) that could be further explored through the final anthropological method: semi-structured interviews. Based on themes identified through the auto-ethnographic methods, interviews were used to establish the validity of the observations and to expose questions that required further exploration and review.

Interviews began 18 months after the beginning of the research, once themes had been identified through the analysis of the data collected via engagement in practice. It was through direct engagement that these ideas emerged, as I worked to write the Design Report and participated in meetings where design and project management were discussed. As I had innate

project knowledge, developed over the months of project participation and coalesced through work in assembling the reports, I used that knowledge of the process to frame my formal engagement with interview subjects to test my hypotheses. Interviews were first conducted with eight architects within the studio, from interns to directors, who were directly engaged in the Metro project that formed the centrepiece for the research. Interviews were conducted after hours to provide clear delineation between the architectural work and the research, though they were held in a meeting room in the studio for convenience. The purpose of the interviews—including that they were specifically for research and outside the bounds of practice—was established with all participants, guaranteeing that the outcomes would inform the research and not be shared directly with the firm. All information obtained from the interviews was de-identified, and anonymity was established through the use of letters to identify participants in any use of quotes. Rapport established through prolonged engagement on the project, as well as my general familiarity with the design and aspects of the culture of the project team and practice, allowed for the interviews to be conversational and quickly focus on themes central to the research, without the need for orientation to the specific project or project type. This was an advantage over research where the interviewer lacks technical or project knowledge. My pre-existing industry knowledge, coupled with my familiarity with project specifics and the personal relationships I had established with other architects on the project, permitted me to be "conversant in what was happening in [the] field setting."[56]

To ensure broader applicability of the research, and to limit the potential for bias related to the specific project or firm, interviews—ten in total—were also conducted with architects at the firm who did not work on the Metro project, architects at other firms in Australia who worked on similar project types, and with selected international practitioners engaged in similarly scaled MTP projects. Contacts were established through professional networks, which gave me the opportunity to engage directly with practitioners. In introducing myself, however, I presented the interviews as academic research, with my background and involvement in architecture positioned as a credential—not as a primary role. In this way, the interviews were typically quickly grounded in knowledge of the project type, leveraged common architectural jargon, and allowed for conversance and comfort.

56. Charmaz, *Constructing Grounded Theory*, 40.

Standard interview protocols were established, with potential interview subjects provided with documentation about the nature of the research. They were assured that their participation was entirely voluntary and that they could withdraw from the study at any time, with any previously collected data being removed from the data set. Interviews were recorded, though complete transcripts were not produced. Rather, I documented pertinent quotes and distributed these extracts to each participant for verification. Quotes ultimately used in publication, including this dissertation, were again reviewed by participants before inclusion. Given the potential for commercially sensitive information to be discussed, I decided to further anonymise the interviews by removing any references that might identify the practices in which they were engaged. Of course, those who are engaged in the project are likely to be able to tell who said what based on the actions of the architects. However, no additional value would be added by stating their names or roles as the quotes solely serve to support observations and conclusions.

In the interviews, the previously identified themes were expanded upon through discussion, providing opportunities to confirm certain ideas and obtain relevant supporting quotes, as well as to identify issues that needed to be reconsidered through further interviews and continued project involvement. The interviews also offered an opportunity to introduce criticality into the otherwise largely self-reflective work that defined my active engagement in, and reflection on, the role of the architect. The interviews were conducted over two months, midway through the three-year research process, and enabled me to refine the trajectory of the research. Following the completion of the interviews, my work within the firm continued, though the collection of “raw data” using anthropological methods no longer focused on the emergence of key themes. Instead, it shifted to the construction of an analytical frame through which the themes could be explored, as well as the documentation of observations to contribute to the emerging methods of analysis.

Inherent Tensions and the Emergence of Themes

Being simultaneously architect and researcher forced me to reflect on the actions undertaken and assumed as “normal” in practice. As an architect, I participated by working to accomplish the tasks I had learned in school and honed over years in practice. As a researcher, I observed the actions of the architects (both collectively and as individuals) and thought critically

about what those actions meant when I was removed from these ingrained processes. The first 18 months of participant-observation were fully devoted to immersion in the actions of the architects in the various facets of practice involved in the development of MTPs; from this, themes emerged. This was not necessarily a conscious process but, rather, something that took place through my evolving understanding of the work undertaken in my architectural capacity, filtered through a growing understanding of research methods. The use of auto-ethnographic methods resulted in reflection on the activities of the architects—myself included—and the documents used in practice. This self-reflection and criticality in relation to the actions undertaken in the daily work life of myself and my colleagues led me to question elements that I would not otherwise have considered worthy of further interrogation. The actions I was required to take in developing the deliverables for which I was responsible required further introspection.

Patterns emerged in my engagement with practice which, upon reflection, became dominant themes in the actions of the architect; over time and re-evaluation, disparate observations consolidated into three broad themes. Once these themes were identified, I needed frameworks to understand and evaluate the themes. This in turn necessitated the adoption of various methods and modes of analysis that would allow me to interrogate architecture's role in the broader context of the project. The frameworks emerged organically, stemming from the context of the observations. For an example, if the theme often manifested in drawings, drawings became the means of framing the exploration of the theme. The following account briefly presents the three themes, as well as the background methods employed to construct thoughts around each domain.

The order in which the themes are presented in the following chapters roughly corresponds with their emergence during the trajectory of the architectural process. This characterisation is tempered by the fluidity of the architectural process, and the interrelation between the deliverables and production needs. However, the traditional order of the development of an architectural project continues to direct the daily activities of architects, and proved to be an appropriate organisational framework for the presentation of findings. In other words, the three themes (and the methods employed to frame the research) largely corresponded with the established framework of architectural practice and the orderly design development process as described.

In practice, the development of a project is divided into phases, roughly characterised by the Australian Institute of Architects (AIA) as (1) concept design, (2) design development, and (3) construction documents.[57] While the architectural process is one that doubles back on itself, this research leverages the pre-existing formula of design development as it generally characterises the evolution of the architectural process. Of course, the production of qualitative visual representations and the active advocacy for human-centric ambitions occur throughout the various design phases, in the same way as does cross-disciplinary exchange and the production of models or the generation of data and management of the project team. While a definitive start or end to a phase is largely a contractual formality, overall, the trajectory of the project moves across the spectrum from concept design to construction documents, with the architect always evaluating progress against the phase benchmarks to ensure the project is on track (and that they may get paid accordingly by the client). While the characterisation of phases as fixed benchmarks is largely a simplification of the fluidity of practice, it forms a sound basis for representing the overall design trajectory, logic, and rigour for presenting the research.

Theme 1: Architects as Advocates for Human-Centric Aspirations Through Drawing

From the outset of the project, the catch phrase "through the lens of the customer" underpinned the overall design of the Metro station, including public domain interfaces and key public zones throughout the station, such as concourses and platforms.[58] The idea pervaded not only the rationale behind the design, but also permeated the production and representation. With the trope engrained in the architectural process—as well as the delivery of the overall project by the government—its application within the studio and its tangible impact on the development of design warranted investigation. When layered onto the actions of the architects, and the deliverables

57. It is worth noting that the characterisation of phases is fairly universal in western architectural practice, with the AIA divisions roughly corresponding with those of the Royal Institute of British Architects and the American Institute of Architects. Notably, the organisations do acknowledge that the linearity of this conceptualisation of phasing has given way to hybridisation, but no new characterisation of design progression has taken hold. Australian Institute of Architects, "Acumen Practice Notes," accessed 17 December 2020, https://acumen.architecture.com.au/; Royal Institute of British Architects, *RIBA Plan of Works* (2020). https://www.architecture.com/-/media/GatherContent/Test-resources-page/Additional-Documents/2020RIBAPlanofWorkoverviewpdf.pdf?la=en; R.L. Hayes, ed., *The Architect's Handbook of Professional Practice*, 15th ed. (Hoboken: John Wiley & Sons, 2014), 515.

58. While the theme was identified in relation to the work undertaken on a specific project, the overall approach (including the catch phrase "through the lens of the customer/traveller" was leveraged on multiple MTP projects in which I participated during the three years of research.

produced, the expression became more than merely a given; it became a parameter against which each design development, and the representation of that development, was measured. As I assembled the Design Report and requested images from a third-party renderer, I became inadvertently complicit in the idea, furthering its reach through actions in constructing a visually represented narrative to accompany the text I wrote. The opening text of the Design Report noted the fundamental role of this hypothetical customer in the development of the design. E-mails were sent and meetings were held about how to capture this idea in imagery. As the architect tasked with conveying the ideas through the Report, I pushed the cause, at the urging of other architects, past what would seem logical to an outside observer. Reflecting on these activities long after the Design Report had been submitted and the project successfully won, I wonder what motivated the development of the imagery, which was sometimes at odds with the technical deliverables that were being developed simultaneously to be presented as part of the same package.

Why was I so adamant about being able to capture a certain view in an image? I had to confront my own bias. It was not merely that my boss had asked for it. Rather, as an active participant in delivering a document that represented our collective ideals about the design, I realised that the architectural expression through visuals embodied the ethos that served as a rallying cry. Ultimately, the style, material, and tangible manifestation did not matter—the design itself was transcended—I, and the other architects, cared about the narrative, as represented through visualisations.

The first theme emerged: architects have a defined role as advocates for human-centric ambitions. The role was not necessarily one that had not been ascribed to architects in the context of large-scale urban projects before. Its roots are perceptible in the ideas of *placemaking* advocated by Jan Gehl, the generative potential of transit-oriented development (TOD) established by Peter Calthorpe, and the phenomenon of tactical urbanism which has led to a broadening interest in the "retaking" of urban spaces for people (a theme that has tentacles reaching back to Jane Jacobs).[59]

59. Jan Gehl, *Life between Buildings: Using Public Space*, trans. Jo Koch, 5th ed. (Copenhagen: The Danish Architectural Press, 2001); Peter Calthorpe, *The Next American Metropolis: Ecology, Community, and the American Dream* (New York: Princeton Architectural Press, 1993); Janette Sadik-Khan and Seth Solomonow, *Streetfight: Handbook for an Urban Revolution* (New York: Viking, 2016); Jane Jacobs, *The Death and Life of Great American Cities*, Vintage Books ed. (New York: Vintage Books, 1992; repr., first published 1961 by Random House).

Arguably, there is not a piece of urban infrastructure as public as *public* transport. In practice, this role was continually illustrated in the production of imagery to communicate the design. Informed by the role of the drawing as a means of communicating intent, the exploration of the meaning of drawings in the architectural process—something debated and researched by many—offered an opportunity to analyse the theme through a decidedly architectural means of representation. The conceptualisation of drawings and their role in the architectural process by Robin Evans, Nigel Cross, Vinod Goel and Peter Pirolli, and Juhani Pallasmaa all informed the development of the ideas, allowing arguments to be formulated to broaden and reframe the architect's drawing within the context of this architectural role.[60]

Theme 2: Architects as Mediators of Colliding Priorities Through Objects

Jeremy Till constructed his entire epistemological argument in *Architecture Depends* on the premise that architectural knowledge and production are the product of interdependence between architecture and other disciplines.[61] The time devoted to cross-disciplinary exchange and coordination by architects throughout the design process underscored the validity of Till's argument, though it never seemed to be something up for much debate.[62] Till's argument focused on a pervasive mentality of autonomy of architectural practice, manifesting as a practice in denial of its reliance on factors outside of its remit. His work was contextualised through primarily small-scale and atelier-style practices and constituted an indictment of the profession and the pedagogical foundations of architectural education. Of course, his arguments were not without merit.

However, this research uncovered a related, though fundamentally different concern in the context of architectural dependency. As established in Chapter 1, infrastructure as a project type is demonstrably reliant on external forces. That reliance was clear not only in conversations with architects, but also in their actions. A common issue in the development of design was consternation

60. Robin Evans, *Translations from Drawings to Buildings and Other essays*, ed. Richard Difford and Robin Middleton (London: Architectural Association, 1997); Cross, *Designerly Ways of Knowing*, 33; Vinod Goel and Peter Pirolli, "The Structure of Design Problem Spaces," *Cognitive Science* 16, no. 3 (1992): 395, https://doi.org/10.1016/0364-0213(92)90038-V; Juhani Pallasmaa, *The Thinking Hand: Existential and Embodied Wisdom in Architecture* (Chichester, UK: Wiley, 2009), 59.

61. Till, *Architecture Depends*.

62. In all the interviews with architects from various firms involved in these large-scale, complex projects, none ever argued that architecture did not depend. Rather, it was a well-established and accepted fact that architectural production was inextricably intertwined with the work and expertise of other fields.

at the expediency or comprehensiveness of information from other disciplines, with architects acknowledging the need for critical information before design or documentation could proceed. It was not that practitioners did not understand the inherent dependency—it was a well-known and embraced component of the architectural process—but, rather, that the role of architects in the resolution of the multi-disciplinary dependency in the advancement of the design was unclear. Put simply, it was never the dependency that was in doubt, but how that dependency might be resolved through the process of architecture, which remained elusive.

The nature of that dependence required scrutiny to better understand the role of the architect in facilitating the integration of information from disparate specialist sources. While architects would attend meetings with dozens of outside parties, send and receive countless e-mails, and labour over drawing mark-ups to communicate competing intent, the reconciliation of design elements was not merely in the realm of this human-based interactive information exchange. The production and evaluation of tangible mechanisms of representation—among them, models, samples, and 3D prints—within the office to assist in the work raised questions about how the work was conducted.[63] These mechanisms of representation were not merely tools to represent the presently "resolved" state of the design. Rather, they were mechanisms of discovery, themselves prodding and goading the human actors into action by highlighting the limitations of the present "resolution". The fluidity of the role of the non-human actors, as they were leveraged as mechanisms of representation and mechanisms of discovery, highlighted their importance. In one instance, 3D printed model cladding panels were passed around a meeting, with the form of each discussed.

Was it the architects who knew what questions to ask about each, or was it the panels themselves that forced discussions about how they had evolved to ensure that the resolution considered the competing factors? As an architect, I had only ever seen the architects at the table, using the mechanisms of representation to illustrate their thoughts. However, it was now clear that

63. The idea of a "mechanism of representation" encompasses both formalised architectural deliverables and the incidental items produced to represent the state of design at any given time. A mechanism of representation is a snapshot of the state of an element or elements that can be used to demonstrate the status of that element either internally or to a broader audience. They can range from a small material sample to represent the colour or finish of an object, all the way to a set of technical drawings to demonstrate the resolved state of the entire project as it relates to a number of facets.

the objects had autonomy, they were actors in their own right, produced by an architect with specific knowledge and skills, imbued with defined purposes. They were able to ask those seated around the table, with different interests, to reconcile their knowledge. These non-human actors forced conversation; if they were put aside without resolution, they continued to call out until someone either provided a solution or killed off the actor in favour of a new resolution that no longer asked the question.

The second theme coalesced around the actions taken by architects in interacting not with other disciplines, but with the objects generated in the architectural process: physical and digital models, material samples, 3D prints, and 2D visualisations. Architects have a defined role of reconciling inputs by responding through iterative design moves. The ideas of the architectural role defined by interdisciplinarity were stimulated by the writings of Dana Cuff and Jeremy Till and furthered by a chorus of architects acknowledging the dependence.[64] However, these ideas were of little help in uncovering the actions I observed of these non-human actors, which proved so integral. In order to examine the role of the object in helping the architect reconcile cross-disciplinary inputs, I leveraged theory from outside of architectural practice. Specifically, I applied actor-network theory (ANT) to architecture, borrowing from Latour's and, later, Yaneva's, work, to reframe inter-disciplinary collaboration and the role that architectural actors (both human and non-human) play in the architectural process, thereby reconceptualising the ideas of authorship and reflexive work.[65] Granting autonomy to the non-human actors in architectural practice gave them a voice and provided an alternative to the present understanding of this role of architecture.

Theme 3: Architects as Managers of Data and Process Through Organisational Tools

The activities required of architects in practice are wide ranging. To accommodate the heterogeneity, specialisation within practice by individual architects is required. Specialisation relates to a range of skillsets and experience, including knowledge of computer programs to produce the required architectural deliverables, familiarity and prior experience with projects of a similar type, and background as it relates to the management and delivery of architectural services. The

64. Cuff, *Architecture*; Till, *Architecture Depends*.

65. Bruno Latour, *Aramis, or, the Love of Technology* (Cambridge, MA: Harvard University Press, 1996); Latour and Yaneva, "Give Me a Gun and I Will Make All Buildings Move"; Yaneva, *The Making of a Building*.

immense breadth of the architects' collective responsibilities and capabilities, while represented in the activities of the studio, were often at odds with the perception of those working on the project. This was observed through tensions in meetings and frustrations expressed through casual conversations, and corroborated through formalised interviews. Notably, the activities that occurred within the studio relating to the management of data were often divorced from the deliverables that were derived from this information. With a substantial amount of energy and resources devoted to data—gleaned from personal experience, observations, and interviews—and data's direct correlation with the successful execution and representation of the design, the role of data in the architectural production process required critical investigation.

Often, the activities associated with data management were attributed to non-architectural activities, despite clear indications of their interdependence with the provision of architectural services. This disparity between the realities of architectural production and the self-conceptualisation of architects resulted in questions that were not easily addressed from within the profession. If all of these management activities, specifically related to data management, were part of the production of architectural deliverables, were they not an integral part of architectural knowledge? Since I often filled a non-creative role within the firm, leveraging tools such as Excel to organise the work I did, the role of data was never far from my understanding of architectural production. However, the more I spoke with other architects, it became clear that the link between the production and management of data was not something that was always at the forefront of the architectural process, even when it was inextricably linked to the success of the project. It was only when data were left to the last minute, or were unable to keep up with the rate of required production, that their importance became glaringly obvious to everyone. Yet, through interviews, it was clear that data were not at the forefront of thought.

The third theme took the longest to fully materialise, manifesting in the lack of acknowledgement of data-centric roles in practice: architecture is responsible for the management of data and its deployment in the trajectory of design to produce required deliverables. Dana Cuff had pointed out that management of projects, while often a maligned part of architectural production, was indisputably important to the viability of a project and practice.[66] However, to

66. Cuff, *Architecture*.

contextualise this disconnect between the realities of practice and the self-identity of the architects responsible for this work in the studio, it was necessary to evaluate the role of information in shaping the identity of architects in their daily activities, building on previous work by Sumati Ahuja, Natalia Nikolova, and Stewart Clegg.[67] From this, a broader reading of the tasks of management and operations, considered against the role of data in the smooth management of the architectural process and production of deliverables, had to be considered. To this end, I drew on management theory of knowledge intensity to shed light on those forms of organisation that keep a project on track but upon which architects do not typically reflect. In particular, I drew on the work of Mats Alvesson and others to frame the idea of architectural knowledge in a comprehensive way.[68]

Methods of Presentation

The following chapters explore these three themes in depth. The analyses are empirically grounded in the observations and analysis of architectural practitioners in the act of producing architectural deliverables that embody architectural knowledge. This section briefly outlines and explains the format of the subsequent three chapters. The means of representing this research and its varied methods and outcomes required the use of distinct methods of presentation, borrowed from the same sources that inspired the methods of data collection and analysis. The work of a number of researchers who have presented along similar themes influenced the format of the presentation of findings in this dissertation. These will be briefly noted here.

Like this chapter, the subsequent three chapters—each focusing on a specific role of the architect—begin with a brief auto-ethnographic account to establish the context of the chapter. This method borrows from Cuff, who uses scenes from practice or vignettes of practitioners to introduce chapters, as well as Latour's book *Aramis, or, the Love of Technology*, where he moves more fluidly between account and analysis.[69] The intent, much like that of Yaneva's interspersion of reflections on her experience at OMA, provides a tangible practice-based link to the real world application of the concepts defined in each chapter.[70] The auto-ethnographic approach is neither fully employed

67. Sumati Ahuja, Natalia Nikolova, and Stewart Clegg, "Paradoxical Identity: The Changing Nature of Architectural Work and Its Relation to Architects' Identity," *Journal of Professions and Organization* (2017), https://doi.org/10.1093/jpo/jow013.
68. Mats Alvesson, *Knowledge Work and Knowledge-Intensive Firms* (Oxford: Oxford University Press, 2004).
69. Cuff, *Architecture*; Latour, *Aramis, or, the Love of Technology*.
70. Yaneva, *The Making of a Building*.

for poetic purposes nor to provide a wholly empirical account of the phenomena I observed (and participated in) during the three years of research. Rather, the ethnographic components are used to first understand what the questions should be and, secondly, as a means of framing the larger themes that emerged in the research. In these instances, I have endeavoured to be critical of the words and jargon used in architectural practice and architectural engagement, to present an ethnography free from what John van Maanen terms "high-wire abstraction".[71]

Throughout the dissertation, architects involved in the design process and those who were interviewed are consistently identified with a letter or multi-letter code. Those identified by a single letter (A-Z) correspond with those who were actively engaged in the design process of the Metro project in the studio. Some, but not all, of the architects identified in this manner participated in interviews and are quoted, again using the letter to identify their quoted material. Those identified with a two-letter code (NA-NK) were not affiliated with the development of the Metro project and were solely interview subjects with project experience in MTPs. This mode of de-identification, noted in the description of the interview protocol, borrowed from the general format used by Freestone, Davison, and Hu in their work on design excellence in Sydney.[72] De-identifying the participants enhances their privacy and reinforces the broader applicability and generalisations of the actions and conclusions from the research, decoupling them from the specific project or person.

Finally, while this PhD is about architecture and architectural practice—a field that is decidedly grounded in visual representation—it should be noted that little imagery is used. This was not an initial choice, but developed in recognition of both the commercial in confidence restrictions and the requirements of working in the context of a larger team, where gaining permission to use imagery proved difficult. However, as the research developed it became clear that abstraction of the ideas (furthered by the limiting of visual representations of specific station conditions) afforded the reader the opportunity to apply the insights to other contexts. Ultimately, it does not matter what the station designs looks like—it is the processes that are under investigation. The limiting of images of the station design facilitates generalisability of the findings beyond the aesthetics of a single project or aspect of a project.

71. Van Maanen, *Tales of the Field: On Writing Ethnography*, 174.

72. Robert Freestone, Davison Gethin, and Richard Hu, *Designing the Global City: Design Excellence, Competitions and the Remaking of Central Sydney* (Singapore: Palgrave MacMillan, 2019).

Chapter 3
The Human Elements

Figure 3.01 - The "octopus sketch”.

Nothing Sells an Idea Quite Like an Octopus

From my earliest days in the studio, it was simply referred to as "the octopus sketch" [see Figure 3.01]. The name was understandable, considering that a quick glance would give the impression of an unenthused cephalopod, perhaps emitting cosmic rays, as it loomed over three vaguely human-like apparitions. It was simultaneously odd and captivating.

The embryonic sketch was drawn by Architect F early in the design process of the station. As the project developed, it became omnipresent in material generated by the studio, appearing on the front cover of all presentations made by the project team—a sort of mascot to represent the project at a glance. For those unfamiliar with the project, the sketch was visually intriguing, despite (or perhaps, because of) its simplicity. At its most basic, it communicated the idea that future station patrons—represented by those three ambiguously human-esque figures—would encounter a space where the design of the station would catch their attention and draw them in a certain direction; both the sketch and the view it captured were meant to create a sense of awe. When accompanied by the explanation that the eyes of the octopus were skylights and the tentacles escalators, the idea that daylight would pierce the inner sanctum of the station and draw people upwards toward the concourse could be understood in an abstract way. But, to the countless people who encountered the sketch as the opening slide of a Design Review Panel (DRP) presentation, or a stakeholder engagement meeting, or a development partner session, the octopus was a subtle, if slightly perplexing, reminder of the architects' ambitions.

The primary purpose of the sketch was to illustrate the intended relationship between the subterranean passages (adits) leading form the platforms to the concourse above, which the architect envisioned to be bathed in daylight from the two skylights. The sketch—done in black pen on trace paper—embodied both simplicity in wayfinding and a distinctive customer experience. It revolved around the ethos of "through the lens of the customer," an oft-repeated trope by Architect F, that engendered design

decisions both large and small.[1] The sketch was simple, powerful, and quickly communicated the idea of natural light as a wayfinding mechanism for passengers as they would be intuitively drawn up the escalators into the concourse, where they would then choose where to exit the station.

A few months after the sketch was drawn, I found myself in an office outside the city centre in a meeting with the team responsible for producing the tender submission renderings. I held my laptop aloft for those assembled to stare into the eyes of the octopus on the screen.

"That's impossible," one of the renderers remarked as his glance moved from the octopus back to his own laptop screen. We sat at a conference table with members of the rendering office and assorted members of the project team. The view from the old warehouse in one of Sydney's leafy residential suburbs was of the steep-pitched roofs of terrace houses, a far cry from the high-rise views of the architecture studio which I had been sent from that morning to handle the renderings for the pending tender submission. The e-mails were not working to resolve things, so a face-to-face discussion was decided to be the best course of action. Architect F, still responsible for the sketch long after it had taken on a life of its own, had continued to insist that the vision embodied in it must be captured in the rendering—it was a feature that would sell the scheme over others. An e-mail which had circulated in June following an early round of meetings about the renderings said it all: the "single most important point to communicate" for rendering 12.1.5 (f) (v) was about the "natural light sources above creating intuitive wayfinding".[2]

But, as the renderer said, the view captured in the sketch could not exist. With the digital Revit model as the base for the renderings, there was no realistic vantage point

1. The first recording in my notes of this comment as relates to the project was in June 2018 (two months after joining the firm and just as my year-long involvement began in the project) during a meeting about assembling the project's Design Report. The concept was repeated continually regarding the methodology for design, ultimately becoming a trope that transcended projects in the transport cluster. Architect F, comment made in a meeting, 1 June 2018.
2. Developer DA, email message to design team members, including author, 20 June 2018.

from which to generate such a view. An alighting passenger would never catch a glimpse of the skylight due to the angle of the escalators and the ceiling height of the concourse above. Rudimentary views the architects had set up in the model in the studio confirmed what the renderer was now saying face-to-face, and what they had said in response to multiple mark-ups sent via e-mail about how the skylights were missing from each subsequent draft. I was arguing a lost cause and the renderers were getting impatient.

No matter, it needed to be in there, I thought to myself, reality *be damned; that is why renderings come with the caveat of "artist's interpretation". And Architect F was not wrong: this was the selling view of that part of the architectural response. While it was not perhaps* realistic *in any tangible sense, given the constraints the architects now knew after months of coordination with other disciplines, it was representative of the design intent. It represented a realistic feeling the architectural response was meant to engender, even if the skylights would not be seen once the station came to be in concrete and steel.*

"Well, can we fake it?" I replied, imagining that Architect F would not be thrilled with something pesky like reality getting in the way of the creation of an image to demonstrate one of the highlights of the proposal.

"No. It can't be done." And with that, the team moved onto the next image.

That afternoon, back in the studio, I spoke with Architect F and explained what happened at the meeting. When I said the digital model could not be manipulated any further, that was that. There was no pushback. We had tested the limits of reality suspension and found the edge. And without any more fuss the team moved on, rendered image approved. While it seemed that the octopus was dead, it would live on in other manifestations. The renderer, in killing the octopus in the meeting, had simply freed it from the sketch and allowed it to be realised in its next incarnation as the design process barrelled ahead.

The octopus sketch is a simple representation of a space conceptualised by an architect, translated into a physical, sharable medium through a few quick strokes of a pen to communicate the envisioned concept. The sketch could at first seem a trivial piece of the design process—one of literally thousands of images generated in the production of the design deliverables. In the preceding example, the sketch seemed to transform from an important mechanism of representation to something that, once no longer relevant in the production of the next "reality"—the rendering—became obsolete. However, in this chapter, I will leverage the octopus sketch to explore its drifting role in the architectural process—or, rather, the role of the content of the sketch—analysing both its genesis and its ongoing import in shaping the design response. As an output of the architectural process, the sketch illustrates much more than a subterranean scene; it tells of project ambitions, relationships, and, of course, the role the architect fulfils in the realisation of these projects.[3]

While the sketch represents just one small area of one particular station, and the interaction about it is confined to a specific—and rather early—point in the design trajectory, I will use it to frame some key issues that define the role of the architect throughout the project, and across projects. We can learn three things about the role of the architect in the design process from the sketch:

1) The architect is the advocate for and advancer of the human-centric ambitions of the station, providing the intent of what the station can be and how it can function, as this relates to the theoretical future customers.

2) The architect's expertise is framed around his or her ability to communicate that intent effectively and simply, often through imagery, though also through other mechanisms of representation, in the same way data from team members representing other disciplines are presented in spreadsheets, diagrams, and documents.

3. Architects leverage two types of sketches—those that represent and those that resolve. Sketches that resolve are used to explore a concept and potential alternatives to find a "resolution" and are done in the process of work to further the design. Sketches that represent are unique in that they are created to communicate information, often to external parties. The octopus sketch was born to represent.

3) To communicate that intent, some strategic suspension of reality and constraints can be required and leveraged through a simplification of the parameters that shape design; while the suspension may seem illogical or counter to the design process, it is a tool managed as part of the architectural process.

Chapter Outline

The first section of the chapter introduces the octopus sketch and the ideas that it embodies. The section also establishes how the chapter will illustrate the three preceding points. Additionally, there is a brief—but necessary—aside about how the architect is conceptualised, which will be relevant throughout this and subsequent chapters.

The second section examines the context of transport facilities as public spaces, interlaced with urban and regional aspirations. First, the trajectory of urban transit facilities is interrogated to demonstrate the range of design approaches from pure infrastructure to urban public amenity. Next, stations are considered as a larger piece of the urban context, and shifting perceptions of public space in the urban realm are explored to arrive at the present emphasis in urban transport design on "public good". Finally, the architect is positioned within this design approach as occupying a role that, while not new to the profession, is uniquely applied to public spaces realised in public transport.

The role of the architect's sketch in capturing architectural knowledge relating to human-centric advocacy is explored in the next section. First, the sketch as a means of communicating qualitative experience is analysed. Next, the specific knowledge type captured by the sketch is framed before its deployment in the context of the station environment is defined. Finally, the overlap between the defined knowledge contributions and opportunity space is used to examine the realisation of the sketch as a manifestation of the architectural contribution.

The fourth section of the chapter examines how the architect communicates the developed ideas and architectural knowledge to other members of the design team and the client. It then explores how the same media and methods are used within the architectural process to facilitate a standardised and cohesive approach across the architectural team. The section then explores the

complexities that are introduced in the form of design inputs from a range of disciplines, and how the sketch responds to these parameters before the sketch ambitions are reconciled with new inputs to accommodate new, more advanced visual representations in the rendering.

The last section acknowledges the evolution of the architectural knowledge and contributions over time as they respond to the demands, constraints, and inputs of forces outside of architecture. Finally, the conclusions from the chapter are summarised.

Who (or What) is the Architect?

Before the sketch and its ensuing interactions can be analysed, it is important to acknowledge who the "architect" is and what she or he is responsible for in the example.[4] First, the "architect" is represented by several people. There is the architect as the author of the sketch (Architect F, as introduced earlier), the architect(s) responsible for the development of the Building Information Modelling (BIM) Revit model that will be used by the renderer (Architects C, D, M, and others), the unseen architect(s) who developed the parametric information that went into the model (Architects B, H, and others), the other unseen architects responsible for the organisation and coordination of the digital model (Architects A, G, and others), the architects responsible for the verification of information contained in the model and the various outputs from the model (Architects C, F, J, L, P, and others), and the architects responsible for the distribution of the model and other deliverables (Architect A, C, D, O, and others). And then there is me; the architect at the table, holding up the octopus sketch (Architect U).[5] This constellation of participants represents the range of architectural contributions to the project, but is necessarily abbreviated—by the time the research was completed, more than fifty architects on the team had touched the design of the project.[6]

4. Architecture is a field which, until recently, has been dominated by men. Still, within leadership positions in the profession, women are underrepresented. The use of pronouns in this thesis is limited, but are used for both actual actors (the architects defined in this section, as well as other interviewees and project participants) and, occasionally, representing theoretical people.
5. The architectural process is quick to anonymise the countless hands and minds engaged in the development of a design for such a large and complex project. Jörn Janssen, "Building Design: A Component of the Building Labour Process," in *Industries of Architecture*, ed. Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech (London: Routledge, 2016), 188.
6. While not all are represented in the alphabet soup found in the subsequent chapters, the experiences of those represented can be taken as a generalisation of the overall actions in the design team.

Of course, many of these architectural roles were performed by the same architect. Most architects do not have just one skill, as there is not enough of one specific task to occupy someone full time, and because tasks are inter-related, which means that an architect is required to work across multiple facets of the project and production. Hence, we can see that the word "architect" encompasses a variety of participants with various skillsets and a wide range of experience—from students still in university to directors with five decades in practice. The architect is not a homogenous concept, but all architects are active participants in the architectural process, defined by the architectural work outputs.[7] While it may seem that all of these architects are fulfilling different architectural tasks (pragmatically, they are), in reality, all work as a single system to generate the outputs and outcomes of the architectural process in a cohesive, structured manner (though sometimes that structure is hard to discern). There is, of course, specialisation based on skills and contributions, but the ultimate aim is the same: to develop the contributions of architectural "knowledge" generated through the design process, made tangible through the creation of architectural deliverables.[8] Ultimately, the "architect" is rarely one person, but rather a team of people with a common vision to realise the production of deliverables in a coherent manner through the use of a range of skillsets.

Finally, it is also important to note that, while not all participants identified as "architects" carry the credential of "architect" as recognised by the State of New South Wales (NSW) (or relevant jurisdiction), all are integral to the architectural process.[9] This is not to argue semantics, but to establish a definition that will be important throughout the next three chapters. I use the general term "architect" to refer to each member of the architectural team, as the term "designer" could

7. The range of architectural roles also highlights the division of architects into "authors" and "workers". As in any industry, the definition and delineation of work creates a hierarchy and a division of labour. The architectural deliverables, explicit and codified within contracts, are the product of labour undertaken by certain architects, while others are responsible for managing the production. Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech, eds., *Industries of Architecture* (London: Routledge, 2016), 6.
8. Roles in architectural practice have become notably stratified due to the adoption of technology used in the design process. Sumati Ahuja, "Professional Identity and Status: An Ethnography of Architects in Professional Service Firms" (PhD diss., University of Technology Sydney, 2018); Mats Alvesson, "De-Essentializing the Knowledge Intensive Firm: Reflections on Sceptical Research Going against the Mainstream," *The Journal of Management Studies* 48, no. 7 (November 2011).
9. As a licensed architect in the US, I formerly advocated for a narrow definition of "architect". However, this research has broadened my understanding of the term in order to better capture the role of the architect, not as a singular person, but as a collective organisation comprised of licensed and non-licensed practitioners, generating architectural outputs.

include other members of the team outside the architecture firm—everyone who touches the design process, from consultants to the general public, can be seen as having an influence in the design.[10]

In this and subsequent chapters, I will reference specific architects when necessary for understanding the trajectory of the design process, using the letter designations established in this section. However, when the word "architect" is used generically, it may represent a singular person within the architectural studio, a collective understanding of participants in the architectural studio, or merely a projection of a "typical" architect.

Transport Spaces, Urban Spaces, People Spaces

When Londoners first descended below ground to board trains around the capital in 1863, it was out of necessity.[11] The conditions of the journey were decidedly treacherous, if not torturous; the dimly lit platforms were made even more harrowing by the inky black smoke emitted by the steam locomotives used to haul the carriages.[12] While the station designers did their best to ameliorate the impact of the traction technology of the time, even admitting daylight through lightwells along the rear of the platforms, passenger experience in subterranean stations was, by all accounts, quite bleak.[13] More than 165 years later, however, transport infrastructure in London stands in stark contrast to those early stations. Whereas the first lines of the Underground were developed by private corporations, today's investments are undertaken as truly *public* transport—a trend reflected in most major cities throughout the world.[14] The under-construction Elizabeth Line, also known as Crossrail, epitomises global trends in station design.[15] Stations are acknowledged as

10. Dana Cuff posited "that every individual with a hand in the design process is a designer—the client, the engineer, the contractor, the inhabitant." This approach allows the traditional sense of design as an act of creation/drawing to be expanded to incorporate multiple inputs. With design conceptualised as a participatory process, the architect becomes free of authorship and his role can be explored outside the bounds of a traditional conception of what architects do. Dana Cuff, *Architecture : The Story of Practice* (Cambridge, MA: MIT Press, 1991), 61.
11. London is used as an example because the system has, in its 168 years of service, highlighted many of the characteristics and trends evident in systems throughout the world.
12. One need only go to platforms five and six of Baker Street Station and imagine them without electric lighting to understand just how grave the conditions were in the early years of the Underground. Christian Wolmar, *The Subterranean Railway: How the London Underground Was Built and How It Changed the City Forever* (London: Atlantic House, 2005), 38.
13. Mark Ovenden, *London Underground by Design* (London: Penguin Books, 2013), 18-19; Wolmar, *The Subterranean Railway*, 43-45.
14. Sydney is uniquely positioned, with the State Government having always held control of the transport offerings in the region, as described in Chapter 1.
15. The system not only epitomises trends but serves as a trend setter and benchmark for other systems around the world. Not unlike Whitton in 1855 or Bradfield in 1915, the designers of the Sydney Metro today often compare to and borrow

part of the overall "civic realm" of the city, integrating not only transport infrastructure but landscape and public domain improvements into the scope of works.[16] The integration of transport facilities into a larger urban strategy acknowledges the shift from transport as service to transport as an urban-shaping tool, with public transport seen as part of creating "a better environment" in cities.[17] With the coupling of lofty urban ambitions and the development of transport, the design of transport becomes an element of broader urban design strategy.

The Arc of Station Architecture

The history of changing attitudes towards the design of urban rail facilities transcends borders and decades. In the development of transport infrastructure, emphasis has often been placed on function, with stations viewed as spaces of conveyance and designed for utility.[18] As urban rail transport proliferated, some systems embraced design as a point of differentiation to encourage patronage via the provision of amenity and a distinct identity within the urban context. Additionally, design was often leveraged to represent supremacy—either by one private enterprise over another or by governments to underscore power and promote social causes.[19] This desire to demonstrate government power was leveraged across the political spectrum, with the might of Stalinism on display in the Moscow subway in the same way that Johnson's "Great Society" was reinforced through the design of the Washington, DC Metro.[20] Similarly, the aesthetics of Bradfield's City Railway (described in Chapter 1) sought to establish Sydney as a city on par with those in Europe,

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from the processes and design ambitions of Crossrail. The ambitions for the project beyond infrastructure are clearly demonstrated in its design. Sarah Allen, ed., *Crossrail: The Art of the Build* (London: Crossrail Limited, 2018).

16. Hugh Pearman, "London's New Civic Realm," in *Crossrail: The Art of the Build*, ed. Sarah Allen (London: Crossrail Limited, 2018), 23-25.
17. Peter Hall and Carmen Hass-Klau, *Can Rail Save the City? The Impacts of Rail Rapid Transit and Pedestrianisation on British and German Cities* (Aldershot: Gower, 1985); Brian Richards, *Future Transport in Cities* (London: Spon Press, 2001).
18. This approach manifests in two ways, with a focus on utility driven either by limited resources or by the idea that, to provide the most good for the most people, aesthetics could be eschewed for function (e.g. Mumbai, early stations in Brussels, Stockholm, and Singapore). Austerity can also be understood in the context of monetisation, with privately developed lines and systems focusing on limiting the cost of infrastructure by prioritising utility over appointment and amenity, reducing initial outlay and long-term maintenance costs (e.g. New York, Chicago, and Sydney Airport Link).
19. This approach is illustrated in cases where competition between service providers required differentiation of their services, reinforced through design (i.e. Leslie Green's work for the Underground Electric Railways Company of London), or where government sought to tap into the branding approach by establishing a single, distinctive theme to create a cohesive identity across an expansive network (i.e. Copenhagen's Metro). Ovenden, *London Underground by Design*, 34-35, 65-69.
20. Karen L. Kettering, "An Introduction to the Design of the Moscow Metro in the Stalin Period: 'The Happiness of Life Underground'," *Studies in the Decorative Arts* 7, no. 2 (2000); Zachary M. Schrag, *The Great Society Subway: A History of the Washington Metro* (Baltimore: The Johns Hopkins University Press, 2006).

much in the way North Korea highlights its subway system as emblematic of its prowess and global relevance.[21] All of these design strategies are further tempered by societal expectations of the role of transport infrastructure, technology, and the *zeitgeist* for style and scale of transport spaces.

Urbanism and Transport

Beginning in the 1980s, transport architecture's ambition to express its relationship with broader societal expectations, including the development of urban nodes, coincided with the adoption of the principles of New Urbanism by governments seeking to shape cities through the development of transport infrastructure. The recognition of transport design as a contributor to the public good merged with a push toward urban sustainability and principles that emphasised the creation of "human habitats" to address "social and political relationships".[22] The identification of design decisions and placemaking as political acts extends Lefebvre's conceptualisation of politicised space and firmly locates architectural actions as, if not overtly political, subject to the political contexts in which they are created.[23] This can be read in opposition to the large-scale, top-down planning undertaken throughout the world during intensive urbanisation (corresponding with the proliferation of urban railways between the 1870s and 1970s), which provided the context for the development of the systems discussed in the previous section.[24] Notably, the diverging approaches were united by the involvement of architects (and other design professionals) in the espousal and implementation of such strategies.[25]

Bolstered by the founding of the Congress for the New Urbanism (CNU) in 1992, the ideas coalesced into "a design and social movement", propagating the concept of design for the

21. "North Korean Metro Trainset," *Railway Gazette International* 171, no. 12 (December 2015).
22. David Brain, "From Good Neighborhoods to Sustainable Cities: Social Sciences and the Social Agenda of the New Urbanism," *International Regional Science Review* 28, no. 2 (April 2005): 233, https://doi-org.ezproxy.lib.uts.edu.au/10.1177/0160017605275161.
23. Ray Lucas, *Research Methods for Architecture* (London: Laurence King, 2016), 141-47; Henri Lefebvre, *The Production of Space* (Oxford: Blackwell, 1991).
24. While representing a vast array of urban approaches, the numerous plans (realised to various degrees) developed by architects and planners, including Howard's Garden City (1898), Griffin's Canberra plan (1913), Corbusier's Ville Radieuse (1930), Wright's Broadacre City (1932), and Costa's and Niemeyer's Brasilia (1956), adopted a heavy-handed approach to design of public space, and integrated ideas of movement to and through the city. These plans point to embodiment of political dynamics (and the role of the architect) in the creation of urban form. In each instance, the visual representations of the potential for these cities were leveraged to encapsulate the nature of the designer's social vision.
25. Peter Calthorpe, Lars Lerup, and Robert Fishman, eds., *New Urbanism: Peter Calthorpe vs. Lars Lerup*, vol. 2, Michigan Debates on Urbanism (Ann Arbor, MI: The Regents of the University of Michigan, 2005), 12.

experience of the everyday urbanite, and manifested in the growing role of future-user concerns in design decisions.[26] The New Urbanist ideals, including concern for individual experience and the broader impact of the design of transport spaces on their context, was codified by Peter Calthorpe—a founding member of the CNU—in his branding of such developments as transit-oriented development (TOD).[27] TOD was rooted in Calthrope's explorations of suburbanising cities and sought to address the potential for hubbing of density around transport facilities to create (or bolster existing) polycentric aspirations.[28] Since Calthorpe coined the term, "TOD" has been co-opted and applied liberally to developments around the world that integrate transport, although often with the loss of the attributes embodied in Calthorpe's idea.[29] Still, despite contention around the New Urbanist principles (and the style most closely associated with them, Neotraditionalism), the ideals of designing for everyday urbanites persisted, and have left their mark on both those who commission plans and those who create them, including architects.[30]

TODs to Tactical Urbanism to TODs

While TODs and New Urbanism more broadly precipitated discourse and action around the conceptualisation of urbanity and transport in the context of human-centric environments, a more democratised application appeared at a scale not beholden to mega investment.[31] Fittingly, the design of space *for* the public was adopted *by* the public, allowing people most impacted by the urban form to express and implement their visions. The adoption of principles of human-centric design in urban areas outside of formal government-led implementation began at the micro-scale, with the emergence of tactical urbanism in the early 2000s and its proliferation in the 2010s. The

26. Calthorpe, Lerup, and Fishman, *New Urbanism: Peter Calthorpe vs. Lars Lerup*, 12; Peter Calthorpe, *The Regional City: Planning for the End of Sprawl*, ed. William B. Fulton (Washington, DC: Island Press, 2001).
27. Ian Carlton, "Histories of Transit-Oriented Development: Perspectives on the Development of the TOD Concept," (IURD working paper 2009-02, Institute of Urban and Regional Development, University of California, Berkeley, Fall 2009), https://escholarship.org/uc/item/7wm9t8r6.
28. These ideas predate Calthorpe. Peter Calthorpe, *The Next American Metropolis: Ecology, Community, and the American Dream* (New York: Princeton Architectural Press, 1993). Carlton, Histories of Transit-Oriented Development, 5.
29. Sometimes beneficially eschewing the formulaic and often sterile qualities for which New Urbanism has been critiqued. Carlton, "Histories of Transit-Oriented Development," 22.
30. Karl Besel and Viviana Andreescu, eds., *Back to the Future: New Urbanism and the Rise of Neotraditionalism in Urban Planning* (Lanham, MD: University Press of America, 2013).
31. The ideals of New Urbanism emerged in the waning days of large-scale transport investment by western governments. No fewer than 28 rapid transit systems opened around the world in the decade before the formation of the CNU, which roughly coincided with the start of the global recession in the early 1990s and the subsequent slowing of major transport project development.

term framed planning of places as a factious relationship between the people and past planning principles, arguably a microcosm of wider polarisation and the "us vs them" culture of urban dwellers vis-à-vis the government, which was ostensibly the entity tasked with the design of urban spaces.[32] This trend signified a bottom-up approach to the implementation of principles of designing public space for public occupation at a localised level, embodying the Marxist ideals of Lefebvre a half-century prior.[33] The rise of tactical urbanism offered residents of the city the opportunity to instate changes that could positively impact the urban realm, while simultaneously providing developers and governments the opportunity to let the market test ideas that might have been unpalatable to implement on a larger scale due to cost, time constraints, or bureaucratic encumbrances.[34] While the tactical urbanism movement and the implementation of its principles started in the streets, it was soon sanctioned by governments; a move that could be seen either as the altruistic adoption of ideas that had general public support, or as strategic pandering.[35] As new large-scale urban projects such as TODs adopted techniques tested in tactical urbanism—pocket parks, reclaiming of space long dedicated to private vehicles, and a focus on catering to pedestrians, active, and public transport—advocacy for human-centric ambitions became professionalised.[36]

The Architect and the "Public Good"

Joseph Rykwert contended that architecture "is primarily concerned with the public good."[37] Of course, this altruistic take on practice has limitations, but it is in the context of public transport, a

32. Lesley Bain, *Living Streets: Strategies for Crafting Public Space*, ed. Barbara Gray and Dave Rodgers (Hoboken, NJ: John Wiley & Sons, 2012), 16-22. The idea of urban dwellers organising to resist planning by heavy handed government is most associated with Jane Jacobs. Jane Jacobs, *The Death and Life of Great American Cities*, Vintage Books ed. (New York: Vintage Books, 1992; repr., first published 1961 by Random House).

33. Lee Stickells, "The Right to the City: Rethinking Architecture's Social Significance," *Architectural Theory Review* 16, no. 3 (December 2011), https://doi-org.ezproxy.lib.uts.edu.au/10.1080/13264826.2011.628633.

34. Mike Lydon and Anthony Garcia, *Tactical Urbanism: Short-Term Action for Long-Term Change* (Washington, DC: Island Press, 2015).

35. Janette Sadik-Khan and Seth Solomonow, *Streetfight: Handbook for an Urban Revolution* (New York: Viking, 2016).

36. Paulo Silva, "Tactical Urbanism: Towards an Evolutionary Cities' Approach?," *Environment and Planning B: Planning & Design* 43, no. 6 (2016), https://doi.org/10.1177/0265813516657340; Krzysztof Herman and Maria Rodgers, "From Tactical Urbanism Action to Institutionalised Urban Planning and Educational Tool: The Evolution of Park(ing) Day," *Land* 9, no. 7 (2020), https://doi.org/10.3390/land9070217; David Webb, "Tactical Urbanism: Delineating a Critical Praxis," *Planning theory & practice* 19, no. 1 (2018), https://doi.org/10.1080/14649357.2017.1406130.

37. Joseph Rykwert, "Architecture and the Public Good," in *Research and Practice in Architecture*, ed. Esa Laaksonen, Tom Simmons, and Anni Vartola (Helsinki: Alvar Alto Academy, 2001), 11-12. The sentiment reverberates throughout contemporary practice. Bill Caplan, *Buildings Are for People: Human Ecological Design* (Oxfordshire: Libri Publishing, 2016); Paul Brislin, ed., *Human Experience and Place: Sustaining Identity*, *Architectural Design* 6 (Hoboken, NJ: Wiley, 2012).

type inherently imbued with opportunity for "public good"—that the role of architect as professionalised advocate for human-centric ambitions emerges. In the case of the Sydney Metro, Transport for New South Wales (TfNSW) emphasised "the customer is at the centre of everything we do in transport."[38] It was in this context that Architect F created the octopus sketch "through the lens of the traveller", to illustrate the customer at the centre—both figuratively and literally—of the design. Notably, the octopus is not a distinctly Sydney creature; the ideas embodied in the sketch creep across the oceans and underpin architectural contributions in transport facilities worldwide.[39] From here, we dive in.

Advocacy and Ambition: Knowledge Expressed Through Sketch

Design is an inherently collaborative process. In the earliest conceptual stages of complex projects, consultants and experts across a range of disciplines come together to review the brief, exchange ideas, and share knowledge to lay a foundation from which the design can be developed.[40] The knowledge contributions of many participants outside of architecture are straightforward, with technically clear parameters: structural and mechanical engineers provide inputs in the form of potential systems to be used, lawyers provide legal inputs in the form of contracts outlining obligations of each party, financiers provide fiscal parameters for the project, and the client and relevant stakeholders provide inputs about operational requirements and desired functionality in largely prescriptive metrics.[41] However, architectural knowledge contributions, while just as relevant to shaping the process of design in the long-term, are more ephemeral and difficult to grasp.[42]

38. NSW Government, *Sydney Metro City & Southwest: Final Business Case Summary*, Sydney Metro (2016), https://www.sydneymetro.info/sites/default/files/Sydney%20Metro%20CSW%20Business%20Case%20Summary.pdf. Brain, "From Good Neighborhoods to Sustainable Cities," 233. Carlton, "Histories of Transit-Oriented Development."

39. A project manager for MTPs, who has worked in the UK and Sydney, identified part of the architect's role as to "define the space and create a better environment for the customer." Architect NK, interview with author, 17 October 2019.

40. The founding principles morph and shift as professionals continue to contribute their specialised knowledge to the project until a final design response is developed, documented, and delivered, but there must be a starting point.

41. This represents a few of the dozens of specialty consultants who participate in the design process. While much input from specialists is performative or quantitative in nature, client input is unique in that it is often in the form of both performative parameters (e.g. passenger volumes, modes of acceptable vertical transport) and aesthetics parameters (e.g. all signage must be teal, stations will look modern). This is not unusual in contemporary projects with sophisticated clients, but the volume of information provided by the client in the MTP context makes them unique in their specific expertise and the amount of work that has gone into developing the program and parameters for the project. The client for these projects typically has experience in the type and comes to the table with preliminary work done, potentially by another team of architects and specialists who have already completed a first phase of design to create parameters for the subsequent design development; as was the case in this instance.

42. The contract for the delivery of services for a transport project is comprehensive and discursive, laying out the performative requirements the design must achieve and the means of representation the architect is required to use.

Many of the architect's contributions at the outset of a project—as well as continually through design development—centre not on a physical or quantifiable type of knowledge, but on the definition of conceptual ambitions relating to the future *experience* of the station. These contributions align with the evolving nature of urban transport facility design outlined in the previous section. These are taken on by architects to provide the conceptualisation of and documentation for a design that will fulfil the ambitions of the clients who are interested in delivering transport spaces to serve customers and the city. When these architectural ideas of *experience* are in genesis, existing only in the mind of the architects and derived from their own experiences and knowledge of precedent, it is imperative for this knowledge to be translated into a medium appropriate for dissemination and clear communication of its applicability to the wider team and client. To this end, architects turn to visual methods integral to practice.

Describing Experience through Sketch

The production of "descriptive" as opposed to "prescriptive" visual imagery was used as a means of communicating experiential intent, which typified the conceptual and qualitative architectural contributions.[43] However, early architectural sketches presented a catch-22, as illustrated by the octopus, as the project developed. At the sketch's inception, the architect projected qualitative ideas of a potential future state without being able to map those ambitions onto underlying, fixed, quantifiable parameters. Accordingly, the role of such an embryonic representation was to illustrate what Bernard Tschumi characterised as "architectural realities" to exemplify qualitative ambitions without necessarily being tethered to the tectonic realities of a future building.[44] Rather than representing quantifiable values or results of calculations, such as

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However, the parameters for *what* is contained within the architectural deliverables, beyond their general fitness for purpose, is not codified in any aesthetic sense. Lendlease, "Tender Services Deed," (8 June 2018); Lendlease, "Professional Services Deed, Version 2.1," (August 2019).

43. Architectural practitioner and theorist Bernard Tschumi categorised drawings into two types, descriptive and prescriptive. Those created to express ideas or explore—including to examine concepts of what a space *could* be—fall under the first category, with more technical drawings falling under the second. Bernard Tschumi, "Operative Drawing," in *The Activist Drawing: Retracing Situationist Architectures from Constant's New Babylon to Beyond*, ed. Catherine de Zegher and Mark Wigley (New York: Drawing Center, 2001), 135. For more exploration of the communication of ambiance or qualitative parameters through drawing, see Igor Marjanović and Jan Howard, eds., *Drawing Ambience: Alvin Boyarsky and the Architectural Association*, Alvin Boyarsky and the Architectural Association. (St. Louis: Mildred Lane Kemper Art Museum, 2014). This dichotomy stands in contrast to sketching as a means of "architectural thinking," which ties back into the concept of research by design, as discussed in Chapter 2. Filiz Öngüç, "Revealing the Sense of Place in Architectural Thinking," *The Fifth Column* 7, no. 4 (1990), https://fifthcolumn.mcgill.ca/article/view/466.

44. Tschumi, "Operative Drawing," 137.

those done for potential engineered elements, the octopus embodied a future state of the built form in terms of qualitative ambitions. In turn, these qualitative ambitions clearly correlated with an understanding of the future state of the station spaces as places for people.

This understanding of drawings as a means of translating architectural ideas to demonstrate a future state echoed the ideas of Robin Evans and Juhani Pallasmaa, though notably opposed their more literal, tectonic "translation" in favour of representation of experience.[45] In the case of the octopus, the lack of literal translation from sketch to rendering, encumbered by the imposition of technical parameters, demonstrated the sketch's purpose in representing solely a qualitative reality. The premise of Evans's assertions, echoed by Pallasmaa, was that the architectural drawing was something concocted in advance of the realisation of the entity it represents. While this may be true in a physical sense, the purpose of the architectural sketch in the contribution of architectural knowledge to the qualitative definition of space was based on the architect's understanding of collected precedent and experience, amalgamated into a cohesive package through thought, consideration, and expertise. The material that informed the creation of the sketch was just as important as the future state it projected; it both referred to existing ideas and projected a potential future application, rather than serving as fixed instructions to be built.

The octopus sketch was a manifestation of architectural knowledge in respect to the advancing of the human-centric conditions of the future state of public space and place, which are so highly valued in projects of the type. The most basic form of communication of this intangible architectural knowledge of experiential intent was simple and reductivist, conveying the narrow scope of ideas (e.g. natural light, inherent wayfinding, and a space that generated awe) without complication. This representation of the experience-based knowledge was embodied in its purest form as a sketch, unencumbered by many of the pragmatic realities that ultimately defined the

45. While Evans's assertion that the architectural drawing is a means of translating architectural thought into a future realised tectonic state can broadly be understood as aligning with the characterisation of sketch as reflective of qualitative ambitions, his use of the example of James Turrell's light sculptures and the inability of the spatial and experiential nature of them to be communicated by drawings underscores the limitations of this framing. Similarly, Pallasmaa's framing of the architectural sketch as "mediating ideas to others" is sound, but his emphasis is largely dependent on drawings that are more technical. Robin Evans, *Translations from Drawings to Buildings and Other essays*, ed. Richard Difford and Robin Middleton (London: Architectural Association, 1997); Juhani Pallasmaa, *The Thinking Hand: Existential and Embodied Wisdom in Architecture* (Chichester, UK: Wiley, 2009), 60.

design.[46] It then stands to reason that the sketch as a means of representation is leveraged for strategic purposes, allowing for what Evans calls the "unlikeness" of a drawing to the thing it is ultimately representing; the inherent conflict between the representation and a tectonic reality is then not a liability.[47] Ultimately, while Pallasmaa's characterisation of architectural representation by hand is heavily romanticised, his assertion that "architectural quality is manifested in … the experience" as represented through drawings plays out in the role of the architect as the establisher of the qualitative, human-centric ambitions of the design.[48]

When Architect F first drew the octopus sketch, it was his intention to communicate ambitions for the qualitative possibilities of the adit connection from platform mezzanine to station concourse. In this way, the sketch was devised to highlight the pertinent features of the space through selective inclusion. In the sketch, the space is reduced to a cylindrical open volume, escalators, and circles to represent skylights. The scene is then defined by the three figures, glancing upward toward the skylights, guiding the observer of the sketch to do the same: the key to the scene is the forced perspective upward to the skylights. The human figures and the actual human observers of the sketch alike look toward the defining architectural element—the feature that will make the station a unique and positive experience for future users. This role of architecture and the strategy for realising it is not new and is not limited to transport facilities, of course. The concept of form imbued with the ability to trigger human feeling and evoke emotion is discernible throughout the nearly two centuries since the professionalisation of architecture.[49] Art theorist Heinrich Wölfflin (1864-1945) noted in his doctoral thesis (1886) the role of architecture in the expression of states of human emotion and feeling related to a design's "form strength".[50] Simultaneously, architect Otto Wagner employed those principles in the transport design context, seeking "an aesthetically satisfying way" to resolve the design of the Vienna *Stadtbahn* (1896) for future users.[51] In realising the design as *gesamtkunstwerk*, considering not only the aesthetics as influencing the human-centric

46. Sketches represent a small portion of the overall deliverables of the project, but it is the sketch that carries much of the burden of the representation of qualitative ambitions and intent.
47. Evans, *Translations from Drawings to Buildings and Other essays*, 154; Tschumi, "Operative Drawing," 137.
48. Pallasmaa, *The Thinking Hand: Existential and Embodied Wisdom in Architecture*, 104.
49. Professionalisation of architecture allowed for the carving out of a niche, which has morphed over time. Dana Cuff, *Architecture: The Story of Practice* (Cambridge, MA: MIT Press, 1991).
50. Henry Francis Mallgrave, "Introduction," in *Modern Architecture: A Guidebook for His Students to This Field of Art* (Santa Monica, CA: Getty Center for the History of Art and the Humanities, 1988), 23.
51. Mallgrave, "Introduction," 27.

ambitions through appearance, but function as well, Wagner positioned the architect as advocate for *experience* of transport facilities.[52] Notably, Wagner's hand drawn representations included people experiencing the designs he conceived, positioning the future user's experience within the remit of the architect and highlighting not only the generation of space through appearance, but also the *experience* of it as functional.[53]

From Wagner to Architect F, the use of the perspective of the future user in the generation of visuals to highlight features that they deemed both aesthetic and functional is clear. In the octopus sketch, this included both the general sense of experience and the demonstration that functional benefit is rendered by design, with the eyes/skylight important for both look and operation. This substantiated the distinctly unquantifiable contribution of the architect in relation to the human-centric ambitions of the project. In melding that representation of *experience* with the client's insistence that the customer is at the "centre of everything", the architect created a defensible position of qualitative ambitions, probing the question of how to craft the experience comfortably within the confines of architectural knowledge, with the support of the client.[54] It is important to note the support of the client; all the MTPs that formed the basis for this research were executed in competitive, capitalistic contexts, so the architect was required to demonstrate their benefit to the client, both to win the project and maintain support to leverage the positive outcomes in future tendering. The architect, in advocating for human-centric ambitions, was not an artist seeking to generate beauty and function of space within the context of the design of transport facilities; rather, the architect was in the business of designing transport facilities, thus fulfilling a role the client deemed necessary.[55] The success of this strategy is clear, as MTP design has become big business for some firms, allowing for global expansion of their practices.[56]

52. David Patrick Frisby, "Metropolitan Architecture and Modernity: Otto Wagner in Context" (Master's thesis University of Glasgow, 1998), https://www-proquest-com.ezproxy.lib.uts.edu.au/docview/2162849856?accountid=17095.
53. Frisby, "Metropolitan Architecture and Modernity: Otto Wagner in Context."
54. Many of those whom I came to know through this research noted their interest in making a positive contribution to the urban realm, and expressed a sense of pride in creating spaces that might someday improve the commute of the masses. However, within the context of production in the corporate environment, these feelings are clearly tempered by contractual obligations and commercial interests. Architect NE, interview with author, 4 November 2019.
55. Cuff, *Architecture*; Thomas, Amhoff, Beech, eds., *Industries of Architecture.*
56. Throughout my research, the same firms often appeared again and again, across different projects and on different continents. This is not surprising, given the specialised nature of the work. Architects who have done work on transport facilities in other countries leverage that experience into job opportunities elsewhere. Because transport design at a large-scale is still a very small sector in the grand scheme of architectural commissions, and because the experience is so specific, firms who have made a name for themselves in the typology have found global success with it.

Whatever the reasons for the architect's move into the role of advocate for human experience—somewhere between altruism and good business—it was made possible by heightened general interest in the ability of public spaces to enhance daily urban life and formalised through the parameters established for the creation of new transport facilities. Where once the designers of transport facilities were preoccupied with the function of the stations and the expeditious flow of passengers, the architect of modern transport projects furthers the potential of the human experience within the design process, advocating not just for the design of spaces with aesthetics as an appliqué but, rather, for a holistic ambition of *placemaking* in which the aesthetic and functional dimensions of the design result in a distinct identity, utility, and experience.[57] This ambition was directly correlated with the contributions made by the architect within the larger project team through the production of the octopus sketch. The architect became both emissary of and advocate for the ambitions of future users.

Developing the Knowledge Set

To accomplish this, the architects leveraged knowledge from past projects and more general experiences to generate ideas about how to respond to the needs present in the project and the ambitions of what the project could provide users beyond the "typical" transport experience.[58] They drew inspiration not only from architectural experiences, but from art, product design, or something wholly unrelated. One architect spoke of the possibilities: "We are often pulling up lateral examples: Why can't it be like a nightclub? Why can't it be like a school? Why can't it be like a playground? Why can't it be all these different sorts of things? So, pulling in different and diverse experiences from around the world is just [part of what architects contribute]—the world is our oyster."[59] By asking these questions and gauging the response from the participants, including the client, the architect

57. The growth of the idea of placemaking within architecture and urban design emerged first in the 1960s from the ideas of Jane Jacobs and proliferated in the 1990s and 2000s as a strategic rebranding of design services in the urban realm. This has grown to include transport facilities. John Friedmann, "Place and Place-Making in Cities: A Global Perspective," *Planning Theory & Practice* 11, no. 2 (2010), https://doi.org/10.1080/14649351003759573; Jacobs, *The Death and Life of Great American Cities*.

58. The "typical" transport experience was always framed in what local users already experienced—e.g. crowded platforms, old infrastructure. Ideas were framed as something new, usually imported from elsewhere. Fresh ideas trialled overseas piqued the most interest, which is a phenomenon not unusual in the architectural discourse of Australia. Robert Freestone, Davison Gethin, and Richard Hu, *Designing the Global City: Design Excellence, Competitions and the Remaking of Central Sydney* (Singapore: Palgrave MacMillan, 2019).

59. Architect F, interview with author, 4 September 2019.

sought to identify the ambitions for the project and to "get an alignment of thinking with who the key decision makers [were] around the team—who's actually going to say 'I like that, let's do that'—and trying to understand who they are and what makes them tick."[60] By aligning his design responses with his understanding of the ambitions and attitudes of the decision makers, the architect modified his approach and his selection of ideas to explore and present. By then providing input at the appropriate time through media such as sketches, precedent images, and verbal contributions, the architect substantiated his knowledge contribution and garnered support or, in the case of tendering, contributed to winning the project.

This type of input from the architect is easily misconstrued as a broad knowledge of precedent or a unique creative knack, whereas it was actually a manifestation of his ability to represent the content of the architectural contribution in a way that would garner client support in pursuit of their vision.[61] This reading of the client is not a creative aspect of architectural practice but, rather, an element of the success of the firm as business.[62] The interplay between success in business and the provision of representations of the human-centric knowledge contributions of the architect is clear in the continual deployment of the octopus sketch as the embodiment of a concept the client supported. The idea transcends time; Otto Wagner identified this as a necessary skillset in the architect, explaining that "the ability to perceive needs" is less a matter of clairvoyance and more the result of knowledge gained through experience on projects.[63] Such perception is crucial to avoid the consequences that could follow if the needs are not understood correctly. An architect could just as easily alienate a client (or design team members) as intrigue them with an idea that does not align with their desires or expectations; an understanding of the bounds of acceptable design exploration is key. Failure to establish a positive relationship at the outset of a project—especially one as complex and lengthy as a transport infrastructure project—could jeopardise the

60. Architect F, interview with author, 4 September 2019.

61. Cuff, *Architecture*; Jeremy Till, *Architecture Depends* (Cambridge, MA: MIT Press, 2009). One of the first things I was told in my Introduction to Architecture class in my first semester was that "engineers learn more and more about less and less, while architects learn less and less about more and more." In speaking with other architects around the world and reading on the subject of architectural education, it is clearly a pervasive concept in the industry.

62. Cuff, *Architecture*. This concept is obviously not limited to architecture but is rather a basic concept of business—know your audience. However, the divorce of business acumen from the design process within the profession is documented by Cuff and is still prevalent in the design industry today. It is then necessary to state that this component of the stereotypical "business" side of practice is actually leveraged as a design tool.

63. Otto Wagner, *Modern Architecture: A Guidebook for His Students to This Field of Art*, trans. Henry Francis Mallgrave (Santa Monica, CA: Getty Center for the History of Art and the Humanities, 1988), 68.

architect's ability to complete the project successfully (or, in the case of tendering, win the project in the first place), or dash their prospects of working with this or other clients in the future.[64]

While patterns of exploration can be developed, there are no set metrics for the process of architectural discovery and, especially in the early stages of a project, a range of ideas are explored. The best of these—as both understood within the architect's professional perceptions and informed by what the client might have an interest in seeing developed—are then pursued and are ultimately manifested in the design development, thus transforming the ideas of an experience into a substantive influence on the tangible delivery of the design itself. In this way, the role of the architect is understood through the development of two key facets of architectural knowledge: (1) the ability to leverage existing experience in the form of previous works or precedents to generate deliverables that spatialise the concept to the client and design team through emotive visual representation; and (2) the ability to filter those ideas through those of the client and design team in order to build a positive relationship which will be paramount in the development of the design. The octopus, despite representing a visual means of architectural expression, can thus be seen not as a vehicle for some creative genius, but as a prudent strategy for representing the client's human-centric aspirations for the spatial quality of the station.

Identifying Opportunity Space

The previous section established the understanding that public transport space design demands that attention be paid to human-centric ambitions, that architects have become the bearers of these ambitions, and to accomplish this they must gain and maintain support from the client. The next step is to understand how and where architects deploy this role. A key aspect of the generation of the octopus sketch was the identification of where the architectural ambitions could best be leveraged and represented in an impactful way. Transport facilities are largely comprised of spaces for movement or transition, meaning that they are dedicated to the efficient and orderly flow of people.[65] Corridors and vertical forms of transport lead customers in a linear progression from street to concourse, through the ticketing barriers, and down to a platform—or the reverse if they

64. Cuff, *Architecture*.
65. Architect P, interview with author, 17 September 2019.

are alighting from a train. Interchange stations similarly have connections between platforms or modes that are predominantly defined by their purpose of movement.[66] Added to these prescriptive sequence demands, the costs associated with subterranean construction and the constraints dictated by tight urban areas further restrict the opportunity space for architectural contributions. The allocation of finite architectural resources within the transport context requires the architect to select impactful spaces where resources (both design development time and, later, fiscal resources for materials and specific interventions) can generate the most positive outcomes for the greatest number of people for the greatest amount of time.

In defining where to focus architectural energies (and, therefore, the focus of the contribution of knowledge), participants identified threshold or transition points, which they referred to as "decision making points", "dwell places", "pain points", or points of orientation, as prime opportunity space to engage in interventions with the maximum impact on the human experience.[67] One architect elaborated on how the collision between the client's desires in relation to monetary constraints and the architect's willingness to limit the expenditure of energy on design development to the most impactful areas manifested within the project, noting that much of the design energy focused on threshold points in the station that marked transition points between key spaces, such as ticketed and unticketed areas, or the platforms and main concourse.[68] It is just such a threshold that the octopus represents, (see Figure 3.02).

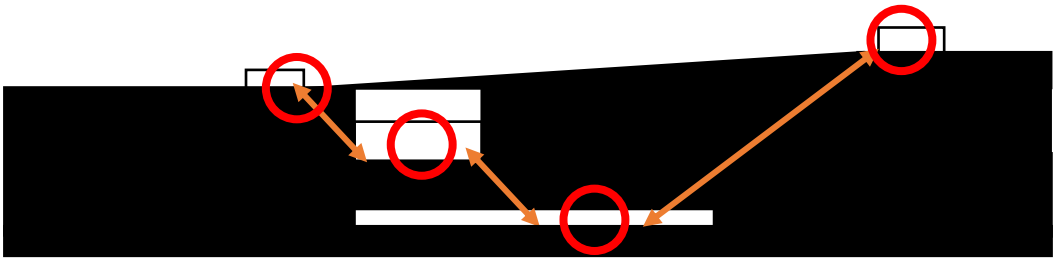


Figure 3.02 - Identifying oppurtunity spaces within a theoretical station environment.

This is not to say that architectural knowledge related to qualitative ambitions was not applied in other areas of the station. However, the large majority of time and contribution was focused on these spaces. The production and continual deployment of the octopus sketch, with its

66. Architect F, interview with author, 4 September 2019.
67. Architect N, interview with author 3 September 2019; Architect F, statement in meeting, 8 March 2019; Architect F, interview with author, 4 September 2019.
68. Architect P, interview with author, 17 September 2019.

focus on one key opportunity space, confirms the architect's understanding of its importance. In addition to representing a key transition space, the octopus sketch also responded to the wider ambition in transport to make underground spaces more inviting through the incorporation of natural light, therefore driving patronage through the creation of spaces people want to inhabit.[69]

Fusing Knowledge and Opportunity Space: The Birth of an Octopus

The octopus sketch was born from the collision of factors explored in this section: the architect's delineation of the role as advocate for the human-centric experience, the leveraging of precedent to define those ambitions within the bounds of client expectation, and the identification of opportunity space within the station. The opportunity space was the point of transition from the large underground entrance concourse—where customers would orient themselves and pass through fare gates—and the escalator adit leading to the cavern deep below street level. The concept for making a positive contribution to the human experience revolved around two very basic premises, both relating to the way in which future customers would experience the station. The primary ambition was the provision of natural light into the station to serve as a wayfinding mechanism for those emerging from below ground. By admitting natural light down the escalator shaft, the architect envisioned that customers exiting the station would be able to orient themselves quickly and intuitively to the direction of the exit. This would have the added benefit of limiting the need for signage, therefore reducing potential visual "clutter"—another of the architect's ambitions. The second, and less tangible premise was that the arrangement represented by the sketch could create a distinctive and impactful experience for the traveller, making the mundane journey through the station more engaging and potentially more enjoyable.

The architectural knowledge and opportunity to leverage it came early in the design process, due to the relatively undefined nature of the parameters to that point. Thus, large ideas were mooted by the architect in the absence of restrictive parameters, as other disciplines were also in the early stages of defining their contributions. The octopus came to life because of a discussion in which the ideas that would later be embodied in the sketch were presented and a place that could

69. Carmen Hass-Klau, *Streets as Living Spaces: Helping Public Places Play Their Proper Role* (London: Landor Publishing, 1999), 123; Pearman, "Crossrail," 25; Richards, *Future Transport in Cities*, 27.

make a difference in the customer experience of the station was identified—in other words, the contribution of architectural knowledge was fused with a place for its ultimate implementation. The sketch had to come about when it did because, if more parameters had been defined, the sketch would have appeared incongruously naïve, devoid of the constraints that would come to define the station in a more concrete manner as the knowledge contributions of other disciplines were added into the design process.

The idea of creating a memorable journey by crafting the concourse in which the skylights were located was generated in part from a discussion about a James Turrell art installation.[70] In one meeting, the idea of the form of a light room was shared as an experiential precedent, sparking the development of a design that embraced the space of the station as not just a place where customers oriented themselves, topped up their electronic tickets, and passed through the fare gates, but as a sensory experience. The conceptualisation of space in the station as not merely functional or aesthetically pleasing, but as actually *experiential* (beyond the experience of taking public transport) allowed the architectural contribution to be understood in the context not just of providing usability for patrons, but in the creation of a distinct *place* to invoke civic pride and/or to differentiate the system and city on a scale beyond that of transport. The oft-repeated architectural ambition of design "through the lens of the customer"—and of the transport agency—was key to this. By seeing the architectural design intent in terms of generating a sense of ownership (or at least a feeling of transport as a space that customers *want* to use instead of *have* to use), the architect made his services invaluable to the mission of the transport organisation in its pursuit of a design. This approach in one city begets its adoption in others, as each system strives to include the latest trend.

The concept was observable not just on the Sydney Metro project, but in other large-scale architectural undertakings around the world. The MTP architects of one firm, in individual interviews spread throughout the day and at differing studios around the city, all used the same term to describe their architectural aims: "joy."[71] One architect who has worked on transport facilities extensively in the last decade opined, in a view shared by other interviewees:

70. Architect F, note written to author.

71. Architect NB, interview with author, 16 October 2019. Architect NC, interview with author, 4 November 2019. Architect ND, interview with author, 4 November 2019. Architect NE, interview with author, 4 November 2019. Architect NF, interview with author, 4 November 2019.

> *They've [transport facilities] got to be beautiful, joyful. One of the great things about transport architecture is that you can bring beauty to the masses, almost more than any typology. We [the firm I work for] do a lot of work for commercial developers and bankers, lawyers, who are investing enormous amounts of money into their ivory towers. But, the beautiful thing [about designing transport facilities] is that it's a very democratic architecture that's for the people—mums and dads, kids, old people, tourists, students—it can be great architecture for everybody.*[72]

The democratic nature of the stations and the architect's distinctive provision of publicly accessible design was a recurring theme among architects involved in the typology. "It's about the ability for humans to engage with each other or withdraw. Stations are one of the few public realms that are still being built in our cities. A lot of spaces crafted in cities are, in effect, semi-private or private spaces. Everyone is welcome and entitled to be participating in life at a railway station."[73]

These aspirations all relate to architecture's involvement not just as a design exercise but, rather, as an opportunity for space definition, in the sense of human experience, to anchor larger *placemaking* ambitions. The concept of placemaking defined the architect's role as making contributions that were not just workable solutions to the needs of the station and its function, the generation of space, but also as the flagbearer for the consideration of people and their potential experience of spaces, contributing to an overall creation of public place associated with the station. In other words, the architect was seen to have a role not only in shaping the places of the station but, through various design decisions and contributions, to the urban space beyond. This view was rooted in the conceptualisation that the community knew best.[74] These ideas have been advocated by practitioners as diverse as Jane Jacobs and Janette Sadik-Khan, and their impact is evidenced by the current professional emphasis on the notion that, to advance a project, the implications of the

72. Architect NB, interview with author, 16 October 2019.

73. Architect NA, interview with author, 16 September 2019.

74. In 2006, the Project for Public Space sought to define the concept of "placemaking" as understood by urban dwellers around the world. Definitions included "thoughtful design", "all the little things that make a spot memorable", and "purposefully creating character and meaning in a public space". Project for Public Spaces, "Placemaking Is...", updated 31 December 2008, accessed 17 December 2020, https://www.pps.org/article/placemakingis.

design for the holistic wellbeing of future users must be considered.[75] Indeed, many prominent firms have of late defined their work by, and capitalised on—if not popularised—this way of urban thinking.[76] It is accordingly in these spaces that architects fuse opportunity and knowledge.

The concept is not unique to transport but, because transport facilities are naturally public facilities and extensions of the public domain, and because they are to be used and experienced by so many, their impact is magnified, as must be the response. One architect noted:

> *I think all projects should ultimately be placemaking projects, especially transport projects. Because these transport nodes are so important. You wouldn't need transport if there were no people, so they need to be people driven. You need to bring people together and you need to encourage people to use the assets and that will then have a knock-on impact on the environment if you encourage public transport to be used.*[77]

Regardless of how they are couched, the concepts represent an interest in envisaging how future users will interact with the spaces created through the design process. To do this, architects leverage prior experience and communicate the intentions through visual representations, such as the octopus sketch.

However, there was another key reason for the creation of the octopus sketch: it was created by the architect because it was needed to communicate the existence of the opportunity space and the potential contribution of the architects in making that space enhance the human experience—in making a *place* out of the space. Of course, the information contained within the sketch could have been communicated through a written description, but the sketch was leveraged as a presentation technique in order to increase the impact of the idea. From a pragmatic perspective, skylights are not an inexpensive proposition and, in order to justify the additional cost

75. Jacobs, *The Death and Life of Great American Cities*; Sadik-Khan and Solomonow, *Streetfight: Handbook for an Urban Revolution*. The topic was also a focus at the Australian Institute of Traffic Planning Management (AITPM) 2019 Conference held in Adelaide. Australian Institute of Traffic Planning and Management (AITPM), "2019 National Traffic and Transport Conference," (Adelaide, 30 July-2 August 2019).

76. Jan Gehl, *Life between Buildings: Using Public Space*, trans. Jo Koch, 5th ed. (Copenhagen: The Danish Architectural Press, 2001), 66.

77. Architect NE, interview with author, 4 November 19.

in constructing and maintaining the station likely to be incurred by their inclusion, their impact must be "sold". In this way, if their value is seen by the client, they will likely support the design feature as a concept and permit it to be further explored, developed, and potentially realised in the final design.

Selling the Experience

The expertise of the architect and the knowledge communicated in early interactions with the client and consultants would hold very limited power if there were no means for it to be easily represented. The generation of sketches as mechanisms of representation is a key component of the design development process, allowing the communication of qualitative information that is difficult to describe succinctly through words or data, or merely easier to understand through graphic representation. The representation choice is necessitated by the unique type of information that must be communicated: *intent* embodied in an idea of what a space could be, rather than something that is quantifiable. Because of its inherently vague and ephemeral nature, the intent captured in the sketch can be read as a value proposition, especially in the tendering phase. To achieve the desired effect, the primary intent must be the focus, even if that requires a suspension of reality and its bounds.

In this way, the sketch allows the architectural ideas to escape the black box of the architect's conceptualisation. By black box here, I am not referring to Reyner Banham's characterisation of the box as a construct of the architectural profession but, rather, to the difficulty, if not impossibility, of defining architecture's contribution to the design process.[78] The sketch is a mechanism to translate the ideas in the architect's mind into a digestible medium for consumption by the client and other design team members.[79] And, much like the early contributions of other disciplines, the architect's sketch is largely unencumbered by the realities that fall under the purview of other disciplines. The sketch, then, lays bare the architectural knowledge for consideration by others, though in a biased way, in order to advance the architect's agenda. The sketch is an item representing a potential reality, or aspect of reality, in the design to come. It is to be "sold", just as

78. Reyner Banham, "A Black Box: The Secret Profession of Architecture," in *A Critic Writes: Essays by Reyner Banham*, ed. Mary Banham (Berkeley: University of California Press, 1996).

79. This conceptualisation of the drawing as a translation echoes Evans, though in a less literal sense. Robin Evans, "Translations from Drawings to Buildings," in *Translations from Drawings to Buildings and Other Essays*, ed. Richard Difford and Robin Middleton (London: Architectural Association, 1997).

the engineer provides input on potential structural systems, their merits and pitfalls, or the lawyer advises on contractual language upon which all parties must agree. Ultimately, none of what is shared is reality until decisions start to be made; and, even then, decisions can be reversed if more information comes along that changes the parameters of that decision.

Leveraging the Sketch

The use of the sketch to capture and describe the nature of an experience, focusing on the architect's human-centric aspirations for the station, fulfils multiple needs. The sketch is a succinct and clear expression of the intent, allowing for communication of the idea to other team members and stakeholders. The octopus sketch, as a sketch created to communicate this envisioned intent, is a specific type of sketch, one that is often heralded as a work of art in its own right. The octopus was not generated as part of the discovery process of design, as a sketch to resolve, but was instead intended as a deliverable itself—a mechanism of representation.[80] This type of sketch is not to be confused with a sketch done by an architect to explore a potential solution; rather, the representational sketch, despite its seemingly innocent and gestural nature, is illustrative of a formed idea. The medium is selected as a presentation technique for a number of reasons:

1) It aligns with a public conceptualisation of what an architect does.

2) It is easy and, therefore, inexpensive to produce.

3) Its generation does not require other inputs; it is an autonomous architectural output.

4) It is gestural and vague, emphasising the concept rather than the view.

5) It can be understood quickly without the need for deep analysis of its meaning.

The first two ideas can be explained and understood quickly, are not specific to the octopus sketch, and do not deserve much attention: (1) At its most basic, the act of creating a sketch conforms to expectations of what an architect does. By leveraging a skillset that is assumed to be the

80. Till, *Architecture Depends*, 109. Till is critical of the concept of the napkin sketch as embodying the ideas of a building. While that is a reductive view of the sketch, its dismissal as a key means for quickly expressing sweeping intent in a simple way disregards its importance.

purview of the architect and one that is often not possessed by the general public—that is, the ability to generate a coherent sketch—the architect legitimises his or her contribution to the design, distinguishing it as something unique that the field can offer. Situating the sketch as a product of the architect substantiates the knowledge contained within it—the idea of the human element potential of space—as lying within the architectural domain. (2) As in any capitalistic endeavour, time is money in architecture. Architecture, as a profit-making endeavour, requires that time be spent wisely, especially by those who are at the helm of the project, as time spent on the project requires a portion of the fee dedicated to the action. Therefore, a quick sketch is an economical way of distributing information about an idea in its infancy, without dedicating much time to an idea that may not find favour and, therefore, not advance the project. Additionally, there is pragmatic value in the speed with which an architect can generate the sketch if it is being done in real time in a meeting and feeds back into the first concept of the architect as having a distinctive and unique skillset.

The next two points require a bit more exploration and unpacking. I will invoke the octopus sketch to help illustrate their significance: (3) Whether a sketch is generated in a meeting or created in the office and brought to a meeting to present, it is created to represent an idea devoid of specific context. It captures a singular moment and is generated with a specific intent—to highlight a feature or idea of a potential future state. The simplicity and reductivism employed in the sketch could make the image appear as a naïvely executed drawing, especially as it is typically generated by someone who has significant experience in other projects and is familiar with external forces that may act upon the view. However, the omission of constraints and parameters, even if they have been established within the design team, is a conscious decision to hold at bay the external influences that are not yet fully understood (or which the architect deems as flexible/fluid), in favour of a purer version of the architectural concept in order to most easily communicate the intent. [81]

This lack of recognition of external forces in the sketch is a conscious generative decision, positioning the ambitions of the architectural contribution—in the case of the octopus sketch, the visual connection between the underground adit and the skylights—above whatever realistic constraints may exist. Would it have been possible for Architect F to consult the existing information

81. Till, *Architecture Depends*, 46.

in the studio regarding the angle of the escalator shaft (something which had been determined in the Stage 1 Design and provided to the team at the outset of the tendering process) and to then calculate that the view of the skylights might not be seen from below? Theoretically, yes, but that physical reality was not relevant to the intent of what he wished to communicate. Rather, the architect recognised that parameters would act upon the same area, making the condition presented in the sketch unfeasible as the design evolved. The octopus sketch established the idea as a benchmark of the *intent* of the space, if not its actual form. It was then not a naïve action to omit items which the architect likely knew from previous experience would ultimately act upon the space he depicted.

That still leaves the question of why a professional would present a sketch that does not represent a possible reality to a group that had been tasked with generating a visual representation, as described in the example that introduced the chapter. After all, the architect generated both the sketch and the digital model with which the rendering was to be generated. And yet, the two cannot be reconciled. How is this possible? Of course, the first explanation is that "the architect" in question is actually a large organisation, and Architect F who completed the sketch of the initial concept and then briefed the team on the design intention embodied in the sketch is not the same as the architect(s) who "built" the digital model in the computer, nor Architect U at the meeting. While Architect U was at the meeting, holding up the octopus, he had neither a hand in the production of the sketch itself, nor the production of the model that would be used in the rendering. Rather, Architect U was an emissary of the information contained within the sketch, tasked with ensuring its inclusion as part of the vision for the project. Architect U interpreted Architect F's insistence that the skylights be visible in the rendering as an attempt to shape the production of the image itself. However, the *intent* of the image was the primary concern for translation into future representations, not the specific view itself. The resultant rendering did not need to visually appear anything like the sketch to still embody the intent of the architectural contribution. Architect F knew this. Architect U learned it when he returned to the studio without having secured the skylights in the rendering.

(4) In this way, the generation of these images can be conceptualised as an act of storytelling, accomplishing the task of design through a series of "what if" scenarios that help the architect understand the space through the accommodation of temporal and social needs. In the octopus sketch, three figures stand prominently in the foreground, directing the person viewing the sketch to follow the drawn viewers' gazes up to the skylight above. With no hard lines, and only a suggestion of what the lines represent, all that can be surmised (without explanation) is that people in the station will be provided with a unique perspective that is captivating and draws attention. The vagueness of the sketch conveys that the sketch is about the experience of those viewers and that, whatever the experience is, it is powerful, evocative, and makes the station a unique and interesting place to be. This is Architect F's goal—to convince the client and other team members of the power this situation could have.

Finally, (5) the interpretation of the sketch is bolstered by the quick description that it is of a bank of escalators leading customers to the main concourse, which is awash in natural light from the two visible skylights. With this, the sketch has achieved its intended goal—to intrigue, captivate, and garner support for the exploration and incorporation of this now worthy component of the architectural intent into the design development process.

Of course, once the complexities of other items are added into the mix, the simplicity quickly disintegrates. The complexity is relegated to those who are generating the design representations themselves as more inputs require reanalysis and reconsideration of the elements previously established. While those who lead the design team also understand these parameters on a fundamental level—based upon years of experience in resolving just such tensions—they often stay outside the fray, existing on a plane of engagement from which they can continue to push the agenda of the intent, unsullied by reality. Where necessary, they enter into the realisation process, but they maintain their role as the guardians of intent.

The Sketch in the Studio

While the sketch takes on a life outside of the studio, leveraged to inform the client and other team members beyond the architectural discipline, it also has a life in the studio, appearing on

desks and showing up on the table at meetings.[82] As the project developed and various inputs acted upon the "reality" of the sketch, the sketch retained autonomy, representing an idea that found application in the iterative design process. As the octopus floated around the office, it took on the role of a benchmark for the ambitions that the architect presented to the client at the outset of the project, with the indication they would form a central part of the design resolution. The intent embodied in the sketch was discussed in meetings and the octopus was trotted out from time to time to remind those working on the project of the intent. This all occurred over a period of months as the design was further developed with external parties and made more defined through inputs across disciplines.

While these inputs meant that the sketch view was quickly made irrelevant by the computer model, the sketch itself retained its relevancy as an idea to drive the design process.[83] For those working on the model, the idea of light as a driver for wayfinding persisted, even as the view was lost. For those reviewing the drawings, the intent of the light manifested in sections, plans, and 3D views. The drawings would be interrogated, with each new constraint understood against the intent, modified against shifting project ambitions and reframed intentions as required. Sometimes new inputs would result in major model changes, jeopardising the wellbeing of the ambitions of the octopus. But it was resilient and malleable and had a strong defender not just in Architect F, but in others who had been repeatedly exposed to the octopus. However, the presence of the sketch was not sufficient to instil its principles in the project, and the sketch was never the only means of reinforcing the concept. Rather, it was supported by continual review of the outputs being produced to ensure that they embodied the ideals established in the sketch. The frustration within the team between understanding the ambitions embodied in the sketch—the ideas generated by those who developed the sketch and sold the concept to the client—and the work being executed was highlighted in a meeting reviewing the appearance of a space when an exasperated Architect C stated, "The problem is we're not in [Architect F]'s head."[84]

82. This is a non-linear process, and it is important to note that the same scenario plays out repeatedly as various items are identified, explored, and developed or abandoned. This does not just happen only at the beginning of the design process, but throughout.

83. The BIM model was used to generate both 3D views and 2D drawings, as well as to allow the project to be "built", exposing more questions about how the project would resolve. This process is explored in Chapter 4.

84. Architect C, comment made in meeting, 18 March 2019.

While the architectural process is a collaborative one, the establishment of the guiding principles as defined in the sketch was still dominated by a single or limited force within the studio. As one architect working on the project said as he talked about the design, "our concept [Architect F] envisioned …",[85] while there was ownership in the statement of the design as "our", there was still acknowledgement of authorship of the design idea. While the team adopted the idea as their own, a guiding principle in the execution of the collective work to be accomplished by the architect as an organisation, there was still an understanding that Architect F was originator and ultimately arbiter of whether the concept was fulfilled in the design realisation. Architect F, and others tasked with reviewing the design deliverables as they were produced, did not relinquish control of the idea once the sketch took on a life in the studio but, rather, continued to invoke the sketch—and the principles put forward in it—through meetings, drawing revisions, and other developments. This is why when Architect U left the studio to meet with other disciplines the octopus came with him, both physically and as an idea that the architect as an organisation furthered. This is also why, when Architect U left the meeting in the example, he was concerned that Architect F would be unhappy that the octopus view could not be captured in the rendering. Architect U was new to the firm when the meeting took place and was still settling into the culture of the firm, resulting in his lack of confidence to fill the role of speaking for or against Architect F's sketch and its manifestation in the rendering.[86]

The idea was reinforced in other interviews, where younger team members referred to the design as originating exclusively from Architect F and other architects who operate at a similar level in the bureaucratic structure of the studio and project.[87] This lack of connection, especially for those architects whose work can seem far removed from contact with parties outside of the studio or who are working on other parts of the project, sometimes results in a lack of ownership by the team, indicating that buy-in to the design intent is vital to ensuring the idea is able to be maintained cohesively through the deliverables. If the idea of the octopus has not been adhered to, eventually a deliverable will not reinforce the idea, and it is up to Architect F or other emissaries of the idea to catch this. No matter how much oversight there is, the reality of the volume of work produced is

85. Architect M, interview with author, 5 September 2019.
86. Cuff, *Architecture*.
87. Architect R, interview with author, 9 September 2019.

that not every aspect of the *intent* can be championed by one. Rather, it takes understanding by the organisation to further the intent and carry it through the design process. Thus, the architect's intent is maintained by the architect as an organisation.

These realities, of the sketch manifest in the thinking of the project development within the office, the intent vocalised in meetings, the models made to understand how the light could find its way from the street above to the concourse below, and deeper still into the escalator adit, were all the products of the octopus. These items and exchanges gave the concepts first "articulated" through the sketch new life in other forms, allowing it to exist beyond the octopus. The octopus did not vanish through this, but rather lurked beneath the surface, waiting to reappear as needed. And that is how it found its way out of the office in June, in Architect U's hand, as the conversation captured at the beginning of this section unfolded at the renderer's office. The octopus was still there (although even Architect U struggled to understand why), a prominent factor in the project, even if the sketch from which it had emerged was long obsolete as a view. The renderer harpooned the sketch as a visual representation, but the intent lived on in the model, and would find its way into the rendering.

It is not that Architect F was ignorant of the complexity in the area, or that he was not aware of the interactions that took place and the work being done in the studio to reconcile the complexity of the multitude of inputs that were constantly shaping and reshaping the digital model. Architect F spent much time in the studio around tables and worked to resolve this collision of logic through iterative sketches: "What if we move this there? Or there?" But there need to be a balance of these gymnastics, and a time to step back to see their results. In this, there was ongoing dialogue between the simplicity narrative, which need to be maintained and shown, and the detailed work that went on within the office to merge the intent and inputs from other disciplines as they were introduced. The sketch was the mechanism of representation that allowed the architect to return to the narrative of simplicity, even when new complexities were introduced into the project.

Introducing Intricacies

Of course, if the architect's role had stopped at the creation of the sketch—the introduction of intent—there would have been little hope that the ideas would be preserved and survive through the design process amid the onslaught of literally thousands of inputs that demanded attention and incorporation. Each item would have whittled away at the intent, with the empirical reality of structure, services, and cost eroding every vestige of the architectural contribution embodied in the sketch. Perhaps a structural member could have more easily be accommodated where the skylights were, or the areas would be the best place for the transfer of mechanical services. Perhaps the skylights would cost too much. In this way, as the design process negotiations unfolded and parties mediated competing desires, the architect had to persuasively advocate for qualitative ambitions in a project type largely dictated by quantitative requirements. The advocacy for the human elements was not passive. Rather, the architect had to actively offer alternatives to meet the needs of other professions or have sympathetic team members who provided support in meetings with both the client and the consultant team to allow the architect's contributions to hold sway.[88] This is why the architect's establishment of strong relationships within the team structure was intertwined with the generation of the sketch.

The meeting in the example was a moment when the architectural design intent, embodied in the sketch, intersected with the realities of other external inputs. This had already happened within the studio, as illustrated in the previous section, resulting in the digital model provided to the renderer. However, it was not the digital model that made the view impossible; rather, it was the angle of the adit established by the tunnelling team, which had itself been influenced by the acceptable slope of the escalators and various other factors. In this way, the design process could be understood as not being driven by any one human or non-human actor; the station could not come into existence without the aggregation of many inputs.[89] Rather, it could be viewed as a constant intermingling of ideas and parameters, brought together in an orchestrated manner by a team

88. Ahuja refers to these aspects of architectural practice as "persuasive strategies". Sumati Ahuja, Natalia Nikolova, and Stewart Clegg, "Paradoxical Identity: The Changing Nature of Architectural Work and Its Relation to Architects' Identity," *Journal of Professions and Organization* (2017): 10, https://doi.org/10.1093/jpo/jow013.

89. Bruno Latour, *Aramis, or, the Love of Technology* (Cambridge, MA: Harvard University Press, 1996).

consisting of multiple disciplines, among them the architect. One architect commented that "design is not a thing on its own. It's actually a way of weaving. What [design teams] do is weave tapestries, and you can pull any one of the threads of the tapestry out and analyse it, but it's just a thread. It's how it comes together—you can't break it down into its constituent areas and expect to see an understanding of the whole."[90] The representational octopus sketch, embodying intent, was one thread of the tapestry, persisting as a single strand of architectural contribution that was integral to the design outputs. This description of the design process shows clearly that there is professional cognisance of architecture's interdependence.[91]

As stated at the opening of the chapter, the design process is a collaborative one, with each discipline bringing its contributions to the table for incorporation into the larger design development process. The sketch, and other visual architectural contributions, are artefacts of the architectural production process and components of a "visual dialogue" through which ideas that are difficult to articulate in words can be quickly and easily communicated. However, the inputs of each discipline are themselves not fully formulated, but based on the siloed understanding of specific requirements. Accordingly, the architectural input of the sketch's intent must be reasserted and integrated with the other inputs. The process is referred to as "coordination", and is the object of much time spent in the studio and in meetings, and the source of much consternation and negotiation on the part of the architect and other disciplines. This coordination is an ongoing action throughout the design process, with new inputs, representing constraints and opportunities, constantly emerging, evolving, and even disappearing.

In the case of the octopus, the inputs that acted on the view included factors such as the selection of materials for the walls and ceiling lining, specification of the escalators, and incorporation of lighting and speakers in the space. Of course, in the abstracted view of the sketch, that information did not matter. However, as—for example—the manufacturer of the escalator became involved as the design developed, colours and materials were assigned to the view based on

90. Architect NA, interview with author, 16 September 2019. This interpretation of the role of the architect, as instrumental in the *process* of design, is what Latour and Yaneva argue. Bruno Latour and Albena Yaneva, "Give Me a Gun and I Will Make All Buildings Move: An ANT's View of Architecture," in *Explorations in Architecture: Teaching, Design, Research*, ed. R. Gesier (Basel: Birkhäuser, 2008).

91. Till, *Architecture Depends*.

both the architect's intent and the client's expectations. To allow the octopus to evolve, more information was incorporated into the model, which in turn allowed the renderer to produce the new version of the view, complete with more context and data—again, not empirical, but visual and experiential. The development of the visual representation is a logical and clear manifestation of the architectural contributions as more elements are more clearly defined and "locked in" for representation.[92] But this permanency created by the generation of the fixed parameters of the model verses the sketchiness of the sketch also created a false sense of resolution. While the rendering, a visual representation of the digital model, may seem to be a more accurate representation of the intent of the design, it is merely a capture of the status of elements at a given moment of the design development. The static nature of the view—and even the defined nature of a dynamic 3D walk-through—betrays the actual process at work. While renderings were to be produced for the tender design submission based on the selection of materials and models of the escalator, they served a very different purpose than the early sketch. While both showed the same space and captured the architectural intent, the rendering would have to be developed within the context of the other inputs defined by disciplines outside of the architecture studio, as they had been incorporated into the model from which the rendering was to be generated. The rendering, therefore, was the result of not just the architectural process, but of the larger process of design shaping the project. The octopus sketch and the rendering that was based on it were independent of each other. The rendering acknowledged its genesis by incorporating intent where it could, but deviated from the sketch as it captured a singular moment of the design process, while the octopus could remain autonomous and timeless.

Developing the Rendering

By the time Architect U held the octopus sketch up in the meeting, the octopus as an illustration of a potentially simple reality was long dead. The sketch represented a state of being left in the past, subverted by new inputs that had advanced the design process since the sketch was first created. While the drawing itself—a static object—had not changed, the conditions around it had;

92. The use of imagery in lieu of merely communicating intent through conversation or interaction is intended to combat the "fleeting" nature of those forms of communication. Barbara Tversky, "Visualizing Thought," *Topics in Cognitive Science* 3, no. 3 (2011): 500, https://doi.org/10.1111/j.1756-8765.2010.01113.x.

from an image representing an idea in an easily digestible manner, it had become one of many inputs that shaped the trajectory of the design development, but still held import in the intent it communicated. In the meeting, Architect U attempted to assert its powers of representation in a physical sense—advocating for a visual connection that did not exist in the reality shaped by project parameters. In doing so, however, he failed to understand that the sketch was a mechanism of representation of the *intent* of the space, rather than a view of a space defined by tectonics.

The octopus illustrated the architectural intent to provide light into the adit, and for the light to provide for wayfinding. However, other inputs had been overlaid onto that architectural idea. There had been a selection of escalators. There had been the setting of ceiling heights, coinciding with material selections. And, most importantly, in a visual sense, the two skylights had merged into a single geometry. In that moment, while Architect U unwittingly pushed a cycloptic cephalopod agenda, he failed to observe that the intent of the octopus was alive and well in the drawings and images being assembled as part of the tender submission, even if it was not realisable in the rendered view to be generated for that space. Rather than a literal interpretation of the view, the same expression of intent could be communicated through the quality of light as it came down the escalator shaft, or by the omission of extraneous signage, obviated by the spaciousness visible at the top of the ascent. The sketch was a presentation technique for these ideas, representing the intent in an easily communicable way, but the few gestures showing the simplicity of the concept could be captured in the next forum: the rendering. In the drawings, the narrative of the Design Report, and presentations to the Design Review Panel (DRP) that informed the rendering, the octopus was not only alive but multiplied, gaining new advocates for the concept expressed in the sketch.

In this way the architectural response through sketch can be framed as a counterpoint to the engineered and pragmatic solutions and parameters being defined through design development of the project by other disciplines. In doing so, the architect defined and refined an ambition for the way in which future users would experience and interact with the infrastructure once it was realised. The content of the renderings could then be seen as a reflection of the content of the sketch, borrowing intent, but not actually mimicking the view itself—since, as the renderer said, the view could not actually exist.

This understanding of the architectural sketch as a form of representation contrasts with a popular technique of highlighting the savvy of the profession by presenting an early sketch of a building or feature next to a photograph of the completed building; the desire is to express the architectural genius—how a building sprang to life from the quick musings of an architect, a sketch manifest in concrete and steel. However, that narrative is reductivist and presents a false equivalency, dismissing the inputs from other disciplines and their impact on the development of the design, positioning the architect as the primary instigator of form. While this may be truer of other typologies that rely on aesthetics (which is outside the scope of this PhD), the narrative falls apart in the complexity of the transport project. To pretend that the early sketch will clairvoyantly predict the inputs of the design process, the work of hundreds, and the many negotiations that take place to arrive at a resolution of the architectural intent embodied in the sketch and the unending deluge of coordination, is a fabrication. The architect is not omnipotent but, through the sketch, merely demonstrates an intended qualitative outcome, divorced from many of the realities and practicalities that will ultimately shape the design resolution and deliverables.

The reaction of Architect F to the news that the rendering would not include the view as envisioned in the octopus sketch could have been foretold. Architect F did not go to meetings such as that in the example because he did not have the time to be at all meetings, but also because it was best that the one who crafted the vision remained at arm's length from the imposition of mundane reality on the project. In an interview later, Architect F stated: "What I'm looking for are relativities—when projects start, quite often what I'm trying to do is excite some ideas and experiences. So, often for me, it will be the storytelling of the experiences, spaces that I've been to, places that I've been to … that might shift or shape a growing concept."[93] When applying this logic to the octopus sketch, understanding its genesis from not only the blended spaces of James Turrell's work, or the lighting conditions within a Metro station in Naples, it is clear that the sketch itself was never intended to be a fixed entity, but rather a "storytelling" of ambitions that were destined to change.[94]

93. Architect F, interview with author, 4 September 2019.

94. Toledo Metro Station in Naples was used as a precedent when the octopus sketch was created. It became one input in many that likely shaped the sketch as it was crafted. But it, like the James Turrell artwork, was just one piece of a much wider web that includes experiences, precedents, and attitudes toward the human experience. Nothing in architecture has one root, but is instead a messy web of inputs.

Architect F accepted that the rendered view could not be reconciled with the view established in the octopus sketch because the intent of the sketch could be captured without duplication of the view itself. Mark-ups of the sketch and its subsequent evolution in the weeks following the meeting indicated that the aspects of the intent outlined earlier—natural light, ease of wayfinding—were manifest in the final rendered output. The intent of providing light in the underground space was reinforced through the brightness and contrast of the materials in the rendering. In multiple iterations of the rendering, the luminosity and sheen of the ceiling and wall materials was manipulated, ultimately creating a sense of a space aglow. Similarly, mark-ups revealed a progressive development of the wayfinding strategy, with the colour of the escalator finish changing over time—from a generic silver to a deep, matte charcoal—conforming to the architect's intention for all vertical transport to be a uniform colour, standing in stark contrast to the white wall and ceiling finishes, to make it easily identifiable. The omission of signage also subtly hinted that the station was so easy to navigate that directional signage was not required.

In framing the sketch and the desire for the rendering to show something that was not actually intended to be a reality, the architect positioned the visual representation as malleable and released it from becoming incorrect or obsolete when parameters changed. This reduction of liability for the content of the sketch and any potential inaccuracy in its depiction ultimately protected the architect and his vision from inevitable changes wrought by inputs. If buy-in had been successfully achieved across the team, the intent was safe even if the sketched view turned out to be an impossibility. To allow for the sketch to embody the architectural intent, it needed to be viewed as a discrete component of the architectural contribution, different from other media produced. Both the sketch and the rendering represented architectural outputs, but the sketch was meant to establish intent and sell an idea. To do this, the architect had to test the realms of reality, as in the rendering example, and focus instead on the simplicity of representation. The resultant rendering did not have to visually appear anything like the sketch to still embody the intent of the architectural contribution. Architect F knew this. Architect U learned it upon his return to the studio.

Reasserting Simplicity After Complexity

Fast forward nearly a year in the design process from the meeting in the example. The design had progressed, team members had come and gone, things that were "fixed" in the rendering had since changed, and changed, and changed again. While the octopus sketch was no longer seen in the studio, those who were familiar with it could still recognise its traces. However, for most in the studio who dealt with the avalanche of inputs that flowed unabated through emails, meeting minutes, spec sheets, and drawings, the singular input of the intent often fell by the wayside. But not for the architects who were designated as defenders of the octopus. On a Monday afternoon design meeting in March of 2019, Architect F, after a long battle over the wall and ceiling configuration and its over-complication in the station's main concourse, which meets the skylight and adit of the octopus, remarked, "I feel like the enemy, but we've deviated from the design intent."[95] In that moment, Architect F invoked the role of the architect as an organisation, drawing those who were documenting, checking drawings, and interacting with clients and consultants, back into the initial architectural intent, reminding them its preservation was still the responsibility of all. Documentation of the project did not mean acquiescing to the parameters established by other disciplines but, rather, asserting the architectural contributions and ensuring that they pushed back on other inputs to jockey for space in the documentation to reflect the initial simplicity.

This did not just happen in the studio; rather, simplicity was reasserted with the client and consultants to ensure integrity of intent as the design process unfolded. As representation of the design moved away from sketches and toward hard-line drawings, reports, and masses of data, it was easy to lose sight of the qualitative aspects of design—the architect's bread and butter—amidst added complexity. Therefore, the intent was continually brought to the forefront in order to motivate other disciplines to re-evaluate their contributions or consider potential cost savings. Again, the architect's best option in this pursuit was to return to simplicity. As Jeremy Till wrote, "one might think that an architectural sketch has a certain innocence, but even these early marks are conditioned by previous experience and present expectations. From then on, the whole design process is opened up to the input and control of others—clients, other architects, consultants,

95. Architect F, meeting 18 March 2019.

potential users, regulators, and so on. While architects may try to calm the resulting flux through the imposition of standard design methodologies, the storm is never abated."[96] The inputs from outside the profession never ceased, and so the reassertion of the architectural intent, best achieved through the reductive sketch, continued to be of import.

With the design development, the narrative of simplicity extended beyond visual representations, emerging out of sketches to be translated into required documentation. Simplicity in realisation of form was a decision of intent, involving both aesthetics and function, and its use reflected a popular approach to transport design. However, to realise simple design required intricate work to accommodate infrastructural and technological requirements within often-restrictive station spaces. Intensive coordination to feign simplicity was undertaken, with inherent complexity of services and systems masked with an applique of the architect's design to yield a final, streamlined appearance.[97]

One architect who has worked on the typology for a number of years summed up the sentiment in an interview, stating:

> *The real design challenge is to make something appear inherently simple and beautiful, but it comes from enormous complexity. So, if you look at the underground stations in particular, the amount of equipment and machinery and cabling and conduit and utilities that go into that are quite extraordinary. But the public has no knowledge of that—it's hidden from view; what they see is the end state of hundreds of thousands of hours worked to distil a complex program down to something that is simple and is beautiful. I think that's one of the real challenges: distilling simplicity from complexity.*[98]

Of course, the execution of a simple sketch, and the return to the medium throughout the evolution of the design process, is predicated on the idea that the simplicity in execution of the

96. Till, *Architecture Depends*, 46.

97. This is seen in systems including Bilbao (Norman Foster, 1993), Copenhagen (Arup, 2019), and even in the Stockholm Metro.

98. Architect NB, interview with author, 16 October 2019. The principles of modern architecture are still alive and well in practice.

selling of the idea, the infusion of that idea into the design process, and the inclusion of that simplicity in the documentation will ultimately yield simplicity in its realisation.

This may seem to indicate that the architect's human-centric intent, grounded in only a qualitative ambition, has somehow prevailed over the calculations and quantitative reasoning of other disciplines. This could not be further from the truth. While simplicity may be reflected in the design resolution, it required buy-in from the team: the client, consultants, and even the larger "team" of the public (through community engagement). It was hard fought, as realities of the function and pragmatic concerns weighed heavily on the final architectural deliverables. The deliverables would not have been possible without the input from across the team, and the architect had to stand his ground on the intent of the octopus, just as the structural engineer stood her ground on the spanning capacity of the concrete slab around the eyes of the octopus, or the fire code consultant ensured that customers would be able to evacuate up the octopus's tentacles in an emergency.

While the ultimately realised architectural manifestation of the drawings may differ greatly from the initial sketches, this did not mean the architectural contribution to the design process was not maintained. Rather, just because the tectonic realisation—or even the rendering that was generated after parameters from other parties had been incorporated—differed from the imagery produced initially by the architect, the theory and concepts embodied in the initial sketches persisted. While the formal arrangement may have been greatly impacted by the realities of practical requirements and considerations, the *ideas* and intent embodied in the early sketches still held true where they were elements key to the success of the design. The embryonic sketches embodied intent, further acted upon throughout the design process, until the design was resolved and delivered; the conceptualisation leveraged artistic license to express an idea, later translated with the parameters of functionality into something that could be realised. In the same way that structural drawings or mechanical drawings alone could not result in the construction of a building, architectural representation alone is nothing more than an idea. The octopus was sketched to encapsulate ideas which themselves would never be a reality—the octopus would never appear as itself in the final design, but do not doubt that the influence of its piercing black eyes is there.

Concluding Remarks: Qualitative Ambitions as Expertise

The design of transport facilities in urban areas has represented a range of ambitions, as diverse as the geographic, temporal, and social contexts in which they are developed. Tethered to themes of efficiency and austerity, government power, private enterprise differentiation and branding, and a push toward public amenity and urban benefit, the designs represent the conditions from which they emerged, the result of engineered and architectural contributions in ever-changing proportions. Today, MTPs represent multi-billion-dollar investments in the urban realm. Their large scale, and the aspirations and expectations held of them by government and the public, are decidedly shaped by the wider objective of creating a city that is more democratic in spatial configuration; they are a robust expression of the catalytic generative potential of transport facilities.[99] In achieving these ambitions, architects have established themselves as experts in not only generating an experience for future customers that addresses both aesthetic and functional considerations, but also capturing them in a manner that instils them in the design outputs to be constructed.

This role can be understood through the architect's production of conceptual sketches that capture key elements of the human-centric aspirations of the station. These vignettes reflect an architectural "reality" of future condition and represent the contributions of architectural knowledge to the design process. The sketch represents the distillation of design intent, established through leveraging of precedent, identification of opportunity space, and interactions with the client, stakeholders, and other team members to ensure support for the long-term viability of the ambitions. Beyond serving as a mechanism for "translating" the architectural ambitions into a tangible, distributable medium, the sketch also serves to "sell" the ideas of the architect outside of the architecture studio and instil the ambitions within the architectural team to preserve the intent as the design develops.

99. Sydney Metro West is slated to cost $25 billion, with stations to "be among the most expensive components of the rail project, each costing hundreds of millions of dollars." Investment in the customer touchpoints epitomises the government aspirations and public expectations of what stations mean for the city and urban fabric. Tom Rabe and Matt O'Sullivan, "Government Green-Lights Metro West Station at Pyrmont," *The Sydney Morning Herald*, 11 December 2020, https://www.smh.com.au/national/nsw/government-greenlights-metro-west-station-at-pyrmont-20201210-p56mfz.html.

As the architectural process progresses and new encumbrances and constraints to the design are revealed through collaborative work, the view portrayed by the sketch may no longer reflect the tangible, physical reality that emerges through iterative design. However, as the octopus demonstrates through its malleable application, the power of the sketch as a representation of reality tethered to experiential human-centric ambition, persists. It is through the initial reductivist approach that the medium's continued application is achieved, even as it is superseded by other architectural deliverables. The ideas of the octopus, an early, simple sketch that conveyed basic information about the human-centric architectural ambitions of the future station space, lived on beyond the sketch itself, allowing the essence of its creation to manifest as the design progressed, to be realised in the built form.

Chapter 4
External Pressures

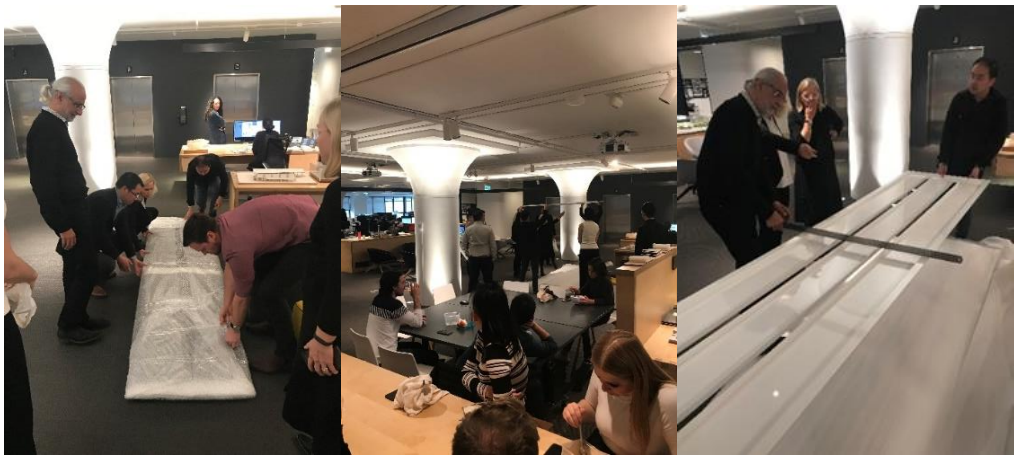


Figure 4.01 - The reveal, the hoist, and the deflection test.

The Really, Really Big Box Arrives

It was an early afternoon in September, in the middle of lunch, when the box arrived. The poor deliveryman, lugging the two-metre-long box off the elevator, caught the attention of those eating in the kitchen. As it became clear that the box was the prototype wall and ceiling panels for the station, a dozen or so team members gathered in the centre of the office. A few of the younger staff armed themselves with make-shift cutters—opened scissors, keys, a blade from the model making area—and began to tear at the box. As the spectacle unfolded in the middle of the studio, in front of the reception desk, architects from other clusters began to meercat above monitors to see what was unfolding … or unboxing. The first hints of the white panel became visible as packing material was pulled away. I waited, with everyone else, in anticipation—holding back a bit to take in the scene (just out of reach of the jerry-rigged cutting utensils). The glassfibre reinforced concrete (GRC) panels, agonised over for more than a year, would soon be fully revealed.

But then the first panel was out, and two team members were hoisting it above their heads to give the project director a look, to understand the deflection which would occur when the panels were suspended as a ceiling. There was a definite sag in the centre of the panel. Architect P sought out a long metal ruler to use as a straight edge, to determine if by bracing the centre of the span the sag could be eliminated. Everyone looked and touched, commented on the appearance, the dimensions, the curved form of the slots, and the sheen of the finish. As I observed and took a few photos—after all, in my capacity as researcher I should document this as it might feature in the dissertation—one thing was clear. This was not a GRC panel! That would be far too heavy for two to lift. It wouldn't deflect in such a way. And it wouldn't be so thin.

The second box was opened, and a similar panel was removed. It was hard to discern a difference. Perhaps there was a slight variation in the dimensions of the slots or their end conditions. To the rest in the office, the spectacle was winding down and the eyes, captivated by the initial excitement of it all quickly returned to computer screens or

lunch. As the interest in the office waned and team members began to drift away, I reflected on what I had just seen. I had been pulled away to other projects and wasn't always aware of every change that had occurred—especially when it came to things like finishes and materials, as those were in a near constant state of flux—but this seemed a big change to miss.

For months I'd participated in conversations about development of the station's interior cladding. It was a defining feature of the station, as it covered nearly every surface, aside from the floors. I had heard in weekly meetings how the panels were developing. How they must be sized. How they must be shaped. How they would be hoisted into place. What's more, I had written about the GRC in design reports, espousing its merits, acknowledging how it would be supported, and citing its successful adoption in similar projects. How had I missed the transformation of the panel from GRC to aluminium? And why, after all this time spent discussing and defining parameters of the panels, had the material changed? Puzzled, I moved my food from the microwave queue and sought out some answers.

To sort out what I had missed, I went to speak with Architect S, who was tasked with coordinating the material response. On the windowsill behind Architect S's seat—she is one of the lucky ones with a window in the studio—sat piles of material samples. There was a stack of terrazzo floor finish samples—to be expected given the ongoing discussions regarding not just aggregate size, but shape and colour as well. There was a stack of anodised aluminium—who knew there were so many colours of bronze? As expected, there were three small pieces of GRC—little rectangles to hint at the colour white of the wall and ceiling panels. But among everything else was something surprising: a catalogue for an aluminium locker manufacturer; the same manufacturer who had sent the box that had just showed up at the office. Aside from the staff lockers in the changing rooms, there was no need for a locker manufacturer. But now, the panels sitting in the centre of the studio were a testament to a direction the architectural process had gone in.

To understand the translation of the material, arguably the defining aspect of the interior station cladding, from GRC to aluminium, the development of the cladding strategy had to be reflected upon. It couldn't have been a simple transition to abandon all of the development which occurred over months, all of the coordination, in a material switch. I pondered it over lunch, thinking about what I had seen of the panels. Perhaps they weren't GRC, as expected, but they did share many of the attributes which I had heard being refined over the months. The slots, the dimensions. And the material, so light it could be hoisted by two architects—that fulfilled the demands that the panels be easy to install and replace, not to mention require less structure and less cost. And with those thoughts, I finished lunch and headed back to my desk to dive into work on a different project. Undoubtedly, while this was the first time I had seen the physical panels, it was hardly the final form they would end up taking.

The opening of the box in the studio attracted a lot of attention that afternoon because it was a spectacle. Of course, the arrival of samples is not a rare occurrence in a busy studio, and there are plenty of high-profile projects that keep the various clusters busy and engaged—and bring in plenty of interesting items. But there is interest in the unknown—those who did not know about the development of the project were keen to catch a glimpse of its trajectory, if only through the arrival of a single sample. General interest of those in the studio was eclipsed by the acute interest of those on the project; until the time the panel emerged from the box, the concept of the panel (or, more generally, the cladding of the cavern) meant a different thing, or things, to each team member.[1] Each team member had, through gathering of external inputs in meetings, emails, conversations, and research, developed his or her own conception of it. But, when the panel was unboxed, each team member saw the same reality as every other member—this was significant, as it allowed for alignment of understanding. Before the panel arrived, each member of the project team had a different "reality" of the panel in mind, based on their compartmentalised role on the project. Now there was a shared understanding.

1. Referred to as "options" or "schemes", all represent various possible forms for the project (or an aspect of the project) to take.

It is this compartmentalisation of the design process that obscures the development of ideas to both those outside of the profession and those involved in the design process, but that says so much about the role of architect and architecture. Many bemoan this siloing of the architectural profession and point to the splintering of responsibilities of the "traditional" architectural roles—for example, project management, specifications, material specialists—as evidence of a profession in demise. But it is the observation of each discrete reality, removed from the "final" product and examined, that shows that architectural practice is alive and well, ironically in a project type that is seen as largely engineering-led.[2] The observation, documentation, and analysis of the construction of the multiple realities of an architectural project generate the following conclusions:

1) Architectural practice is based in the logical integration of inputs from various fields with the architectural intent, which can be constructed and expressed as an analogy to non-architectural ideas.
2) Architectural practice necessitates the siloing of information due to the sheer volume of inputs in large-scale projects.
3) The realities constructed through the assemblage of inputs allow for the architectural idea to develop independently and, later, be reconciled within the larger design.

This compartmentalisation is inherent to the logical progression of the architectural design and is indicative of a profession that still retains a significant role in the shaping of space. However, the diffusion of responsibility makes tracing the trajectory of design decisions hard to perceive and perpetuates the perception that architecture develops in enigmatic ways.

The events surrounding the development of the cladding, culminating in the arrival of the box in the office, allow for the unpacking of a persistent conceptualisation of architecture as a mysterious, undefinable process, which relies on analogies and the amorphous concept of "creativity."[3] This idea stems not only from critical analysis of architectural by-products (buildings) and the outside take on what goes on within the architectural process, but is furthered by the

2. Chris Bryant, Caspar Rodgers, and Tristan Wigfall, "The Changing Forms and Values of Architectural Practice," *Architectural Design* 88, no. 5 (2018): 57, https://doi.org/10.1002/ad.2336.
3. Serap Durmus Ozturk, "Rethinking the Black Box in Architecture Design Studio," SAGE open 10, no. 2 (2020), https://doi.org/10.1177/2158244020927408.

profession—that the outputs generated through the design process are somehow arrived at through mystics, shrouded in representational ideas (e.g. a space as a James Turrell artwork).[4] However, a critical (participant) observation of the discrete actions of the architectural process generated a new perspective on the factors that drive the design process. By first observing and recognising the panel as an independent actor, rather than merely an artefact that resulted from the actions of the architect, the autonomy of the panel—and, subsequently, other items—within the design process emerged as a major factor in shaping the design development. To understand the elements of practice that resulted in the development of design and production of architectural deliverables, actor-network theory (ANT) was leveraged to animate and lend a "voice" to non-human actors and explore further their role in design through interaction with the architects.

The application of ANT, with its granting of autonomy to each non-human actor in the architectural process, was explored by Albena Yaneva during her multi-year research embedded at the Office of Metropolitan Architecture (OMA).[5] Her research confirmed the applicability of ANT in architectural practice, but the observations were largely defined by the generation of architectural intent in conceptual design.[6] The scope of her exploration and analysis was delimited by the nature of the project she analysed, which was cancelled before it was fully developed in an architectural sense. In examining the conceptual phases of design, Yaneva built a body of research that explored the role of non-human actors, including models, documents, and other tools of the industry in shaping the architectural ambitions (as explored in Chapter 3). Due to the phase of work under investigation, Yaneva often fell back onto the romanticised components of architectural practice, including the creation of models.[7] While she granted autonomy in design to actors such as the foam and the cutting machine, she was unable to examine the actors related to further design development and detailed documentation, as the present study has done. By applying the Latourian

4. Reyner Banham, "A Black Box: The Secret Profession of Architecture," in *A Critic Writes: Essays by Reyner Banham*, ed. Mary Banham (Berkeley: University of California Press, 1996).
5. Albena Yaneva, *Made by the Office for Metropolitan Architecture: An Ethnography of Design* (Rotterdam: Uitgeverij 010, 2009); Albena Yaneva, *The Making of a Building: A Pragmatist Approach to Architecture* (Oxford: Peter Lang, 2009).
6. Other instances of ANT application to examine architectural production are limited, but include: Inger Mewburn, "Lost in Translation: Reconsidering Reflective Practice and Design Studio Pedagogy," *Arts and humanities in higher education* 11, no. 4 (2012), https://doi.org/10.1177/1474022210393912; Mattias Kärrholm, "Building Type Production and Everyday Life: Rethinking Building Types through Actor-Network Theory and Object-Oriented Philosophy," *Environment and planning. D, Society & space* 31, no. 6 (2013), https://doi.org/10.1068/d15312.
7. Yaneva, *Made by the Office of Metropolitan Architecture*, 57.

rigour of ANT to the production of architectural deliverables as the design developed, and by adapting some of Latour's concept of simultaneously existing realities (explored in *Aramis, or the Love of Technology*), much as Yaneva did, it was possible to see method and logic in the architectural process as realities were constructed and reconciled.[8]

Through *Aramis*, Latour brought order to the outwardly haphazard multi-decade trajectory of the eponymous project (which sought to develop autonomous personal rapid transport vehicles), seeking to determine what ultimately led to the derailing of the project. By examining not only the technical facets of the project development, but also the design of the system within the social, political, and cultural contexts of its realisation, Latour constructed a compelling account of who and what "killed" Aramis. Latour did not merely construct a history of the project through anthropological and social methods, but considered the actions of participants—individuals, agencies, and non-human actors—in the post-mortem. The research was presented as a series of accounts, conveyed through anecdotes, interview excerpts, and even "statements" from Aramis (a train prototype) itself, all of which fed into the analysis. In doing so, Latour showed that no single actor was responsible for the failures, and successes, of the project through the years, and that the seeds of its downfall lay in the organisation and expectations of the process, giving the final outcome a certain inevitability.

This chapter leverages many of these techniques, tracing components of the design as they responded to demands of both human and non-human actors. While the architectural design process started and progressed with no clear vision of what the result was to be, it was not through luck, accidents, or mystics that a design resolution materialised. Although the result could have taken any number of diverging tracks, there was—like a building itself—an internal structure that supported the realisation of the design. By spending a year in the design process, as part of the team, observing and participating in the generation of the various "realities" of the panel, I was able to gain an understanding of the trajectory of the architectural process and actions in crafting the various "realities" in pursuit of the final reality—the documentation for building in the form of architectural deliverables.

8. Bruno Latour, *Aramis, or, the Love of Technology* (Cambridge, MA: Harvard University Press, 1996).

Of course, that structure of logic also relies heavily on a structure in the office to allow the process to be organised. While the non-linear progression of a specific designed element may seem chaotic at times, the chapter will reveal the existence of a framework that allows the project to advance, despite complexity and uncertainty.[9] The architectural process is then inseparable from the organisational structure in which the architectural production occurs. I will show that it is the structure of the practice, the structure of the project, and the rigours of the working method that yield a result which, while not easily predictable in form, can be guaranteed. Specifically, in the case of the panel, I will explore how the architects knew that they would deliver a cladding system that fulfilled the demands of the project, the client, and the aesthetic intent, navigating parameters that evolved as the project progressed. The architects knew the design resolution must be achieved collaboratively, they knew that each parameter must be elastic enough to accept changes if needed, and they knew that the design resolution must be representable and replicable as to make it realisable in physical form as a reality when the time comes for the client and contractor to transform the architecture from deliverable to constructible.

Chapter Outline

The first section of the chapter introduces the big box, in preparation for its literal unpacking of its contents, and the ideas the panels inside embody. Before the primary content of the architectural role in relation to external contributions is explored, there is a brief section on the role of the organisation in design. Building on the identification of the architect at the beginning of Chapter 3, the aside establishes the general framework in which large-scale projects are realised by groups of architects working together, including the specialisation and stratification that is necessary to accommodate the complexity of the project. This sets the groundwork for further examination of the bureaucratic structure of the architecture studio and its relationship to design responsibility, diffusion of information, and production.

The second section of the chapter frames architectural practice as a methodical endeavour, integrating fixed inputs from design team members and aspirational architectural inputs like those

9. The structure of the office and the specific project, therefore, has an impact on the realisation of the designed objects. Robert Schmidt and Andy Dainty, "The Influence of Practice Culture on Designed Artefacts," *Architectural Research Quarterly* 19, no. 4 (2015), doi:10.1017/S1359135516000051.

identified in Chapter 3. The framing of practice as rational and systematic, despite the unknown of final outputs, establishes a counter point to Banham's "black box" narrative of architecture and the impossibility of explaining the origins of its practical outputs except by allegory. The section explores the dependency of the architectural profession that is inherent in practice and which is acknowledged and embraced by practitioners. This establishes the framework for the rest of the chapter, which follows the methodological development of the cladding, from the inception of the design to the arrival of the aluminium panel.

The third section introduces the origins of the interior station cladding, establishing the departure point for the architectural development of the panel. I then dissect the generation of the station's internal cladding system, adapting a technique of Latour's from *Aramis*, to give the immaterial and intangible outputs of design a voice in the construction of realities that move the project forward toward specificity. This is explored sequentially. First, the earliest realities are developed, embodying the qualitative aspirations of the architects as autonomous influences. Subsequently, the earliest realities are enlivened as actors, requesting reconciliation with project demands as new external factors and parameters are introduced, requiring the architects to facilitate intensive coordination. Finally, the section probes the splintering of these non-human actors from the human architects and their various roles in the firm, which results in a complex web of realities that must be reconciled.

The subsequent section continues to track the panel as it gains detail and is then forced to reckon with what is has become and what it wants to be. The design trajectory is traced from the moment the panel is conceived as a reality and as options are explored for development with the aid of technology that is used by architects who are lower in the hierarchy of the studio, yet whose work enables the progression of the design. Externalities throw the entire process off track, representing the unpredictability and non-linear progression of design, which is subject to concerns such as price, resourcing, and politics—issues that are not part of the architectural scope, but which play a role in shaping the design outcomes. The section then explores how the aggregation of actors developed to that point pushes back to allow for previously completed work to be resilient in the face of new demands. Finally, the section describes the arrival of the aluminium panel and explains how inputs,

filtered through the architectural development of the realities, resulted in an outcome produced by the network of actors that structures the architectural process. This account of the architectural process offers a new narrative of design development. The narrative responds to the criticism that architectural contributions are arbitrary and to concerns that the value of architectural contributions is lost through the splintering of roles and diffusion of inputs across multi-disciplinary teams.

If Everyone is an Architect, Who Designs?

If the "architect" is not an individual, but an organisation of individual architects (as established at the outset of Chapter 3), there must exist a structure that organises these participants, acting in the name of the architect-as-organisation.[10] The collectivisation of the architectural process pervades the execution of design works and is evidenced by the ethos of responding "we" in emails about a project, at once acknowledging that the organisation is responsible for the decisions about the project, while also limiting the liability of a single person as a decision maker within the larger context of the project.[11] While every firm structures itself differently based on any number of factors, some key divisions are largely universal, including years of experience, project type experience, and technical/production skills. The first two are obvious and exist in any given profession. Of course, as people work in a profession (or a particular project type) over years, they gain experience that allows them to rise in a structured hierarchy as they—hopefully—become more adept at not only anticipating the demands a project might bring, but also how to manage those demands and respond to them in the form of deliverables.[12] With the range of levels, and required outputs to support the scale of infrastructure projects, stratification along the

10. There are any number of ways to classify the structures of an architectural practice, though some commonalities among the taxonomies of large firms include the siloing of particular areas of expertise and a hierarchy based on experience. Paul Segal, *Professional Practice: A Guide to Turning Designs into Buildings* (New York: W.W. Norton, 2006), 106; Stephen Emmitt, *Architectural Management in Practice: A Competitive Approach* (Harlow: Longman, 1999), 42-43.
11. Architect X, personal communication with author.
12. The corporate nature of large firms often demands organisational hierarchy for general management, though its rigidity varies from firm to firm. Dana Cuff, *Architecture: The Story of Practice* (Cambridge, MA: MIT Press, 1991), 134-45. David Chappell and Michael Dunn, *The Architect in Practice*, 11th ed. (London: Wiley, 2015), 61. There are also major pressures reshaping the traditional experience-based hierarchies with a focus on the specialisation of skills, which extend beyond architectural practice. Sumati Ahuja, Natalia Nikolova, and Stewart Clegg, "Paradoxical Identity: The Changing Nature of Architectural Work and Its Relation to Architects' Identity," *Journal of Professions and Organization* (2017), https://doi.org/10.1093/jpo/jow013; Sumati Ahuja, Natalia Nikolova, and Stewart Clegg, "Identities, Digital Nomads, and Liquid Modernity," in *The Oxford Handbook of Identities in Organizations*, ed. Andrew D. Brown (Oxford: Oxford University Press, 2020).

lines of experience accommodates the demand for architects as not just authors of the design, but also as the numerous skilled workers who are required to develop and document the design.[13]

The third division, along the lines of technical/production skills, is more nuanced, and results in the division of tasks and handling of project actors, ultimately determining who produces the visual representations (and therefore the architectural outputs) of the design process. Of course, the defining of the structure in the architectural industry is not merely a product of the development of technology, but a remapping of social organisation and relations in professional structures dictated by changing technological considerations.[14] These "digital commodities", as conceptualised by Tizianna Terranova, are the immaterial by-products of the work undertaken by architects, which are then used to establish and reinforce the hierarchy that exists in the studio.[15] Technical skillsets—among them Revit/BIM, parametric modelling, and data management—have largely defined architectural practice in the last few decades, resulting in new relationships between those who lead the design effort and those who produce deliverables.[16] These skills, such as the use of programs, are just as important to the design process as knowledge of more traditional architectural ideas such as detailing and specification development, resulting in the distinctly collaborative environment of the modern studio, where those who hold knowledge of the information required in deliverables must transfer that understanding to those who have the ability to express it through the required medium.[17] This sentiment is palpable, with large firms addressing the disparity in knowledge to combat the idea that in school, architects are taught tools and programs for production, but not actually how to put a deliverable package together.[18]

However, some forms of knowledge are held more sacrosanct than others. The knowledge of how to program or execute parametrics in the computer, while important to the development of the scheme, is transferrable. Students learn computational design in school and the studio can bring

13. Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech, eds., *Industries of Architecture* (London: Routledge, 2016), 6.
14. Thomas, Amhoff, and Beech, *Industries of Architecture*, 2.
15. Tiziana Terranova, "Free Labor: Producing Culture for the Digital Economy," *Social Text* 18, no. 2 (Summer 2000): 48, http://web.mit.edu/schock/www/docs/18.2terranova.pdf.
16. Ahuja, Nikolova, and Clegg, "Paradoxical Identity."
17 Sumati Ahuja, "Professional Identity and Status: An Ethnography of Architects in Professional Service Firms" (PhD diss., University of Technology Sydney, 2018). Roles in architectural practice have become notably stratified based upon the adoption of technology used in the design process.
18. Cluster meeting discussion with author, 19 June 2020.

this knowledge into the project by hiring a graduate designer. However, the input of an architect with many years of experience in designing, but who cannot translate that information into the computer or a deliverable, may "rank" higher within the firm, but their input is incorporated into the deliverables by those who can translate it into the required computer program and is often contingent on parametric and data outputs produced by those who work with the computer.

As I observed the development of the panel (and other parametric elements of the design), it seemed to me that the entrenched hierarchy was subverted, with those who had relatively little "design" experience bearing primary responsibility for the documentation of the architectural outputs and the driving of the design based on information that would be difficult to produce without the aid of a computer (i.e. complex curvatures).[19] Of course, there was oversight of the deliverables, with those who had more experience there to check the documentation produced—both for intent and assurance of quality (required contractually). However, in order for a change to be made in the documentation delivered to consultants and the client, the work of those architects who had the knowledge of the computer program was required. Therefore, the work outputs were clearly defined by the social structure present in the firm and were inherently dependent on far more than the architectural intent or the means of production, but on the social dynamics, such as those explored by Latour at the Salk institute.[20]

Architectural knowledge can then be understood as a type of collective intelligence, expanded by a range of inputs derived through digital production, research, and collaboration.[21] To generate architectural outputs, the knowledge must be coordinated and leveraged in the pursuit of deliverables, themselves derived through resolution of various realities produced during the design process. To accommodate this need for oversight of the outputs created by those who may not fully understand all the requirements and implications of their work, large architecture firms have a bureaucratic structure, necessary for providing assurance of the design and which is especially

19. This is a point of contention within firms, who are concerned about the notion that the design might be controlled by those who are not well versed in the requirements and may open a firm up to liability. However, there seems to be little work presently underway to ameliorate the concerns, which are often dismissed for fear of ramifications.

20. Bruno Latour, *Laboratory Life: The Social Construction of Scientific Facts*, ed. Steve Woolgar (Beverly Hills: Sage Publications, 1979).

21. The concept of collective intelligence, as knowledge distributed among the members of an organisation and coordinated in real time, is derived from the work of Pierre Lévy. Pierre Lévy, *Collective Intelligence: Mankind's Emerging World in Cyberspace* (New York: Plenum Trade, 1997).

important and contractually required in public projects.[22] The bureaucracy is often an object of lament, seen as cumbersome or burdensome.[23] It is the butt of jokes, a source of consternation, and the target of frustration and after-hours discussions. But as Latour says, "to make fun of the files and the bureaucracies, to make fun of the two-page notes of synthesis and the thousand-page appendices, is to forget the work of stabilization necessary to the inter-definition of the actors. It is to forget that the actors, large or small, are as lost in the action as the investigator is."[24] This "stabilization", which Latour notes in the context of the French government oversight of the Aramis transport project in the 1970s and 1980s, was perceptible in the studio over the course of the research, impacting the requirements of the architect-as-organisation in assuring design outcomes.

The structure in the architecture firm and the diffusion of responsibility in production underscores the collaborative nature of design generation and documentation. Each member of the team, be they someone who is developing the intent (as in Chapter 3) or maintaining the flow of inputs into the process through data management (further explored in Chapter 5), is integral to the design process. Team members individually created, developed, and documented a specific version of "reality" within the process of design, even as the representation of these disparate ideas was presented as a collective product.

This raised the general question of "who is the designer?" within any given architectural organisation, highlighting the inseparability of the processes in the modern architecture studio—which vary widely and deviate from the historic conceptualisation of architectural practice—from the generation of design. While the naming of a specific architect as "the architect" of projects still occurs, this is as much an exercise in branding as anything else.[25] While not every architect may "design" in the creative sense, every architect—from intent generator to interdisciplinary coordinator to data manager—is beholden to the design produced and integral to its delivery.

22. Sydney Metro, Victoria Cross - Station Works and Technical Criteria (SWTC), Appendix F2 - Project Administration, Section 2.4.5 (2018). The origins of the emergence of this entrenched bureaucratic structure can be traced to the 1940s, articulated by Henry-Russell Hitchcock. Henry-Russell Hitchcock, "The Architecture of Bureaucracy and the Architecture of Genius," *The Architectural Review* 101, no. 601 (January 1947).

23. Information flow through the project bureaucracy could form its own study, which the PhD will not address directly.

24. Latour, *Aramis, or, the Love of Technology*, 180. This quote jumped out as I had just released a 438-page design report, with more than 1,400 pages of appendices, when I read this passage. While the compilation of these items seemed futile in the moment, it reflects the larger mechanisms at play that shape the architectural role. After all, without information produced to fill these documents, the design would not be realised in full; with no design, there is no building.

25. Donald McNeill, "In Search of the Global Architect: the Case of Norman Foster (and Partners)," *International Journal of Urban and Regional Research* 29, no. 3 (September 2005), https://doi.org/10.1111/j.1468-2427.2005.00602.x.

Architecture, a Methodical Process

Architectural practice was conceptualised by critic Reyner Banham as an enigma, its resultant buildings emerging from a "black box" that obscured design origins in favour of allegoric outputs.[26] His characterisation of practice in this way was understandable, the result of the critic's approach to analysing architecture's ultimate result, the built form, as it appears frozen in time.[27] Notably, Banham's framing of the mysteriousness of design origins within architectural practice came at a time when the profession was in a state of flux, facing splintering due to increased specialisation.[28] His characterisation of representationalism—"comparison with certifiably non-architectural objects"—as a means of conceiving architectural contributions focused on the perceivable elements of a building, a condition that still complicates the understanding of architectural contributions in contemporary buildings.[29] The analysis of architectural outputs manifest in built form, however, raises the question of what actions of the architect occur in the design process that may be imperceptible in the resultant building and, further, what that means for the practice of architecture.

As Albena Yaneva illustrated in *Mapping Controversies in Architecture*, reflection on the resultant built form tells little about the complex process of architecture that precedes the

26. Banham, "A Black Box: The Secret Profession of Architecture."

27. Ada Louise Huxtable, *On Architecture: Collected Reflections on a Century of Change*, 1st US ed. (New York: Walker & Company, 2010), xi. Notably, Banham's restricted views of what should be considered "architecture" excludes many contributions of the architectural profession, likely encompassing MTPs as well. However, as these contributions are produced by architects, much to Banham's post-mortem consternation, they would decidedly fall into this researcher's understanding of architecture. Rory Olcayto, "The Mysterious Contents of Banham's Black Box," *Architects' Journal* 233, no. 1 (2011), http://search.ebscohost.com.ezproxy.lib.uts.edu.au/login.aspx?direct=true&db=aft&AN=505387631&site=ehost-live.

28. Banham's argument emerged at a time when architecture was rife with mysterious comparisons and a perceived secrecy the profession promulgated in, perhaps, an attempt to maintain relevancy as the profession splintered, various roles—from project management to programming—became specialised, and production methods moved toward computer-aided design (CAD). John Kelly, *Value Management of Construction Projects*, ed. Steven Male and Drummond Graham, 2nd ed. (Chichester: John Wiley & Sons, 2015); William Peña, *Problem Seeking: An Architectural Programming Primer*, ed. Steven Parshall and Kevin Kelly, 3rd ed. (Washington, DC: AIA Press, 1987). For more on the growth of the distinct role of management within practice, see Natalia Rochegova and Elena Barchugova, "Project Management Methodology of Contemporary Architecture," *Procedia Engineering* 165 (2016), https://doi.org/10.1016/j.proeng.2016.11.941; Gilles Garel, "A History of Project Management Models: From Pre-Models to the Standard Models," *International Journal of Project Management* 31, no. 5 (2013), https://doi.org/10.1016/j.ijproman.2012.12.011.

29. Of course, the inspiration from and comparison of designed elements to "non-architectural" items is still a major driver in the development of intent, as illustrated in Chapter 3. Banham, "A Black Box: The Secret Profession of Architecture," 293; Albena Yaneva, *Mapping Controversies in Architecture* (Burlington: Ashgate Pub. Co., 2012).

construction of a building due, in no small part, to the multivalency of building components.[30] Yaneva's "mapping controversies method," while providing a framework for understanding the architectural origins of designed elements, also underscores the broad, interrelated network that makes the origins of a design so hard to discern. It also adds to the reading of architectural production as a haphazard and enigmatic process, with elements only slightly less obscured than in Banham's box. However, by focusing on a specific element of the architectural process—"specific sub-solutions for specific sub-design problems," as characterised by Richard Foqué—this chapter argues that it is possible to define a logical, methodical progression within the outwardly chaotic arc of design development.[31]

As such, the role of the architect can be understood as reconciler of design constraints from outside the remit of the profession—a key role in design development.[32] The rigour and methodical framework of architecture can be read through the understanding that, from the outset of the project, certain deliverables will be provided to demonstrate the design resolution. This, despite lack of clarity on how that resolution will be reached, is compounded by uncertainty and instability of contributions from outside of architecture. As design development progresses past the establishment of intent and ambition, the architect is only sure that he or she will ultimately produce documentable design with increasing specificity, driven by inputs from outside of architecture and beholden to fulfilling the yet-to-be-defined parameters.

Architectural Dependency

As Jeremy Till wrote, "architecture depends"—an assertion that few architects would disagree with.[33] Within architectural practice, deliverables include information gathered through the course of the design process from inputs as varied as engineers, specialty consultants, and cost

30. As she illustrates quite clearly, a singular reading of a built form is possible, but does not reflect the multiple potential meanings discernible. For example, does glass represent transparency or fragility? Both? Neither? Yaneva, *Mapping Controversies in Architecture*.

31. Richard Foqué, *Building Knowledge in Architecture* (Brussels: University Press Antwerp, 2010), 124.

32. A condition that Gutman illustrated in the 1980s, as he attributed growing project complexity to an erosion of architectural contribution within the design process. Robert Gutman, *Architectural Practice: A Critical View* (New York: Princeton Architectural Press, 1988), 31-42.

33. The concept of architects working as part of a larger design team is inherent in the structure of the projects, and the collaborative nature of the work was echoed in every interview conducted. You would be hard-pressed to find a practitioner who did not acknowledge the reliance of architecture on other disciplines that are involved in the design of a building. Jeremy Till, *Architecture Depends* (Cambridge, MA: MIT Press, 2009).

estimators. No architect interviewed stated a contrary view, with many asserting that transport projects required more cross-disciplinary exchange of information than other project types.[34] It is in these moments of reconciliation of non-architectural and architectural elements, through a decidedly architectural process and by architects, that the contributions of the profession can be seen. Given the proclivity of lunch conversations to drift toward expressions of consternation about consultants not providing required information fast enough for design documentation and resolution to take place, the interdependency of architectural production with contributions from allied professions within the larger design team was all too real.

From project inception, the architect knows that architectural deliverables must be produced to reflect the coordinated design. This can only be achieved through the amalgamation of information from the wider team, integrating engineered and specialist input to shape the final outputs. As there will be countless inputs in the process, the information must be quicky considered, its implications for the design understood, and, ultimately, incorporated. This progression of design is understood through the architectural interdependency in addressing the need for resolution of multi-disciplinary interfaces (spaces where architectural and non-architectural considerations collide) and of components that must fulfil multiple roles (elements or spaces that serve multiple purposes). As more specific information is developed over the course of the design process, the information must be reconciled with previously obtained information (including elements of the architectural ambition as defined in Chapter 3) and captured in design documentation. It must be reactive and responsive. It is within this reactivity and responsiveness that the architectural activities related to the reconciliation of external inputs can be understood.

Necessary Methodological Rigour

In order to address the myriad of inputs, architects must collect information and engage in what could be conceptualised as “creative problem solving,” developing design resolutions that fulfil

34. This understanding of architectural work as symbiotic with distinctly non-architectural work (often engineering) perpetuates the conceptualisation that transport design is not inherently architectural. Architect NB, interview with author, 16 October 2019. This idea was mentioned by many interview participants and is touched on in Chapter 3.

evolving requirements.[35] As the inputs and parameters—as varied as codes, material constraints, precedents, and structural or mechanical engineering requirements—can be both unpredictable and unquantifiable, each new factor can potentially result in a new manifestation to address the constraint. With each additional modification, the architect must understand the parameters and the way in which the item or space they are designing—from a single door to an entire building—responds. In practice, each iteration can be fleeting, lasting for a short time until the next parameter is applied. To the architect, each new manifestation is a mechanism of discovery, allowing him or her to work out how the parameter impacts the designed element. While the architect may only consider the iteration a means of achieving the required architectural outcome, reflection on each iteration tells of the maturation of design, and the role the architect is fulfilling.

Therefore, the application of actor-network theory (ANT), like that undertaken by Yaneva, can begin to break down the role of the architect, independent of the potential product of a building, and reveal what it is architects and architecture are doing in shaping elements through architectural participation in projects like transport facilities. This means of analysing architectural production, and architecture's outputs, eschews the black box narrative in favour of a rigorous methodological approach to analysis of the operations of the architects. The development of the architectural design can be traced, using the non-human actors as autonomous elements that lend clarity to at least some of the actions within the box. While logic can be applied, there is no denying that some form of non-quantifiable content is used in the generation of architectural outputs, as different architects offer different resolutions to the same design "problem." Perhaps the outputs appear different, but so too do the outputs of the accountant or the lawyer, for no spreadsheet or contract looks identical, but is a product of the requirements and inputs, overlayed and interpreted by the human actors who produce it. By giving autonomy to the non-human actors in the development of the architectural outputs, the actions of the architects themselves can be critically analysed as they reconcile non-architectural contributions through the design process to produce deliverables.

35. Ayla Ayyildiz Potur and Ömür Barkul, "Creative Thinking in Architectural Design Education," *Proceedings of the 1st International CIB Endorsed METU Postgraduate Conference: Built Environment and Information Technologies* (2006), https://www.irbnet.de/daten/iconda/060590080097.pdf.

Constructing Realities

To address competing parameters and increasing complexity in the development of the design of the station, architects must construct "realities" as the project proceeds, capturing the available elements of information to inform the state of the design at any given time. In seeking to understand the generation of "realities" through the architectural design process, and how each of these realities becomes an actor in its own right—both being shaped by and ultimately shaping the understanding of the design by each team member—the subsequent sections leverage the technique of clearly articulating each reality. The "realities" can be understood as manifestations or conceptualisations of the development of the wall cladding, existing, perhaps, in a drawing or sketch, a digital or physical model, a conversation between multiple team members to share an understanding, or merely the conceptualisation of a single architect who has spent time collecting information and culling it into a form that fulfils the requirements as he or she understands them.

Since the "realities" are personal among team members, and their existence is fleeting, it is impossible to construct a comprehensive representation of these "realities". The existence of any particular reality may be fleeting or persistent, its realisation dependent upon the state of the design and the designer or designers working on that particular aspect. Some of the realities may even vanish only to reappear again later, making the construction of a chronology impossible. However, this is not necessary to understand their generation and impact. Rather, I have constructed the list of realities and the coordinated non-human actors—manifestations of a wall cladding panel—based on my involvement in the project, drawing on meeting notes, analysis of drawings and documents, communications, and interviews. Where a reality was created in response to a formalised requirement, the requirement is cited. Where a reality came into existence only through action, invocation, or imagination (singularly or collectively), no citation is provided, though clarificatory commentary is as needed. The order in which they are presented mirrors the maturation of the design through the architectural process as more information shaped the design outcomes, though is not necessarily chronological.

The technique of explicating "realities" that only exist in the process of design and not in tangible form is borrowed from Latour. However, unlike in *Aramis* where these realities are invented

by the researchers (reconstructed from notes, interviews, meetings, and documents), my analysis is bolstered by the participatory experience of design. In *Aramis*, Latour employed the rhetorical tool of a nameless researcher to "discover" and construct various "realities" for the reader, following passages of text containing interviews and empirical data used to form a base of the realities. Unlike the nameless theoretical researcher, who was [re]constructing the realities years after they had come and gone, I had the benefit of seeing many of the realities unfold. Many of these "realities" presented are realities I witnessed being constructed, or even constructed myself through my work in the development of the project. I employed Latour's method of explicating each discrete moment where an item may have existed, or what it potentially could have been, as it was shaped by a single element. In this way, each actor makes its debut. Each actor was its own self-aware reality, a product of every input to that point (or consciously standing in objection to it). In this way, the cast of physical actors developed the cladding strategy: a result of parameters and constraints defined by not only human actors (e.g. the architect, other members of the design team, the client), but also non-human actors (in the form of preceding definitions of the cladding solution which themselves become actors, shaping the decisions made as new parameters are introduced).

The realities are broken down into categories based roughly on the inputs used to generate each reality. The earliest inputs are those that were generated by the architect at the outset of the project, as explored in Chapter 3, and were based on the intent of the architect. As the design process progressed, the inputs relied on information from outside parties, including the client and consultants. Each iteration of a reality was a maturation of ideas, incorporating (or excluding) inputs to craft a clearer, more defined reality. As the realities were conceptualised, they became actors within the process of design, shaping the trajectory and weighing on future decisions. The final realities traced in this process were reliant upon the existence of the previously conceptualised realities, ultimately manifesting in the final, physical, reality: the panel unboxed in the studio on that September afternoon. The progression to that panel was disjointed but, by reassembling the realities that led to its arrival, the architectural design process (and the role of the architect in martialling the realities) becomes clearer.

The Station Needs Skin

It is from this understanding of a methodological approach that the emergence of the designed attributes began. The impetus could have been anything—Banham's major criticism—but the application of the idea and its integration with a range of fixed parameters and requirements required rigour, which the architectural process provided. When each non-human actor was explicated as it emerged, it was possible to identify the role of the architect in the methodical incorporation of design parameters, whether or not they were architecturally generated. More importantly, the deployment of ANT allowed the wider network of interlinked decisions to emerge, demonstrating that design evolved not through random action or creative genius, but through an understandable series of interactions with constructed "realities" that facilitated design development.

The Realities of Intent, the First Non-Human Actors

Early in the architectural design phase, the architect defines parameters largely independently from other disciplines, pursuant to the design intent, as explored in Chapter 3. These intent drivers are shaped by the desired aesthetic or functional outcomes of the design, explored through imagery, and established as ambitions worth developing through interactions with the client. These form the basis on which the design can begin to evolve and include foundational realities. In the present study, these included:

1. The interior of the station's south concourse will have a lining to cover required services and the raw face of the excavation.[36]
2. The interior of the station's south concourse will have a lining to cover required services and the raw face of the excavation and will wrap continuously from wall to ceiling.[37]

36. The inclusion of a lining is not a given, but an aesthetic decision. The excavation could have been left exposed, as is done in some systems (e.g. Peachtree Center in Atlanta and the stations of the Stockholm Metro). The qualitative "realities" documented here are those that were conceived by the project and studio directors (unless otherwise noted) as they carried the most weight and were most likely to be manifest in the final design, as reinforced by the "silent hierarchy" within the team. 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.

37. The continuously wrapping finish was driven by the concepts discussed in Chapter 3, including the purity of the Turrell sculpture. The finish in the South Concourse was also referential to the wrapping form adopted in the station cavern, itself a maturation of the Reference Design. 12.1: *Architectural Elements*, Tender Submission (August 2018), 17.

3. The interior of the entire station will have a lining to cover required services and the raw face of the excavation and will wrap continuously from wall to ceiling to generate a cohesive environment that defines the overall station.[38]
4. The interior of the entire station will have a light-coloured lining to cover required services and the raw face of the excavation and will wrap continuously from wall to ceiling to generate a cohesive environment which defines the overall station to allow the space to feel larger and open (see Figure 4.02).
5. The interior of the entire station will have a white lining … The escalators, public stairs, and elevators will be charcoal, providing high contrast against the lining, allowing the vertical transport (VT) to be easily seen from anywhere in the station.[39]

Figure 4.02 - An early model showing the south concourse with minimally defined cladding, yet the colour and wrap from wall to ceiling are already represented. Note that, even in this early model, the skylights from the octopus sketch have merged into a single skylight.

Each reality, representing an emerging vision of a final design outcome, began to define the spatial quality of the south concourse. While the initial reality was a basic concept, which offered no

38. Sydney Metro, Victoria Cross - Station Works and Technical Criteria (SWTC), Appendix B1.2 - Station Architectural Finishes, Fittings, Fixtures and Materials, Section 2.1 (2018).
39. The definition of the design of the cavern lining becomes interdependent with other aspects of the space; one design decision cannot be separated from others. The network of these decisions aggregates into the final design resolution.

specificity in relation to how the project would ultimately develop, it was a foundational idea that impacted the generation of the subsequent realities. As the design process progressed, by reality five, it became clear that the decisions were driven not just by the intent of the single material or item being dealt with; rather, the implications of the decision had to be understood within the context of other decisions being made simultaneously. In reality five, the colour of the cladding was understood within the context of a design decision about the VT. VT and cladding were concepts that were wholly independent, and the cladding of one did not impact the other in a practical sense. However, the architect had chosen to link the two for aesthetic reasons, creating a united reality (though one which was capable of being decoupled at a later point in time, if required).[40] As the design process progressed, successive linked realities began to form an intricate network, as illustrated by Yaneva.[41]

The first five realities were predominantly aesthetically and experientially rooted. While the decisions may have been shaped by the interactions with the client or other consultants, they were driven by the architect (as organisation) in the name of a qualitative intent. The ambition of the south concourse as a light box (as noted in Chapter 3) began to take shape, further defining a reality which again became specific to the south concourse alone, but which would have implications across the entire station. This was because reality three dictated a cohesion that either had to be maintained through the maturation of realities, or consciously abandoned in a later reality, contingent upon new, prioritised inputs.

6. The continuous white lining of the south station concourse will create the sense of being inside a James Turrell sculpture.[42]

These first six realities came to exist without the input of any other discipline in the design process, aside from the foundational document provided by the client, the Scope of Works and Technical Criteria (SWTC). They can therefore be classified as fully autonomous decisions under the

40. During the maturation of the project, the charcoal clad finish of the VT was deemed too costly and removed from the project. However, the reality of the concourse cladding remained, despite the decoupling.
41. Yaneva, *Mapping Controversies in Architecture*.
42. This relates to the form defined in reality 2, but given a fixed intent as articulated by the design lead. Architect F, interview with author, 3 September 2019.

concept of architect as definer of qualitative intent (Chapter 3). All the realities directly impacted the human experience of the station, but did not have a direct impact on the performative aspects of the space. While all these could be understood as integral to the design process, they were not a realisable or achievable design that could be documented beyond a sketch or written account, as they lacked the critical inter-disciplinarily required in coordinated architectural documentation. To produce architectural documentation, more information was needed, and more decisions needed to be made. While the outputs of the architectural process are architectural deliverables, they are impossible to generate without the input of other actors. Architecture truly depends.

Non-Human Actors Cannot Write Their Own Emails

Now, the design process moved forward with pragmatic considerations. The requirements were known to the architect in advance from experience and were not necessarily project specific, though the requirements were also defined in the project brief and, in the case of life-safety aspects, were codified within statutory documents. These realities therefore were likely conceptualised by architects tasked with the type of specific documentation and detailing that is required in later architectural deliverables, even before formal coordination. These matured realities were shaped by the earlier realties-turned-actors:

7. The continuous white lining throughout the entire station will be fire resistant.[43]
8. The continuous white lining throughout the entire station will have a low sound reflectivity to decrease echo and reverberation, necessitating sound absorptive properties.[44]
9. The continuous white lining throughout the entire station will not be self-supporting, but must rely on a structural system.[45]

43. This was not unique to the lining as all finish elements within the station were required to be fire resistant given the public use, underground environment, and lack of fire suppression system. Sydney Metro, Appendix B1.2 - Station Architectural Finishes, Fittings, Fixtures and Materials.
44. Sydney Metro, Appendix B1.2 - Station Architectural Finishes, Fittings, Fixtures and Materials; Sydney Metro, Victoria Cross - Station Works and Technical Criteria (SWTC), Appendix B1.1 - Station and Buildings Spatial and Functional Requirements, Section 3.2.4 (2018); Sydney Metro, Victoria Cross - Station Works and Technical Criteria (SWTC), Appendix B8 - Noise and Vibration (2018). Email correspondence with acoustician.
45. A decision made for practical reasons between the structural engineers and architects at the outset of the project by the project leads and was not revisited. This decision was based on a number of factors including maintainability, provision of access behind the panels, potential need for replacement, and blast resistance of the structure.

10. The continuous white lining throughout the entire station will be made of a robust material to minimise the risk of damage and increase the life of the station.[46]
11. The continuous white lining throughout the entire station will be easy to clean and maintain and will be graffiti resistant.[47]
12. The continuous white lining throughout the entire station will prevent people from climbing the walls.[48]

The development of these realities was achieved by encumbering the previous realities with tangible properties, which would in turn have material impacts on the design of the lining system as it developed, dictating the need for the selected system. The realities *acknowledged* the need for engagement of other disciplines, such as acoustic specialists, fire engineers, material manufacturers, and structural engineers, while not actually fulfilling the requirement of engaging. The realities became actors, asking the architects questions such as "How will I be fire resistant?" and "How will I be supported?" These questions could not be answered by the architect and required discussion with other team members with the relevant expertise. If no expert could be found, the architect had to research and find a solution, or the team had to grow to include a member who could answer the question. Thus, the realities taking shape in the design process forced the architect into the role of engagement: for the design to be properly documented and assured, the architect was required to seek out additional information.[49]

Realities seven through twelve developed based on practical necessity, being roles that had to be fulfilled by the lining conceived in realities one, two, and three. While similar, two types of actions were required of the architect by the realities that became evident from the performative properties. Realities seven through nine required the architect to *facilitate* the exchange of knowledge between someone who was an expert in material properties and someone who was an expert in the specific topic beginning to be addressed by the reality (respectively, fire, acoustics, and

46. Sydney Metro, Appendix B1.2 - Station Architectural Finishes, Fittings, Fixtures and Materials.
47. Sydney Metro, Appendix B1.2 - Station Architectural Finishes, Fittings, Fixtures and Materials.
48. Sydney Metro, Appendix B1.2 - Station Architectural Finishes, Fittings, Fixtures and Materials.
49. Architect H, Aconex communication to client, Re: Vic X Station – Internal Lining Combustibility Requirement; Cox-GCOR-001629, 13 January 2020.

structure) to assure conformance with mandated requirements.[50] Realities ten through twelve required *active collaboration* between the architect and potential material providers as they worked to reconcile the architect's reality with the demands of the non-human actors through the application of various products.

Both *facilitation* and *collaboration* were effectively participatory actions by the architects, undertaken through in-person meetings and other forms of cross-disciplinary exchange, in which the realities developed to that point served as physical actors, allowing for the communication of the design envisioned. The realities were brought to meetings in the form of drawings or models, with each reality allowing for exchanges "to perform the typical role of the architect: coordination, integration, getting in there and making everything happen, pulling it together, and being able to direct teams and be the people that can—if not make the decision—influence the decision."[51] It was not the architect's prowess or knowledge that allowed him or her to fill this role; rather, the non-human actors that came to the meetings provided singular realities for all to interrogate, address, and manipulate into new, clearer realities. If the non-human actors were not able to ask a question, there would have been nothing to discuss.

Additionally, many of the smaller details were solved through wholly digital means, with email forming the backbone of communication and collaboration to ensure not only resolution, but documentation of the resolution. While it is not the role of architects to sit around and answer emails, it was an activity that was integral to the design process in amassing inputs and the resolutions of questions. Obviously, as a panel reality cannot draft an email asking the engineer how it may be affixed to the structure, the architect was required to email on behalf of the panel.[52] Architecture is far from the only profession inundated with emails. Arguably, most office jobs today

50. Structural Consultant, Aconex communication to Architect S, Re: Station – Internal Lining Support Coordination Workshop Minutes (18 Nov 19), ARCMAC-GCOR-001357, 19 November 2019. The coordination between consultants and architects covered highly specialised information, as well as more obvious constraints. One report contribution by an engineering team noted "the building structures are also designed to resist gravity." *Design Report: Design Package 41 - Stabling and Maintenance Facility: Architecture, Buildings and Facilities (Misc.)*, B ed., Great River City Light Rail (13 December 2019), 26.

51. Architect NF, interview with author, 4 November 2019.

52. Kim McMurtry, "Managing Email Overload in the Workplace," *Performance Improvement* 53, no. 7 (2014), https://doi.org/10.1002/pfi.21424. In the midst of the work on this PhD, the Covid-19 pandemic struck, requiring the project team to decamp from the office environment and migrate to fully digital operations, underscoring the power (and importance) of digital communication in modern practice. For thoughts on this, see the Epilogue.

require the devotion of a large amount of time to digital communication, much as paper correspondences and telephone calls dominated offices of old.[53] Clearly, the coordination that architects undertake by email today is not a new aspect of the role of architecture but, rather a migrated role, with email replacing the paper correspondence prevalent in Bradfield's world.[54]

Emails allowed the instant exchange of information and had the added benefit of remaining as a lasting chronicle that could later be consulted and referenced as the needs of the project dictated.[55] With the development of various realities, the benefit of a searchable record of communication between design team members generated both accountability and traceability—paramount when a project switched hands or when questions arose about why a decision was made many months prior. This made the correspondences a valuable resource when it came to reconstructing the trajectory of the design and the realities of the cladding. My analysis of the correspondences illustrated a two-year-long process, spanning thousands of items between hundreds of parties, relating to the interior station cladding alone. Knowledge of the process through which the cladding was developed was therefore imperative to enable me to locate the information required to reconstruct this narrative, which would have been an unachievable task without pre-existing knowledge.

Differentiation and Emerging Opportunities

While realities seven and eight reflected performance requirements to be addressed throughout the station and were, therefore, shared across the project team as the design developed, instance-specific requirements that also involved external input began to generate diverging realities for the same product. This condition was furthered by the diffusion of responsibilities across a wide team. Like the realities that required coordination with other disciplines based on the need for essential practical solutions (such as fireproofing and structure) to allow for the design to be realised, another type of architectural-consultant collaboration stemmed

53. Jean-François Stich, Monideepa Tarafdar, and Cary Cooper, "Electronic Communication in the Workplace: Boon or Bane?," *Journal of Organizational Effectiveness* 5, no. 1 (2018), https://doi.org/10.1108/JOEPP-05-2017-0046.

54. The importance of inter-office and cross-disciplinary communication became obvious through time, with the archives filled with correspondences just as banal as the contents of emails traded in today's office.

55. I use the term email to represent digital correspondence in general; there were innumerable file transfers of documents, drawings, and models too large to send via email.

from a fusion of functional and aesthetic decisions. Unlike realties that derived wholly from necessary inputs or requirements, realities that fused architectural intent with instance-specific requirements (in the case of this example, the client requirement for signage, addressed through the development of the cladding), necessitated collaboration between architects tasked with resolving specific elements of the design. This type of architect-led decision required internal development, perhaps with assistance or input of other consultants; this resulted in an area-specific modification of the larger trajectory of the design resolution, which in turn led to divergent realties for the lining:

13. The continuous white lining in the south concourse will make provisions for required statutory signage.

13A. The continuous white lining in the station cavern will not include provisions for signage.

Like the decision that informed reality five, these decisions established parameters that then fed back into the development of more specificity in the reality, with reality nine gaining concrete definition from the client-provided parameters of the SWTC *and* the architectural intent of reality five, uniting the colour and finish of the signage in unison with the VT:

14. The continuous white lining in the south concourse will make provisions for required statutory signage, <u>with the continuity interrupted by a continuous charcoal band for signage, located at 2.4 metres above the floor</u>.[56]

With the development of the charcoal band, the required air vents, CCTV cameras, smoke detectors, and lighting could be incorporated to minimise other intrusions on the walls and ceiling, resulting in another maturation of the reality that fused functional requirements, input from external consultants, and architectural intent:

15. The continuous white lining in the south concourse will make provisions for required statutory signage by a continuous charcoal band … <u>which will be wide enough to accommodate the various service elements which are required in the south concourse</u>.[57]

56. Sydney Metro, Appendix B1.1 - Station and Buildings Spatial and Functional Requirements.

57. The Reference Design documents and accompanying engineering drawings and calculations defined much of the service elements. Additional input from the engineers, informed by required air movement, smoke evacuation, and lighting, also played a part in the emergence of the parameters.

At this point, the realties presented opportunity for consolidation. This was not the architect's doing, but the architect's reaction to the emergence of these fixed realties, defined by the fusion of practical, functional, and intentional inputs. From constraint came opportunity, with the need to accommodate services being ameliorated by the requirement for a signage band and its ability to absorb additional responsibility. In its still undeveloped state, the cladding system's inherent flexibility made room for a potential solution which, until that point, was independent of the cladding system itself. True, the architect made the connection to place the services in the band, encumbering the new reality with that task, but it was reality ten, as an independent actor, who first afforded the opportunity.

Despite the emergence of all of these realities, the cladding had not yet been defined. So many decisions had been made about the cladding, including the colour, function, integration with other designed elements, and the need for assistance by other disciplines. However, there was still no tangible design solution, nothing to document in the required deliverables. The performance requirements, established by the client and reinforced by "best practice", need to weigh in. This is where the true power of the non-human actors came into force as the inputs began to stack up. The cladding solution had characteristics, but no physical representation by reality 15. The idea of the reality and its representation was vague, prepared to be further developed by strategies employed by architects from previous project experience or the attributes of the Stage 1 Design. However, clarity would quickly come through the imposition of parameters.

The Non-Human Actors Act

The early actors worked hard, pushing the design development of the cladding system. Yet with no true resolution to speak of at the point of reality 15, they provided far more questions than answers. The reality said, "This vision is good, I will not only provide a light space, and guidance, I will stand out against the circulation so people can easily navigate the station, but how will it be achieved; what am I?" These early realities begged for clarity and definition; it would take far more energy for them to exert any meaning in a tangible, presentable way; nothing produced from these realities fulfilled the required architectural deliverables and documentation, yet the realities appeared in renderings, sketches, 3D models, and written descriptions, working in tandem with

other actors at similar stages of development to illustrate progress of the overall design. However, as clarity began to shape the actors into more nuanced realities, they also began to throw their weight around. The cladding development became too much for one architect to handle effectively. The entire team of architects was called on to address the realities as they matured; numerous questions were asked, input was sought from numerous consultants and disciplines, and vast amounts of specialised knowledge were required to mould the realities in the computer.

These non-human actors had to mature among the growing scope of elements to be considered, jockeying for attention of the architects. Given the complexity of the process and the myriad inputs, specialisation and siloing of specific architectural activities was leveraged, resulting in competing actors emerging from the design process.[58] Those competing non-human actors came to the table (literally, as in a meeting or, figuratively, in drawing, models, emails, and conversations) and were invoked in the advancement of the design, pushing and pulling at the overall process. From the murky early realities of actors who addressed sweeping roles that lacked specificity, broad questions emerged about how to accommodate them. This in turn led to more pointed questions and clearer definition as the design progressed.

The Panel is Born

While the first 15 realities defined aspects of the wall cladding, it was now up to the architect to shape a more concrete reality; one that could be documented and presented to the client, one that could be developed in drawings and shared with other team members so that their input could exert further parameters on the emerging condition. This maturation was occurring even as realities 1-15 took shape, though independent of the process. The panel was born as architects began to address specific nuances largely disregarded in realities 1-15:

16. The continuous lining throughout the entire station will be panelised to allow for easy erection and replacement of damaged sections; if a portion becomes damaged, it must be easy to fix while the station is closed overnight.[59]

58. Various team members gathered information from outside parties and independently developed elements with the intention of ultimately fusing them back together and reconciling the various parameters in future iterations—a type of divide and conquer strategy.

59. This was the specific manifestation of one of the factors that shaped reality 9.

With the development of reality 16, the creation of panels, a key decision was made about the trajectory of the design. The decision to accomplish the cladding through panelisation underscored the importance of the preceding realities. It addressed the flexibility needed to clad all areas of the station while adapting to the distinct needs of each area, and answered questions raised by realities nine, ten, and eleven, relating to how the cladding system could be erected and how it could be maintained in high-traffic areas. The decision to use panels cannot be understood in isolation because, while it is a defining attribute, the conceptualisation of that reality directly related to the architect's understanding of potential materials that could be used.

17. The continuous lining throughout the entire station will be panelised glass-reinforced concrete (GRC).

The decision to move forward with a GRC panel was precipitated by an understanding of the material's use gained from its deployment on Crossrail in London, as well as its use in Wynyard Walk, a transport facility in central Sydney designed by Woods Bagot and completed in 2015. The architects were comfortable in using the material because of the past performance of the product in a local context, as well as its global use in a transport installation, thereby validating the decision as a rational one. From the precedents, knowledge about the material and its application was gained in the development of the design. As well, TfNSW and Sydney Metro had confidence in the product as it was used in an asset (Wynyard Walk) they already controlled. By proposing GRC and providing the client with a precedent that demonstrated successful installation in a similar transport context, the architects bolstered their choice with fact. Now, other tectonic parameters would begin to exert their influence, with the panelised actors forced to respond to strict, non-negotiable requirements dictated by both quantifiable and non-quantifiable forces:

18. The lining will be panelised GRC and will need to be sized appropriately to ensure the weight is not too heavy for installation and of a dimension that is both transportable to the construction site and manoeuvrable within the defined parameters of the station.[60]

60. Discussion in meeting, Cox studio, 20 February 2019.

19. The lining will be panelised GRC and will need to be sized appropriately to ensure the weight is not too heavy for installation … with smaller panels situated near station entries, where higher passenger volumes will likely result in higher damage risk and therefore greater ease of replacement.[61]

Decisions then began to be made about the panels themselves, in order to advance the design. Again, these decisions were largely defined by the actions internal to the architectural process as solutions were tested in adherence to the parameters that had been defined outside the architectural discipline. If the system was panelised to allow for erection and replacement, and it was required to be sound absorptive, and it was to be white, and it was to be GRC—all realities being demanded by the growing troupe of actors—the realisation of the cladding began to take form. With the actors' demands becoming more focused, it was up to various architects to map the realities up to that point against the requirements laid out by the client, demanded by the property of the selected material, and the flow of new information from consultants across a range of disciplines as they worked through similar processes relating to their fields. The architects on the project were beholden to the existing actors, working with them in their computers, taking them to client and consultant meetings, and bringing them back to internal meetings to apprise others of developments (see Figure 4.03):

20. The lining will be panelised GRC and will have joints large enough to allow for installation, but small enough to prevent climbing.
21. The lining will be panelised GRC with 40mm joints.
22. The lining will be panelised GRC with 40mm joints and horizontal grooves to give texture to further break down the mass of the panels.
23. The lining will be panelised GRC with 40mm joints and horizontal grooves which can become slots backed with insulation to achieve noise attenuation.
24. The lining will be panelised GRC with 40mm joints and horizontal grooves and slots, but the slots must be located out of reach to prevent climbing.[62]

61. Discussion in meeting, Cox studio, 8 March 2019.
62. The options were conceived rapid fire over the course of two meetings as Architects A, D, F, J, L, U, and P worked out how the panels could meet requirements they were each aware of, illustrating the diffusion of responsibility for different aspects. Discussion in meeting, Cox studio, 27 February 2019; discussion in meeting, Cox studio, 4 March 2019.

25. The lining will be panelised GRC with 40mm joints and horizontal grooves and slots, but, in coordination with the signage band, the grooved GRC will be located below the signage band and the slotted GRC will be located above it to prevent climbing.[63]

Figure 4.03 - A small team meeting where the cladding was discussed, with imagery representing some of the realities in play.

From the parameters both established by the architects and defined by others, the station lining (and therefore the south concourse lining) began to obtain definition that was documentable and detailable—key elements of the architectural process for providing contracted deliverables. The appearance of these panels, despite the fact that nothing had actually been created yet, began to be visually represented in detailed drawings, lending the formerly amorphous actors fixed dimensionality that could be represented in technical drawings and the master digital model. These were far from "final", but provided a fixed condition against which future changes could be mapped.

Even as items became fixed, however, not every reality was guaranteed to survive the continual design development. Options—opposing realities—were developed and tested; each fulfilled the requirements established, but they were studied as different, though related, realities

63. The signage band configuration predated many of the other discussions appearing in the tender proposal, but the concept itself was not fleshed out until detailed design nearly a year later. Message from Architect T to author, 25 June 2018.

which could then be weighed against aesthetic ambitions and performative requirements. The modelling was not just to determine which panel looked best; with the help of parametric modelling, questions of complex geometries and optimisation of panel configuration were explored. Computer programs were used to resolve complexities, requiring the participation of architects who could use the specific programs, adding more members to the already bustling team. Visuals were created from the programs, 3D models were printed for inspection, and, for the first time, the entire team was able to view a physical representation of the panelised cladding, with a "reality" (or, considering the options, multiple realities) understood by the whole architecture team, rather than existing as an individual interpretation in each participant's mind (see Figure 4.04).

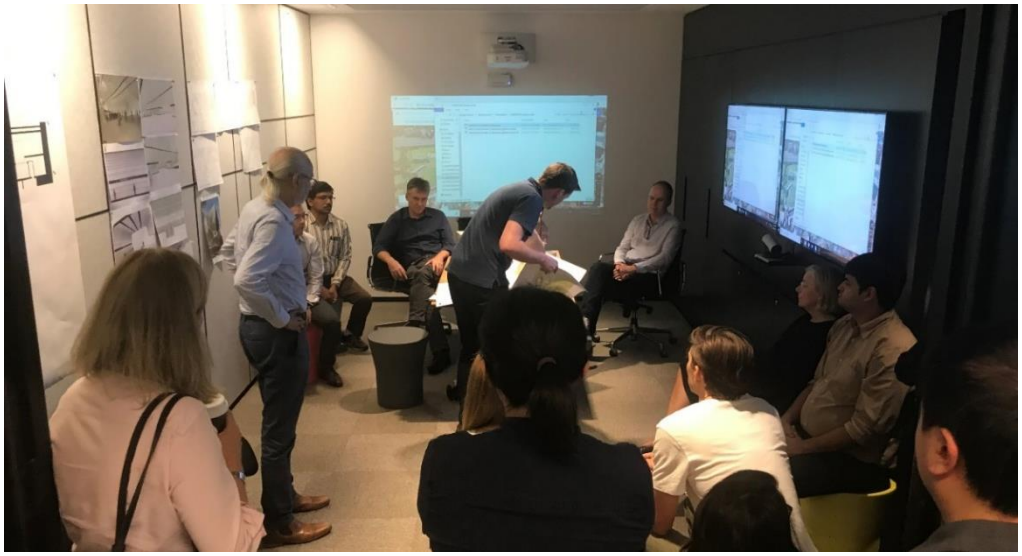


Figure 4.04 - The project being presented for feedback to members of the office, with representations of the panel studies pinned to the wall at left.

The Panel in Plastic

While the early actors could be understood in a logical, perhaps linear order, the new actors taking shape in the context of specialisation required that their characteristics be developed individually, with the understanding that they would be reconciled as the design progressed. Each input placed parameters on the emerging realities, but the involvement of outside consultants and the need for different types of information (some questions taking minutes to answer, others months) meant that different trajectories came to be, each of which had to be studied and analysed, generating alternate realties as they developed. One track to follow was the development of horizontal striations to define the panels, with implications related to rigidity, sound attenuation, anti-scalability, and aesthetics:

26. The lining will be panelised GRC with 40mm joints and two horizontal grooves or slots running the length of each panel.
27. The lining will be panelised GRC with 40mm joints and three horizontal grooves or slots running the length of each panel.
28. The lining will be panelised GRC with 40mm joints and four horizontal grooves or slots arranged in two rows, with a middle divider to create rigidity in the panel.
29. The lining will be panelised GRC with 40mm joints and six horizontal grooves or slots arranged in three rows, with a middle divider to create rigidity in the panel.[64]

With these alternate realities, questions had to be answered regarding the structural integrity of the panels, the aesthetic impact the decisions would have, and the sound absorptive properties of each. The task of tackling each of these questions, chasing down answers, and evaluating the success of each reality in addressing the required performative and aesthetic aspects, meant that the number of realities among the ever-expanding team was far broader than those explored here.

For realties 26-29 (and other similar variations), each alternate reality was printed in plastic (see Figure 4.05), renderings were produced, and the physical representations were (literally) brought to the table. These non-human actors joined the human actors as part of the design discussion. They did not speak, but their appearance at the table changed the dynamic of the conversation as they were fitted into a sectional model of the south concourse and examined. There was something physical to be considered, drawn on, pointed at, and argued about in a tangible way. Ideas were developed from the physical representations, and any team member was able to weigh in on the future development of the panel. Ideas for realities were thrown out to address the panels as part of the wayfinding strategy.

64. The discussion continued into the following week, as the team worked to resolve outstanding items for the Design Review Panel (DRP) to provide feedback. Discussion in meeting, Cox studio, 4 March 2019.

Figure 4.05 - A stack of 3D printed panel options with different groove and slot configurations, and a team meeting, with the sectional model of the south concourse on the table.

One architect in the studio became responsible for the slots of the GRC. How many were required to ensure the reduction of noise to the required level? A specialist consultant was engaged to determine this, but before they could answer the question the entire system had to be modelled. The geometries were too complex to address in Revit, so Rhino—a Revit plugin—was introduced. The entire process could be accomplished through parametric modelling, so an architect with that skillset became involved. Architect B was able to do that, necessitating time allocated for him to join the team and be briefed on the realities with which he must contend—to be introduced to the actors (both human and non-human). The decisions continued without a resolution as to the number of slots, independent of the parametrics being conducted in the virtual world:

30. The lining will be panelised GRC with 40mm joints [and a yet-to-be-determined number of grooves and slots] and the slots can be shaped to indicate direction.[65]
31. The lining will be panelised GRC with 40mm joints [and a yet-to-be-determined number of grooves and slots] and bronze can be inserted in the slots to be viewed from one direction to create visual cohesion between the concourse and the platform, playing into the idea of intuitive wayfinding.[66]

65. The concept had been proposed weeks before the discussion about spacing, but was not further explored until the dimensions began to inform the direction of the design development. Design team meeting discussion, 27 February 2019.
66. Design team meeting discussion, 27 February 2019; design team meeting discussion, 18 March 2019.

With these new proposed realities, production commenced on material which, although it might never leave the studio, was necessary to progress and achieve the design. The reality had to be tested before it could be dismissed. A process of mediating the requirements and ambitions being presented and understood by the various architects was undertaken as the design developed. When someone suggested the bronze of reality 31, did they intend it to look like this or that? And, whatever was intended did not actually matter. With both realities developed, which one looked better? Or were neither good, and reality 31 could then be relegated to the "superseded" folder in the cladding files? These questions did not just relate to the panels; considerations about the impact of the smaller decisions on the quality of the space in which the panels would feature was also key. Further exercises were undertaken to formalise qualitative aspects of quantitative requirements, through the "resolution" of design, such as the "softening of edges" within the south concourse.[67] Even still, the quantitative requirements (e.g. fire resistance, light reflectivity, sound absorption, weight, dimensions) of the previous realities remained integral, and had to be present in the future realties, or an architect would risk being admonished by the realities of the past, asking what happened to their attributes. Tensions arose between qualitative and quantitative requirements.

One "discussion" to resolve these tensions unrolled on trace paper as Architect P and Architect F sketched out ideas about the space, as other meeting participants watched on. Architect C interjected with the dimensional realities and constraints, minimum dimensions, almost to the point of consternation, for he knew the requirements of the SWTC—the main document from the client that guides the architectural response—backwards and forwards. He had read it, absorbed it, and had to fight for the preservation of its requirements in the work being executed in the office. In the same way, the pens of Architect P and Architect F duelled for supremacy on the trace as they collaborated on how to best achieve an aesthetic vision. Each architect was passionate about defending the attributes they knew, that formed the reality in their mind, as they worked together to reconcile diverging understandings into a single, new reality.

These are the tensions at play in architecture. The deliverables must at once fulfil the quantitative parameters established in the contract and brief, the code and guidance provided by

67. Design team meeting discussion, 13 February 2019.

the client, and be imaginative and sellable. The exchange not only showed the role of the architect but also highlighted the stratification and specialisation within the firm that was necessary to achieve the required outputs. The architectural design process could not be realised without the input from across the team. While neither the parametric modeller nor the document manager was at the table, their foundational work was there in the sizing of the panels and the drawings over which the architects traced. Those representational methods, those decisions about the dimensions, formed a framework on which the discussion—both in word and in image—was built. The non-human actors stood in for the architects that had worked to create the mechanism of representation, demonstrating their "realities" to that point.

As the exploratory processes moved forward simultaneously, the panels—for a brief moment conceptualised cohesively across the architectural design team—quickly diverged, with different realities again emerging. The realities of the parametric modeller were driven by geometries, informed by the weight of the material, the size of a truck on which the material would be delivered, itself a product of the width of a traffic lane. Meanwhile, Architect D grappled with the parameters of the digital model, providing information back to Architects B and H. Architect C weighed the requirements of the SWTC, not engaging with the parametrics until meeting time. Architects L, J, and M attended meetings with the structural engineers, exploring how to support whatever panel was developing. Architect E modelled the escalators, understanding how the slope of the VT would impact the panels it abutted. Architect A kept the digital models up and running, managing information exchange between the studio and consultants, while Architect K did the same with spreadsheets tracking the development of each drawing in which the panels appeared. Architect U updated the Design Report—a playbill describing each actor and the various understudies that were being developed as the realities kept coming:

> 32. The lining will be panelised GRC and will <u>have a maximum length of 2800mm to allow for transportation, installation, and any required access as per requirements determined by the services located behind</u>.[68]

68. Another instance of an earlier reality, reality 9, becoming a more tangible requirement. Design team meeting discussion, 8 April 2019.

33. The lining will be panelised GRC and will have a maximum height of 2400mm, constrained by the length in order to keep the weight at an acceptable limit for manoeuvrability throughout their lifecycle.[69]
34. The lining will be panelised GRC and the panels should be standardised as much as possible to allow for repetition in production, keeping costs down and easing installation through standardisation.[70]
35. The lining will be panelised GRC and there will be two standard panel types to maximise efficiency.[71]
36. The lining will be panelised GRC and there will be four standard panel types to accommodate structural, acoustic, and form requirements.[72]
37. The lining will be panelised GRC and [there will be two or four standard panel types] but two-way curvature is required at certain junctions, dictating the need for special panels.[73]
38. The lining will be panelised GRC and the structure supporting the panels will need to be more robust in order to carry the load of the GRC.[74]

The Panel Gets Pricey

In the studio, the realities requiring reconciliation were growing, with each architect learning about new constraints as they became acquainted with each actor. When an architect was introduced to a new panel reality developed by another architect, who had different concerns and had spoken with different consultants, there was potential for issues to arise; new questions were raised as two human actors brought two non-human actors to the table and the two non-human actors could not be reconciled. Simultaneously, another architect in the office spoke to the manufacturer of the GRC. They spoke to the client. They did research about how GRC was developed in London for Crossrail. Concerns emerged:

69. Design team meeting discussion, 8 April 2019.
70. Design team meeting discussion, 11 March 2019.
71. Meeting at Cox studio, Architect F, 11 March 2019.
72. Meeting at Cox studio, Architect C, 11 March 2019.
73. Meeting at Cox studio, Architect B, 11 March 2019.
74. Research was undertaken as to the weight of GRC.

39. The lining will be panelised GRC but this could be prohibitively costly.

40. The lining will be panelised GRC but this could be hard to source.[75]

Discussions ensued. There was pushback from the client about the amount of GRC:[76]

41. The lining will be panelised GRC, but the client wants another solution that is more cost effective and easier to source.[77]

And just like that, a spanner was thrown in the works. A flurry of activity began in the office when the client began to worry about the panel that was coming into existence. The panel was functional, yes, and responded to the requirements presented. It fulfilled the aesthetic ambitions established in the earlier phases of intent generation. But reality 39 was a prima donna with expensive tastes and reality 40 made the client think twice about the potential delays to the project if acquiring an entire cast of similar panels proved difficult. The client perhaps spoke with cost estimators or did research about the panel's cousins on the Crossrail project—the lives of those panels, exposed through budgets and stories in the press, indicated that the manufacturing process was expensive and time-consuming. They asked, "If this happened to a panel so similar to the one being proposed for our project, will the same thing happen to us?" They liked the panel, but in learning its backstory they became concerned. They wanted options, lots of them, and they needed them presented ASAP so that the trajectory of the design was not delayed.

From the work, a new reality emerged; one that incorporated the chorus of voices from the previous panel realties, but which asked its own questions as well:

42. The lining will be panelised GRC or potentially another material with 40mm joints and four horizontal grooves or slots arranged in two rows with a middle divider to create

75. To produce the required GRC in London, the contractor had to buy the company that produced GRC panels, and even then, there have been delays in getting the material. Meanwhile, there was no manufacturer of GRC in Australia and the material had to be shipped in. That would have implications for the sustainability of the project. This shows how an architectural choice can have real-world repercussions on a much larger scale. The choice to use GRC in London reshaped the construction industry with the creation of new factories and new company structures to handle the demand. "Laing O'Rourke Acquires Glass Reinforced Concrete UK Limited," news release, 20 March 2014, https://www.laingorourke.com/media/news-releases/2014/laing-orourke-acquires-glass-reinforced-concrete-uk-limited.aspx.

76. Design team meeting discussion, 29 July 2019.

77. Design team meeting discussion, 5 August 2019.

rigidity in the panel while still providing acoustic dampening, will be standardised as much as possible with a maximum length of 2800mm and height of 2400mm, will feature double curvatures as indicated by the parametric model, and be deployed consistently across the walls and ceiling of the South Concourse with smooth panels below the black signage band at 2400mm in order to prevent climbing and ribbed above the signage band.

As more parameters of the design were introduced—from external parties, from the parametric model, as architectural intent—rationalisation and resolution occurred within the architectural team, resulting in the various realities of varying specificities. Naturally, as more items were resolved, the panel became clearer but, to move the design forward, different realities were generated and progressed by different parties—sometimes simultaneously and sometimes with diverging outcomes. However, the general trajectory of the design process meant that the resolutions kept accruing, yielding singular realities, shared by larger groups of architects, forming departure points for new realities to be generated. As this process unfolded, my role in the project waned as versions of the reports were produced and submitted. Some weeks I would attend multiple design meetings, others I would not be involved in the project development. Then, as the panel progressed to reality 42, I was pulled off the project altogether to work on another job. While it was initially frustrating, if not detrimental to the research, to walk away from the tracking of the development, this ultimately allowed me to zoom out and analyse the larger processes at play.

The Panel Pushes Back

A few months after my departure from the daily activities of the project, the box arrived. The realities previously conceived were suddenly thrown into a state of suspension as the first prototype—the product of months of work by dozens of team members—was unboxed.

43. Two white aluminium panels measuring 2800mm by 1200mm, each with two rows of two slots with curved ends are sitting on the floor of the studio.

Did the realities of the cladding system conceptualised in points 1-42 exist? While they did not exist in any physical sense (aside from 3D printed models, scaled to hold in one hand) and,

ultimately, were not the finalised resolutions represented in the architectural deliverables for realisation, for the designers—including myself—they represented reality. Calculations were made, programs were run, renderings were generated and shared, reports were written. Consultants and collaborators were involved, sizing the required structure, determining the acoustic mitigation steps. Yet, when the first physical manifestation of the panel, the first prototype, arrived, the reality of the panel was not realities 1-42. Rather, the cladding had been reshaped.

> 44. The interior of the South Concourse will have a white lining comprised of panelised GRC to cover required services and the raw face of the excavation, standardised as much as possible with a maximum length of 2800mm and height of 2400mm, and be deployed consistently across the walls below the black signage band at 2400mm in order to maximise the robustness of the finishes which customers may engage with. The lining will also be panelised aluminium material and will be standardised to match the dimensions of the GRC panels, with 40mm joints and four horizontal grooves or slots arranged in two rows with a middle divider to create rigidity in the panel while still providing acoustic dampening, and located above the black signage band at 2400mm. Supplementary special GRC panels will be used where complex double curvature is required, with the dimensions rationalised using parametric modelling and fitting into the required weight and dimensional requirements.

However, reality 44 (and the subsequent realities of the panel as the design moved from Stage 2 to Stage 3 and I moved on to other projects) would not have come into existence without the intervening realities as envisioned by the architects working on the design. The existence of the panel cannot be taken for granted or assumed, as it was the result of many decisions—some simple, some complex; some independent of any other parameters, some contingent upon other decisions impacting other aspects of the project; some qualitative and expressive, some quantitative and functional. The panel did not emerge fully formed from a black box (the box was brown, as most cardboard boxes are) but from a physical box, as a reality to become an actor in its own right. It was comprised by the interactions among other actors, and by the birth and death of “realities” in the minds of the architects who worked on the project, who drew it and modelled it in the computer.

Although none of those previous realities could be read explicitly in the tangible panel pulled from the box, the panel was the aggregate of those former realities, even those that were not manifest at all in reality 44 (i.e. reality 31). The process was only known to those who witnessed it, the architects who went about conceiving it through the mediation of various requirements. Those architects took the process for granted; it was all part of their job. As a researcher, however, I watched it happen and documented it, though I was not initially aware of why. The notes on the development of the panel are surrounded by notes on the development of the fire compartmentation strategy, or the North Building façade. All of these became artefacts that are not relevant to the final product in any meaningful way, unless one wants to know how the final product came to be—and this is only important to the architect if they must prove their work was done with the required professional rigour should a promised outcome not eventuate (or if a researcher wants to analyse the process). In *Aramis*, Latour's hapless rhetorical intern reconstructed the realities of the system as understood by those party to its development (and demise), at first sceptically, to understand why it did not come to be. The architectural design process I have traced through the panel narrative is one that would not be explored further by practice, as it is understood as merely part of the actions of practice in designing a building, just at the reconstruction of the realities of Aramis was solely undertaken because the project did not materialise.

The Panel Reflects (on its) Progenitor

This begs the question, what do these realities tell of the process and the role of the non-human actors in the creation of the web that is architectural design development?

The story of the south concourse cladding illustrates the role of non-human actors in the development of the architectural design. By acknowledging their propensity to "ask questions" of the human actors, the animation acknowledges the autonomy of the objects developed by architects in providing direction and challenges and, ultimately, shaping the design. As the example indicates, the evolving panel was not merely one actor, but encompassed an entire troupe of theoretical panels, which existed in various media and states, from the ethereal conception in the mind of the architect (with each head harbouring a different panel, fulfilling the needs understood and internalised by that particular architect) to the digital model in Revit or Rhino, to the aluminium

panel that arrived in the studio. There were many commonalities behind the series of realities that existed in these various states, linked by their purpose. While the appearance matured, flowing from an amorphous concept at reality one (there is a lining) to reality 44 (mixed panel types with colour, dimensions, and physical attributes), both cladding actors achieved the same intent as demonstrated by the architect in Chapter 3.

The cladding solutions that existed in the realities in between were not, however, merely a pre-determined outcome that ran its course thanks to architectural design. Rather, the network woven among the actors was the architectural design process as it unfolded in a non-linear fashion. Reality 19 can be invoked to provide understanding*: the lining will be panelised GRC and will need to be sized appropriately to ensure the weight is not too heavy for installation, with smaller panels situated near station entries, where higher passenger volumes will likely result in higher damage risk and therefore greater ease of replacement*. The reality can be diagrammed to indicate both the major formative inputs that resulted in its conception, and the powers that the actor then leveraged in its interactions with the design as it progressed.

(1) "the lining" stemmed from the first reality, one of **architectural intent**.

(2) "will be panelised GRC" stemmed from **precedent**, involving the pursuit of the intent, as well as the **practical requirements** that the architect considered with the selection of the material, and the **client requirements**, embodied in the conditions that modified the panel:

    a. "and will need to be sized appropriately…". This was the point at which intent was no longer applicable. Instead, the **architect's past experience**, as well as learned information specific to the project—gleaned through both **research on material properties** (weight per square metre) and **information provided by other disciplines** (structural, how that weight can or cannot be supported)—which was analysed further through **information that fell outside the direct project participants** (what mobile elevated work platform will fit in the space, what is its weight-bearing capacity, and how is it operated). It was human actors who responded to the emails, attended the meetings, or answered the phone

call, but it was the properties and inputs, such as weight and dimensions, lift types, and material properties, that drove the design process and which was pushed forward by the non-human panel.

b. "with smaller panels …" This was again a reading of the **requirements of the client**, filtered through both the **architect's past experience** in design and the **design reality of other elements of the station** at the point where the reality was being developed, shaped by anticipated passenger movement through the station and the mapping of that movement against areas of the cladding that could more easily be damaged (therefore necessitating replacement) and accommodating ease of replacement through sizing.

These various inputs into reality 19 were also present in later realities, and in the panel that arrived in reality 43, despite the change in material and evolution of the design based on additional demands and constraints. The combination of factors, however, did not mean that, given the same parameters, the same outcome would result, as the non-human and human actors interacted in a complex network in which the non-human actors were filtered through both the understanding of each human actor and the means for assembling them into a cohesive output. Reality 19 first existed as a concept expressed at a team meeting. From there, Architect B—who worked with the parametric modelling program Rhino—could have been tasked with generating a representation of the reality in the computer. The skillsets (arguably another form of actor) of the architects shaped the way in which the non-human actors were manifest in the reality that was constructed. The reality that existed only in theory was then formalised and interpreted into a fixed reality 19, with the sizing of the panels filtered through the parametric modelling program by Architect B and his interpretation of the non-quantified descriptor of "smaller panels" in order to produce a representation that allowed for a shared reality 19 among the team. However, with no way of accurately mapping the true proliferation of the actors and their spread through the project, it could have been days or weeks before that representation was shared. In the meantime, other architects had made their manipulations based on their understanding of the discussion and the needs fulfilled by the reality.

As such, reality 19 allowed for the development of new realities by various participants in the design process. The series of realties existed in heads, on computers, and in 3D prints sitting on the architects' desktops, and played a vital role in the development of the concrete—or aluminium—panel. Latour's notion of the impact of non-human actors came to life in a meeting when two opposing realities, 35 and 36, were nearly simultaneously proposed by Architect F and Architect C, respectively, illustrating different understandings of the various parameters at play. If both architects had not been at the meeting, perhaps the design team would have moved forward with two panel types instead of four, and the final result would later be adapted in a different way to accommodate Architect C's concerns. The trajectory of design was immediately shaped by the inputs that informed these realities. Therefore, the panel that arrived in reality 43 was not guaranteed to exist, and the final outcome was shaped just as much by realities 1-42 as by the architect actors.

There was no tangible material actor until the box showed up. And even after the arrival of the panel, the usurped actors waited in the wings—in the form of sketches, digital files saved in "superseded" folders on the server, and in the minds of the architects who had invested so much time in willing them into being through the incorporation of information from outside parties—hoping that the chosen physical actor would not be able to perform, and an understudy would be called in. This left the panel (and the larger project) in a constant state of suspense, unsettled until a clear decision was made to establish the concrete (though still theoretical, only existing in architectural documentation) element on which other decisions could be made.[78] This is why in architecture, reality is subjective.

To this point, it cannot be claimed that design decisions are arbitrary, or that the panel was the result of architectural sorcery, ill-defined and un-discernible, emerging from a black box. Rather, its realisation was the result of a tedious, methodical process. To be sure, the process was not a linear one. It moved in jolts, reacting to new inputs as they were discovered, presenting themselves in emails, meetings, drawings, and cathartic moments of design. One could not argue that the process was illogical but, at the same time, the outcome could have been completely different given the same parameters. If the process were undertaken again, perhaps by the same group, the

78. Latour, *Aramis, or, the Love of Technology*, 44-45.

outcome could be different; for architecture, there is not a single right solution, which is perhaps what makes it mysterious. But the mystery is an illusion. It is the result of the repeated application of logic to parameters.

Therefore, in a sense, design can be reduced to a series of unending operations following a logical sequence. However, the nuance of design is it follows an intent that may not be fully defined by functionality. Rather, along the way, pragmatic considerations may conflict with the intent (as defined in Chapter 3). In the case of the cladding panels, the addition of new actors, and their questions, precipitated the panel's metamorphosis from GRC to aluminium. The theoretical panel had autonomy—the material did not want to be GRC once all the inputs were understood and reconciled. Therefore, the panel tested itself; was it required to push back, or could it adapt to the other actors, the new information, and maintain its integrity? Other parameters weighed in and demanded change, but the architect's contribution held its ground. Sometimes it faltered. The aluminium panels arrived at the office, but then it was up to the architect to tweak the narrative.

Some of the parameters were defined by code, some by client, some by consultants, but they all asserted themselves, either manifesting in a reality or being filed aside to be addressed by another element of the design. The design process could then be understood as the aggregation of all this information. It did not come all at once but, rather, over the course of the design development phase. New information came in, old information was superseded, and ultimately the design evolved to meet these requirements. The architectural output was the documentation of the continual process of adapting based on these parameters.

Concluding Remarks: Architects Depend on Non-Human Actors

In June 2020, long after the panel arrived in the studio, the architectural documentation for the project was sent to the client for review. By that time, I had moved to other projects, ducking in during the final, frantic push as required to support my colleagues. There were late nights, of course, but I never saw the whole picture of the panels, as I worked on updates to the Maintenance Report; I cannot say I missed seeing the panel grow up.[79] Although I appreciated being away from the battles

79. This was all compounded by the pandemic and working from home; see the Epilogue.

and babysitting of an actor which showed its craving for attention by challenging the architects tasked with wrangling and appeasing it, my curiosity was piqued. What had become of the station cladding, of all the work that had gone into generating those various realities that were simultaneously embodied in and negated by the arrival of the panel so many months ago? Of course, the design submitted to the client continued to be tweaked into 2021 as the project moved forward. Manufacturing of prototypes and more rounds of value engineering will no doubt create new realities, but the tangible properties that allow the project to be realised will be present in the cladding, the history of the inputs, manifest by the myriad of actors who have come and gone, shaping the architectural deliverables as they went. The architectural exchanges, resulting in the arrival of a reality with dimensionality, or with sound attenuation properties, will be visible in the whole picture. Of course, the "whole picture"—the conclusion of the panel's journey from inception to reality—will not be formed until 2024, when the station opens.

Inputs are recognised in the statement "architecture depends". Inputs formed the biography of the non-human actors and did not need to be architectural (though those related to intent were). Inputs were ideas and parameters, provided by the client, the brief, and the architects themselves:

- a material must be robust or have a certain dimensional constraint
- air must flow through the space at a certain rate
- sound must be handled in a certain way
- GRC weighs a certain amount
- the South Concourse will be like a James Turrell sculpture.

Yet, while the narrative might be legible in the architectural outputs, the drawings, and the reports, the architectural work that defined the actors will not be laid bare. It will not need to be. The work got the project to the required resolution, appeasing the client, fulfilling the needs of the other consultants, and (hopefully) maintaining the integrity of the architectural intent concocted so long ago.

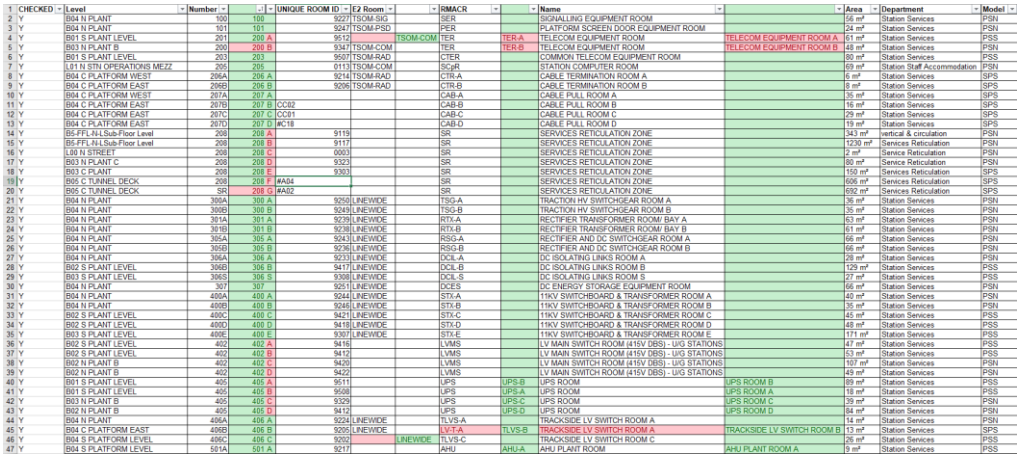
An architectural critic bearing Banham's banner may see the product of the realisation of the architectural deliverables—the completed, built work—and hear a lecture by Architect F on the

inspiration taken from a James Turrell sculpture, and bemoan the co-option of a non-architectural idiom in the production of architecture, or architectural reliance on analogies. Another might point to the production of the design and identify the architect's reliance on other disciplines at every turn of the process and bemoan the downfall of architecture or its subservience to other allied professions. However, by deploying ANT and examining the development of the architectural deliverables through an iterative, collaborative process, I have generated an account showing that the role of the architect is definable and inextricably intertwined with the design of a typology that is often seen—incorrectly—as the product of engineering alone.

The generation of realities, based on inputs of intent, functionality, and practicality, allowed the maturation of design, with the cladding actors driving the architects to search for solutions, clarity, and collaboration to elucidate the realities until they were fully realised and had no more questions for their creators. It was at this point the panels were ready for documentation in the architectural deliverables required by the client and the contract. Some of the realities were created nearly instantly, as if their existence was predetermined by knowledge. Some evolved over many months, vacillating as various inputs weighed upon them. But all the realities shaped the architectural outcome. Yet, the outcome is defensible against the intent, preserved by the architect as organisation, just as the engineers ensured the lighting and systems were accommodated, or the client ensured the budget was adhered to.

The architect as an organisation worked in tandem with a series of non-human actors, generated through the filtering of inputs, in order to advance the design. The architects often failed to acknowledge the autonomy of these creations, seeing them instead as drawings, 3D models, sketches, or concepts. In reality, however, they were not just tools; they pushed and pulled; they asked questions at a meeting, just as another team member would; they required attention and nurturing in order to mature; they lived and, so too, they died. It was up to the architects to interrogate the non-human actors and bring them along to meetings, to seek answers that allowed clarity to develop, and to embody the answers gleaned along the way in shaping the ultimate architectural deliverables.

Chapter 5
Data Management



	CHECKED	Level	Number		UNIQUE ROOM ID	E2 Room		RMACR		Name		Area	Department	Model
2	Y	B04 N PLANT	100	100	9227	TSOM-SIG		SER		SIGNALLING EQUIPMENT ROOM		56 m²	Station Services	PSN
3	Y	B04 N PLANT	101	101	9247	TSOM-PSD		PER		PLATFORM SCREEN DOOR EQUIPMENT ROOM		24 m²	Station Services	PSN
4	Y	B01 S PLANT LEVEL	201	200 A	9512		TSOM-COM	TER	TER-A	TELECOM EQUIPMENT ROOM	TELECOM EQUIPMENT ROOM A	61 m²	Station Services	PSS
5	Y	B03 N PLANT B	200	200 B	9347	TSOM-COM		TER	TER-B	TELECOM EQUIPMENT ROOM	TELECOM EQUIPMENT ROOM B	48 m²	Station Services	PSN
6	Y	B01 S PLANT LEVEL	203	203	9507	TSOM-RAD		CTER		COMMON TELECOM EQUIPMENT ROOM		80 m²	Station Services	PSS
7	Y	L01 N STN OPERATIONS MEZZ	205	205	0113	TSOM-COM		SCoR		STATION COMPUTER ROOM		69 m²	Station Staff Accommodation	PSN
8	Y	B04 C PLATFORM WEST	206A	206 A	9214	TSOM-RAD		CTR-A		CABLE TERMINATION ROOM A		6 m²	Station Services	SPS
9	Y	B04 C PLATFORM EAST	206B	206 B	9206	TSOM-RAD		CTR-B		CABLE TERMINATION ROOM B		9 m²	Station Services	SPS
10	Y	B04 C PLATFORM WEST	207A	207 A				CAB-A		CABLE PULL ROOM A		35 m²	Station Services	SPS
11	Y	B04 C PLATFORM EAST	207B	207 B	CC02			CAB-B		CABLE PULL ROOM B		16 m²	Station Services	SPS
12	Y	B04 C PLATFORM EAST	207C	207 C	CC01			CAB-C		CABLE PULL ROOM C		29 m²	Station Services	SPS
13	Y	B04 C PLATFORM EAST	207D	207 D	#C18			CAB-D		CABLE PULL ROOM D		19 m²	Station Services	SPS
14	Y	B5-FFL-N-LSub-Floor Level	208	208 A	9119			SR		SERVICES RETICULATION ZONE		343 m²	vertical & circulation	PSN
15	Y	B5-FFL-N-LSub-Floor Level	208	208 B	9117			SR		SERVICES RETICULATION ZONE		1230 m²	Services Reticulation	PSN
16	Y	L00 N STREET	208	208 C	0003			SR		SERVICES RETICULATION ZONE		2 m²	Service Reticulation	PSN
17	Y	B03 N PLANT C	208	208 D	9323			SR		SERVICES RETICULATION ZONE		80 m²	Service Reticulation	PSN
18	Y	B03 C PLANT	208	208 E	9303			SR		SERVICES RETICULATION ZONE		150 m²	Services Reticulation	SPS
19	Y	B05 C TUNNEL DECK	208	208 F	#A04			SR		SERVICES RETICULATION ZONE		606 m²	Services Reticulation	SPS
20	Y	B05 C TUNNEL DECK	SR	208 G	#A02			SR		SERVICES RETICULATION ZONE		692 m²	Services Reticulation	SPS
21	Y	B04 N PLANT	308A	308 A	9250	LINEWIDE		TSG-A		TRACTION HV SWITCHGEAR ROOM A		36 m²	Station Services	PSN
22	Y	B04 N PLANT	308B	308 B	9249	LINEWIDE		TSG-B		TRACTION HV SWITCHGEAR ROOM B		35 m²	Station Services	PSN
23	Y	B04 N PLANT	301A	301 A	9239	LINEWIDE		RTX-A		RECTIFIER TRANSFORMER ROOM/ BAY A		63 m²	Station Services	PSN
24	Y	B04 N PLANT	301B	301 B	9238	LINEWIDE		RTX-B		RECTIFIER TRANSFORMER ROOM/ BAY B		61 m²	Station Services	PSN
25	Y	B04 N PLANT	305A	305 A	9243	LINEWIDE		RSG-A		RECTIFIER AND DC SWITCHGEAR ROOM A		66 m²	Station Services	PSN
26	Y	B04 N PLANT	305B	305 B	9236	LINEWIDE		RSG-B		RECTIFIER AND DC SWITCHGEAR ROOM B		66 m²	Station Services	PSN
27	Y	B04 N PLANT	306A	306 A	9233	LINEWIDE		DCIL-A		DC ISOLATING LINKS ROOM A		28 m²	Station Services	PSN
28	Y	B02 S PLANT LEVEL	306B	306 B	9417	LINEWIDE		DCIL-B		DC ISOLATING LINKS ROOM B		129 m²	Station Services	PSS
29	Y	B03 S PLANT LEVEL	306S	306 S	9398	LINEWIDE		DCIL-S		DC ISOLATING LINKS ROOM S		27 m²	Station Services	PSS
30	Y	B04 N PLANT	307	307	9251	LINEWIDE		DCES		DC ENERGY STORAGE EQUIPMENT ROOM		66 m²	Station Services	PSN
31	Y	B04 N PLANT	408A	408 A	9244	LINEWIDE		STX-A		11KV SWITCHBOARD & TRANSFORMER ROOM A		40 m²	Station Services	PSN
32	Y	B04 N PLANT	408B	408 B	9246	LINEWIDE		STX-B		11KV SWITCHBOARD & TRANSFORMER ROOM B		35 m²	Station Services	PSN
33	Y	B02 S PLANT LEVEL	408C	408 C	9421	LINEWIDE		STX-C		11KV SWITCHBOARD & TRANSFORMER ROOM C		45 m²	Station Services	PSS
34	Y	B02 S PLANT LEVEL	408D	408 D	9418	LINEWIDE		STX-D		11KV SWITCHBOARD & TRANSFORMER ROOM D		48 m²	Station Services	PSS
35	Y	B03 S PLANT LEVEL	408E	408 E	9307	LINEWIDE		STX-E		11KV SWITCHBOARD & TRANSFORMER ROOM E		171 m²	Station Services	PSS
36	Y	B02 S PLANT LEVEL	402	402 A	9415			LVMS		LV MAIN SWITCH ROOM (415V DBS) - U/G STATIONS		47 m²	Station Services	PSS
37	Y	B02 S PLANT LEVEL	402	402 B	9412			LVMS		LV MAIN SWITCH ROOM (415V DBS) - U/G STATIONS		53 m²	Station Services	PSS
38	Y	B02 N PLANT B	402	402 C	9420			LVMS		LV MAIN SWITCH ROOM (415V DBS) - U/G STATIONS		107 m²	Station Services	PSN
39	Y	B02 N PLANT B	402	402 D	9422			LVMS		LV MAIN SWITCH ROOM (415V DBS) - U/G STATIONS		49 m²	Station Services	PSN
40	Y	B01 S PLANT LEVEL	405	405 A	9511			UPS	UPS-B	UPS ROOM	UPS ROOM B	89 m²	Station Services	PSS
41	Y	B01 S PLANT LEVEL	405	405 B	9508			UPS	UPS-A	UPS ROOM	UPS ROOM A	18 m²	Station Services	PSS
42	Y	B03 N PLANT B	405	405 C	9329			UPS	UPS-C	UPS ROOM	UPS ROOM C	39 m²	Station Services	PSN
43	Y	B02 N PLANT B	405	405 D	9412			UPS	UPS-D	UPS ROOM	UPS ROOM D	84 m²	Station Services	PSN
44	Y	B04 N PLANT	406A	406 A	9224	LINEWIDE		TLVS-A		TRACKSIDE LV SWITCH ROOM A		14 m²	Station Services	PSN
45	Y	B04 C PLATFORM EAST	406B	406 B	9205	LINEWIDE		LVT-A	TLVS-B	TRACKSIDE LV SWITCH ROOM A	TRACKSIDE LV SWITCH ROOM B	13 m²	Station Services	SPS
46	Y	B04 S PLATFORM LEVEL	406C	406 C	9202		LINEWIDE	TLVS-C		TRACKSIDE LV SWITCH ROOM C		26 m²	Station Services	PSS
47	Y	B04 S PLATFORM LEVEL	501A	501 A	9217			AHU	AHU-A	AHU PLANT ROOM	AHU PLANT ROOM A	9 m²	Station Services	PSS

Figure 5.01 – A screen capture of the room data reconciliation document from 20-12-2019, with red highlighting discrepancies to resolve.

Room Number Bingo

It was just past 2:00AM on New Year's Eve Day. The studio lights were mostly off as the two of us stared at the four glowing monitors of two adjoining workstations. Running on the energy from a bag of lollies and a fresh cup of tea, we pushed on. Architect V would call out a number and letter—I would sift through the Excel file and see if the combination existed and, if found, ask a series of questions coinciding with the code—an endless game of bingo where all 900 combinations not only had to be identified, but reconciled for type, location, and function. There had been discussions of an algorithm and Python script to do the job we were doing.[1] It had been developed and run, twice. But here we were, doing it manually. We could be assured that way, without running the risk of duplicates or outliers surfacing in the drawings or schedules.

To prepare for the "game", I had arrived at the studio in the late afternoon and found a seat at Architect R's desk; when I had arrived, I had been surprised at how many other architects were in the studio working on various projects. After all, the studio was technically closed between Christmas and the New Year, but the demands of the many large projects in the office meant dispensation from the work ban for many, to ensure a smooth delivery of required project information. As the summer sun faded, everyone had packed up to head home. Meanwhile, I set things up for the long night ahead; I was determined to be ready once Architect V arrived, fresh from the airport, to assist in our task of coordination. Neither of us minded the odd hour—the week before we had stayed at the project office on a Friday evening reviewing the rooms and quickly realised a full audit was necessary. With more than a dozen people constantly working in the digital model files, more concerned about their specific deadlines than coding rooms, there were countless inconsistencies. Having found a colleague just as pedantic as me, I knew I would have a compatriot in the daunting task of reconciling the room numbering, coding, and naming when the time came.

1. Python is one of a host of plug-ins for the BIM program Revit, used to automate certain processes.

So, on the eve of 2020, we eschewed the project office over the Bridge and instead commandeered seats in the main studio in the city—a much easier commute for both of us. The atmosphere was decidedly more architectural than the project office—a space shared with engineers, consultants, and contractors. Surrounded by models and drawings—the media typically associated with architectural deliverables—we worked, pouring over room types to create a coordinated master room schedule. We developed a rhythm with our call and response:

501A? AHU plant room!

709? Fire stair![2]

6P4B? TVS Riser B! But which floors does it pass through? This plan is cut at B04. Which site? South. Okay, we'll need to trace it. Flag it to come back to later.

I coloured the line in Excel red and we were on to the next:

604A? TVS Fan Room A!

1011? Refuse room!

And so, it went, until the levels, names, numbers, departments, room type codes, and room acronyms were sorted. Risers and shafts were chased. The cells of the spreadsheet I was working in slowly began to turn green as I marked off what was done. On the other computer, the room schedule of the Revit model began to take on a consistent appearance. Rooms were deleted and added, floor-by-floor from the lowest level of the north site to the highest level at the south site. At 3:46AM I sent a team email explaining the work that had just been completed and imploring that no rooms be added or changed without first getting confirmation of the pertinent information—a request that would be largely heeded over the following months.

2. The fire stairs presented a different numbering challenge, with stairs merging and splitting on their way from the platforms to the street, six levels above. That would not be resolved that night, instead spilling over into a complex discussion that drew in the fire consultant, accessibility consultant, and the architecture team tasked with calculating the width of the egress routes.

Out of more than 400 rooms and spaces reviewed that evening, one thing was immediately clear. The vast majority—well over 95 percent—were dedicated to identifying non-public spaces which, unlike an octopus or wall panel, would never be seen by the travelling public.[3] Where Chapters 3 and 4 examined the seen elements of the station, this chapter delves into the unseen—the spaces located outside the public conceptualisation of the station, and the actions and information required of the architects which, arguably, are outside the public consciousness of the role of the architect. These spaces and these actions are both visible in the bingo scenario; I first explore the idea of space, before expanding that into the definition of the data-centric role of the architect. And much like the distribution/allocation of space within the station as public verses service can drive the stigma of the project type not being conceived as "architecture", so too are the actions of architects in managing the data largely unseen aspects of the architectural process, which would not necessarily be considered as activities of architectural practice.[4]

The architect's facilitation of non-architectural content and the management of the data relating to that content, it will be argued, are just as integral to the production of the required architectural design deliverables as the service spaces of the station are to the operations of the station. Just as no awards are given for the back-of-house (BOH) architectural spaces, neither are awards given to the management of projects or data by architects in any meaningful way; however, the architect relies on fulfilling both of these roles successfully to win and complete projects.[5] It is perhaps why this unseen, and under-discussed side of architectural practice—all the more important in this project type—is of particular note as an element of practice not yet fully analysed and explored in the present literature or research. These roles of the architect demonstrate the depth and breadth of industry knowledge that permeates the profession and allows firms to differentiate themselves as regards the execution of projects of this type. It also highlights the interdisciplinarity required in a mega transport project (MTP), and the role of the architect within the larger constellation of specialists who work in the design space.

3. A portion of this includes the emergency egress spaces which, while technically accessible by the public, would only be used in the event of an emergency evacuation of the station.
4. In the teaching of architecture in studio, this is often characterised in served and service spaces, creating a sort of superior/subordinate relationship between the two. However, this project type turns this traditional relationship on its head for, while the service spaces may serve the public spaces, they are integral to the effective operation of the station and, therefore, just as important for the customer experience as those spaces physically experienced by the passengers.
5. Dana Cuff, *Architecture: The Story of Practice* (Cambridge, MA: MIT Press, 1991).

While the room numbering exercise represents just one singular management activity of one particular station, I will use it to frame two key issues that define the role of the architect throughout the project—and across projects.

1) The design of the BOH spaces of the station, while not largely an aesthetic exercise (apart from occasional selection of finish materials in certain staff spaces), is a major task of the architect, requiring coordination and the development of a level of understanding of the function required of each space, typifying the type of architectural "knowledge" that must be documented as part of the architectural services.
2) The actions of organising the design and its documentation are largely contingent on the management of data and the use of that data to generate the required deliverables and reference the applicable parameters that define the design, in order to fulfil the architectural obligations of the contract and assure the proper elements and functions are provided for, even if these fall outside of the direct architectural role.

From the world of the seen station elements and architectural practices, this chapter moves into the activities of the architect that can be considered "unseen". This has two meanings, which are interrelated.

Chapter Outline

The first section of the chapter establishes the unseen elements of the station and the design process behind them, including the management and reconciliation of data related to design documentation. As in the previous two chapters, the first section establishes the key themes embodied by the introductory anecdote, to be further analysed. Before the analysis, the section frames architectural practice within the context of the knowledge intensive firms (KIF). The knowledge demonstrated and cultivated architectural actions and communicated through outputs is explored in opposition to the widely conceptualised roles of the architect. This contradiction is then linked to identity incongruence within the architectural organisation, providing a framework for analysing how architects mediate the design-versus-engineering schism inherent in large-scale infrastructure projects.

The second section explores the BOH spaces of the station, revealing what is held behind closed doors and how the architect becomes a participant in the shaping of the spaces. I frame the architect's involvement in these spaces around actions undertaken to acquire knowledge relating to their function. Three different methods of achieving this collaborative work are defined to permit the required functionality to be understood, accommodated, and ultimately documented as a component of the contractually required architectural deliverables. The section first introduces the passive role of architecture in the BOH spaces of the station that fall outside of the architectural remit. This type of works is framed as "transliteration". The section then examines operations and statutory requirements that demand consultation with either specialist consultants or external documentation. This role is defined by quantitative requirements to which the architect must adhere and for which the architect is directly responsible, requiring the architect to undertaken "collaborative generation". Finally, the section explores the architect's involvement in cross-disciplinary coordination activities for design aspects between non-architectural participants. A role defined as "referee/coordinator".

From these three roles, the third section defines the emergence of a range of deliverable types required to capture the knowledge relating to the unseen elements of practice. These deliverables are overseen by architects who assume identities synonymous with the deliverable types themselves, thus creating identities based in production and representation. Beyond the creation of these new deliverable-based identities, the section explores the management required to permit this process, involving even more identities—those entrenched in the structure of the project itself. This management is framed around generating expertise that ultimately drove the project forward.

Finally, the chapter defines architectural data—raw numerical or quantitative parameters that shape the project—proposing a taxonomy of data types that provide power for the project to progress. The data of the architectural design process can be understood in terms of four categories—foundational data, data of design, data of documentation, and data of deliverables. Foundational data are data provided by the stakeholder or client at the outset of the project to which the architect must conform (or challenge). They establish the formula for the design, that is,

what must be included and proven through the architectural deliverables. Data of design is then added to the foundational data to shape the development of the design and its conformance to elements specific to the design itself—be they relevant building codes or scripting codes developed to allow the design to achieve the established ambitions through parametrics. To produce the architectural deliverables—vehicles of architectural knowledge and the design process—data of documentation need to be generated by the architect in order to present a cohesive, comprehensive package. The data of documentation allow for coordination across delivered documents and, generally, for all parties to understand what they are looking at. Finally, the data of deliverables are the representation of the design through data, including matrices, schedules, and compliance spreadsheets to "prove" the design's fulfilment of requirements established in the foundational data. The section concludes by exploring the architectural language contained within the myriad of deliverables—drawings, Excel spreadsheets, written reports generated from Word, visual reports with graphics and images generated using Adobe Create Suite—and showing how the entire package is necessary to deliver the architectural knowledge that embodies the contents of Chapters 3 and 4, but which largely is based on the data and information from collaborative activity in relation to both front-of-house (FOH) and BOH spaces.

Knowledge of the Project

At first glance, the work of reconciling room numbers seems non-architectural, unrelated to the design work that typifies the conceptualisation (both outside of the profession and in the generation of an internally conceived identity) of architectural practice.[6] Indeed, this work sits outside of the qualitative parameters as defined in Chapter 3, embodied by creative production and representations generated by the architects in the development and representation of human-centric aspirations. And, it sits outside of the quantitatively and functionally oriented coordination works as defined in Chapter 4, focused on the balancing of aesthetic ambitions with pragmatic demands, reconciled by the bureaucratic diffusion of architectural responsibilities, through the development of non-human actors shaped through cross-disciplinary engagement.

6. Sumati Ahuja, Natalia Nikolova, and Stewart Clegg, "Paradoxical Identity: The Changing Nature of Architectural Work and Its Relation to Architects' Identity," *Journal of Professions and Organization* (2017), https://doi.org/10.1093/jpo/jow013.

Chapter 5 frames architectural practice not within the creative or pragmatic drivers and actions of architecture, but within the context of the knowledge intensive firm (KIF). This designation, which was conceived by William Starbuck in the 1990s, refers to a type of professional services consultancy for the realisation of projects based on the knowledge of individuals.[7] Following Starbuck, this chapter leverages the designation to analyse architecture in relation to its seemingly non-architectural outputs, which characterised much of the work of the firm in the execution of the project that forms the basis for this research.[8] By decoupling architecture from the design process (as defined in Chapter 2), the framing allows for architectural practice to be disconnected from its visual results and instead examined as a profession that deals in knowledge specific to the project—something which, while not quantifiable (or even definable), says much about what architects actually contribute to the transport project type.[9]

Architecture is well suited to characterisation as a KIF, and is indeed mentioned in Alvesson's and Maister's work on the subject.[10] Architecture possesses distinct KIF attributes (as defined by Alvesson), such as its own jargon, a distinct culture, elements of uncertainty or ambiguity in the roles of practice, and a focus on unquantifiable "expertise".[11] Yet the development of architectural design—or its delivery—stands in contrast to the position generally taken by those who study KIFs, and the characterisation of knowledge as an intangible asset, usurping tangible "real" capital.[12] For,

7. The firm structure mirrors the knowledge held by employees, with hierarchy established along the lines of experience. David H. Maister, "Balancing the Professional Services Firm," *Sloan Management Review* 24, no. 1 (Fall 1982).
8. William Starbuck, "Learning by Knowledge-Intensive Firms," *The Journal of Management Studies* 29, no. 6 (1992), https://doi.org/10.1111/j.1467-6486.1992.tb00686.x.
9. "Knowledge" in the sense of this research is understood as specific understanding or skills leveraged by the architects in the activities related to the delivery of design. The knowledge is broad, but manifests clearly around the handling of "data" as defined in the chapter.
10. Mats Alvesson, "De-Essentializing the Knowledge Intensive Firm: Reflections on Sceptical Research Going against the Mainstream," *The Journal of Management Studies* 48, no. 7 (November 2011); Maister, "Balancing the Professional Services Firm."
11. Alvesson, "De-Essentializing the Knowledge Intensive Firm." For information about jargon, see Jeremy Till, *Architecture Depends* (Cambridge, MA: MIT Press, 2009), 159-62; Tom Porter, *Archispeak: An Illustrated Guide to Architectural Terms* (London: Routledge, 2004). For more information on culture, see Cuff, *Architecture*, 112-15; Igea Troiani and Suzanne Ewing, "Inside Architecture from the Outside: Architecture's Disciplinary Practices," *Architecture and culture* 2, no. 2 (2014), https://doi.org/10.2752/205078214X14030010182308. For more information on ambiguity in the roles of architecture, see Sumati Ahuja, "Professional Identity and Status: An Ethnography of Architects in Professional Service Firms" (PhD diss., University of Technology Sydney, 2018); Ahuja, Nikolova, and Clegg, "Paradoxical Identity." For more information about expertise, see Thomas Yarrow, "Architectural Expertise," in *Architects: Portraits of Practice*, ed. Thomas Yarrow (Ithaca: Cornell University Press, 2019).
12. Eskil Ekstedt, *Knowledge Renewal and Knowledge Companies*, (Uppsala: Ekonomisk-historiska institutionen, 1989), 2; Robert M. Grant, "Toward a Knowledge-Based Theory of the Firm," *Strategic management journal* 17, no. S2 (1996), https://doi.org/10.1002/smj.4250171110.

while the design itself may be an intangible deliverable, the documentation as a vehicle for the design is physical (even if digital), and the final realisations of those designs—in this case a Metro station—are wholly physical. What differentiates architectural practice from other professional services firms and KIFs is this translation of the deliverables of the architectural design process, which encapsulate the architectural contributions defined in Chapters 3 and 4 in the design, into tangible, physical outputs.

Accordingly, this chapter focuses on the dissonance between this constructed conceptualisation of what architects do and the actual role of the architects in the delivery of architectural services for large-scale city-shaping projects.[13] Previous research on self-identity within the profession has acknowledged the dissonance between the perception of architectural design and the requirements of modern large-scale projects that increasingly define professional practice (and the urban experience).[14] However, it has positioned this tension as evidence of a disconnect of identity and an impediment to practice. While the polarity of elements of practice (design vs. management, sole authorship vs. collective authorship) are present in the daily work of the architect, they can not only be read as a struggle for verisimilitude—what does an architect want to be?—but also as a record of what architecture is (or must be).[15] The inherent dichotomies of practice and the tensions at play were very clear during the years of embedded work, and need to be addressed within the structures of practice. It is not that the tension must be resolved, nor that it is wholly a disservice to the profession or execution of professional activities. Rather, by seeking to better understand the tensions, the profession can leverage the tension to improve itself. In particular, education to prepare and license future architects should include the ability to tackle the

13. Keller Easterling characterised the actions of the architect in the resolution of spaces as "organizational expressions", countering the "aesthetic and geometric principles" that are often used to define the parameters of design activities. Keller Easterling, *Organization Space: Landscapes, Highways, and Houses in America* (Cambridge, MA: The MIT Press, 1999).

14. Ahuja, Nikolova, and Clegg, "Paradoxical Identity"; Peggy Deamer, "The New Architectural 'Profession'," in *Defining Contemporary Professionalism: For Architects in Practice and Education*, ed. Alan Jones et al. (London: RIBA Publishing, 2019).

15. The polarity of architectural practice does not indicate binarity, as suggested by Hitchcock. There is more credibility in the postmodernist idea that a spectrum exists in the production of architectural outputs, as posited by Sylvia Lavin. Henry-Russell Hitchcock, "The Architecture of Bureaucracy and the Architecture of Genius," *The Architectural Review* 101, no. 601 (January 1947); Sylvia Lavin, "How Architecture Became Attitude," Canadian Centre for Architecture 2020, accessed 7 January 2020, https://www.cca.qc.ca/en/articles/72107/how-architecture-became-attitude.

demands of delivering architectural projects through the definition of architectural knowledge.[16] First, however, those requirements must be better understood.

To understand the scope of architectural knowledge, we must first understand its limits. Contractually, the architect must develop deliverables to represent to the client the resolved design of the building, fulfilling the requirements for the execution of architectural services. As illustrated in Chapter 3, these can be sketches, drawings, renderings, and other visual (pictorial) representations of the project, or, as in Chapter 4, physical models. Behind closed doors, however, there are no sketches or visualisations. What matters in the documentation for BOH spaces is the provision of space and adjacencies to permit the accommodation and proper functioning of systems, services, and operations that dominate the spaces hidden away from the public. Defining what these spaces must be, or how they work, is decidedly outside the remit of the architect, and no architect I interviewed expressed any view to the contrary. Rather, the architect, as the Authorised Engineering Organisation (AEO), is responsible to assure only those aspects related to the delivery of the design, such as code compliance, height requirements, and selection of materials.[17] For architects to step outside the realm of that knowledge would be to expose themselves to a liability they have no desire to assume.

To uncover the actions of architects in the process of design, it is imperative not only to consider the narrative espoused by practitioners and the roles taught in architecture schools, reinforced by the traditional conceptualisation of architect as artist, but also to cast any eye toward deliverables and tasks undertaken in pursuit of those. While the FOH spaces offered affirmation of the visually oriented roles of the architect, tempered by the requirements of functionality—the work that will be seen by the public, the work which will be reviewed by critics, and the work that may win the architect an award—much of the work undertaken by the project team is far less overt. It is

16. The statutory definition of the architect is largely predicated on the performance of the roles of requirements for documentation, project and practice organisation, and regulatory frameworks, even as this stands in contrast to the romanticised version of the architect as creative generator that persists in society. The path to licensure can be seen as representative of the role of the majority of architects in their in daily practice, including their work in MTPs. Architects Accreditation Council of Australia, *The National Standard of Competency for Architects*, 2015 ed. (2018), http://competencystandardforarchitects.aaca.org.au/library/page/document/nsca-briefing.pdf.

17. A confusing and misleading name for a program requiring the architect to certify architectural elements of projects relating to the Sydney Metro. Similar requirements are built into architectural services' contracts for large-scale public infrastructure projects in other countries and contexts.

represented in deliverables that are much the same as the FOH elements, but not nearly as celebrated or recognised outside of practice. In order to see them, the following section turns attention to what goes on behind closed doors, acknowledging identities that are often embedded in professional actions—either reframed in design/creative space or wholly dismissed as non-architectural—despite clear indications that they not only exist in the project, but are integral to the delivery of architectural services.

The struggles also highlight the work that must be done to produce the architectural deliverables, illustrating the architectural "knowledge" that is not just embedded within the design itself, but also within the process through which the design is developed and documented. This is the knowledge that firms seek to grow and retain as collective knowledge that can be deployed in future projects.[18] This chapter explores the forms in which the knowledge of the project is manifested, demonstrating the architect's role in defining the design of the station and the construction of knowledge related to the design in three ways: transliteration, collaborative generation, and coordination. An examination of the knowledge developed through these actions, defined by the work of the architects in the development of the design, enables the construction of a better understanding of the production of deliverables and inter-disciplinary interactions undertaken by the architects.

Behind the Doors Marked "Do Not Enter"

The majority of space (by area) and spaces (by number of rooms/areas) in an underground station are devoted to service and operations, much of which is located BOH, behind closed doors.[19] While out of sight of the public domain of the station—and therefore out of mind for future patrons—the spaces are integral to the success of the station, inseparable from the more conspicuously "designed" elements discussed in the preceding chapters. Put simply, without the BOH spaces and the functions they accommodate, the station would not be able to serve a modern

18. Stephen Emmitt, *Architectural Management in Practice: A Competitive Approach* (Harlow: Longman, 1999), 103. Dorothy Leonard and Sylvia Sensiper, "The Role of Tacit Knowledge in Group Innovation," *California Management Review* 40, no. 3 (1998), https://doi.org/10.2307/41165946, https://journals.sagepub.com/doi/abs/10.2307/41165946.

19. "Predominantly, [the station] is back-of-house. It also is the machine, and the front is just the front of the stage—the workings are hidden." Architect NC, interview with Author, 4 November 2019. "A [station is a] lot of back-of-house, which is a much bigger area than the front-of-house area." Architect NE, interview with Author, 4 November 2019.

system, reliant for its operation on technology, safety systems, and support spaces. If architecture were merely an aesthetic practice, preoccupied with public spaces alone, then the idea that transport stations are engineering-based projects would be largely substantiated behind the doors marked “do not enter”, hiding the inner workings of the station. However, this is clearly not the case, as evidenced by the architect’s contracted requirements, as well as the work done within the architectural firm, which draws the architect’s engagement through the door frame and deep into the service zones.[20]

If so much space in the building is devoted to functions and services the public will never see, it is worth stepping BOH to understand what goes on behind closed doors. First, it is worth acknowledging that while the station’s daily users probably do not give the service spaces a second thought, they likely would not be surprised that it takes a great deal of infrastructure to run a complex, technologically advanced transport system: Crossrail in London and the Metro in Sydney, as just two examples, are hailed as technological marvels with features including driverless trains. Second, it would also be no surprise that safety of passengers and assets alike is paramount in the development of the design. Means of egress from public spaces up to 30 metres below ground must be provided, of course, but there must also be provisions for extracting smoke from tunnels and caverns in order to give people the opportunity to breathe as they evacuate. There must also be provisions for the fire brigade to access underground areas of the station and to manage fire response. There must be places for hoses to draw water to fight a fire. There must be communications infrastructure in place to allow for coordination while fighting a fire. And this is only the fire response. Add to that maintenance access to do things like change lightbulbs, polish the floors, or remove the rubbish; staff provisions for break rooms, locker rooms, and toilets; and ventilation systems to supply fresh air and exhaust air from the tunnels, and the BOH spaces quickly balloon in requirement and complexity.[21]

20. The agreement for the design services on the project does not mention any aesthetic requirements, but merely holds the design team to fulfilling the requirements of the Scope of Works and Technical Criteria (SWTC)—a document of technical criteria (as the name suggests) to allow the station to function. The contract clearly establishes the parameters for what the architect must deliver. Cox Architecture, “Schedule A23. - Designer Deed of Covenant,” (30 August 2019).
21. The importance of each BOH facet is relative to the function served, with the architect’s response beholden to the rigidity of parameters bound to purpose. For example, fire services are very important and must be accommodated in prescriptive ways, whereas the architect has more flexibility in accommodating rubbish removal or staff break facilities.

Of course, one of the marks of design success is that the public need not consider the BOH operations of the station.[22] If the design meets its requirements (under normal operations, of course), then the passengers should never have to consider what goes on behind closed doors. Those designing the BOH operations must give much consideration to ensuring that those who will eventually use the station will give no thought to them. However, in the design of the transport project, the future passengers are not the primary stakeholders, despite the architect's advocacy for their experience as outlined in Chapter 3. Rather, the group of primary stakeholders (who may or may not be the architect's "client", depending on the structure of the contract and delivery method) who commission the station care about the operations very much and, indeed, provide volumes of information about how the station will operate. In the case of the Sydney Metro, these documents are known as the Scope of Works and Technical Criteria (SWTC).[23] The architect was not only required to be aware of the SWTC requirements, supplemented by countless other specialist inputs as the design developed, but was complicit in their inclusion, incorporation, and wholesale integration into the design. If the function were disregarded, the project would not have been successfully delivered, and an architect who is unable to deliver a functional station is not likely to get a commission (or be paid—arguably the most important factor in the business of architecture).

While the BOH functionality may not be glamorous and, if done correctly, will not consciously factor into the daily experience of the station by future users, much of the architectural design process is defined by the reconciliation of the BOH functionality and pragmatics with the FOH aesthetic (and functional) considerations. It is the mental/spatial/design acrobatics necessary to result in this perceived simplicity that defines the work of the architect behind closed doors. As one architect who had been involved in the project type for years stated:

> *The real design challenge is to make something appear inherently simple and beautiful, but it comes from enormous complexity. So, if you look at the underground stations in particular, the amount of equipment and machinery and*

22. As noted in Chapter 4, this is often embodied not just through proper accommodations for BOH spaces, but aesthetic decisions which actively mask the complexity of the BOH spaces and operations to create a sense of (forced) simplicity.
23. The SWTC comprised 56 volumes totalling 1886 pages of content related to every facet of design. Architect C knew the document well and was tasked with assuring its regulations were adhered to in the design as it developed.

> *cabling and conduits and utilities that go into that are quite extraordinary. But the public has no knowledge of that—it's hidden from view; what they see is the end state of hundreds of thousands of hours of work to distil a complex program down to something that is simple and is beautiful. I think that's one of the real challenges: distilling simplicity from complexity. What we've been trying to do recently with that complexity is then to—because the back-of-house areas are like catacombs, there are just hundreds and hundreds of rooms—define ways of delivering that efficiently means. You've really got to understand the engineering almost more than the engineers do so that you can reorganise their elements to make them more compact, easier to maintain, easier to service. It's not formulaic at all.*[24]

At their most basic, these stations are utilitarian and function-driven, yet the ambitions with which they are imbued stem from their public, civic purpose and the aspirations to represent something about the city they serve. Therefore the architectural design process must ultimately deliver something that is "fit for purpose", requiring not just well-crafted spaces for passengers, but functional spaces to meet the demands of the station operations both at opening and as projected into the future.[25] In interviews, even those architects who aligned more with the "traditional" identity of the profession and who oversaw the high-level design decisions of projects acknowledged this: "It's also the behind-the-scenes things—structural elements as well as the cladding and knowing where services are and coordinating everything that is behind-the-scenes as well as in front of the passengers."[26] One architect was more blunt, remarking that "design is more meeting requirements on different things … your design is being influenced by other people and their requirements."[27] Cynicism aside, I now explore three means of constructing knowledge that the architects used to develop the design as it relates to the BOH spaces.

24. Architect NB, interview with Author, 16 October 2019.
25. Architect NE, interview with Author, 4 November 2019.
26. Architect ND, interview with Author, 4 November 2019.
27. Architect R, interview with Author, 9 September 2019.

The Architect as Transliterator

While the responsibility for deciding what rooms are necessary, how large they are, or how they function did not belong to the architect, it was up to the architect to deliver a design that incorporated these elements as defined by the brief, supplemented heavily by members of the project team with knowledge specific to the functions required. This raises the question of how that is possible, as there is a clear dissonance between the architect's knowledge and what they are required to represent. This uncertainty immediately created a certain level of instability within the design process, as the architect navigated the bounds of their knowledge (both contractually and literally). The architect had to ensure the viability of the space documented and that the spaces would fulfil the most mundane and pragmatic functions of the station, such as moving air, allowing egress in an emergency, and providing electricity. Therefore, the architect had to understand what was going on in those spaces and how to achieve the required functions without taking responsibility for them.

The manifestation of this navigation between knowledge of others and architectural project-specific knowledge was omnipresent in the design process for BOH spaces, with one architect noting: "There's actually very little architectural input," yet "we've spent a lot of time working with the engineers on the back-of-house areas." [28] In the span of just a few seconds, the interviewee performed mental gymnastics in an attempt to reconcile the self-perceived role of the architect ("very little architectural input") with the time and effort spent on the space ("spent a lot of time"). It was representative of the identity crisis Ahuja identified in the modern firm, and a product of the architect equating only work that involved contributing tangible input as architectural contribution.[29] Even if he gave little input, Architect M, working in the BOH spaces, focused on understanding what was going on and weighed in only when it was necessary to accommodate the spatial requirements of one engineer or function with those of others in an area within the remit of his remit. For example, the ventilation of the station required a complex series of fan rooms, vertical risers, and horizontal plenum spaces to create a complete system for drawing fresh air from the exterior, transferring it down to the cavern, and vice versa.

28. Architect M, interview with Author, 5 September 2019.
29. Ahuja, "Professional Identity and Status."

The generation and representation of knowledge in this process was not necessarily something discernibly architectural. Rather, the specialised architectural contribution was represented by work the architects did to internalise and understand the accommodation of the non-architectural function in the station, both at the outset of the project, and through the ongoing design and refinement of the BOH spaces as more information became available. The architect did not know what the mechanical engineer knew about air flow. The architect did not know what the electrical engineer knew about the required high voltage provisions. Nor did the architect know what the plumbing engineer knew about extracting wastewater from far below ground. The architect did, however, know the space he was designing, the need to accommodate the engineers' requirements—whatever they might be—and became versed in what could and could not give.

In the example of the ventilation system, once these were defined as trackway exhaust system (TES) and tunnel ventilation system (TVS) provisions, the architect had to first know the purpose of those spaces. Architect U, tasked with the room numbering, did not begin the project knowing how the air flowed through the building. Before the all-night room coordination session described at the beginning of the chapter, Architect U engaged with the engineer who had specific knowledge of the ventilation systems. To learn about this high-tech system, he spent time with the mechanical engineer and some very low-tech tools—printed plans and highlighters—to map the flow of air through the building. The specific requirements, defined in the model by the engineer, were not known by Architect U, nor did Architect U need to know them. Rather, to accomplish the task at hand—ultimately, correctly identifying the rooms in the architectural deliverable of drawings—a basic understanding was sufficient.

The diagram created during this process (see Figure 5.02) allowed the architect to communicate to the rest of the architectural team that TVS fan rooms were located on upper floors, adjacent to the exhausting accommodations, while TES fan rooms were located in the depths of the building, near the trackways. This simplified understanding of the operations of a decidedly more complex system, and the schematic representation, allowed the architect to transmit this information and understanding to the team for inclusion in their work. As such, it represented the architect's role of transliteration—explicating the means of properly representing the items without

unnecessary detail of their functions. Or, as one architect noted, “You need more of an understanding as to what is going in those spaces, even if you don’t necessarily understand the full mechanics of how to integrate it into the full system.”[30]

6P1	TUNNEL VENTILATION PLENUM INTAKE	TVS-IN-P
6P2	TRACKWAY EXHUAST VENTILATION PLENUM INTAKE	TES-IN-P
6P3	TRACKWAY EXHUAST VENTILATION PLENUM OUTLET	TES-OUT-P
6P4	TUNNEL VENTILATION PLENUM OUTLET	TVS-OUT-P
6R1	TUNNEL VENTILATION INTAKE RISER	TVS-IN-R
6R2	TRACKWAY EXHAUST VENTILATION INTAKE RISER	TES-IN-R
6R3	TRACKWAY EXHAUST VENTILATION OUTLET RISER	TES-OUT-R
6R4	TUNNEL VENTILATION OUTLET RISER	TVS-OUT-R

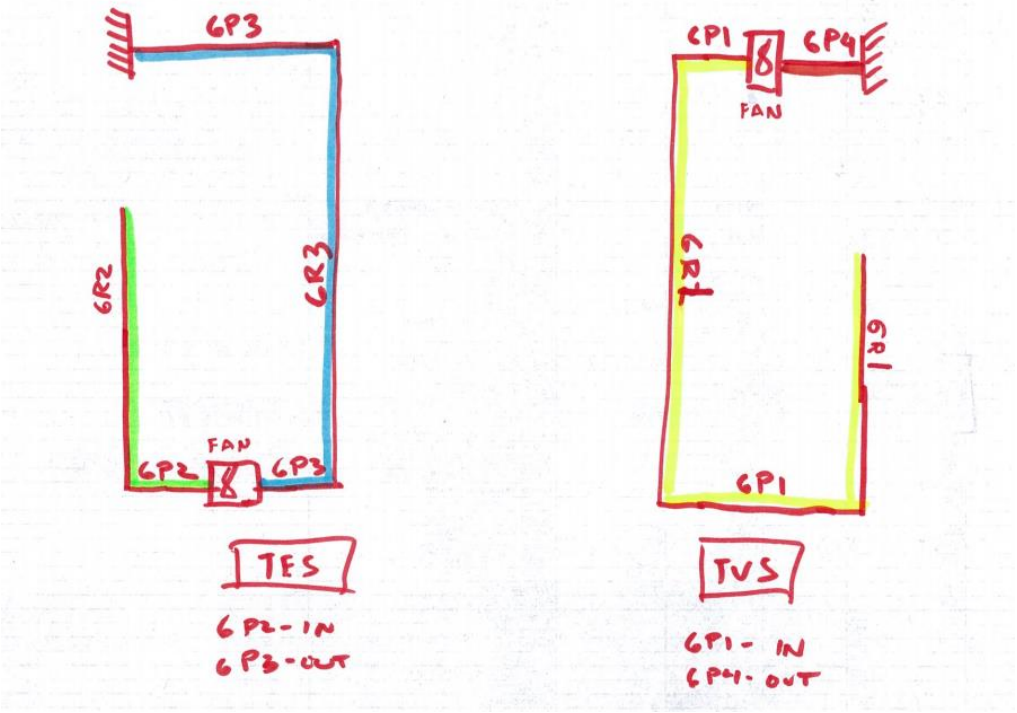


Figure 5.02 - A diagramatic representation of the trackway exhaust system (TES) and tunnel ventillation system (TVS) operations in the BOH spaces. Drawn by the Author for team distribution.

The role of the architect in all of this might seem easy to dismiss. After all, the engineers were responsible for providing sizing and adjacency requirements for the BOH spaces and, therefore, the proper functions of the station, which indicated the leading role of engineers on the project. There was little architectural input; however, there was a requirement for an amount of architectural understanding—knowledge that had to be documented to ensure the functionality of the BOH spaces, even as the architect was not specifically sure how the spaces permitted the station to function. For many BOH spaces and functions, the architect served in this transliterator role,

30. Architect ND, interview with Author, 4 November 2019.

allowing the engineered and other specialist content to be read within the architectural deliverables, yet not necessarily understood for purpose. In the example at the opening of the chapter, cursory knowledge of the TES and TVS systems was imperative for the correct identification of the rooms, allowing the architects to undertake architectural documentation and reconciliation of information for the model.

In tasks where it was not the architect's role to define content, and where the content had no direct bearing on the architect's responsibility, the architect was still required to have a general understanding of the systems and functions provided within the volume of the building, as anything within the scope had to be properly documented in the architectural deliverables.[31] Where this was the case, and there was no bearing on the FOH spaces or the architect's qualitative ambitions, the architect had to acquire a cursory understanding of the expertise of other disciplines in order to properly capture the criteria of that knowledge in the architectural documentation. In this way, the architect became party to the understanding of functional complexities and the project knowledge—not of the function itself, but an awareness of the parameters within which that function must be accommodated—as a means to an end.

The Architect as Collaborative Generator

Transliteration served the architect well in cases where the BOH conditions did not impact the aesthetic or functional requirements that were directly related to the architect's FOH ambitions, nor the service and operational aspects for which the architect was contractually responsible. However, there were also BOH (and, more generally, statutory) aspects of the station for which the architect had to take ownership, while not necessarily possessing expertise about them. In the example project, the architect was assigned as the lead on a range of activities, with some seemingly sitting well outside the bounds of architecture. Out of the comprehensive matrix of tasks that were required to complete the design of the project, and the documentation required to capture the design, those that fell under the remit of the architect included:

31. This sentiment was articulated by one architect in relation to a very specific facet of rail technology: "What I know about rail signalling is very limited, and I'm very keen to make sure that it stays limited. Because it's a world in its own right. So, there's all sorts of specialised stuff—we need to know what the parameters are that affect us, but let the experts do their job, and they in turn need to let us do our job." Architect NA, interview with Author, 16 September 2019.

- Fire rating and compartmentalisation
- Stair design and means of escape (egress)
- Services penetrations of façade and roof. [32]

As mentioned in Chapter 3, architects are often characterised as generalists, knowing a little about a lot. As in other professions, some knowledge (such as technical criteria) is often little-used, and the architect may not have direct knowledge of it, but has knowledge enough to know how to reference and subsequently integrate the requirements into their work. Certainly, over time and through work on numerous projects, an architect may be aware of technical minutiae and the right questions to ask, but he or she still relies on the knowledge of other disciplines (again, architecture depends). However, unlike the scenario of the panel in Chapter 4, the architect tasked with addressing any of the three preceding examples was not developing an aesthetically appropriate response. Rather, he or she merely needed to gain enough information to generate spaces and plans that afforded the other disciplines the proper amount of space in the proper sequences to allow a station to exist or permit proper function.

This role of working outside what the public might expect of an architect is not new; conformance with building codes is a long-established part of architectural practice and knowledge.[33] This role, however, was expanded in response to the increased technological demands of the station. Whereas it could have been expected that, as engineered operational systems became even more advanced, the need for an architect in these contexts would decrease. In fact, the opposite has proved true. As complexity has increased in station BOH, so too has the risk of adverse impact on the FOH spaces. While the perception of the project type as "engineering led" stems from the overall high percentage of space devoted to functional (engineered) elements, the involvement of architects in the shaping and allocation of those spaces highlights the relationship between the disciplines in the design process. As one architect noted, "You need architects in those back-of-house environments because they've got to work just as hard to preserve the things that the

32. List from Lendlease, *Design Interface Responsibility Matrix - Vicx_Rev03*, Lendlease Building Management System (12 April 2019). Author recategorised based on physical deliverable or coordination task. Some tasks omitted/combined for clarity.

33. Paul Segal, *Professional Practice: A Guide to Turning Designs into Buildings* (New York: W.W. Norton, 2006).

everyday man will see as well. The back-of-house design is extremely important."[34] Further, while the architect's time was spent on the BOH elements, the focus of that time was not the same as that on the FOH: "Anything that isn't publicly seen is more spatial and structural."[35]

The architect, in undertaking these "spatial and structural" tasks, needed to deploy knowledge that was specifically non-architectural, such as the means for providing required fire separation within areas of the station that had different uses. While the architect was "responsible" for these elements, this did not mean that he had the knowledge necessary to undertake these tasks, even if he had been given information by the relevant specialists. One architect remarked, "In our profession—yes we're architects—but we then become pseudo engineers, mechanical guys … so we can become this kind of multi-specialist kind of manager."[36] To do this, the architect must consult with other team members who have specialised knowledge. In the case of developing the fire compartmentation drawings, these included the fire engineer and the egress consultant. It was not that the architect required the same knowledge as the experts; rather, it was the architect's responsibility to apply that knowledge to the designed specifics. In assuming the role of "pseudo" specialist, the architect took ownership of specific content that fell outside of the clear definition of the architectural role. Each architect in the process "learned" aspects of the function of the station to execute their job. No two architects in the process gained the same knowledge, thus creating distinct expertise which could then translate from one project to the next. In this way, the architect assumed an identity within the studio of possessing a distinct knowledge set which could (1) differentiate the firm and its ability to deliver similar projects in the future, and (2) allow that specific architect to take that knowledge/ability and transfer that knowledge to other members of the studio, or (3) even take that knowledge and transfer it to a new firm.[37]

In the case of fire-related requirements, compartmentalisation provides a designated time of protection should a fire start in any one part of the building, by isolating its impact from adjacent areas. Architect U had no prior experience in developing compartmentation, but this required architectural deliverable was assigned to him. Hence, the development of knowledge related to this

34. Architect F, interview with Author, 4 September 2019.
35. Architect R, interview with Author, 9 September 2019.
36. Architect NK, interview with Author, 17 October 2019.
37. Emmitt, *Architectural Management in Practice*.

deliverable became a task in pursuit of the architectural documentation. Unlike the ventilation example in the previous section, where Architect U merely transferred the information provided by the relevant specialist to the architect's documentation, in the case of the compartmentalisation, Architect U had to fully understand the requirements of each fire compartment and use that knowledge to represent the delineation on the digital model, which would then be further represented in exported drawings, including plans and sections. Architect U worked collaboratively with the consultants who had expertise in the area, gaining knowledge from them about the requirements for the compartments and applying that knowledge to the work undertaken. The exchange was not a one-off occurrence but, rather, an iterative process through which, as he learned more about the requirements, he ultimately became independently knowledgeable about fire compartmentation, specifically within the context of BOH transport spaces. As plans changed, Architect U was able to go back and reference the material he had previously generated in order to apply that knowledge again to the drawings, not unlike a lawyer going back and reviewing legal precedent in the development of arguments for a case. The documents produced by Architect U would not just stand alone, but would then inform the requirements for fireproofing walls, doorways, and MEP penetrations that passed between compartments, having a knock-on effect. In this way, the architectural knowledge of fire compartmentation would go on to define other aspects of the architectural response, not necessarily directly correlated with the fire compartmentalisation.

In undertaking this task, Architect U assumed the professional identity within the cluster of being the "expert" on fire compartmentation in stations. The signifier of "expert" did not mean that Architect U knew everything about fire compartmentation, nor that he assumed the expertise of the consultants who advise on the process. What it did mean was that, when fire compartmentation was required on the subsequent Metro station, he was asked to assist, advising Architect W on the general parameters of fire compartmentation in the previous station and how they may be applied to the next station. He was also asked to review the drawings produced by Architect W on the second Metro station, providing feedback which, in addition to the direct consultant input sought by Architect W as she undertook the drawings, allowed for collectivisation of knowledge within the team, and furthering the firm's general ability to undertake the task on future projects.

Notably, this type of architectural knowledge is not immediately an overt knowledge type but, rather, the ability to apply received information in a way that allows the architect to develop required deliverables within their remit.[38] Architects U and W, through the process of developing the fire compartmentation drawings for the two projects, did not become experts in fire compartmentation. Rather, they became experts in the application of fire compartmentation knowledge to the project type. They would not be able to independently undertake fire compartmentation without the input and guidance of specialists, including the fire consultant, nor would the information they provided in the form of drawings be specifically useful in the construction of the station. However, their understanding of the parameters of fire compartmentalisation and application of those parameters, in a structured environment, permitted other architects to ensure that the proper doors, walls, and other features at the borders of fire compartments designated by Architects U and W would fulfil the requirements as specified by code and best practice. As one architect put it, the design "solution(s) need to be driven by circumstance, not by a predetermined idea."[39]

Therefore, when working in complex, large-scale projects, the architect must spend a lot of their time learning about what is required and how to meet those requirements in order to develop the design and document it so as to capture those requirements. This learning is largely contingent upon the architect's specific role in the project, either throughout the duration of the project, or on any specific task. Given the range of inputs and specialist consultants who provide context, the architect is as much a student as a collaborator. As one architect put it, "You have to understand rail, and you have to understand all of the safety issues, and all of the requirements around rail, and there are lots of technical requirements that you need to get your head across."[40] To understand, the architect must engage with those who are specialists in the information they require, not just to gather information, but to understand it well enough to be able to incorporate that information with other requirements, adjusting it as needed, and documenting it. The architectural design process relating to the station function, epitomised by the BOH spaces, is therefore an exercise in learning—

38. Richard Foqué, *Building Knowledge in Architecture* (Brussels: University Press Antwerp, 2010), 114-21.
39. Architect NA, interview with Author, 16 September 2019.
40. Architect N, interview with Author, 3 September 2019.

not just gathering information, but understanding it and being able to repackage it, with other inputs, for documentation and distribution. This results in the expansion of architectural knowledge as it relates to the project.

The Architect as Referee/Coordinator

As explored in Chapter 4, coordination is an important task of the architectural process. However, unlike the case of FOH items that must be reconciled with the aesthetic considerations of the station, the BOH coordination is far more reliant on function. As such, the architect was less a party impacted directly by coordination, and more a referee in the overall coordination of information across disciplines which was necessary to vet and deliver a solution that incorporated the needs of the various participants. As the keeper of the drawings that incorporated the inputs of various disciplines, it was up to the architect to ensure delivery of coordinated documents. It is worth noting that the programs of production and documentation used today have a feature known as "clash detection", which alerts participants to potential coordination issues. Therefore, as members of the design team worked, they were made aware of clashes that required resolution before the documentation could be completed. However, where specialists were not able to directly resolve the clashes, the architect often facilitated the coordination to allow for the clash to be removed within the documentation. As no digital program was foolproof (as evidenced in the opening, where a program designed to run the room audit did not negate the need for manual coordination), it was incumbent on the architects to actively resolve clashes discovered during their work in the model, or facilitate the resolution by external parties.

The coordination process for functional requirements challenged specialists and stakeholders to adapt their design requirements and solutions to their given set of parameters to the spatial and technical considerations of others. In doing this, the architect participated in a sort of "weaving" of the parameters.[41] In an example of this intensive process of coordination, one architect framed the requirements of each participant in coordination as a large matrix:

41. Architect NA, interview with Author, 16 September 2019.

> *You can't break it down into its constituent areas and expect to see an understanding of the whole. But having said that, the way we also look at design is like a peace treaty. We have 35 different stakeholders—most of them are single-issue stakeholder groups—not many of them see their mandates being beyond their specific discipline. We have to bring all of those into a coherent whole. That's the design. Our art and science is then taking owners into a thing that's greater than the sum of its parts. If you think about it as a peace treaty, it means virtually everyone has given up something; let's image you've got an intersecting matrix of 15 different variables. If any of them are ten out of ten, it means that something else is probably three out of ten—which is not enough. So everything needs to be seven or eight, so we can't leave anyone behind, but we also can't take any component of it too far ahead either. That's the art of architecture, and then being able to advocate for your team to the client and then to the broader community as well.*[42]

Framing the actions of coordination and negotiation as an "art" is an attempt to conceptualise decidedly business-oriented aspects of the architectural role—management and negotiation facilitation—within the parlance of a creative endeavour. In this way, the architect framed the role of coordination as the pursuit of a creative solution.[43] Architecture is in the unique position of being a linchpin within the larger framework of the design process, even in relation to elements that are decidedly non-architectural. The provision of assistance in striking a balance highlighted the act of coordination, and resulted in compromise whereby each discipline had to pare its requirements down to what must be achieved. This role was seen by architects as "getting everybody into agreement" through compromises, while ensuring that the functional requirements were met.[44] In this way, innovative solutions could be arrived at, while the coordination efforts

42. Architect NA, interview with Author, 16 September 2019.
43. This is notable as it recognises the compromise inherent in the collaborative production of design that is so beholden to parameters related to function and restricted by the excavation and technological demands of the project type. It stands in contrast to the uncompromising heir employed by famous architects such as Wright, Corbusier, and Mies van der Rohe in almost mythical ways. From the actions of practice in the context of transport facilities, it is clear that compromise is not something to be avoided but, rather, a means of advancing the project and a critical component of the architectural role.
44. Architect M, interview with Author, 5 September 2019.

allowed for the expansion of architectural knowledge. The process of arriving at a demonstrably documentable resolution of compromise that addressed the needs of all parties—while not directly applicable to other areas of the project, or other projects more generally—could be used as a tool to address similar coordination issues in the future.

The product of coordination, the design outcome, was still recognised by the architect as an architectural endeavour, despite its rather prosaic origins in resolving competing functional demands.[45] This was because the architectural drawings were the deliverable that captured the overall input and result of the coordination, something that the entire design team leveraged collectively to ensure conformance with the stated criteria.[46]

The act of coordination is, then, the third form of project-specific knowledge generation, less focused on the generation of design, but again integral to the delivery of architectural documentation. The negotiation of space and allocations and the achievement of compromise through collaborative creative solutions may seem a managerial task, but is instead undertaken by each architect on the project, regardless of role or position in the bureaucracy. An aspect of architectural practice that seems at first quite limiting is, instead, a uniting factor. Architect A facilitated this inter-disciplinary compromise relating to the organisation of the model in pursuit of a common output, much in the same way that Architect M worked with engineers to make sure their functional requirements were met and accommodated within the spatial parameters of the project. Given these disparate roles of the architect, the final task was to demonstrate how they all came together to demonstrate their fulfilment.

Managing and Demonstrating Knowledge

The foregoing discussion has explored how project-specific architectural knowledge relating to the operations of the station developed through transliteration, collaborative generation, and coordination. Subsequently, the architect's primary role was to manage that knowledge and thoroughly apply it though design development and incorporate it into deliverables. Of course, it

45. "At the end of the day I'm trying to deliver an outcome, and to me that's still architecture." Architect NK, interview with Author, 17 October 2019.
46. Architect P, interview with Author, 17 September 2019.

was one thing for the actions of knowledge generation to be undertaken, and another altogether for the outcomes of the work to be properly packaged and represented. This packaging and representation fulfilled the contractual obligations of the architect—where the design met the documentation—through the production of deliverables.

In order to ensure that the developed knowledge is duly represented in the documentation, the various forms of architectural knowledge pertaining to operations must be collected, organised, tracked, and distributed to the overall team and, ultimately, to the client. It should represent a resolved state of the design, fulfilling the needs defined by stakeholders and specialists. It is within these drawings, documents, datasets, and digital files that the breadth of the architectural contribution is observable, and the varied identities of the architects are revealed. While the archetypical image of architectural contributions is the drawing, the complexity of the designed spaces, the performative requirements of those spaces, and the interplay between the specialty inputs drove a multi-faceted, multi-media representation of the architectural contributions.

Deliverables of Architectural Knowledge

As one would expect, a comprehensive set of drawings was produced by the architects as part of the deliverables, showing the plans, elevations, sections, axonometrics, details, and related schedules which demonstrated the design resolution in a visual manner. This was much the same as any other large-scale architecture project with hundreds of A1 sheets created. The production of drawings is central to the core identity of the practice of architecture and, while digital modelling technology has theoretically usurped the need for fixed drawings, they are still integral to the architectural deliverables. At the most basic level, the drawings show the design as it has been resolved in a fixed state, telling little of the design process and coordination undertaken to arrive at the design. However, within the drawings, much of the resolution is the result of the exchanges outlined in the previous 200 pages, with architectural drawings representing not only the work of the architect but the collective work of the entire design team, featuring input across the range of specialists and stakeholders.[47] The architects' acknowledgement that the architectural drawings—

47. Architect P, interview with Author, 17 September 2019.

the defining deliverable of the architectural design process—are actually created collaboratively underscores the role and identify of the architect, specifically in this project type, not as a designer, but as a gatherer and amalgamator.

In order to facilitate the integration of information related to the operations of the station and exposed areas, define the parameters of those spaces, and allow for the coordination to take place, the digital model was an essential tool for manifesting the knowledge. The model became the site of compromise, with production in the digital space key to resolving the knowledge into documentation. As one architect noted, "You keep working, you keep modelling, and you end up with a documentation set," which allowed the components integral to the shaping of the design to be visualised.[48] The skillset needed to run the software correctly in the intensive use environment falls within the architectural scope. While various aspects of the model were "owned" by specialist parties, corresponding with contractual requirements, the accuracy of the deliverables relied on the coordination of all these elements, even if they never appeared on the same drawing. Layers were turned off and on to create different representations of the same thing for different purposes, but within the model all layers had to be reconciled to create a coordinated package. As such, the architectural role of amalgamator required not just an understanding of the elements being brought together, but the tools with which to bring them together.

While the drawing set is traditionally the centrepiece of the architectural deliverables (and the flagbearer of architectural identity), it represented just a small portion of the corpus of documentation. The substance of much of the unseen architectural roles existed in the numerous written reports, spreadsheets, and other mechanisms of representation that detailed the trajectory of the design process, including coordination and technical resolutions. In these deliverables, the architects documented the rigour and logic behind the design, and captured the design's conformance to the stakeholders' functional requirements, bolstered by the input of specialists. The production of the reports and spreadsheets was an ongoing task, undertaken by team members as the project progressed, creating a record of development. This could then be read (literally) in descriptions such as those contained in the Design Report or (figuratively) in documents such as the

48. Architect A, interview with Author, 11 September 2019.

return brief, which identified each required element and how it was addressed in the final design. These deliverables were direct products of the functional reconciliation activities, unable to exist without the cross-disciplinary exchanges.

In addition to the documents representing the architectural identities required for the exchange, the creation of the deliverables themselves also generated identities for the architects responsible for their production. Reports, data sheets, and other mechanisms of representing the results of the cross-disciplinary exchange and fulfilment of project requirements resulted in identities such as “responsible for reports” or “responsible for tracking assurance”. While these characterisations could be applied to professions other than architecture, the creation of these roles within the project team spoke directly to the actions of the architects in delivering the required documentation to the client.

Beyond representing the design outcome, the way in which the design was documented meant that the architectural knowledge of the exchange of information became a record of the process. This served to inform the stakeholders of the fulfilment of requirements and, depending on the procurement method, the architects who would be involved in future phases of the work already done and the reasoning behind it. At the same time, it also served as the firm’s records. The architect “responsible for reports” became the “expert” for that form of representation, who furthered the template and could be deployed on other projects to leverage their skillset, in much the same way as the architect who oversaw the fire compartmentation drawings. As such, the documentation of the design further spoke to the process; whether through diagrams, written context, or execution of management tasks related to specific aspects of the drawings/digital model, these identities became a resource for the next project. This knowledge retention through document production built a library of tools for the architect to reference in the future. With reliance on digital documents and models, the files served as templates for future phases of the project or future projects, with the adaptation of previously completed work forming a baseline for new work to commence, without the need to rebuild the format.

Management

The architect had enough understanding of the functional requirements framed around specialist inputs to represent them in the architectural deliverables. Where necessary, the architect also served as a specialist, advising and representing the architecturally oriented functional considerations, and incorporating specific elements in the design, as per codes and established requirements. Further, the architect coordinated as required, delving into the roles of other specialists and assisting in the reconciliation of disparate objectives to add clarity to the deliverables for which they were ultimately responsible. In doing so, the architect introduced a new range of deliverables. Through all of this, the information needed to be managed. The interactions between parties and the content that was generated needed to be traced. Responsibility had to be delegated and results had to be properly reviewed, logged, and shared. Just as was the case with addressing the BOH functionally focused spaces, the management of the process did not immediately seem architectural in nature. Yet, it was integral to the delivery of architectural services. Through all of these actions, architects constructed (and resisted) identities. To accommodate these identities and generate cohesion across them, management within the firm and, specifically, the project team had to be structured to allow for management as the project progressed. However, the perception of this bureaucratic structure and its organisational merits depended on where participants sat in the process and the stage of the project.

Generally, the project was divided into different facets based on types of information required for production. To handle the size and complexity of the project type, the team working to "build" the digital model was divided by zone of the building. For example, in both Metro stations where work was undertaken for this research, there were three model teams: one each for the north station entrance, the south station entrance, and the station cavern. These divisions immediately lent identity to the architects assigned to them, positioning them as overseers of the information that informed the allocation of space and the functional adjacencies within their domain. While they primarily saw themselves as responsible for documentation, working with others to supply elements of the design such as parametrics (the station cladding) and kit-of-parts elements (ticket machines, benches, toilets, signage), the majority of their work actually relied heavily upon

transliteration, collaborative generation, or coordination, undertaken through meetings, email exchanges, one-on-one conversations, and consideration of drawings and documentation provided by specialists.

Aside from the "production" work undertaken by these teams, another group of architects on the project—numbering more than those assigned specifically to facets of the digital model—oversaw specific elements that were common to the project, or worked across the multiple zones, including the design reports, materials and finishes, room data sheets, and other items of general coordination. In order to ensure cohesion across the team, a massive amount of data had to be maintained, vetted, and reviewed, establishing one final layer of complexity (and identity generation). This is explored in the following section.

The Four Ds of Data

Generally, just as the functional spaces of the station required much architectural attention but will likely be unacknowledged by users of a completed station, the work undertaken by architects to make the project feasible was also largely unseen, if done correctly, and existed outside of the public conception (or even the profession's acknowledgement) of what goes into a project. This lends to the view, held even by professionals, that the work being undertaken in the design of MTPs was not "architecture"; yet it was linked to the ability of the space to deliver on the design requirements. The definition of architectural practice must then be expanded, as the work is inseparable from the delivery of the design. Much like the architects who both acknowledge the roles and responsibilities of architecture, but then disassociate them from practice, many architects would baulk at the characterisation of the profession as one of data management. Nonetheless, much of the time spent by architects in the design process is devoted to gathering, understanding, and confirming data.

It is now time to consider the method—how is all of this information received, coordinated, vetted, and ultimately documented in a way that can demonstrate the architectural knowledge generated through the various forms of cross-disciplinary exchange. Aside from a bureaucratic structure of filing, which permits this organised tracking of information, one of the most contentious

issues in KIFs is the ambiguity of knowledge and its inability to speak for itself. However, because there must be assurance in the delivery of the architectural knowledge outputs, it must be fastidiously documented in a number of media, and composed in such a way as to demonstrate its utility and prescience in addressing the known and anticipated concerns and requirements. While there is ambiguity as to how a design will be resolved, there is assurance that it will be resolved, as that resolution is inherent in the agreement to provide architectural services. The resulting design is the product of the application of architectural knowledge.[49] While architecture is knowledge-based in many ways and the deliverables themselves represent a design process that is inherently ambiguous and undefinable, the *aim* of the deliverables—buildability—is clear cut.

At every stage of the design process, data played a central role in the construction of architectural knowledge and the realisation of the project.[50] From the engagement of architectural design services, stakeholders provided seemingly endless parameters and functional requirements—reflecting the complexity of the typology and the stringent/robust functional demands that had to be met—described largely through fixed, quantitative information sets. Through the life of the project the data grew, as the design developed tangible characteristics and specialists added input to the process. As BOH spaces were defined, airflows were calculated, with volumes of air to be moved translating into spatial parameters, thereby generating data that had to be captured through the transliteration process. As the architect worked through code requirements and functions within their remit, data were gathered to fulfil those requirements based on the design itself, gleaned through the architect's collaboration with specialists and reference to the applicable statutory regulations. As attributes such as the proposed height of the building were determined and structural spans were developed, they had to be shaped and refined where they interacted with other disciplines, thus producing coordinated data, that is, data that are interrelated or dependent, despite being generated by different parties.[51]

49. Leonard and Sensiper, "The Role of Tacit Knowledge in Group Innovation," 126.

50. The integration of data in the architectural process is not new. Mario Carpo, *The Second Digital Turn: Design Beyond Intelligence* (Cambridge, MA: The MIT Press, 2017), 9-19.

51. This is best understood by examining the configuration of an egress corridor—something which at first seems simple. However, if the corridor is widened to accommodate additional egress capacity, the span of structure will increase. If the span of structure increases, the depth of the spanning member may become deeper. If the depth of the spanning member increases, the mechanical system may have to be dropped beneath the beam. If the mechanical system is lowered, the ceiling would then need to be lowered. However, that may result in the ceiling becoming too low.

All this content was translated into numbers and descriptive data, captured in spreadsheets and documents, accumulated by each architect working on the project, and, when pertinent to the larger project, collected in overarching documentation. The data collected served both to allow for the production of the required deliverables, and to establish a benchmark by which the success of the design in accommodating that relevant data at a later point could be measured, thus providing empirical evidence that the established requirements had been fulfilled (and, therefore, signifying a "successful" design). For the data to be properly deployed by the architect in the process of design, they had to be both understood and captured in a way that allowed them to be accessed by the design team.

Ultimately, the source of the data, be it internal or external, did not matter, as it all had to be recognised and incorporated (or deemed as not required and therefore excluded from the documentation, though even this decision and rationale required documentation should the question arise again). To manage all of this and accommodate documentation, architects added yet more data to allow the content to be traced. The vignette at the beginning of the chapter, the consolidation and vetting of room numbers, is a prime example of this extra layer of data generated purely to allow the project to move ahead, though it is far from the only instance of this.

Finally, the design deliverables contained much of these data, both raw (in the form of spreadsheets, matrices, schedules, and data sheets) and processed and interpreted (through annotated drawings and documents explaining functions, such as maintenance reports). The inclusion of data as integral to the architectural deliverables squarely positioned the quantifiable parameters that defined the project within the remit of the architects, making them accountable for the fulfilment of the stakeholders' requirements established by the data at the outset of the project. The data came full circle, manifesting at each stage of the design development process, first as a guide to what must be provided, then as a means of providing, and finally as proof that the design accommodated those requirements. The data of the project can then be broadly defined in four ways: data for departure, data of production, data of documentation, and data of deliverables. Each of these is elaborated below.

Therefore, to accommodate the widening of the corridor to allow for emergency egress, the entire structural system may require re-evaluation to eliminate the knock-on effect.

Data for Departure

When the Metro project first arrived at the firm, it came in the form of requirements. Due to the procurement strategy, there were drawings and reports that communicated the previous architect's intent, and which allowed for the operations as envisioned to that point. However, even if the project had started with no completed design work, there would still be a trove of data with which to begin, in the form of parameters such as codes, best practice, and stakeholder requirements for the technology and operation of the station. In the case of the Metro, the organisation had at least a decade of experience in developing the parameters with which to define the design and refine requirements, including years of station construction for the first phase of the line. As such, "they ha[d] a very sophisticated set of technical criteria … a specification of what they want[ed]. And it's like an encyclopedia—it is very big, you're talking thousands of pages. So, you have to start with that."[52] The data served as a point of departure for the architects, establishing the foundation for the project.

The data provided by Metro—much of it contained in the SWTC—was used to cull the requirements that fell to the architect.[53] Architect K, who at one point oversaw the data provided by the client and tracking of the overall team response to that data, noted that more than 1100 items falling under the architect's purview had to be accommodated in the design. She described the method of tracking each requirement against where it was documented in the architectural deliverables, ensuring traceability and, ultimately, the design's conformance with the parameters defined by the stakeholders.[54] Where quantifiable or verifiable data were not explicitly provided by the client, or by specialists as the production was undertaken, the architect translated the qualitative framework into a characteristic which the architects could define. Ultimately, according to one architect, the design and documentation largely "c[a]me down to requirements and the SWTC. You ha[d] to know the SWTC. A lot of things start[ed] in terms of 'is it meeting requirements?' and things like that. And then from there any design elements, the way they look, it c[a]me

52. Architect NB, interview with Author, 16 October 2019.
53. Architect NB, interview with Author, 16 October 2019.
54. Architect K, interview with Author, 11 September 2019.

afterwards. It's got to comply to be built or produced."[55] In order to be built or produced, that compliance has to first be documented by the architect.

Internal team meetings focused largely on data procurement to allow the design to advance. Interspersed with discussions of qualitative ambitions (as outlined in Chapters 3 and 4), much of the discussion within the firm centred on procuring information and then ensuring its application in the design; this represented the range of items requiring documentation by the architects. In February, it was the number of carpark spaces, including the disabled and courier provisions from the architecture firm designing the tower above the station.[56] In May, it was wall type criteria to provide for acoustic separation from the acoustic consultant and thermal separation from the mechanical engineer.[57] In July, it was egress width requirements from the egress consultant.[58] While the final impact of each item on the design and deliverables varied widely, the data required for the design and documentation, while mundane, had to be gathered before inclusion in the project. Ultimately, much incidental discussion took place around delays due to the lack of appropriate data from other parties, indicating that the production could not move forward without data.

Data of Design

The process of translating the data for departure—from building codes to scripting codes—into the design was undertaken by the architects, who manually transformed it into a design solution. The data were considered in much the same way as the qualitative parameters were defined in the design process, as discussed in Chapter 3. Technology has dramatically changed the way data are handled in architecture in the last two decades, opening up the possibility of reconciling large volumes of quantitative parameters with visionary aesthetic conditions to generate the complex forms and intricacies that are present in design today. The same capabilities made famous by architects like Zaha Hadid and Frank Gehry can be applied in any context, leading to the establishment of parametrics and computational design as a mainstay of large architectural practice. This expansion of the identity of architecture demonstrates the profession's ability to adapt to

55. Architect R, interview with Author, 9 September 2019.
56. Internal meeting, 12 February 2019.
57. Internal meeting, 10 May 2019.
58. Internal meeting, 19 July 2019.

changing technological demands and redefine itself based on new opportunities; with new technology to reconcile data, the generation of new, complex forms was made possible. However, while the output of computational design is aesthetic, it is simultaneously based in data.

An example was the development of the panel (Chapter 4), which showcased not just data management but the leveraging of technology and data to allow for quantification of complex qualitative ambitions. In this case, design aspirations and functional parameters were combined through computation design, which one architect noted as "having the biggest impact on this project."[59] Rather than relying solely on collecting data, computational design allowed for computers to gather the design requirement data and aggregate it into solutions that were not easily definable through manual work. Of the process, an architect noted, "We are trying to do certain things—like automating stuff—not just data entry in a dumb way. We are trying to make it more intelligent, because with scripting we can then reuse that script in other jobs. Whatever lessons learned on how to segregate the models and combine the models, which we can apply to other projects."[60] In this way, the quantification of the elements as discussed in Chapter 4 was made possible by this data-driven process. Regarding parametrics and modelling, "there was already the overall design and shape there—it was a matter of how … 'we need to really start defining the panels, how big are the panels going to be, starting to talk with people about how heavy [the panels are], how the bits and pieces come together.'"[61] From this statement it is easy to see how the data of design then afforded the architect the ability to generate architectural knowledge through the methods of processing data, allowing it to be applied to the documentation for both the current and future projects.

Data of Documentation

Some kind of order had to be imposed on the complexities of the data being documented to ensure ease of communication between the architects and other design team members. To this end, the architects has to devise a system to apply to various facets of the project. This type of data generation and organisation stemmed from a need for organisation and clarity in the documentation

59. Architect R, interview with Author, 9 September 2019.
60. Architect A, interview with Author, 11 September 2019.
61. Architect R, interview with Author, 9 September 2019.

of the design in multiple media, bleeding into other design team members' work and client engagement. Given the multi-year duration of these infrastructure projects, and the potential for changing parameters and priorities over time, the data of documentation allowed for consistency in the development of documentation, generating a record that was vital for referencing. As one architect noted, "You may have looked at something three years ago … and then you have to refresh your memory, so that's where all the paperwork comes in handy because you have a collection of logs and registers for each activity."[62]

As well as enabling referencing for occasional items, the data of documentation were integral to the daily activities of coordination. In the case of the room numbers, the identification of the rooms was a clearly necessary task, allowing for coordination in the drawing sets produced by the architect and other design team members, accommodating the tasks of coordination and communication about the project in process, as well as providing ease of referencing in the final documentation. By establishing a single system to identify rooms in a logical manner, the architects and other design team members could easily discuss a specific room without confusion. Further, the data could contain embedded information, as the room numbers did, with the prefix 6 designating the function of the room relating to mechanical needs (604 for Tunnel Ventilation Fan Room and 6P4 for the Tunnel Ventilation Plenum Outlet that serves it). Unique codes were applied to the rooms as well, with the first two numbers signifying the zone of the project (north, south, cavern) and the corresponding level, with the final two numbers identifying the room. This strategy was based on a system developed for the previous Metro station, on which work had begun in the office some months before. The graphic produced in-house to represent this information and allow for consistent room numbering (see Figure 5.03) was subsequently included on future drawings as a coordination tool to allow others outside the firm to leverage the data generated.

62. Architect NC, interview with Author, 4 November 2019.

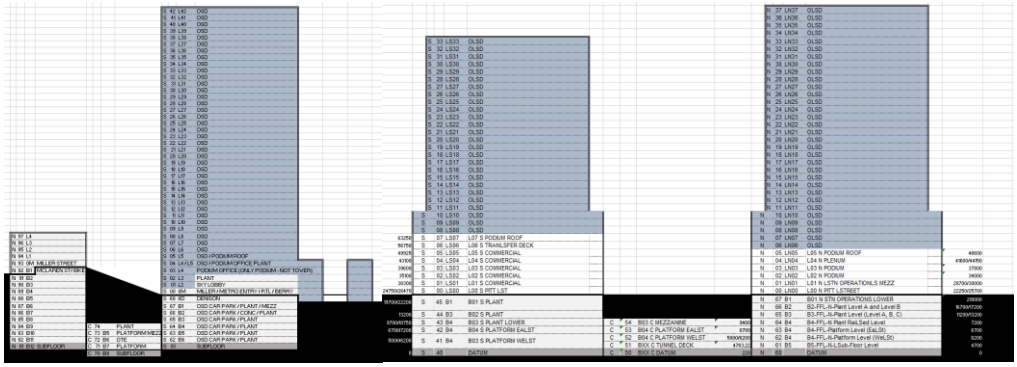


Figure 5.03 - The room number logic for two stations; the one at left was generated first and the one at right six months later based on the original.

Aside from the manual task of reconciling the room numbers and codes according to these datasets, the production of documentation was largely a data-driven task, performed using building information modelling (BIM) software; as one architect noted: "Revit is basically a database and it has modelling tools built on top of it—at its core it's still a database first."[63] The production of the model, while at first seemingly an act of design, was actually inseparable from the production of data for documentation.[64] The parameters that defined the model required hard data to construct the reality in the computer, which was then represented through the production of drawings. The deliverables were produced from the model, ensuring cohesion between what had been designed and its representation.

The use of BIM to develop documentation has had a profound impact on the architectural profession. However, it muddies the identity of the architect, as the actions of modelling can be conceptualised as acts of both design and documentation—a major reconceptualisation of the act of design undertaken in 2D.[65] This disconnect is acknowledged by architects, and the impact on the production of deliverables is noted as upending the traditional phasing of projects and the time it takes to complete them.[66] Despite the incongruence, however, architects continue to maintain the division of project phases. Revit modelling exposes issues and elements that must be addressed further to push the design development forward.

63. Architect A, interview with Author, 11 September 2019.
64. "Revit is mainly used as a documentation tool." Architect M, interview with Author, 5 September 2019.
65. Foqué, *Building Knowledge in Architecture*, 96-98.
66. Depending on the country, the phases have different names, but at their most basic can generally be described as schematic design, design development, and contract documents, as noted in Chapter 2.

Data of Deliverables

Architectural deliverables are replete with data, resulting from the consolidation and reconciliation of foundational data, data of design, and data of documentation, through the process of design. Ultimately, much of the data generated by the process is delivered directly through the documents produced, including schedules, room data sheets, and even data represented in other visual ways, including drawings (as in the case of the fire compartmentation plans). The most overt form of data in the architectural process is the requirement that the architect actually provide numerous instances of data in the final architectural deliverables, allowing the design to unequivocally "prove" that it meets the requirements as outlined by the stakeholders or established by specialists. This is done through documentation tracking the requirements. In Metro, this was known as the assurance process and was tracked through Requirement Verification Matrices (RVTMs) that were updated through the design process to indicate conformance with the SWTC.[67]

An example of the collision of all four types of data in the deliverables were room data sheets. These amounted to a biography of pertinent information for the rooms required for the station function. They parroted the dimensional requirements provided by the stakeholder as well as any specialist input (foundational data), allowing for instant evaluation of the room provided against the performance criteria. Any unique requirements that influenced the design, such as placement of equipment, as well as code compliance of travel paths to egress points, were noted on the plan (data of design), making the parameters that shaped the space immediately legible to those looking at the document. Finally, the drawing was annotated with critical dimensions, openings were tagged, fire ratings were identified, and the room type and code were displayed along with the name (data of documentation), allowing for ease of cross-referencing with other deliverables and representations of the room in drawing sets.

With digital submission of architectural deliverables, the range of PDFs uploaded to the client contained information as varied as the programs in which they were developed. The drawings were exported from Revit after their creation from the digital model. There were reports generated

67. Architect K, interview with Author, 11 September 2019.

in Word, and others developed in InDesign, with supporting graphics, illustrations, and diagrams created in Illustrator or Photoshop. There were spreadsheets of data such as the RVTM, along with multi-page schedules detailing elements such as doors, windows, wall types, and finishes. Beyond merely fulfilling the requirements of documentation, the various forms of representation produced allowed for the understanding of the project by different parties with different interests and different areas of expertise. By leveraging multiple modes of communication, various observers were able to see the information in a way they could understand.[68] This allows for the verification of the content being produced by the architect through different modes of representation.

The deliverables also fulfilled the aims of the documentation, which varied depending on the phase of the project. In many instances, the same deliverables at the same phase were used for different purposes by different parties, highlighting the variability of the data. Of one release, an architect noted:

> *There's two main aims for the current package, which is 70 percent design. One is for tendering, so [the developer] wants to use this package … for costing, so my understanding is that in order to deliver this scope we have to ensure that all of the quantities—everything that needs to be in the station—have to be there. Location-wise, they can be changed in the future. It doesn't actually affect the pricing of it, but we don't want to miss out on items. So that's from our client. And from Metro's side, 70 percent for them is pretty much finalising all of the front-of-house and back-of-house room layouts. And checking all of the general reticulation and delivery routes are satisfactory in terms of back-of-house delivery and in terms of front-of-house, that it meets all of the SWTC requirements.*[69]

This statement acknowledged the architect's understanding of the varied roles of a single deliverable, leveraged by different organisations in different ways. Where an architect might argue that the documentation captures the design, the same documents may be costing tools for the developer, as well as allowing the end-user stakeholders to verify that their requested functions are

68. Architect P, interview with Author, 17 September 2019.
69. Architect M, interview with Author, 5 September 2019.

met. In this regard, the “architectural” content of aesthetics—already reviewed and approved—becomes of little consequence.

This is a case of architectural deliverables not expressing a design but, rather, providing proof that the technical criteria and specifications have been met through the work that has been generated. The design was merely a vessel for providing the requirements, embellished by the architectural solution. Of course, there is an acknowledgement that the architecture is important, or else the concept of placemaking would not be central to the Sydney Metro program. Yet, there is no way to quantify the architectural response, so the process relies on a seemingly endless back-and-forth.

Hard Data, the Architectural Language

It would not be an overstatement to say that the ultimate architectural deliverable, the embodiment of the entire architectural design process, largely comes down to data, its management through the course of the project, and its representation through deliverables. For an industry that relies heavily on an identity rooted in aesthetics and qualitative narratives, this characterisation of the architectural process does not sit comfortably with the definition of architectural practice. Yet, from my observations of and participation in the design process, it is clear that many of the actions of the architect are defined by the generation and accumulation of data, its implementation in the design, and the tracking of this process. Of course, there are numerous qualitative aspects of the design, which define the aspirations of the project outcomes, but those too must ultimately be reduced to quantities, material properties, and functional considerations. Architects deal in data, and architectural knowledge is about how to both extrapolate data into a documentable design and extract data from the design process to provide clarity about what the design is.

Architects have a range of tools, both industry-specific and more generic, on which they call to manage, understand, and document the data of the project. There are drawings, generated directly as 2D representations and produced from 3D digital models, which themselves contain immense amounts of data. One architect noted that the architectural deliverables are:

> *More information or knowledge that is required for construction. The stage we are in, our focus now is that the deliverables are supposed to be showing how to build it. Not the process behind it to say 'this is how this got designed', so those kinds of reports are done outside of Revit. We can use imagery or views from the model to justify our story. But technically, the model and the information contained within the model is more on how we are going to build it and how this facility or asset is going to be maintained. Rather than 'what is the process we went through to design it?' I don't think it contains any information for the previous stage except that it is going to get more information added in later stages. Which is to say, 'we have this many equal number of panels', for example, 'and we have this many asymmetric panels'. This is the type of information that is being stored. Not why this panel is this size.*[70]

The drawings that were produced in documentation were quantitative, providing information required to realise the project. The outputs produced as deliverables in the project were purely quantitative, while specifications were qualitative, that is, they indicated the qualities a material or element needed to have.

Ultimately, when considering the volume of documentation produced for an architectural project, the capturing of purely qualitative impressions, such as renderings or material samples (which, arguably, also provide quantitative information) is highly limited. These deliverables are mostly used to communicate the design intent to those who either do not need to know the details of the project (the general public) or who cannot read architectural drawings. These items are also used by the architect until the project is realised, at which point these qualitative representations become relics of process and are usurped by photographs of the built works themselves. In this way, the architectural language defining architectural deliverables and the embodiment of the design process is data-centric.

70. This complicates the information that can be gleaned from archival research of documents. While exploration and examination of iterative versions of the same drawing may tell of process, and elements of style—be it architectural or drawing—can be extrapolated to uncover hints at what might have driven certain decisions, it is almost impossible to understand what the building is and the process that led to it without documentation of the interactions and mediation of ideas in reports or other chronicles. The design deliverables are therefore an indecipherable aggregation of decisions which are represented without bias toward the inputs that shaped them. Drawings can be seen as empirical data within the context of the larger, qualitative design process. Architect A, interview with Author, 11 September 2019.

Concluding Remarks: Data as Design

The development of the architectural design and its documentation requires the architect to undertake numerous tasks that are largely discounted as "non-architectural" in nature. Yet these management and organisational operations—leveraging writings, datasets, presentation generation, and computer programming—are central to the delivery of architectural services throughout the phases of the project. As such, the development and management of data in the development of design are components of the architectural services themselves, required for the production of the required architectural outputs. As such, they are as much architecture as "design".

The delivery of the architectural design is not as reliant on visual documentation as the conceptualisation of the profession might suggest. Rather, it comprises an integrated package of written documents, matrices and spreadsheets, images, files, and drawings. The coordination of all this information is the responsibility of the architect, in tandem with the army of consultants. Together, these deliverables depict the work undertaken to achieve the design and demonstrate the architectural "knowledge" embodied in the production process.

The development of effective production systems to accommodate the flexibility and complexity of the project type is imperative to the delivery of transport infrastructure architectural contributions. Knowledge of design is not enough to ensure its delivery; rather, mechanisms for organising production are just as important to the successful delivery. These systems, honed through the project, mean that the knowledge can be transferred from project to project, and that a practice's ability to handle the requirements can help it to build a reputation for completing infrastructure projects and, therefore, win similar projects in the future.

Throughout my years of embedded research, I have worked as an architect on a variety of transport projects, which underscores the diversity as well as the interconnectedness of these large-scale city-shaping public-oriented projects. Along with many architects involved in the digital model, I worked on documentation—reconciling data with the architectural ambition, creating drawings and other visual depictions of the design as it is developed—which might lead some to question my profession. However, even though my outputs focused not on visual representation, but on data

representation of the designed project, the work in which I was engaged is decidedly architectural, comprising both elements that allowed for the architectural deliverables to be produced and, in the case of reports and spreadsheets, direct deliverables as well.

It is not so much that the role of the architect has changed, but that the demands of such a robust project type require a certain level of internal coordination and management that is the responsibility of the architect (as organisation).[71] The architect manages the data that are integral to the delivery of design by communicating architectural knowledge via a range of media to demonstrate that the design fulfils the functional requirements, that it incorporates the work of a range of specialist consultants, and that all this is reconciled with the ambitions of the client to realise the final product: a Metro station.

71. Indeed, the change was precipitated long ago, as the profession reacted to the metastasising of data-oriented demands to reframe practice as a bureaucratic, data-centric endeavour. Hitchcock, "The Architecture of Bureaucracy and the Architecture of Genius."

Conclusion

A Journey with Many Destinations

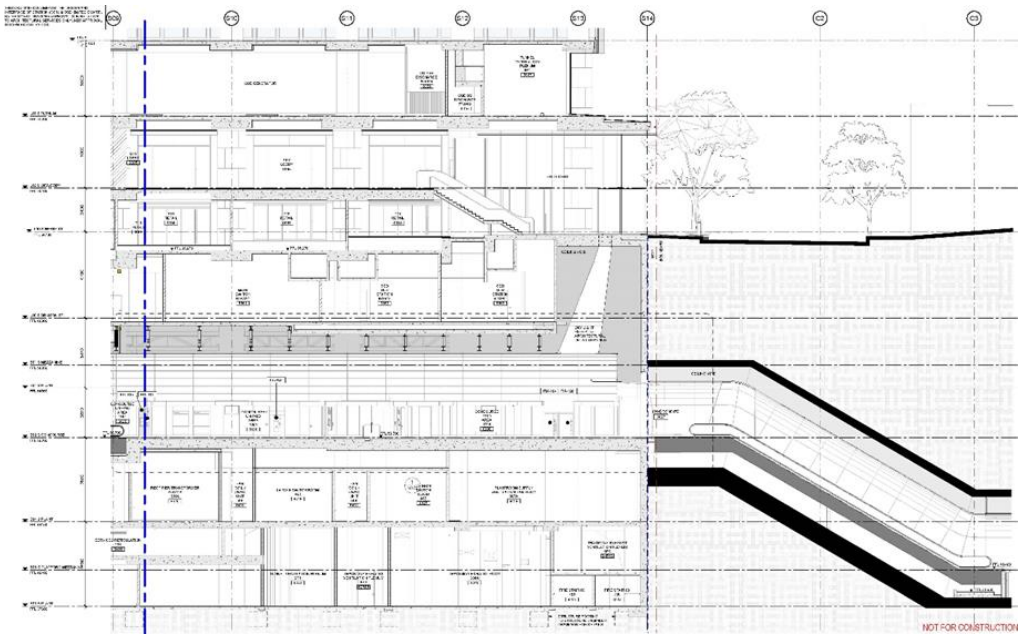


Figure 6.01 – Drawing SMCSWSVI-LLC-SVC-AT-DWG-140012[C]: a longitudinal section through the station's south concourse showing skylight and escalator adit.

Drawing SMCSWSVI-LLC-SVC-AT-DWG-140012[C] (see Figure 6.01) is one of more than 500 drawings in the stage three architectural submission set. The unique code designates the drawing is for the Sydney Metro City & Southwest line, the specific asset (transport jargon for "station"), the main contractor for the project, the general categorisation of information contained in the document, and the document type (in this case a drawing). The numbers reference the building site, specific to this particular asset (south), the type of drawing (a section), and its scale (1:100 at A1); the C designates the revision series of the drawing itself.

To those not acquainted with architectural drawings, the image likely offers little information. For those who can "read" the drawing, it shows spatial adjacencies and allocations, critical dimensions and clearances, room types and structural systems, fixtures and finishes, and even offers clues to the back-of-house (BOH) operations which will ultimately allow the station to function. There are egress stairwells, ventilation and exhaust systems, and switch rooms and substations. There are also indications of the future public experience of the station: a double-height concourse, long escalators leading down to the platform, and a wedge-shaped skylight connection between the "Concourse Paid Area" and the "OSD Lobby". It's all there, in black and white and shaded grey tones.

But what is at once visible and yet indiscernible in the drawing are the years of work by the architects on the development of the design—what the architects have contributed. The architectural work is embedded, for sure, but the observer does not see it; it is not critical to the purpose of the drawing, to communicate the design resolution. Even analysis of the drawing does not reveal it. But there are hints: the previous three chapters have equipped the reader to see the architect's contributions. The skylight aperture, positioned above the adit, embodies the octopus. The lines on the concourse elevation mark cladding panels. And, data are embedded through the drawing, from the document code and room numbers to the thickness of the structure and allocation of BOH spaces.

I had no direct hand in the production of the section. By the time the drawing was exported, I had been off the project for more than six months. But to go back and look at the drawing, even eight months after it was created, the process embedded in the drawing is legible; I can draw parallels between the linework and the pages of the design reports, the meetings I participated in, the conversations about coordination, and the design iterations long past. What's more, I can project into the future in my mind. I can see users experiencing the station illustrated in the drawing. In 2024, as passengers move through the depicted space they will be presented with natural light, bouncing off the white cladding panels that gently curve from the ceiling down the wall, masking the structure and systems that allow the station to operate. In the drawing, it's all there—hidden, but discernible for those who care to dive in.

Each architectural deliverable, be it a section like SMCSWSVI-LLC-SVC-AT-DWG-140012[C], a design report, or a matrix of room data information, is the product of the architectural process and a testament to the heterogeneity of contemporary architectural practice. While the deliverables do not necessarily tell of the process that led to their production, embedded in them is the range of architectural knowledge outputs, engendered by qualitative aspirations, shaped by cross-disciplinary collaboration, and coordinated through intensive data management. Architectural production of the deliverables was achieved through iterative refinement and reconciliation of qualitative ambitions and quantitative parameters, facilitated by data management, into tangibly realisable forms. This process led to architectural documentation, the packaging of those qualitative ambitions and quantitative parameters into constructable representations guided by the underlying data. The architectural process—haphazard at times, though with pre-defined outcomes (there will be a station and it will function to certain predefined parameters)—underpinned the deliverables. The essence of the octopus is captured in the wedge-shaped skylight of the section, the process of the cladding development is captured in the lines of the wall, and the entire package is built on the data that ensure requirements have been fulfilled, just as data permitted the production to occur.

Not only is the architectural process responsible for the form of the outputs, but the architectural deliverables become the means of translating the work of the design team into a

tectonically realisable format. As the deliverables do not expose the history of their origins, the ultimately built station will not betray the complexities of the architectural process. To the public who walk through the south concourse in 2024, the natural light reflecting off the panelised walls will be a fleeting experience. In the conception of the architect (and endorsed by the government and private developer partners who lead the project), it is a defining and pleasant addition to an otherwise ordinary journey through a transport station, an inviting extension of the public domain for the travelling public. However, to achieve that momentary experience, the architect had to envision it, reconcile it with the myriad of inputs from other disciplines and even his own constraints, discovered through the production of "realities", and then track and document the trajectory of the design through its final form with data that permitted and demonstrated the empirical success of the design response.

Architectural Knowledge and Actions in Support of Infrastructure

The primary conclusions of the research focus on the role of the architect and, more broadly, the profession of architecture, in the development, production, and delivery of design for large-scale urban infrastructure projects, encompassing the architectural design process in pursuit of a design resolution. The key themes of contributions, roughly coinciding with the general trajectory of architectural production from conceptual design, through design development, and, finally, the delivery of the design (regardless of phase, from tendering to construction documents), embody the knowledge of the profession. The research is contextualised within Mats Alvesson's concept of the knowledge intensive firms (KIF), notably seeking to reduce the inherent ambiguity of the architectural contribution in such a context.[1] In doing so, the research identifies themes that unite the broad work of the architect as a heterogenous organisation comprised of individuals, connected by common understanding of the inputs and outputs necessary to generate cohesive deliverables that clearly communicate the architectural "knowledge".

1. Mats Alvesson, "De-Essentializing the Knowledge Intensive Firm: Reflections on Sceptical Research Going against the Mainstream," *The Journal of Management Studies* 48, no. 7 (November 2011); Mats Alvesson, "Organizations as Rhetoric: Knowledge-Intensive Firms and the Struggle with Ambiguity," *The Journal of Management Studies* 30, no. 6 (1993), https://doi.org/10.1111/j.1467-6486.1993.tb00476.x.

To move beyond "false scientificity" and into the bureaucracy of architectural production, this research leveraged the experience of an architect engaged in the project to rationalise the "trained and specialized competence" of the profession.[2] Methods from outside practice were employed to critically reflect on architectural actions and identify the knowledge contributions of architects within the team and overall project design. More obviously "architectural" contributions, such as drawings or sketches representing the architect's ambitions for the future state of the design, were considered within the context of their role in the design process, while less "architectural" contributions, such as data, were explored through analysis of the inherent tensions in the work of professionals, and their self-conceptualisation of professional identity. The three specific roles identified and explored in the research were: (1) developing and presenting human-centric ambitions, (2) mediating architectural ambitions with outside inputs and parameters, and (3) data management to permit production and dissemination of knowledge.

Taken together, the conclusions drawn from each chapter provide a new context—that of a production-oriented practice engaged in the processes of regimented, prescriptive project delivery—within which to explore architectural roles that have been identified in smaller scale architectural projects and practices (Cuff), or conceptual design contributions in a form-focused, atelier-style office (Yaneva).[3] In this way, the research contributes to the existing literature on architectural practice from an unexplored perspective, and sheds new light on what constitutes contemporary architectural practice. The subversion of a traditional view of architectural contribution—that of the distinctly "creative" type—in favour of a data-driven, management intensive process, speaks to the reality of this mode of practice. Further, the work establishes a contextualised understanding of the generation of architectural knowledge—knowledge "from within", as framed by Shotter—as a means of more fully framing what it means to be engaged in practice.[4]

2. Michael Fores, Ian Glover, and Peter Lawrence, "Professionalism and Rationality: A Study in Misapprehension," *Sociology* (Oxford) 25, no. 1 (1991), https://doi.org/10.1177/0038038591025001005; Alvesson, "Organizations as Rhetoric."
3. Dana Cuff, *Architecture: The Story of Practice* (Cambridge, MA: MIT Press, 1991); Albena Yaneva, *Made by the Office for Metropolitan Architecture: An Ethnography of Design* (Rotterdam: Uitgeverij 010, 2009).
4. John Shotter, Cultural Politics of Everyday Life: Social Constructionism, Rhetoric and Knowing of the Third Kind (Buckingham: Open University Press, 1993); Jeremy Till, Architecture Depends (Cambridge, MA: MIT Press, 2009), 166.

Infrastructure as a Discrete Type

Compare SMCSWSVI-LLC-SVC-AT-DWG-140012[C] to a section of any other large building and the drawings will appear similar: architectural deliverables, regardless of project type, contain information for building. However, the research has made clear that the processes involved in arriving at the deliverables in the context of mega transport projects (MTPs) make the infrastructure type unique among architectural activities, since it is enmeshed in a larger context of political, social, and urban-scaled issues that are inherent in such public-facing undertakings. This research investigated a mode of architectural practice—increasingly prevalent, but not the only form of contemporary practice—that designs large-scale, city-shaping infrastructure. It is not necessarily corporate practice; rather, it addresses a project type that is contingent, crafted on contextual complexity, and characterised by inherent contradiction. It is public and private. It is government initiated and controlled, but developer led and subject to market monetisation. It is iterative, revised and reframed over many years through successive plans that prompt changes, sometimes small, sometimes fundamental. Architectural practice is party to these elements through the years of ideation; architecture exists on the periphery, grafted onto a process that extends well beyond the scope of the architect. When the time comes for the station design to be developed, practice is enjoined into a process that is already deeply involved. As demonstrated in Chapter 1, architectural practices come and go as participants in projects as priorities and procurement methods change, but there is continuity in the general contribution brought by the profession: the role fulfilled by architects.

The architectural role is the product of historical, political, and social landscapes as much as it ultimately shapes the physical urban landscape in the contemporary city. The evolution of transport spaces into more than places of interface between the urban realm and utilitarian requirements accommodates the architectural contributions. As ostensibly egalitarian and demonstrably democratic spaces within the city, stations are imbued with ambitions to create a pleasant experience of movement for urbanites. At the same time, station design is the result of resolved tensions. Architectural practice in this context exists within the wider contested space, addressing current concerns around placemaking through a complex, politicised process. In this

scenario, the architectural process itself need not be political—though, of course, it can be. The architectural outcomes have broad implications for the design of the city, with practice manoeuvring around political shifts and linkages between public space and infrastructure.

Embracing Integrated Data

It is important to recognise that the data of a project do not exist in isolation, but are integrated with the aspirational and coordination roles played by the architect at various points throughout the trajectory of the design process. Since the activities are inseparable in the actions of the architect, the role of data needs to be understood within the context of each aspect of the architect's role. For example, what data are implicit in the creation of the sketch? What does the sketch contain that is sacrosanct and must be preserved in the same way as legally required clearances for compliance with code must be preserved? When the translation of even qualitative architectural contributions into data is acknowledged, the implicit nature of the data management role becomes clearer. This then provides a means of ensuring that architectural contributions are captured in the final production of deliverables.

While consideration of the qualitative and aspirational outputs of the architect as data may violate the sensibilities of those who continue to defend the conceptualisation of architect as artist, the realities of production and assurances in the realisation of complex projects require that each aspect be represented empirically if it is to be included in the realisable design. Architects may engage in artistic endeavours, but it is imperative to understand how those creatively aligned actions translate into the data-driven deliverables. Conversely, abdication of responsibility for the qualitative aspects of the design by those who handle data and production, even when those aspirational elements must be represented and reinforced through the data management and production role, is also a persistent concern. Architects who deal in data are making decisions that will impact the design, even if they do not recognise this. This ultimately raises questions about authorship of design, which warrant further exploration.

Data are the key to understanding the discordance of thought within the profession that dismisses many aspects of the architect's role as "non-architectural", yet which represent many of

the actions undertaken by architects. The relationship between data and data management and the allocation of the role of data in architectural production are important features of contemporary architectural practice, and of infrastructure design more broadly. The integration of data-intensive aspects of the design process, and the acknowledgement of these roles as distinctly architectural, could enhance the connection between various activities and actors in the design process, generating cohesion and consistency to improve efficiencies in practice. It is important to note that such acknowledgement does not require an abdication of non-data-driven aspects of designing, nor the distillation of all architectural activities into quantitative parameters; what differentiates architectural practice as a KIF from other design team members is the blending of qualitative and quantitative outputs.

The onerous requirements of data and data management result in the bureaucratised and seemingly banal daily actions of the architectural studio—meetings, emails, producing drawings in Revit—as the new activities of placemaking in the urban realm. By embracing the process and accepting that design can encompass data management as much as drawing, with spreadsheets as integral to ensuring the best outcome for future users as sketching, contemporary architectural practice engaged in complex city-shaping projects can assert its place in the range of architectural activities that comprise a variegated professional landscape. There are clear expectations that transport projects, and infrastructure projects more broadly, work in support of creating place in the city—and architects are agents in the endeavour.

Place and Spacemaking Through Rigour

Despite the data-centric requirements of realising the design of these project types, the role of the architect in placemaking and spacemaking is central to the identity of the architect, and central to the role of delivering infrastructure design. In contemporary transport projects, public space is being realised through non-public and semi-public processes. It is the architect who often stands in for the public interest and must defend inclusions that will serve some future public. This is represented not just in the way architects speak of the projects, but in their actions as well. There is a broad recognition that these are unique project types, which architects also experience as citizens as they go about their lives. Unlike a hospital, stadium, or mega-high-rise, the infrastructure project

type is more broadly relatable as a daily experience for those who work on them; this understanding permeates the way in which the architects handle the projects.

This all ultimately plays into the role of the architect in the realisation of the aspirations of transport facilities—and, more broadly, infrastructure projects—to make a positive contribution to the urban environment. Each action of the architect, be it creating and protecting an aesthetic vision or coordinating and documenting the resolution of negotiations between fixed functional requirements, ultimately shapes the realisation of the places and spaces built in the context of the city. While it would be easy to assume that the civic-shaping aspirations of the "democratic" transport spaces rely on the aspirations defined in Chapter 3, it is only through the actions framed in Chapters 4 and 5, which yield the documentation, that the aspirations can be realised. Coordination and data, while relating to largely quantitative parameters of architectural contributions, permit the realisation of the qualitative ambitions of the projects.

Ultimately, all of these architectural actions coalesce into the development of deliverables—in a broader sense than Evans's and Pallasmaa's conceptualisation of architectural outputs as instructions for building—that embody the placemaking and spacemaking ambitions of agencies responsible for these infrastructure projects.[5] It is not, however, a direct translation. The content that went into the section (see Figure 6.01) took into account the aspirations and parameters defining the ultimate realisation of distinct spatial qualities and placemaking in the urban realm. Similarly, the built station will embody those aspirations in physical form. However, the drawing that permits this translation from idea to reality does not indicate these experiential qualities known by the architect, shared by the project team and stakeholders. Rather, the realisation of the ambitions and aspirations hinges on the ability of the architects, through the course of the design process, to instil the experiential and functional ideas into the empirical documentation that is produced and presented as the architectural deliverables.

5. Robin Evans, "Translations from Drawings to Buildings," in *Translations from Drawings to Buildings and Other Essays*, ed. Richard Difford and Robin Middleton (London: Architectural Association, 1997); Juhani Pallasmaa, *The Thinking Hand: Existential and Embodied Wisdom in Architecture* (Chichester, UK: Wiley, 2009).

Simply put, the management of data through architectural bureaucratic processes—as unglamorous as that is—is the means of enacting placemaking aspirations that are cultivated through years of decidedly non-placemaking oriented political posturing in order to realise the creation of public space through the development of infrastructure projects. The actions of the architects, beyond merely setting the vision with the client at the outset of the project and reinforcing its inclusion through the construction of iterative realities, all merge in the final outputs: the coordination, the data management, and all the ancillary activities of the architect are the modern activities of placemaking. The architectural contributions are evident not only in the fleeting experience of the future patrons, but in the lasting impact the piece of infrastructure—and the synergistic potential of a welcoming, engaging place and space in the urban realm—on the city.

This project type requires specific consideration in the roles fulfilled by the architect. To accommodate this, the operations and structuring of the firm and project must be considered to accommodate divisions of labour and specialisation suited to the delivery of required data-centric outputs. The research underscores the need for a more rigorous approach to data management strategies in the context of practice and project delivery. This also applies to the analysis of architectural outputs for their data-driven merits, building on Cuff's assertion that practice must do a better job at recognising the importance of management, though on a much larger scale.[6] This has implications for firm structure in relation to efficiency in addressing infrastructure projects, the marketability of architectural services and the contributions of architects, as well as understandings of what constitutes architectural expertise that are reflected in professional identity incongruence. While based in the transport project type, the conclusions are broadly applicable to other large-scale infrastructure project types in which architects are increasingly being called upon to participate.

Theory and Methodological Contributions

Aside from the analytical outcomes of the research, numerous outcomes relate to the method of analysis of professional practice derived from the extended embedded research format. First, the research responds to the call by practice and academia to further understanding of the potential intersection of research and professional practice—a question that was continually raised

6. Cuff, *Architecture*, 195-245.

throughout the course of this research by those in practice. The hybridised role of participant-observer has been deployed in other studies of professional practice, including architectural practice. The present study, however, was unique in terms of the active engagement of the participation element, which allowed for immersive analysis of actions as they related to the production process. The method allowed for the generation of data and preliminary content through active architectural participation, followed by analysis using methods outside of architecture. This approach acknowledges the hybridised nature of the research and responds to Till's call for a model to advance research that is neither research by design nor analysis of architecture and its outputs by those removed from the practical realities of practice.[7]

Auto-Ethnography and Architectural Practice

The use of auto-ethnographic accounts is a common means of conveying information developed through participant observation and has been leveraged by those examining architectural practice.[8] However, the generation of the ethnography of practice not as a research outcome, but as a means of identifying key aspects of practice to explore, differed from the existing applications of the method. The use of auto-ethnography as a means of framing research questions proved a useful tool in establishing and defining trajectories for further exploration. The raw data, derived from experience and supplemented by interviews, required self-reflection and critical appraisal of work done as an active participant.

Methods for Active Participant-Observation

While traditional anthropological fieldwork often involves the generation of an ethnographic account of the actions observed in the process of participation—like Yaneva's work at OMA—my direct involvement in the architectural design process meant that the accounts generated were auto-ethnographic.[9] This distinguishes the present study from previous research on architecture

7. Jeremy Till, "What Is Architectural Research?," (position paper written on behalf of the Royal Institute of British Architects (RIBA) Research Committee); Jeremy Till, "Is Doing Architecture Doing Research?" (4th International Meeting on Architectural and Urbanism Research, Valencia University, 2012); Jeremy Till, "Architectural Research: Three Myths and One Model," (2007), https://jeremytill.s3.amazonaws.com/uploads/post/attachment/34/2007_Three_Myths_and_One_Model.pdf.
8. Sumati Ahuja, "Professional Identity and Status: An Ethnography of Architects in Professional Service Firms" (PhD diss., University of Technology Sydney, 2018); Yaneva, *Made by the Office of Metropolitan Architecture*.
9. Yaneva, *Made by the Office of Metropolitan Architecture*.

conducted in this manner. The work also differed from the auto-ethnographic accounts of practitioners, like Cuff and Till, who observed the actions of architecture, and were familiar with architectural practice, but were not active participants in the projects and processes which they examined.[10] The three-year duration of the engagement, coupled with my participation in the generation of documentation, represented a unique approach to participant-observation, in which the hybridised work of researcher and practitioner provided previously unavailable insights that were informed by the activities of the practitioner in the execution of work.

In this way, the research has expanded the sociological and anthropological methods leveraged in the investigation of fields such as architecture. While there are inherent biases in engaging in self-reflection and research of one's own group, there are also numerous benefits, including the ability to access information, relate to fellow participants, build immediate rapport through common understanding, and understand the specific application and significance of items and decisions throughout the process. Concerns about bias were ameliorated by the use of interviews, review of documents, and application of social science research standards, which ensured that the qualitative data were not merely the product of a sole line of inquiry. Further, my involvement across multiple projects allowed me to confirm the applicability of ideas across projects of the same type. The direct involvement and hybridised role, however, came with challenges that were not easily reconciled through these methods and which must be addressed in future research of this kind. These are explored in the following section.

Ethics, Contribution, and the Active Professional Participant

As an architect actively participating in the design process with other design professionals, specialists, clients, and stakeholders, it was not possible to explain the hybridised role in every interaction. Therefore, within my professional capacity (as architect), I was precluded from directly leveraging the information shared in meetings or other interactions when serving as an architect. This is not likely to have been an issue for Albena Yaneva, as her observations in meetings and participation in processes was always accompanied by an inherent understanding of her role as researcher. In my own research, this was generally addressed by reflecting on such activities and

10. Cuff, *Architecture*; Jeremy Till, *Architecture Depends* (Cambridge, MA: MIT Press, 2009).

filtering specific information into a broader account via the auto-ethnographic methods, and revisiting the ideas through more formalised research methods, including interviews. However, in certain instances, comments made in meetings or experiences specific to sensitive project elements posed an ethical issue, as their use in the research without the participants' knowledge would not have been appropriate, despite their relevance to the research topic.

The conduct of interviews and handling of commercially sensitive data also presented a challenge in the final representation of research outcomes. The identity of participants in interviews was anonymised. All quotes were provided to participants for approval prior to publication to mitigate potential concerns about commercial sensitivity and, in the case of the employees of the firm, potential repercussions from anything that may be deemed contrary to the ambitions of the firm. Similarly, all references to the firm and specific projects were removed where possible in the documentation of the research, although, writing about the design itself, some representations were unavoidable (e.g. the octopus, the panel).

As the architecture firm was contracted to clients and the production of such material fell within the deliverables produced under that contract, the use of such information was approved by the firm. Given the limited distribution of a PhD, this was deemed sufficient. However, the current structures of academic research ethics may need to be evaluated in the context of active participation to address the idiosyncratic nature of the work, including complex contractual relationships and the bureaucratic governance of the release of imagery and content related to projects. The present study does not seek to "resolve" the inherent tensions between active participation and research of architectural production, but proposes a format through which such research can be undertaken in the future. Numerous questions remain, including the reconciliation of ethics—between practice and research—in undertaking research within a non-research role. This grey area warrants further analysis and consideration as hybridised research becomes normalised within academia and practice. The implications of embedded research conducted by active participants, while an exciting proposition that can generate unique perspectives and new lines of inquiry, must also be considered.

The Next Stops

Architectural involvement in the design of urban transport facilities—and even less obvious infrastructural involvement, including sewer systems and electrical distribution networks—shows no signs of abating; nor, should it, as evidenced by the varied roles the profession fulfills in the realisation of such projects. With the growth in global investment in mega transport projects, and increasing emphasis on the creation of urban nodes anchored by transport within the polycentric metropolis, the role of the architect as advocate for human-centric ambitions will continue to be asserted through the design process. Generally, the trajectory of design for urban transport facilities—viewed as an extension of the public domain—reinforces the democratised context of public transport. As societal and political expectations of such outcomes have evolved, architecture has reasserted its role, and this is expected to persist. Notably, it is not necessarily the profession of architecture that drives the evolution; rather, the changing architectural emphasis occurs as architects exploit their uniquely positioned skillsets to create a place within the design process—between politics, technology, and social contexts—for their contributions.

Ultimately, this research recognises the role architects play in such projects. It is hoped that architects might take advantage of this and, by emphasising the contributions of the architectural process, potentially increase the coherence of architectural work and contributions in these contexts—both within the profession and to those outside of architecture. By acknowledging the role of the architect in mega transport projects—especially the integration of data management within the larger design process—architects have the potential to adapt the way firms approach the work, not only to improve efficiencies but also to underpin the actions in practice that embody advocacy for the generation of public space in the context of the city. By formalising these architectural values and the contributions of the profession, architects working in city-shaping infrastructure projects can continue to contribute positively to urban considerations in the implementation of these projects.

Epilogue

Sitting at a table in the centre of the main office the morning after a holiday weekend, the sound of the office intrigues me. I've never really thought about it, but the office sounds like any other—the prototypical office in a movie. The clack of keyboards and the clicks of mice. People stirring coffee in the open kitchen, the low murmur of conversation, punctuated by the occasional louder thought which slices through the continual din.

I look around after catching up with a few friends—I've been in North Sydney [at a site office for a Metro project] for a long time—and there are so many new faces in the cluster. When I started two years ago, we were just 15 or 20 people. Now the cluster is pushing 70; a testament to the import of transport to the office—and the city. Two Metro stations, a light rail system, ferry wharves, an airport … while we still "chase" more work.

I'm sitting next to [architect r]—I check in to see what she's working on this morning—room tags. Still room tags. The drawings are looking much better, I note. Legible. The mundane dominates much of the work for some, telling of the bureaucratic layering. [Architect B] walks by…

"Happy New Year, Merry Christmas, Happy Australia Day…" Clearly a lot of time has passed.

What's new? Nothing. Still the same. Remodelling the entire station. All the GRC has been replaced with aluminium panels.

Quite the change.

[Architect A] stops by. He's still on Victoria Cross … and WSA … and PLR…

"I'm subject to availability," he quips.

[Architect J] rockets by. "Oh. There he is…"

I TELL HIM I'M WAITING FOR [ARCHITECT P]. "HE'S IN NORTH SYDNEY—CALL [ARCHITECT Z]; THEY'RE WAITING FOR YOU." PHILIP COX WALKS BY AND WAVES.

AS I PACK UP, [ARCHITECT Z] CALLS: "STAY PUT, [ARCHITECT P] IS COMING BACK TO THE MAIN OFFICE."

ALL THE PARTS, MOVING AT ONCE. [ARCHITECT P] ARRIVES AND WE STAND AT THE KITCHEN BENCH TO TALK ABOUT PROJECTS. I'LL BE ASSISTING [ARCHITECT L] WITH PLR DD.

28 January 2020, 9:30am – Cox Sydney Studio

After the morning meeting, I packed up my bag and headed down the street to a new satellite studio that had just opened to house the Paramatta Light Rail (PLR) and Western Sydney Airport (WSA) project teams. Things had gotten crowded in the main studio while I was working in another project office in North Sydney—with so many transport projects, there simply was not room for cluster five to be under one roof. Working on PLR was a major change from the 18 months I spent on Metro, with the light rail stops—street-side shelters—many magnitudes smaller than the mega challenges presented by the underground stations. Still, through my interactions and coordination activities to produce the design reports for the team, I saw many similarities: an emphasis on the customer experience, the intensive coordination demands of accommodating technological infrastructure in compact spaces and, of course, plenty of data to track and represent. I never could have guessed that morning would be my last time working in the main studio during my three-year contract—at that point I still had 15 months to go.

I would be in the PLR office less than two months before the city was locked down and architectural production—along with the rest of life—infiltrated the domestic space. Collaboration was quickly relegated to the digital sphere, upending the dynamics of the studio to which I had become accustomed. There was no more incidental chatter, or casual observation of project development. The shift coincided with my move to support the WSA team as they prepared for a design submission. Working a team from Zaha Hadid Architects, our partner firm in London—again underscoring the almost hackneyed trope of importing international talent to realise MTPs in Sydney—the work-from-home condition suited the project well. I would spend all night on calls with London, facilitating the exchange of information in overseeing the production of a 450-page

comprehensive design report with another 1400 pages of appendices. The collaborative nature of architecture—the importance of communication and, specifically, data management—was magnified by the move to remote work. Each interaction, each step in the design process, seemed to take much longer. Maybe it was the time wasted at the outset of each Zoom call, attempting to ensure everyone was online and able to hear one another. The ability to communicate intent—once achieved in a quick sketch—became much more difficult. Drawing on a screen with a mouse just does not work in quite the same way. After a year, we have settled into a hybrid stasis, somewhere between fully remote and fully in person. The exchange of information between team members still sometimes presents issues around efficiency, and has broadened the scope of the architect's task in placemaking: what is the future of the city in a digital age?

For the research, the shift to remote working was well-timed as well. The primary data had been collected and, while my experience on WSA continued to inform the research, the time for direct observation and construction of an ethnography had long passed. Work was largely work, and my reflections only served to sharpen my arguments. This was fortuitous, as the encumbrances to communication, as well as the stymying of opportunity to casually observe the activities of others, would have severely limited—or fully removed—the potential to gather data through many of the anthropological methods that came to define the research. Simply put, the research would not have been possible in the fully remote environment; it was the daily interactivity in the office—both formally and informally, as illustrated in the opening anecdote—that informed the production of this dissertation. It was the daily vibrancy, the bustle, that creates the social context in which the architectural role plays out.

Serendipity aside, the hybridised role of researcher and practitioner—one that I never would have imagined three years ago—was a unique opportunity. The experience presented its fair share of challenges, with work demands and bureaucratic quagmires stemming from the collision of ambitions in my activities. However, it was all worth it, if only to change my perception of practice and the role of theory in understanding what architects do. The ability, as a practitioner, to critically analyse the work undertaken and interrogate it for meaning has resulted in shifting perceptions of

what is important in the arc of design development—an experience not dissimilar to those of other embedded architectural researchers, such as Laurene Vaughan at RMIT.[1]

Overall, it is interesting to contemplate engagement in research, and the production and codification of knowledge in an academic context. A century ago, as J.J.C. Bradfield worked to design the tectonics of Australia's first underground urban railway system, he also laboured to translate the knowledge he was collecting into a dissertation. His PhD, the first for engineering awarded in the country, traced the design decisions and parameters that came to define Sydney's transport system through the 20th century. The parallel to this work, tracing the development of Australia's first metro system is poetic, perhaps, as this could be seen as a product that loosely traces the design decisions and parameters that will likely define Sydney's transport system through the 21st century. However, the fundamental difference in method and outcomes—tangible, physical knowledge of how to do, verses a process-based knowledge of perceived actions—points to an evolved means of understanding and contributing to knowledge in modern academia.

As the emphasis has shifted from documenting new and innovative means of physical production, to understanding the operations of a firm—and, broadly, the actions of the profession in general—the generation of knowledge and its potential benefits shifts as well. As I manage more projects, the knowledge gained from this research will impact my approach. And, as I carry on with my career, I see the potential to continue to straddle the line between practice and academia, if the opportunity presents itself. As a profession, architecture has the potential to continue to grow and change as the breadth and scope of architectural contributions grow and change. With the omnipresent and growing demand for infrastructure and transportation development in response to the densification of cities and the growth of technologies, the role of architects in ensuring not only integration, but the generation of public good—through management of inputs from political to technological to data—will be an important facet of the profession.

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Appendix A

Sydney Metro City Station Design Profiles

Station	Architecture Firm	Station	ISD/OSD*	Office	Notes
Crows Nest	Woods Bagot	X	X	Sydney	Station to be part of an ISD, including four new residential and commercial towers.
Victoria Cross	Cox Architecture	X		Sydney	Station to have two entrances, with north entrance integrated into services building and southern (main) entrance as part of an OSD commercial office tower.
	Bates Smart		X	Sydney	
Barangaroo	Foster + Partners	X		London	Station located beneath new park at Barangaroo.
	Architectus	X		Sydney	
Martin Place	Grimshaw Architects	X		London**	Interchange station with existing ESR station. Metro platforms below the existing station and adjacent sites as part of a major ISD.
	Johnson Pilton Walker (JPW)		X	Sydney	
	Tzannes Architects		X	Sydney	
Pitt Street	Foster + Partners	X	X	London	Station located in the heart of the Sydney CBD with OSD development located atop the north and south entrances to the station.
	Cox Architecture	X		Sydney	
	Bates Smart		X	Sydney	
Central	John McAslan + Partners	X		London	Interchange station with all existing railway lines. Metro platforms are being constructed below the existing station, with major renovation and expansion works.
	Woods Bagot	X		Sydney	
Waterloo	John McAslan + Partners	X		London	Station to be developed as part of a new residential and commercial precinct with multiple towers constructed as part of the project.
	Woods Bagot	X	X	Sydney	
	Hassell		X	Sydney	
	Aileen Sage Architects		X	Sydney	
	Bates Smart		X	Sydney	

*ISD stands for "integrated station development" and OSD stands for "over station development"—both represent non-station aspects of Metro projects.
**Grimshaw was founded in London in 1980, but established a Sydney studio in 2010.

Information for this Appendix was sourced from Sydney Metro literature, publicly available government information regarding tenders, firm websites, and various design publications related to MTP development.

Appendix B

Metro System Construction 1950-1979

Country*	City	Designation	Opened	Notes
Sweden	Stockholm	Metro	1950	
Canada	Toronto	Subway	1954	
Italy	Rome	Metro	1955	
USSR	Saint Petersburg	Metro	1955	
USA	Cleveland	Rapid Transit	1955	Officially the Regional Transit Authority (RTA) Rapid Transit Red Line
Japan	Nagoya	Subway	1957	Officially the Nagoya Municipal Subway
Portugal	Lisbon	Metro	1959	
Japan	Tokyo	Subway	1960	The second subway system to open in Tokyo, officially known as the Toei Subway
USSR**	Kyiv	Metro	1960	
Italy	Milan	Metro	1964	
Canada	Montreal	Metro	1966	
USSR	Tbilisi	Metro	1966	
Norway	Oslo	Metro	1966	
USSR**	Baku	Metro	1967	
Netherlands	Rotterdam	Metro	1968	
Mexico	Mexico City	Metro	1969	
China	Beijing	Subway	1971	
Germany	Munich	U-Bahn	1971	
Japan	Sapporo	Subway	1971	Officially the Sapporo Municipal Subway
Germany	Nuremberg	U-Bahn	1972	
Japan	Yokohama	Subway	1972	Officially the Yokohama Municipal Subway
USA	San Francisco	Rapid Transit	1972	Officially Bay Area Rapid Transit (BART)
North Korea	Pyongyang	Metro	1973	
Brazil	São Paulo	Metro	1974	
Czechoslovakia	Prague	Metro	1974	
South Korea	Seoul	Subway	1974	
Chile	Santiago	Metro	1975	
USSR**	Kharkiv	Metro	1975	
Austria	Vienna	U-Bahn	1976	
Belgium	Brussels	Metro	1976	
USA	Washington	Metro	1976	

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*Country of political administration at the time of construction of the system.
**Governed by Moscow as a constituent Union Republic of the Soviet Union.

Basic information for this Appendix was sourced from a Wikipedia database, with data spot-checked and updated as required.

Country*	City	Designation	Opened	Notes
France	Marseille	Metro	1977	
Japan	Kobe	Subway	1977	Officially the Kobe Municipal Subway
Netherlands	Amsterdam	Metro	1977	
USSR**	Tashkent	Metro	1977	
France	Lyon	Metro	1977	
Brazil	Rio de Janeiro	Metro	1978	
UK	Hong Kong	Mass Transit	1979	Officially Mass Transit Railway (MTR)
USSR**	Bucharest	Metro	1979	
USA	Atlanta	Rapid Transit	1979	Officially Metropolitan Atlanta Rapid Transit Authority (MARTA) Rail

*Country of political administration at the time of construction of the system.
**Governed by Moscow as a constituent Union Republic of the Soviet Union.

System Naming Designations		
Total	40	100%
Metro	25	63%
Subway	8	20%
Rapid Transit	3	8%
U-Bahn	3	8%
Mass Transit	1	3%

Systems by Region		
Total	40	100%
Asia	10	25%
Europe	20	50%
North America	7	18%
South America	3	8%

Basic information for this Appendix was sourced from a Wikipedia database, with data spot-checked and updated as required.