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In becoming a smarter city: Pragmatist experiments in Sydney's transport information systems

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In becoming a smarter city

Pragmatist experiments in Sydney's transport information systems

Tim Tompson

Thesis in fulfilment of the requirements for the degree of

Doctor of Philosophy

School of Planning

Faculty of the Built Environment

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Thesis/Dissertation Sheet

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Abstract

Cities are primary centres of human population, productivity and environmental impacts. Their adaptation to the challenges of the 21st century is critical. Since the mid-2000s, the concept of the smart city has emerged, proposing digitally-mediated 'solutions' to these challenges. Yet, the smart city's ill-defined and ideological discourse has little relevance to urban design and development initiatives undertaken within local contexts. There is insufficient guidance for practitioners, with many of the realities of practice hidden or excluded from the discourse, particularly the impact of the socio-material.

This thesis responds to this dilemma. It draws on the rich history of philosophical pragmatism to 'reassemble' the smart city discourse, making it responsive to the immediate and situated challenges of 21st century cities. The thesis strips out the ideology of the smart city, grounding the concept in the experience of existing projects. As a result, the research constitutes a reassembly of the smart city, understanding it as a concept 'in the making'; one which includes other voices in the discourse. It reimagines the smart city in terms of post-anthropocentric urban politics: the Cosmopolitical.

To enact this contemporary pragmatist ontology, the thesis presents a visual history method, developed through empirical studies of two transport information system projects in Sydney, Australia. Over a three-year period, data on both projects were drawn from observations, oral histories and secondary sources, including media and reports. The data were then analysed, using Actor-network theory.

It is argued that these visual histories and the pragmatic positioning of the research explain smart city initiatives as necessarily heterogeneous processes, open to multiple interpretations. This lays the foundations for my proposal for a process-based ontology of 'becoming' rather than 'being', asserted to adequately conceptualise the smart city for future initiatives. Practitioners are urged to adopt process-relational approaches, rather than more limited rational ways of conceiving and planning the smart city. Whilst challenging, pragmatism offers a significant contribution to understanding the smart city; an alternate epistemology and relevant ontology in the remaking of our cities for 21st century challenges.

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Acknowledgements

Research always originates from an institutional and social context. This research from locations largely around Sydney, Australia. I had preferred places to work, comprising of furniture, books, software, and internet connections. All of these contributed in their own ways, among innumerable other elements to this research. This research inquiry emerged from, and was shaped by my experiences, it cannot be presented as separate from these.

The context of inquiry

This thesis subject would not have been possible without the unprecedented opportunities provided by the Australian Research Council Grant, *Responsive Transport Environments*. An explanation of this grant can be found at Appendix A. This research was also supported by the Australian Government, through an Australian Postgraduate Awards (APA) scholarship, and later through a UNSW Australian Postgraduate Awards Industry (APAI) scholarship. I sincerely hope this work can foster more effective relational practices between universities and industry partners, if only at a local level, and that it is useful towards addressing the goals of the grant.

There many industry partners with whom I was in varying contact for the first three years of my doctoral research; too many to mention here. I thank them for giving up the time and resources for this research, and trusting in the process proposed, to ensure that their views were represented clearly. I would like to also thank the various supporters we had inside each of the organisations, and their organisations, for being open and willing to share some of this information with a university researcher: I am indebted. I am wary this was a big step and a leap of faith for some of you.

The collaboration and openness of all the organisations involved is, I feel, truly a sign of our changing times. This thesis documents multiple oral histories of two transport information system projects for Transport for NSW and Sydney Trains. Their contributions gave me access to their realities, and a truer nature of the projects in these contexts. So many thanks to all the interviewees, and the many others who gave their time for earlier interviews and workshops in the scoping activities of the grant of which this research was a part: Responsive Transport Environments. While many of these interviews are not adequately represented in this thesis, this is the nature of academic research. The objectives and goals change, along with how data is used. I would like to

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To my Research colleagues—those on the ARC grant—I learned a little off each of your very different dispositions towards research practice. Thank you to Matthias H. Haeusler, Martin Tomitsch, Michelle Zeibots and Nathan Kirchner. And here a special mention to our timely project manager for the second and third year of our grant: Briedy Mahar.

Personal acknowledgements

I now know for certain that a Doctoral study is a demanding journey, which, contrary to previous belief, is not carried out alone. Academic work cannot be created in isolation. When I started I would have thought this statement meant with other people, but I now have a greater awareness in the role that technology plays in breaking down the notion of an autonomous researcher. A researcher is enmeshed in an assemblage of people, technologies and environments that actively shape their research inquiry. The researcher is constantly making trade-offs with where to apply effort to reach an outcome that is favourable to the university, reviewers, future prospects and, in my case, provide useful research for the funding research grant. Over the last five years I had the good fortune to have met hundreds of people, many with similar interests; had innumerable conversations; dozens of workshops and travelled to many conferences. These experiences have changed my whole way of working and undoubtedly changed the way that I think—and will think—in the future. It is this experience that has been the true value of the PhD journey. I cannot know of the future conversations and arguments I am now better prepared for. There are many people to thank both for this experience, research opportunities and the formation of this thesis, many of whom I will mention here.

Firstly, I would like to thank my supervisors, Susan Thompson and Matthias Haeusler who from the beginning gave me space to follow the paths necessary to reach a finished inquiry and have it written coherently. It is true that a thesis cannot be achieved directly, but only obliquely, and in ways that cannot be comprehended at the outset. I realise that from the beginning my subject matters had little overlap with your areas of research, but I am thankful that this did not perturb either of you. Thanks for both giving me the boundaries to ensure this mammoth task was completed while still allowing my ever-wandering interest to go where it

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Fifth, in light of the methodology used in this thesis (this will make more sense later in the thesis), I would also like to give thanks to the millions of technologies and natural actants that enabled me to do this research. These include the computers, the software, desks, chairs, mugs, books, university ID card, library book ordering services, backpacks, bicycle, pens and paper, supermarkets, buses, trains, data servers, modems, power sockets, sandwiches, soup cans, light bulbs, air-conditioners, email servers, sneakers and smartphones. Also, importantly, the clean air, water, grass, bacteria, trees, birds, rain and winds I am also afforded, which sustained my energies. This thesis is a product of my relationships with these actors, and it should not be represented as separated from. Special thanks to those technologies that, as you will understand later in the thesis, allowed me to take liberties in their performance in the case studies, as they do not (yet) have the abilities to say otherwise.

Sixth, I would like to thank those who gave feedback on drafts, from my father Bruce Tompson, Sam Flint, Garry Glazebrook, and special thanks to Michael McAllum—who in the final 18 months of this research supported with some much-needed feedback from someone who has recently been in the same position—for reading through the first 300-page draft of bordering on illegible content and helping to conjure some key arguments from it. Additionally, I would like to thank professional editors Lynda Windsor and Isabella Leslie for helping to shape this Frankenstein's monster of a document into one that was less so.

In all, "you don't finish a thesis, you abandon it," a former colleague Dreu Harrison explained to me a year before I submitted, as some words of consolation. This thesis was going to be many different things at different times. But in the end, it was just this.

Finally, to all of my family. Thanks to my grandmother Shirley, who thinks my knowledge is beyond her, but hers is really far beyond mine. My brother and sister who will likely never read this but helped me get through it in different ways. Lastly to my parents, my mother and father, Sally and Bruce. Sal for forcing me to do things that I didn't want to do, which helped me land

on those that I did. Bruce for your mentoring and leading the way into the world of the less than rational world of public bureaucracies. I am surprised that this idiom now has some significance in that 'the apple never falls far from the tree'. I always intended on steering clear of my parent's work paths—teaching, and public-sector planning activities—but it appears that this thesis is a demonstration of both.

I realise that this rare opportunity and very privileged opportunity to apply myself to an intellectual exploration for five years is a situation not afforded to many, so I hope that this work does something to progress the cause of others who do not have the voice nor circumstances to do so.

I dedicate this thesis to my parents Sally and Bruce, for encouraging me to do weird things my whole life. This has been yet another.

Tim Tompson,
April, 2018

Related publications and research

The following publications are based on the research in this thesis.

Andersen, TJ, Gatti, L & Tompson, T (forthcoming) 'Time as Context: Kairos, and the Spatio-temporal "quality" of Strategic Leadership', in TK Das (ed), *Time Issues in Strategy and Organization,* Information Age Publishing, Charlotte, NC.

Tompson, T 2017, 'Understanding the Contextual Development of Smart City Initiatives: A Pragmatist Methodology', *She Ji: The Journal of Design, Economics and Innovation,* vol. 3, no. 3, pp. 210-228.

Tompson, T 2015, 'Development of Real-time transport applications in Sydney – A hybrid model', in *Proceedings of the State of Australian Cities Conference (SOAC'15),* 1-4th December, Urban Research Program at Griffith University on behalf of the Australian Cities Research Network, Gold Coast, Australia, 11 pages.

Tompson, T 2014, 'Designing towards the leverage points in an open innovation project for digital urban transport interventions', *Proceedings of Relating Systems Thinking and Design,* (RSD3), 15th-17th October, Olso, Norway [online], <https://systemic-design.net/wp-content/uploads/2015/03/RSD3_Working-paper-Tim-Tompson.pdf>.

Tompson, T & Tomitsch, M 2014, 'Understanding public transport design constraints by using mock-ups in stakeholder conversations', in H Winschiers-Theophilus, V D'Andrea & OS Iversen (eds), *Proceedings of the 13th Participatory Design Conference: Short Papers, Industry Cases, Workshop Descriptions, Doctoral Consortium papers, and Keynote abstracts - Volume 2,* 6-10th October, Windhoek, Namibia, pp. 53-56.

Tompson, T 2014, 'Reframing a Bus stop's 'What is' and What if's?'', in N Gardner, MH Haeusler & B Mahar (eds) *Interchanging; Future designs for Responsive Transport Environments,* Art Architecture Design Research, Spurbuch Verlag, Baunach, Germany, pp. 33-37.

Gardner, N, Haeusler, MH, Mahar, B & Tompson, T 2014, 'Interchanging: Responsive transport infrastructures for twenty-first century urban digital culture', *Proceedings of the*

7th International Urban Design Conference 2014, September 1-3, Urban Design Australia, Adelaide, Australia, pp. 48-60.

Tompson, T & Haeusler, MH 2013, 'Investigating tools for multi-stakeholder decision making to improve the spatial performance in transport interchanges', *Proceedings of eCAADE Conference 2013, Computation and Performance,* 2nd International Conference, 18-20 September, Delft, Netherlands, pp. 233-42.

Tompson, T & Zeibots, M 2013, 'Participatory Design to Engage, build capacity and Innovate in public transport', in H Melkas & J Buur (eds), *Proceedings of Participatory Innovation Conference: PIN-C 2013,* 3rd International Conference, June 18-20, Lappeenranta University of Technology, Lahti, Finland, pp. 461-466.

Glossary of terms

a priori	Relating to, or denoting reasoning or knowledge, which proceeds from theoretical deduction rather than from observation or experience (Cambridge Dictionary 2018).
actor-networks	The relationship between actants in networks that are existing in 'continuous making and remaking' (Latour 2005b).
actor/actants (human/nonhuman)	'Something that acts or to which activity is granted by another...an actor can literally be anything provided it is granted to be the source of action' (see Latour 1996a, p. 373).
anthropocentric	Viewing and interpreting everything in terms of human experience and values (Cambridge Dictionary 2018).
arational	Not based on or governed by logical reasoning (Oxford Dictionary 2018). More particularly not governed by scientific rationalism or Cartesian rationalism (author; see also Wendt 2018).
Arup	Firm of designers, planners, engineers, consultants and technical specialists working across every aspect of today's built environment.
Assemblage	A group of objects of different or similar types found in close association with one another.
Cartesian rationalism	The theory that reason rather than experience is the foundation of certainty in knowledge and thinking in terms of the Cartesian dualism.
Cartesian dualism	A theory or system of thought that regards a domain of reality in terms of two independent principles, especially mind and matter (Dictionary.com 2018).
City of Sydney	Sydney city's municipal council.
contingency	A future event or circumstance, which is possible, but cannot be predicted with certainty (Cambridge Dictionary 2018).
cosmopolitical (adj.)	Of the nature of interactions in multiple polities or interests, specifically the post anthropocentric perspective of politics (author).
Cosmopolitical, the (p.noun)	The proposal of Stengers (2005a) to create forums for the politics of the cosmos: where everything is open to question.
description	To describe, however, the term may refer also to its actor-network theory definition; to unfold a process from a technical artefact; a returning to the network that constitutes it. Inverse, or use of a *script*; to enact a scripted action (Akrich & Latour 1992, p. 9).
design (verb)	The intentional making, modifying and arrangement of elements in such a way as to turn situations into preferred ones. (adapted from Simon 1996).

designer	A person who designs.
enrolment	When other actants in the network accept (or get aligned to) interests defined for them (Callon 1986a).
epistemology	The part of philosophy that is about the study of how we know things (Cambridge Dictionary 2018).
ethnography	the study and systematic recording of human cultures; also: a descriptive work produced from such research (Mirriam-Webster 2018).
ethnomethodology	A branch of sociology dealing with nonspecialists' commonsense understanding of the structure and organization of society (Mirriam-Webster Dictionary 2018)
experimentalism	Reliance on or advocacy of experimental or empirical principles and procedures (Mirriam-Webster 2018). The philosophical belief that the way to truth is through experiments and empiricism (author).
fallibalism	A theory that it is impossible to attain absolutely certain empirical knowledge because the statements constituting it cannot be ultimately and completely verified (Mirriam-Webster Dictionary 2018).
genealogical	Relating to the study or tracing of lines of descent (Oxford Dictionary 2018, modified author).
Grimshaw	An architectural firm that operates worldwide.
heterogeneous	Consisting of parts or things that are very different from each other, most predominantly consisting of both human and nonhuman elements. A reference to systems that contain both human and nonhuman actants, equivalent to Deleuze and Guattari's (1987) definition.
historiography	The study of history and how it is written (Cambridge Dictionary 2018).
idiographic	Pertaining to or involving the study or explication of individual cases or events (generally opposed to nomothetic) (Dictionary.com 2018).
infographic	A picture or diagram or a group of pictures or diagrams showing or explaining information (Cambridge Dictionary 2018).
infralanguage	'Language used by analysts to help them become more attentive to the actors' own fully developed metalanguage, a reflexive account of what they are saying' (Latour 2005b, p. 49). The language of actor-network theory.
Inscription	The creation of artefacts that would ensure the protection of certain interests (Latour 1992).
medium	A method or way of expressing something (Cambridge Dictionary 2018).
metaphysics	The part of philosophy that is about understanding existence and knowledge (Cambridge Dictionary 2018).

modernism	A philosophical movement that arose from wide-scale and far-reaching transformations in Western society, including the Roman Catholic Church, during the late 19th and early 20th centuries (Oxford Dictionary 2018, modified author).
multiplicity	The state of being multiplex or manifold; manifold variety (Dictionary.com 2018).
neopragmatists	The philosophical tradition that infers that the meaning of words is a function of how they are used, rather than the meaning of what people intend for them to describe.
nonhuman	Entities that are not human.
obligatory passage point	A situation in which all of the actants have to achieve their interests as defined by the focal actor (Callon 1986a).
open data portal	A platform that enabled app developers to access the real-time and static data feeds of Transport for NSW relating to the Sydney transport system.
ontology	The branch of metaphysics dealing with the nature of being (Merriam-Webster Dictionary 2018). Also, the set of concepts and categories in a subject area or domain that shows their properties and the relations between them.
ontology of becoming	Identifies metaphysical reality with change and development. An ontological state that does not produce fixed entities, such as being, subject, object, substance, thing.
ontology of being	Accepts reality as composed of fixed entities, such as being, subject, object, substance, thing.
ontology of process	An ontological state that does not produce fixed entities, such as being, subject, object, substance, thing.
Performative	That which makes another perform (author).
performativity	The capacity of speech and communication to act or to consummate an action.
politics	'[P]rogressive composition of the common world' (Latour 2005b, p. 250).
postmodern	Postmodernism is a broad movement that developed in the mid- to late-20th century across philosophy, the arts, architecture, and criticism and that marked a departure from modernism.
pragmatism (philosophical)	An approach that evaluates theories or beliefs in terms of the success of their practical application.
process philosophy	Philosophy that identifies metaphysical reality with change
Public Information Display System	Digital display screens used within the transport network at stations displaying train arrival times.
Public Transport Information and Priority System	A computer-based system in Sydney that brings together information about public transport entities, such as buses. Where applicable, PTIPS can also provide vehicles with priority at traffic signals (interfacing with SCATS).

rational	Relating to clear thought and reason, but specifically to think in terms of scientific rationalism and Cartesian rationalism.
rationalism	Relating to scientific rationalism and Cartesian rationalism (of the mind only).
Real-time information	Digital information that is updated continually, such as actual arrival times of public transport (eg. buses and trains).
reflexivity	The circular relationship between a researcher or designer's action and effect. A person shapes action in relation to context, whilst the context itself is constantly being redefined through action.
reify	To make something more real or consider it as real (Cambridge Dictionary 2018).
Roads and Maritime Services	An agency of the New South Wales Government responsible for building and maintaining road infrastructure and managing the day-to-day compliance and safety for roads and waterways.
science and technology studies	An interdisciplinary field that examines the transformative power of science and technology to arrange and rearrange contemporary societies.
science, technology and society	A more recent naming of science and technology studies, encapsulating the broadened societal scope of research.
Scientific rationalism	The way of thinking that presumes a single universal reality to exist and the world to be objectively knowable.
scripting	How something is intended to be used as informed by its designer. To enfold process into a technical artefact. Inverse of *description.* (Akrich 1992; Akrich & Latour 1992).
sense-making	'A motivated, continuous effort to understand connections (which can be among people, places and events) in order to anticipate their trajectories and act effectively' (Klein, Moon & Hoffman 2006, p. 71), and; 'the ongoing retrospective development of plausible images that rationalize what people are doing' (Weick, Sutcliffe & Obstfeld 2005, p. 409)
smart cities	The proposal, discourse and practices of cities that employ different types of sensing and data to supply information used to manage urban assets and resources efficiently. The term pertains both to 'software-enabled infrastructure and networked digital devices' and 'sensors used to augment urban management and governance' (Kitchin et al 2015, p.17). Moreover, it can also refer more broadly to a city's economy being increasingly driven by technological innovation (Caragliu, Del Bo & Nijkamp 2011).
social	Relating to society and living together in an organised way. To do with human relations, but after the introduction of ANT (chapter 4) to include relations with nonhumans (Latour 2005b).
socio-material	The constitutive entanglement of the social and the material in everyday organisational life (Orlikowski 2010).

socio-technical	Recognising the interaction between people and technology in systems and workplaces.
Sydney Coordinated Adaptive Traffic System	The system that manages road signalling that provides priority at traffic control signals for public transport vehicles.
Sydney Trains	The Sydney suburban passenger rail network and operations
tenet	One of the principles on which a belief or theory is based (Cambridge Dictionary 2018).
the moderns	People who think predominantly with the modernist mindset, particularly scientific rationalism and cartesian rationalism (author, see Latour 1993a; Latour & Leclerq 2016).
translation	The process that allows a network to be represented by a single entity, which can in itself be an individual or another network (Law 1992).
Transport for NSW	A statutory authority of the New South Wales Government that was created on 1 November 2011 to manage the transport services in the state of New South Wales, Australia. It is the leading transport agency of the state.
Information systems	An information system (IS) is an organised system for the collection, organisation, storage and communication of information. Information Systems is also an academic study of systems with a specific reference to information and complementary networks.
visuals	Designed predominantly in a 2D form, and arranges shapes and picture elements of that which can be observed. Visuals are distinct from written text, but can include written text (author).
western	Relating to countries in the west part of the world, especially North America and countries in the west of Europe (Cambridge Dictionary 2018); regarding European thinking tradition, particularly evident in regions of Europe, and its colonies, but evident through education systems across much of the world
wicked problem	A problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognise (Rittel & Webber 1973).

Abbreviations

ANT	Actor-network theory
NSW	New South Wales
OPP	Obligatory Passage Point
PIDS	Public Information Display System
PTIPS	Public Transport Information and Priority System
SCATS	Sydney Coordinated Adaptive Traffic System
STS	Science, Technology and Society (formerly Science and Technology Studies)
UNSW	University of New South Wales
UTS	University of Technology, Sydney

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Chapter 1. Introduction

This thesis seeks to reconceptualise the smart city discourse through literature review and the detailed exploration of two empirical cases. Chapter 1 sets out the necessary frameworks through which to understand the inquiry. It first introduces the smart city as an emerging discourse regarding the use of digital technologies for renewing cities. This discourse is critiqued as a narrow epistemology; of limited application and in need of more diverse perspectives. Philosophical pragmatism is introduced. This is proposed as a research paradigm and epistemology to reimagine the smart city discourse for greater relevance to the challenges of 21st century cities. Pragmatism has inspired the development of many approaches to research, on which this thesis draws in discussing notable pragmatist thinkers, including Charles Sanders Peirce, William James, John Dewey and Richard Rorty. Over the last century, pragmatist thinkers have sustained a critique of many of the dominant metaphysical distinctions and dualisms of Western thinking. They have argued for an evolutionary understanding of ideas, experimentalism and ecological perspectives of relations. This gives primacy to experience, rather than appealing to ideological and *a priori* categorisations. These salient points of pragmatist thinking are introduced as relevant to the reconceptualisation of the smart city discourse for the challenges of 21st century cities.

The research aim of this thesis is to explore the relationship between pragmatism and the smart city to ultimately contribute an alternative perspective. This will widen the limiting discourse by developing a pragmatist methodology with which to research the development of two smart city projects.

In the next section of this chapter the research questions are introduced. These questions are later addressed in the literature review covered in 'Part A: Suspending the smart city' and the empirical studies of 'Part B: Two Cases'. 'Part C: Reassembling the smart city' provides an outline of what it may mean to take pragmatism seriously; an expansion on methodological implications of a pragmatist approach. The current chapter concludes with an outline of the structure of the thesis, together with considerations of the scope and limitations of the research. But first, we depart from the necessary background to understand the research aim.

The elusive smart city

The smart city is a conceptual urban development model that proposes the use of digital technologies to address governance issues of the city. For many this concept is difficult to grasp. It promises interventions and solutions at the city scale and a utopian vision of city operations that largely ignores the implicit political nature of cities. From this broad discourse, it is not clear why and how one might develop initiatives in the practice of real local contexts. In drawing on a long list of existing critiques, I argue that the smart city discourse remains ill-defined and ideological, which is an inadequate basis for applying its concepts in practice. This is the rationale for this research inquiry.

CONTEMPORARY URBAN PROBLEMS

This thesis takes as its starting point that cities, not nations, are the world's dominant and enduring social structures. It argues that throughout multiple civilisations, cities have enabled humanity to live better, more efficient and productive lives. Much is riding on the success of cities in the 21st century. Cities facilitate the essential social nature of humans as a species, so much so that 54% of the 7.4 billion global population now live in cities (World Bank 2017). By 2050 this figure is expected to reach 75% of an estimated global population of 9.7 billion (World Bank 2017). This staggering level of growth is estimated to double the urban population from 3.5 to 7.4 billion in 30 years (World Bank 2017). As part of a more interconnected world, cities are playing an increasingly active role in the global economy. Cities are attractors promising opportunities of employment, access to services and varied lifestyle choices. As such a predominant vehicle of human prosperity, cities must function effectively, and provisions must be made now to accommodate for this future demand. Cities are now crucial to the

generation of economic growth in the predominant knowledge-based economies. Currently, around 80% of GDP is generated in the cities of the global north, with many other countries catching up as they increasingly become knowledge-based economies (Worldbank 2017). For this reason, cities continue to compete against each other to attract the best talent and investment in a globalised and mobile world (Florida 2005). In contrast, the nation-state is losing its prominence in defining social and economic entities (Ōmae 1995).

Ulrich Beck's thesis in *The Risk Society* (1992) articulated that modern society would organise itself in relation to risk. This concept is telling for urban governance institutions of the 21st century. Perceived risk in decision making often leads to paralysis, due to the increasing complexities of urban politics. But inaction is also a significant risk in the context of continual change. It is often said that 'demographics are destiny'. However, preparing for this unprecedented growth and change poses significant challenges for a contemporary city's governance. Populations are living longer, leading to a smaller proportion of the population being working age. With longer life comes chronic medical conditions and resultant care, leading to escalating costs and need for related services. With less people of working age there is less tax revenue for governments. The types of housing required to meet these needs have to change, as will the demands on services, transport, and social activities. Governments need to support the generation of future employment opportunities and help attract the talent capable of excelling in these roles.

It is almost a cliché to say that cities need to provide public services more efficiently, while concurrently supporting sustainable and long-term economic growth. With the majority of the global population now residing in cities, the city structure itself is understood as a defining attribute of inequality, environmental degradation, service provision and housing. Planning is not a problem that can be 'solved' or 'perfected' as a process. The management of urban problems is an ongoing dilemma. Rittel and Webber (1973, p. 160) argue, 'theory is inadequate for decent forecasting; our intelligence is insufficient to our tasks; plurality of objectives held by plurality of politics makes it impossible to pursue unitary aims; and so on'.

The planning levers that governance organisations can use differ greatly and have varying costs and implications. Around the world are thousands of examples of attempts, each with their own local idiosyncrasies, to deal with such issues. Zoning densities increase housing, but these require time to develop, displacing what is already in place in those areas. Economic levers can

change what types of activities take place in certain regions, and sway individuals to make certain decisions regarding investment, business and lifestyle decisions. Large scale infrastructure is costly, and can take decades to complete, causing massive disruption, particularly in densely populated areas. Major roads and rail systems are expensive. These projects can return huge benefits despite their costs, but they represent enormous political challenges and disruption in established cities to make them happen. In this context, those who govern are looking for ways to address these problems in efficient and adaptable ways. Urbanism, or the development and planning of cities and towns, is therefore subject to changes in relation to context.

Emerging and largely experimental methods to deal with these changes require the adoption of new models of decision-making, organisation and service provision, thus breaking with traditional processes of urban governance. Urban performance is no longer just about physical infrastructure; it is increasingly based on the availability and quality of knowledge and communication infrastructure (Caragliu et al. 2011). An emerging urban discourse, which proposes to address these and other contextual changes, is 'the smart city'.

The smart city

The smart city is a disourse that proposes the use of different types of sensing and data to supply information used in the efficient management of urban assets and resources. It pertains to both 'software-enabled infrastructure and networked digital devices and sensors used to augment urban management and governance' (Kitchin et al 2015, p.17). This model promises digital technologies to address some of the previously mentioned planning and management challenges, such as enabling the maximum use of existing infrastructure and optimising urban systems through efficiency gains of more complete, real-time information for decision making and management. As a post-industrial development model of urbanism, digital systems are seen as an attractive, cheaper alternative to the adaptation of physical infrastructure (Picon 2015).

The concept itself was developed and driven from the mid 1990s by vested corporate interests such as IBM, Siemens, Cisco and Intel (Paroutis et al. 2014; Townsend 2013). Their agendas pushed a technologically determinist view of urban planning, in which their products and services would be indispensable to city governance. From a commercial perspective, the smart

city is a significant concept with a market value projected to grow to an estimated $1.5trillion by 2020 (Frost & Sullivan 2014). Since the mid-2000s the 'smart city' has become widely known, proposing technological solutions to govern and manage urban complexities (Picon 2015). Thus, while conceived as cost-saving and technological in nature, the smart has more recently been understood as a conceptual urban development model; utilising human, collective, and technological capital (Angelidou 2014), and additionally, used to refer to a city's economy being increasingly driven by technological innovation (Caragliu et al 2011).

Since the advent of the microchip in the 1960s, digital technology has advanced into an age of 'ubiquitous computing', as envisioned by Mark Weiser (1991). Weiser saw that computing would come to support every aspect of existence, ultimately becoming largely unnoticeable. More than a quarter of a century later, it is asserted that Weiser's vision has become reality, as has the exponential improvements in microchip processing capability, following George Moore's (1965) earlier predictions. Computational technology has collapsed data processing speeds and connections to almost zero. Technology has made the world's knowledge more accessible. Information communication technologies have reshaped the way that humans relate to each other and the world, their past and their futures. 'Data is the new oil', has been championed as a mantra, referring to its tremendous value (Hirsch 2014). 'Big Data', as it is more recently referred to, is entrusted with preventing pandemics, revolutionising business and improving healthcare. At the centre, the data scientist is positioned as the engineer of the future (van der Aalst 2014). With the ability to process and analyse vast amounts of data collected in real-time, pervasive technology companies such as Google, Facebook, Apple, and Amazon have amassed immense wealth from the world's data. This expansion is unlikely to retreat. Attention is now moving towards making widespread use of technologies such as artificial intelligence, blockchain and virtual reality. There are hundreds of newly established organisations rapidly making these technologies commercially available, even as many of their applications are currently unimaginable.

Clearly, these changes will impact urbanism, the development and planning of cities and towns, and also influence how humanity regards urbanism. In 2018, shaping discourses include: the aforementioned increasing migration to urban regions; the rise of the 'sharing economy'; the growth and diversification of digital businesses; generational shifts in citizen behaviour; and autonomous vehicles. Several related discourses have emerged as their own distinct categories. Each describes, studies, designs and structures the ideas and projects at the

intersection of urbanism and digital technologies. Each proposes a range of approaches for technological solutions that support the management of urban complexities through information and communication technologies (ICT), as well as its own unique perspective. These categories include: 'Digital Cities' (Ishida & Isbister 2000); the 'Real-time City' (Townsend 2000); 'Ubiquitous Cities' (Anthopoulos & Fitsilis 2010); 'Urban Informatics' (Foth 2008); 'Intelligent Cities' (Komninos 2002); and 'Smart Urbanism' (Marvin et al. 2015). These categories are part of the larger 'smart city discourse', which, this thesis asserts, is both ill-defined and frequently ideological.

AN ILL-DEFINED AND IDEOLOGICAL SMART CITY DISCOURSE

The relationships of the idealised 'smart city' in many cases remain little more than conceptual ideas. After two decades of discourse, technology is reshaping the city, yet the information on how to practise a smart city initiative context remains largely inaccessible. The knowledge is situated in the expert fiefdoms of consultants, subject matter experts, or reductive, comparative explanations of cities.

Due to the technocratic nature of the discourse, there is an inherent lack of social perspectives. The perspectives that will support practitioners make sense of what could be done. The smart city's technologies and the political, social and economic factors that relate to them are not yet usefully interpreted for local governance (Cosgrave et al. 2015). As Cosgrave, Doody and Walt (2015, p.74) state '[m]any of the industry developed 'smart city solutions' have been criticised for failing to understand how they fit with the existing capabilities and functioning of local city governments'. Meijer and Bolívar (2016) further this, arguing that there are aspects relating to smart city governance that create confusion in the literature. Firstly, many scientific studies do not address the socio-technical nature of smart city governance, nor its emergent quality. Secondly, there is confusion about the role of government; in many cases there is a requirement to transform existing government processes which is not apparent in the discourse. Thirdly, there is a lack of clarity in the legitimacy claims of the smart city discourse, whether it is for governing towards outcomes or a governing process.

Different archetypes of what the city is, and how it can be known, guide certain actors' decision making and range of appropriate responses to any proposal. Perhaps it is no surprise that the exact meaning and context of the smart city is still debated (Anthopoulos & Fitsilis 2013), given

that the concept of a city is not in itself a precise idea. The conception of smart cities largely presents a technocratic model of urban management that holds that a city is knowable through data (Hollands 2008). Kitchin (2016, p. 7) argues the lack of clarity around words like 'city' in the discourse leads to the perception that the city is a technical entity which consists of knowable, manageable systems that act largely in rational, mechanical, linear and hierarchical ways. However, a city is much more than this. The great urban historicist Lewis Mumford, in attempting to explain a city, notes that a city is many things at the same time: 'in its complete sense [the city] is a geographical plexus, an economic organisation, an institutional process, a theatre of social action, and an aesthetic symbol of creative unity' (Mumford 1937, p.93).

While many research accounts applaud the smart city concept, since Hollands (2008) there have been a growing number of critiques. The smart city is argued to have been an industry-led, technologically determinist agenda, wherein technology companies attempt to position themselves as the essential gatekeepers of efficient management of cities (Söderström et al. 2014). The smart city has been deemed as ideological and part of the neoliberal privatisation agenda through; 'development' benchmarking (Vanolo 2014), labelling that ignores potential downsides of technology (Graham & Marvin 2001), is self-congratulatory (Hollands 2008), and represents corporate storytelling (Söderström et al. 2014).

Many accounts of existing smart city projects take the forms of reports, websites and other media. These accounts have been created on behalf of technology companies (e.g. Google, IBM, Cisco, Huawei, Fujitsu, Siemens), consultancies (e.g. Deloitte, Booz Allen and Hamilton, Bain, BCG, McKinsey, PwC, Arup, KPMG), global funding bodies (e.g. development banks such as the World Bank), and governments (e.g. local governments as well as State, Federal and other municipalities). Unsurprisingly, the accounts abstract their projects; speak about them in brief and, often, favourably. The consequence appears to be an idiosyncratic, complex and wide-ranging discourse that is unable to settle on meaning. Even as a noun, the smart city hypothesises the achievement of a 'state' in which a city becomes unambiguously 'smart'. As an implicit aim for all cities, it is nonetheless a state which remains 'proximate', or just around the corner. Bell and Dourish (2007) noticed this same phenomenon in the discourse of ubiquitous computing, one which 'prefigures' the smart city discourse: the language of research, relating to the topic, is always referring to a future state.

While there are many proponents, there are also many critical perspectives, which, since the late 2000s, have criticised the concept of the smart city for its underlying utopian and technologically determinist ideology. Many smart city definitions tend towards 'solutionism' (Morozov 2012); where problems are able to be broken down into solvable components that can be addressed by technology. Morozov (2012) argues that the promises of smart urbanism are based on 'technological reductionism' and 'neoliberal short-termism', in which all of the city's ills appear to be resolved in privately de-politicised ways.

One intent of the smart city is to benchmark. Frameworks disseminate urban benchmarking techniques, such as how 'good', 'healthy' and 'technologically-advanced' a city is (Vanolo 2014). Such benchmarking occurs across the diversity of projects, in a diverse number of cities, in different countries, with different systems of organisation between public and private sectors, technology companies and citizens (Vanolo 2014). Benchmarking presents a universalising and linear trajectory for digital urban development in recent decades. Within this agenda, technology companies and consultancies work to create paths along which cities must 'develop', dictating certain steps towards this goal. Kitchin, Lauriault and McArdle (2015, p. 31) argue that the reductionist benchmarking practices are developed by those who know the 'contingencies, relationalities, politics and technical shortcomings' of smart city initiatives, but through engagement of 'strategic essentialism' eliminates them to promote their approaches and products, and to deflect critique. One may find parallels between the use of gross domestic product (GDP) in shaping a linear development process and the limited view of 'progress' of nation-states in the last 50 years. GDP is now considered as an outdated, reductive economic mechanism, and it is critiqued from economic (Raworth 2017; Stiglitz 2009) and social perspectives (Sassen 2001).

The smart city discourses argue, in different ways, that a city can be rationally knowable, through data (Mattern 2017); yet, these same discourses create an impervious wall of 'development' that will reshape cities as we know them. Furthermore, the processes to become 'smarter' inevitably offer different ways for public sector services to be developed. Thus, the concept appears co-opted and driven by many agendas. Another way of understanding the discourse is by examining the ways in which the smart city is conceptualised, and made instrumental, by urban managers and political and economic urban elites (Vanolo 2014). The discourse is often used to further the agendas of technology giants, as well as local and national governments. There are many close links between neoliberal development agendas and the

smart city concept, particularly as a useful means to attract investment (Vanolo 2014; Hollands 2008; Brandt 2007; Jonas & While 2007). This critique has become a common but recognisable theme for those wanting to represent the perspective of citizens; those rarely engaged in 'top down' planning processes (Foth et al. 2015; Hemment & Townsend 2014). Some argue that smart city discourses have been captured by corporate ideologies, that they lack socio-technical integration, and they have only been marginally addressed by sociological studies of the human aspects of the initiatives (Hollands 2008).

It is also useful to note that attempts to define the smart city continue to address it as a global phenomenon. In addition to the attention of technology companies, global management consultancies have quickly moved to provide offerings in the smart city space, such as capabilities for governments' management of data or the Internet of Things (IoT). However, in a nascent field, even these organisations appear to be 'learning on the job', still collating reports of first and universalising principles without a clear understanding of the local implications of the solutions they advocate. To date, there are too few cases of success and only a small number of practitioners with experience, who have limited means to create and share useful contextual knowledge. However, the sophistry of innovation remains. The promise of the smart city is always just around the next corner.

Kitchin (2015, p. 135) argues that 'smart city research is at a relatively early stage of its conceptual development and empirical understanding'. He further identifies four shortcomings of research that inhibit making sense of the concept; a lack of genealogy of the concept and initiatives, the repeated use of canonical examples, an absence of in-depth empirical case studies and a lack of comparative research of similar initiatives in different locations (Kitchin 2015, p. 134). While many scholars have been disputing what the smart city is, critics and proponents among them, local governments, entrepreneurs and citizens are still looking for explanation and guidance. Meijer and Bolívar (2016, p. 12) argue the prevalence of the 'idea of 'one best city' is still dominant in the technological discourse about Smart Cities'. However, many authors have highlighted the contextual nature of urban systems relating to smart cities (Caragliu et al. 2011, Giffinger et al. 2007, Kourtit et al. 2012). Kitchin's (2015) comments also tend towards the need for more contextualised and practice-based studies of smart city initiatives. In contrast, most smart city discourse tends towards 'definition' of the terms and narrowly defined 'normative studies'. Perhaps these are the wrong objectives, when the smart city does not have adequate descriptions of how it works in practice?

As design theorist Donald Schön (1983, pp. 15-16) explains; 'the situations of practice are not problems to be solved, but problematic situations characterized by uncertainty, disorder and indeterminacy'. One positive attribute of an ill-defined concept, or an insufficient discourse, is that it requires further clarification. That process of clarification may be carried out in local contexts, as local problems are defined and addressed.

Consequently, this thesis argues that, before normative recommendations can be made about what *should* be done, more can be achieved by describing initiatives in practice, in efforts to understand the complexity of how projects unfold. Only then can we understand the *nature* of smart city initiatives in practice in real contexts.

What might be relevant theory for practitioners of the smart city? The perpetual challenge of 'relevance' between theory and practice has been noted in other related fields of study such as information systems (Benbasat & Zmud 1999) and management studies (Fendt & Kaminska-Labbé 2011). It is also an issue for the smart city. Many theoretical studies have been undertaken on the concept, yet, for those wanting to take action, the existing literature may not be adequately relatable to their own contexts. The ontological nature of practice is fundamentally different to most theoretical research (Fendt & Kaminska-Labbé 2011).

THE NEED TO RETURN TO EMPIRICAL DESCRIPTION

Efforts dedicated to defining the 'smart city' have diverted attention from the 'actual existing smart city' and richer descriptions of the range of initiatives already taking place in cities around the world (Shelton 2014). It was mentioned earlier that several scholars have noted that, in reality, the ideology of neoliberalism dominates the discourse (Shelton et al. 2015; Morozov 2012). But how useful are such descriptions, particularly when they are layered upon what is already an urban 'labelling phenomenon' (Hollands 2008)? Reductionist perspectives of the smart city discourse are counter to the understanding of the smart city as a problem urban planning.

Alternative urban epistemologies can configure the city as a laboratory; a socially inclusive city; sustainable; a start-up; or, as the hegemonic smart city discourse configures, the city as a computer. Taking a stance in describing the processes of development allows a detangling from some of these *a priori* categorisations and implicit corporate and technocratic value systems. Further, this detangling allows a researcher to look, and to experience. It is my

intention to decentralise the dominant smart city discourse, that of a 'city knowable by data' (Mattern 2017). Diversity is what makes any system able to renew itself, and thus, the contrary, diverse positions on these city-making discourses are essential to prevent unsustainable reduction.

The smart city could be understood as 'an ontological standpoint that frames all urban questions as essentially engineering problems that can be analysed and solved using empirical, preferably quantitative methods' (Bell 2011, p. 73). Yet, this limited epistemology arguably makes it harder to understand smart city initiatives in practice, as they cohere with lived experience, and a complex, changing socio-technical context that demands qualitative and contextual inquiry. Without an adequate *description* of smart city initiatives in practice, the smart city will continue to evade clear understanding.

In addition, it can be argued that theories are being constructed and shared that abstract 'best practices' from the locations of their creation (e.g., Green 2016, Garrido-Marijuan et al. 2017). Kitchin (2016, pp. 6-7) asks 'for whom and for what purpose are smart city initiatives being developed?' He argues that the high-level goals of the smart city are clear, at least to some, but they lack the normative goals required at a local level.

> ...the 'city' is treated as a generic analytical category, meaning a solution developed for one city can be transferred and replicated elsewhere. Such a view of cities is limited and limiting; not only does this narrow, technical view fail to capture the full complexity of cities, but it also constrains the potential benefits that smart city technologies might produce by producing solutions that are not always attuned to the wider contexts in which urban problems are situated (pp.7-8).

These approaches marginalise the knowledge and experience of the professionals working on these projects. Kitchin (2016, p.8) highlights this disconnect between what state organisations know about their cities, and what they are compelled to try as approaches:

> Intrinsically, city administrations know that cities are complex, open, multiscalar, contingent and relational, yet they often practice a form of strategic essentialism and seek to tackle urban issues through narrow technical fixes that ignore wider interdependencies.

Smart city initiatives are now taking place in thousands of cities. Nevertheless, they are not being recorded in ways that adequately captures and makes accessible involved practitioners' knowledge. Two epistemological approaches are often used to understand these initiatives: the

'Big Data' approach, which uses one-dimensional quantitative studies; and the scientific approach, which enables data generalisation across cities (Kitchin 2016, p. 9). Claiming objectivity and neutrality, both approaches de-contextualise data. Data is removed from its social, economic and environmental contexts, systems and history, politics and political economy, culture and communities. Without a change in epistemology, the underlying scientific rationalities of smart city technologies and approach will remain; anaemic, partial and open to significant underperformance and failure (e.g., RAND's poor modelling of fire risk in New York City (Flood 2010).

For Kitchin (2016, p. 3), the smart city discourse 'treats the city as a knowable, rational, steerable machine' and not 'a complex system full of wicked problems and competing interests'. The smart city is comprised of wicked problems. As Rittel and Webber (1973, p. 165) state, 'every wicked problem can be considered to be symptom of another problem'. In this view, problem elements cannot be isolated and improved without impacting other parts of the city system. Furthermore, individual, discrete projects may have low impact on the city by themselves; however, their agglomeration can lead to significant changes, as Komninos et al. (2015, p. 32) note:

> The plethora of smart city applications, created in an uncoordinated bottom-up manner, leads to the creation of smart cities by agglomeration. Somehow, the spontaneous urbanization process, which nurtured the growth of cities by the geographical concentration of people and activities, has begun to replicate.

What approach, then, might be used when inquiring into the smart city? Unsurprisingly, there have been calls for more detailed empirical studies on the subject (Kitchin 2015; Shelton et al. 2015; Meijer et al. 2016). Meijer and Bolívar (2016, p. 13) have called for viewing smart city governance as an emergent socio-technical practice. Specifically, they mention three works for indicative guidance: two relate to information systems in organisational contexts (Fountain 2004; Orlikowski 1992) and third, an edited book, details the social construction of technological systems (Bijker et al. 2012). Information Systems offer rich perspectives in the challenges of explaining the development of complex systems, for example, in increasing capability of learning from existing and past projects (Lyytinen & Robey 1999) and applying contemporary models of system development (Ciborra & Hanseth 2000). Similarly, the published work of Bijker et al. (2012) emanates from several prominent science and technology

scholars; an edited book of several accounts of technological implementation projects taking a distinctly social perspective. Science and Technology Studies, as a discipline, have been grappling with the challenges of socio-technical accounts since the 1920s.

To frame and understand the smart city as 'practices' is to take an approach that diverges from current smart city wisdom, which tends to look at completed interventions as whole entities. This divergence is, at its core, what has been described as 'proximal thinking', or to think of entities as continually incomplete. This perspective articulates an appreciation of emergent realities that are in the process of becoming, and thus incomplete. It manifests in practice-based inquiry; an inquiry which may deploy narrative-based description of stakeholder activities and depend on qualitative methods, such as ethnography, interview and observation (Schatzki et al. 2001). Meijer and Bolívar (Meijer & Bolívar 2016) state that 'smart city' governance needs studies that look at the ways in which urban governance institutions both transform and conserve themselves in practice. So, through more detailed study of practices, these could be observed.

Using what exists in this ill-defined and ideological smart city discourse as a starting point, there is a clear need for different, complementary epistemologies that can situate these concepts in their contexts. Moreover, rather than examining the 'generalisable', perhaps it is time to look towards the specific; towards epistemologies that can describe the complex relations between social and technical elements that relate differently in different instances and locations. It is appropriate to employ epistemologies that are open to multiple interpretations, rather than the universalising reductionism of quantitative interpretations.

While the smart city literature appears, at face value, to be non-ideological, common-sense and pragmatic, it is broadly the opposite (Kitchin 2015). It has also been noted that the smart city requires a practical or pragmatic approach that links what is proposed to the existing needs and operations of cities (Centre for Cities 2014). There is the possibility that the current limitations of the smart city discourse could be addressed by the adoption of an alternative epistemology. This thesis, therefore, asserts that philosophical pragmatism offers a useful research framework to address the current limitations of the smart city discourse.

An introduction to pragmatism

I now introduce pragmatism through five key tenets and contemporary applications relevant to this reassembly of the smart city. Pragmatism, according to the Cambridge dictionary is 'the quality of dealing with a problem in a sensible way that suits the conditions that really exist, rather than following fixed theories, ideas, or rules' (Cambridge Dictionary, 2018). This emphasis on practicality is a common everyday use of the term. This usage is described as 'vulgar' pragmatism, a perversion of the initial meaning of the term, where all theory is discarded to focus on expediency (Kaplan 1964). Pragmatism, in its deeper philosophical sense has a rich history, and its theoretical tenets must be maintained in a research inquiry. Far beyond being just a 'sensible way' of dealing with problems, philosophical pragmatism (hereafter, pragmatism) has far greater implications for reassembling the smart city discourse. It provides a rigorous epistemology or 'way of knowing'. In practice, pragmatism promotes a mixed-methodological research inquiry towards relevance in action.

As a philosophical movement, pragmatism was first defined in the late 19th century by Charles Sanders Peirce. This was later developed by James, Dewey and Mead, who as the 'first generation' led the pragmatic movement in the 20th century; a movement often termed 'American Pragmatism' (Menand 1997). Pragmatism, according to James was a 'temper of mind, an attitude; it is also a theory of the nature of ideas and truth; and finally, it is a theory about reality' (Dewey 1908, p. 85).

Peirce's (1878 [1997] p. 36) defining pragmatic maxim was to '[c]onsider the practical effects of the objects of your conception. Then, your conception of those effects is the whole of your conception of the object'. Although James and Dewey's ideas diverged from Pierce's, the pragmatic maxim is a useful explanation where the pragmatist epistemology leads. Pragmatism is focussed on effects of any conceptualisation; in simple terms, what holding a certain idea will result in. The pragmatic maxim is a relevant point from which to explore the implications of pragmatist epistemology.

At the turn of the 20th century, pragmatism was, as James (1907) noted 'a new name for some old types of thinking'. Pragmatism contended the dominant Western philosophical canon was obfuscating sound philosophical inquiry. The early pragmatists, including Peirce, James and Dewey, believed that the contemporary conceptions of 'thinking' and 'acting' were wrong.

Menand describes this as 'an effort to unhitch human beings from what pragmatists regard as a useless structure of bad abstractions about thought' (Menand 1997, p. xi). Pragmatists hoped to propose a more useful philosophical tradition, in line with how people actually conceived of thought and action in the world, without dominant logico-scientific rationalisations. Pragmatism was a divergence from rationalism's static and inert relations, towards the leading power of ideas to return to particulars and experience (Dewey 1908).

Many philosophical perspectives assume that there is an objective reality – the 'truth' of which can be discovered through the scientific method. Pragmatism countered this notion, controversially arguing that truth was a social construct. To pragmatists, facts and values are treated interchangeably. In opposing more widely accepted understandings of truth and realism of an objective reality, pragmatism remained a fringe philosophical approach for much of the 20th century. It ran counter to another dominant wisdom of Western philosophy, which holds that thinking was separate to, and greater than, action. However, these more challenging aspects of pragmatism have been widely validated with the postmodern movement in the second half of the 20th century. I will return to this point in Chapter 2.

So how useful is pragmatism to the task of reassembling the smart city? Pragmatism, unlike many other philosophical perspectives, focuses on the amelioration of problems. Pragmatism offers a philosophical hopefulness towards the not yet realised world (Koopman 2006), consistent across its treatment of truth, pluralism and humanistic world view. Thus, pragmatism is arguably well suited to the 21st century. It is useful towards reimagining relational systems, given the increasing complexities, contradictions and uncertainties of globally-connected societies. The smart city is one such context. Pragmatism is widely treated as an epistemology, with largely methodological implications. However, pragmatism when considered more holistically, also has its own metaphysics including its own commitments of social ontology (Pratt 2016).

Importantly, it must be noted, pragmatism is not just 'one approach'. Each of the founding pragmatic thinkers had differences in their ideas. Some of these differences will be drawn out in later chapters. For the purposes of this inquiry, however, five tenets of pragmatism will be treated as critical to the reassembly of the smart city discourse.

Five key tenets of pragmatism

These five central tenets ground the epistemological and ontological commitments of pragmatism in 'understanding by' and 'being in' experience: viewing change as an evolutionary process; a commitment to experimentalism; the dismantling of metaphysical systems; the rejection of dualisms; and, finally, an ecological perspective. I will now explore each of these tenets as critical to the maintenance of the pragmatist epistemological perspective, and to a pragmatist understanding of phenomena.

EVOLUTIONARY PROCESS OF CHANGE

Pragmatists view the world as an evolutionary process of change. Darwin's theory of evolution (1850), resonated with the pragmatist ideas that followed. Pragmatists argue for genealogical accounts of nature, technology and ideas. They argue for accounts that explain where things come from, how they were made, and what ideas underlie their inception. This perspective prevents the disassociation of ideas from their originating contexts. Pragmatism proposes that an ideology or proposition is true if it works satisfactorily; that the meaning of a proposition is to be found in the practical consequences of accepting it. As a result, pragmatists believe in the rejection of impractical ideas. Consequently, 'truth' is understood to be constructed, but not arbitrarily. Truth is grounded in lived experience and understood through an evolutionary perspective. All conceptions are built on what has come before. Truth is also subject to an evolutionary process of change. The pragmatist conception of truth is perhaps better understood with a notion of 'solidarity'; that the most useful ideas have the most believers (Rorty 1989). As James (1907, p. 55) states, 'theories thus become instruments, not answers to enigmas, in which we can rest.' Further, James (1907, p. 55) states 'ideas (which themselves are but parts of our experience) become true just in so far as they help us get into satisfactory relation with other parts of our experience'. A 'true' belief is one that fits with what is experienced. This tenet supports the understanding of phenomena as a result of the effects of their histories, though ever-changing. The smart city, through this tenet, is emerging from the existing legacies and path dependencies of the urban and organisational contexts in which they exist. Moving towards pragmatist 'process thinking' to understand the smart city is a central theme of this thesis.

EXPERIMENTALISM

In the evolutionary perspective of truth, all propositions are fallible. Fallibility is a strong example of the pragmatist notion of experimentalism. Peirce described pragmatism as a 'laboratory philosophy', demonstrating that theories are tested through experiments. Experimentalism for pragmatists is the belief that the only real means of progress can be made through experimentation. This is best illustrated with the scientific method and Darwinian evolutionary theory. Although they differed, both Peirce and Dewey had theories of inquiry focussed on experimentalism. For Peirce (1877), inquiry was a 'struggle' to replace doubt with 'settled belief'. He believed that only the method of inquiry can make sense of the fact that we are disturbed by inconsistent beliefs, which we then try to resolve. Conversely Dewey saw all inquiry as beginning with a problem aiming for the 'the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole' (Dewey 1938, pp. 104-105). Peirce, according to Smith (1978, p. 98), aimed at 'fixing belief', whereas Dewey aimed at 'fixing the situation'. Both of these notions treat progress as a result of experimentation.

Dewey (1916 [1997], p. 211) states, '[t]he experimental method is new as a scientific resource– as a systematised means for making knowledge, though as old as life as a practical device'. In the evolutionary perspective, understanding, meaning and interpretation are temporary. What works is what is used. Thus, experimentation is continually occurring to derive more useful propositions that are more relevant to context. Pragmatists are committed to experimentalism, such as that provided by the scientific method. Dewey sometimes characterised his philosophy as 'experimentalism' or 'instrumental experimentalism' (Bernstein 2010, p. 11). This perspective maintains that any belief systems, or even technology, should only be treated as temporary, which heightens awareness to potential others. For the smart city this tenet helps us understand that what exists now is an incomplete system, continually in the making through experimentation.

DISMANTLING METAPHYSICAL SYSTEMS

Western thought maintains its own distinct metaphysics (having prior categorisations of what exists and how these elements relate to each other). Scientific knowledge, for example, is

privileged. Pragmatists are committed to dismantling these traditional metaphysical systems, and to offering contrary views in response. Dewey, for example, argued that knowledge from the sciences and arts should be treated equally. Indeed, pragmatism attempts to bridge the Cartesian dualisms that exist between theory and practice, or between factual and valuational sciences. For James (1909, pp. 54-55), it was 'the attitude of looking away from first things, principles, 'categories', supposed necessities; and of looking towards last things, fruits, consequences, facts'. It is also 'used in the wide sense, as meaning also a certain theory of truth' (p. 55). In doing so, pragmatism had rejected the dominant scientific metaphysical systems: notions of objectivity and realism. Clearly, this tenet locates a person in their experience, continually challenging the assumptions previously held. The smart city is treated as a utopian ideal; to dismantle the metaphysical systems of the smart city discourse is to look to 'last things' as James stated, or what is tangibly experienced rather than appealing to higher order beliefs.

REJECTION OF DUALISMS

Consequentially, and worth noting as a category in its own right, pragmatism rejects dualisms. For example, pragmatism does away with the dualism between realism and anti-realism. Foundationally, this also involves the rejection of Cartesian dualisms between culture and nature, thinking and action, and people and technology. This includes the dominance of Cartesian rationalism, the privileging of theory over practice, and the assertion of scientific knowledge above all other forms of knowledge. Dewey (1916 [1997], p. 205), argues against theories that 'imply basic divisions, separations, or antitheses, technically called dualisms…these barriers mean the absence of fluent and free intercourse'. Dewey's rejection of these assertions is based on his argument that they have negative effects in education, closing spaces of inquiry that should remain open, thus limiting thinking. Dewey (1916 [1997], pp. 208-211) notes three reasons in particular to challenge Cartesian dualisms; first, that scientific studies were showing that the mind was inseparable from the body; second, evolutionary theory demonstrates that humans are inseparable from the natural world; and third, that experimentalism derives what knowledge is, not *a priori* categorisation. This last tenet ensures that people are continually aware and challenging these categorisations that frame their experience. The smart city discourse has been argued to treat technology and social aspects dualistically. However, there are many more dualisms that are evident in the smart city

discourse, including progressive versus regressive; bottom up versus top down; physical versus digital; and public versus private. A pragmatist perspective seeks continuity between these categories, rather than predefining relations through crude *a priori* categorisations.

ECOLOGICAL PERSPECTIVE

With the emphasis on contextual continuity, connection and balance, and a rejection of dualism, pragmatism also lends itself to environmentalism and social ecology. Pragmatism is principally concerned with relevance, and a key dimension of relevance is how things relate to each other. Pragmatism, therefore, is rooted in an ecological perspective. This focusses attention on the relationality of experience. Thinking ecologically forces the researcher to ponder in terms of context specifics. The evolutionary process of change is not to be understood as linear cause and effect, but rather closer to a Darwinian notion of context informing the evolution of an idea. Multiple experiments in both science and Darwinian evolution are being carried out simultaneously, thus a linear model could be replaced with a spatial orientation. The ecological perspective understands entities in relevance to their contexts. The world is not universal; there is not one way to understand it. James, in particular, had strong perspectives that reality is multiple, existent in what he called a 'pluriverse'. This notion is extended later in the thesis as critical to the pragmatist reassembly of smart cities. The notion provides space for other relevant perspectives in the constitution of the smart city concept. Even morality for pragmatists is said to evolve as an ecosystem. In environmentalism, Dewey was known to publicly criticise business and corporations that destroyed virgin lands, polluted rivers, and wasted valuable resources seeking immediate profit (Watras 2015). He tied these notions to his interest in education, with the desire to develop students in ways that benefitted the students and society (Watras 2015). The ecological perspective supports the understanding of entities in relation to other entities in their contexts. To treat the smart city with an ecological perspective is to understand it relationally, and in a situated way, amongst all other entities and agendas in the 21st century city.

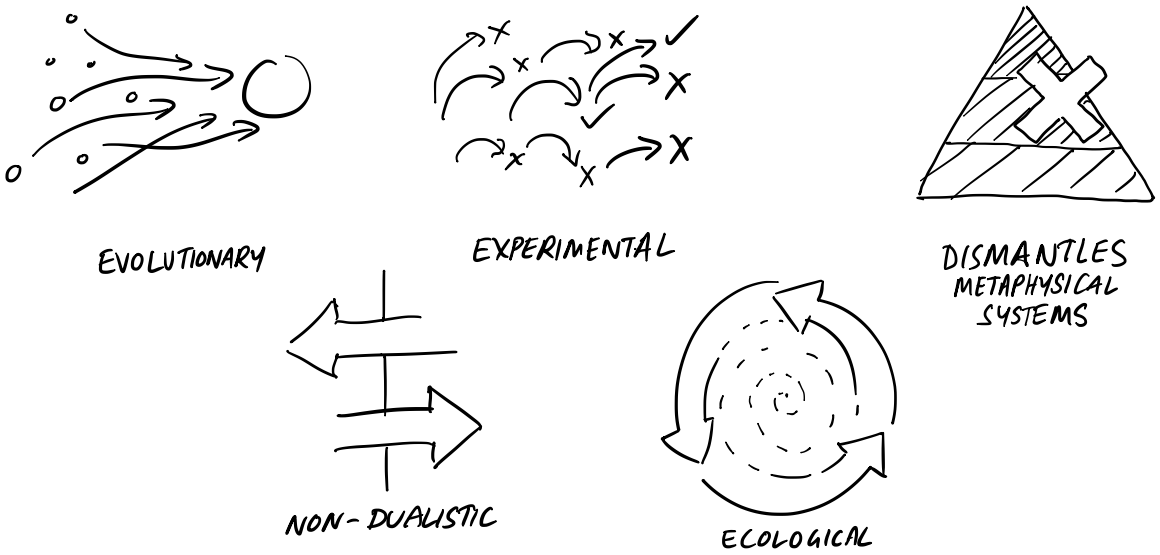

Figure 1: A visual summary of the five tenets of pragmatist thinking, as introduced. Source: author.

In summary, figure 1 is a collection of illustrated icons of these five key tenets of pragmatism. Having established and explained these, I will now turn to describe the ways in which pragmatism has been applied and developed since the late 20th century.

Contemporary applications of pragmatism

Pragmatism has never quite managed to overcome the ideological problems that Peirce, James, Dewey and Mead had originally challenged. Dominant ways of knowing in the West through scientific rationalism, particularly Cartesian rationalism, still continues today to prevail in the framing of thinking processes. Yet, pragmatism is arguably more relevant today; those responding to our plighted ways of being increasingly turn to the deconstruction of Western thought. In the 1970s and 1980s, there was significant resurgence in pragmatist references, largely due to the influence of Rorty and Putnam. Both drew on the works of early pragmatists, particularly James and Dewey, and reimagined them in the postmodern context. More recently, there has been a growth in the use of pragmatist methods, especially in the social sciences: the use of a deconstructive paradigm that advocates the use of mixed methods in research. The pragmatist research paradigm removes the contentious issues of 'truth' and 'reality', and instead focuses on 'what works' as the truth regarding the research questions under

investigation. It has therefore been seen as useful by those studying the development of science and technology, such as the smart city.

As stated earlier, pragmatic approaches value the consequences of a design, rather than its initial intentions. Each of the five tenets, outlined above, are heavily informed by an empiricism of experience, where knowledge is based on what is evidenced by the senses. As the pragmatists argue, experience is without categories. This informs a different epistemology for the design methods movement, design theory and design research. It champions roles that are speculative, as the actual outcomes are not always known, particularly in complex contexts.

It is asserted that the need to pay attention to context and experience is somehow a contemporary proposal. Along the path of enlightenment, during the Industrial Revolution, and throughout ever-pervasive global development, attention to context and experience has, for the most part, been lost. Renewed attention suggests that not all developed cities need to have a ubiquitous sameness, modelled on many others, nor indeed do they necessarily require the same products and services. Difference, relevance and appropriateness can only emerge if the pragmatic approach is engaged in a way that facilitates, philosophically, a future-oriented ability to think outside of limiting dominant paradigms.

In recent years, pragmatist approaches in urban studies have reframed broad, ideological categories such as globalisation (Sassen 2003), the city (Latour & Hermant 1998), and architecture (Yaneva 2009a). The philosopher of science, Isabelle Stengers, has argued for an ecology of practices as a way to think with the situated context, '*par il milleu*' (Stengers 2005b, p. 188). Elsewhere, Stengers has proposed a 'slowing down'; a proposition to not be so certain of what we think we know (Stengers 2005a). In studies of scientific practice, pragmatist thought has been pursued by the development of social approaches, such as the Sociology of Scientific Knowledge, and Science and Technology Studies. Contrary to more traditional models of epistemology, pragmatism privileges relevance over objectivity throughout scientific practice.

This thesis uses a mixed method approach in order to create meaningful research and a useful research output. Below is an image representing the significant difference in views between Scientific rationalist perspectives and the pragmatist perspective.

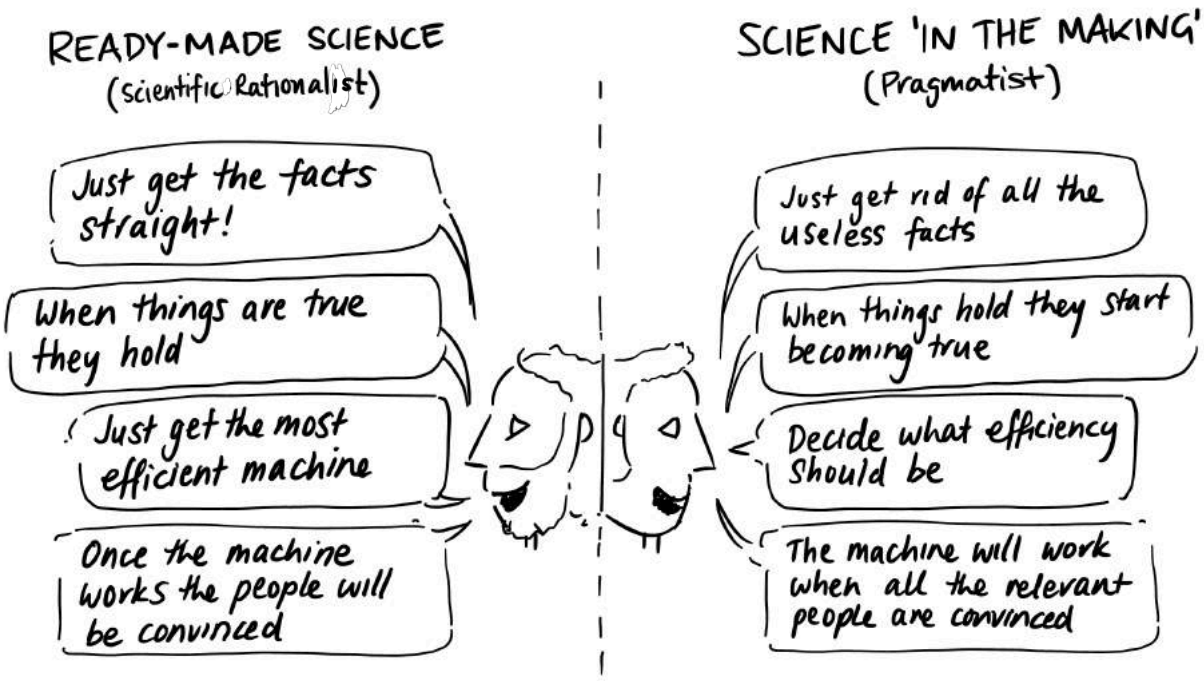

Figure 2: Comparing 'Ready Made Science' with 'Science in the Making'. Adapted from Latour (1987, p. 4-10).

Furthermore, from this perspective, this thesis uses Actor-network theory (ANT) to explain the socio-technical relations of actors in smart city initiatives. ANT is a pragmatist approach to social description and an exemplar research methodology to enact the five pragmatist tenets described. The methodology also draws on other pragmatist methods such as oral histories and infographic visualisation. Rather than adopt one pragmatist stance or another, this thesis instead 'thinks with' various pragmatist ideas in relationship to each other, and as they appear relevant to the context of reassembling a pragmatic smart city.

Reassembling the smart city discourse with pragmatism

The discussion this far leads to the assertion that pragmatism is a useful philosophical paradigm to explore the smart city discourse. At this critical time in their histories, cities are in need of thoughtful action. Pragmatism is well placed to bring a better contextualised socio-technical understanding of these initiatives, with explanations of local politics, genealogies,

and introduce more non-canonical studies into the discourse. The intent of the present inquiry is therefore to reconceive the smart city discourse using a research paradigm of pragmatism.

As discussed, the deconstructive nature of pragmatism is well suited in its application to the ill-defined and ideological nature of the existing smart city discourse. Practitioners and scholars alike are looking for useful knowledge in relation to emerging smart city initiatives. The thesis seeks to reassemble the smart city discourse along the five tenets of pragmatism. It seeks an understanding of practitioners who have experienced smart city initiatives in action, through:

- Understanding the context of smart city initiatives along historical and genealogical lines (the evolutionary process of change);
- Observing the development of smart city initiatives as made through propositions (experimentalism);
- Dismantling any metaphysical hierarchies that privilege certain forms of information over others in the smart city discourse;
- Rejecting dualisms as an *a priori* means of categorisation of smart city related entities; and
- Describing smart city initiatives through a social ecological perspective.

The smart city must, firstly, be understood in terms that are without metaphysical distinctions; a re-construction of the category from its contexts. Yet, in order to meaningfully do this, the smart city must be positioned in the context of real cities in the 21st century. The hope is to reassemble the smart cities' ill-defined and ideological categorisation; to establish some complementary perspectives on what it takes to practice smart cities. Following the pragmatist tenets, normative judgements of 'how the initiatives could be improved' should be held back, until the description is adequate to make such interpretations. Instead, the argument of this thesis is a process of unfolding the context of the smart city throughout three inseparable premises: the situated contexts of the city; the situated contexts of its practitioners; and the situated contexts of research inquiry. Part of doing this in a pragmatic way is to understand that all actors will have different views on what is relevant and how they and other actors relate to the situations.

DEPLOYING CONTEMPORARY PRAGMATIST METHODOLOGY

To help articulate this, the argument does not assume that these can be brought together into a universalising perspective as much of the smart city discourse encourages, rather it

maintains, as William James (1909) argued for a 'pluriverse', where multiple realities of many actors co-exist.

The methodology that guides this study is a pragmatist approach to social theory Actor-network theory (ANT) (Latour 2005b). ANT is an arational, exploratory and material-semiotic approach to where description of both human and nonhuman entities are treated in symmetry. ANT is an exemplar of the five tenets of pragmatism. The theory is described in detail in Chapter 4.

In thinking through the practical effects of this research, I draw extensively on a contemporary pragmatist concept: Stengers' *Cosmopolitical* (Stengers 2005a). Stengers' approach is also another exemplar of the five pragmatist tenets. She proposes a new political forum, where all facts and perspectives are open to question, through which many agencies can be concurrently held together; where politics remains, rather than privileging just the most powerful actants, giving voice to other mutually counter-balancing perspectives. It is a space where 'the common world must be free to emerge from the multiplicity of their disparate links…' (Stengers 2005a, p. 999). This perspective creates an alternative, multi-voiced depiction of the many stakeholders of the smart city, composing its reassembled nature. The cosmopolitical explanation is expanded in Chapter 4.

Research questions

My early observations assert the hypothesis that philosophical pragmatism could serve as a useful epistemology with which to understand the smart city in the context of 21st century cities. Importantly, the commitment to pragmatist epistemology requires a conscious effort *not* to begin the inquiry assuming what one wishes to explain. The intention, however, is to provide a counter to the current discourse; to provide a more holistic, situated and relevant description of smart cities. This intention leads to the principal research question:

How might we pragmatically reassemble the smart city discourse to support action in the 21st century city?

This question has had some introduction in the critique of the smart city discourses in this chapter. In order to answer this overarching question, an extensive literature review is conducted in Part A, to establish a suitable methodology for an empirical study. Pragmatism

is based in action, so therefore, following the literature review, an empirical study is conducted as Part B to understand smart city initiatives as they are experienced in practice. Both of these parts are then used to formulate Part C, the reassembly of the smart city discourse as relevant to action in 21st century cities. The thesis will later take this further, moving on to challenge normative notions of description and representation towards pragmatic knowledge that is *useful in action*.

With this in mind, the principal question has four interrelated sub questions as follows:

- How does the smart city discourse relate to the context of 21st century cities?
- How could the smart city discourse be more pragmatically conceived?
- Given this understanding of smart city practices, what experience could be useful for more pragmatic action?
- Given this understanding of useful experience for the practitioners of the smart city, what is an adequate research methodology that will address this need?

These questions give the context in which to then conduct the empirical study, based on attempting to understand and simultaneously provide useful research for the context of smart city practices. An empirical study is conducted in 'Part B: Two Cases', as a culmination of the pragmatist methodological approach developed in 'Part A: Suspending the smart city'.

Part B discusses the application of the pragmatist epistemology in the study of developing smart city initiatives. It applies the speculative research methodology, developed in Part A, in practice. The application takes the form of two case studies, enquiries into two Sydney-based transport information system projects, *Responsive Environments* and *Real-time Applications*. The two cases are related to the development of public transport customer information systems in Sydney and they emerge from an Australian Research Council Grant (number LP110200708), *Responsive Transport Environments* (see Haeusler et al. 2010). The intent of Part B is to understand what happens during smart city projects in the experience of practitioners.

The methodology uses a pragmatist approach to social description—Actor-network theory (ANT)—to develop a detailed empirical perspective of the emergence of the smart city initiatives. These projects are to be represented in a useful format; one which engages practitioners in discourse with other practitioners about the emergence of projects. Specific questions relating to the methodology of ANT are:

- From a pragmatist perspective, why and how these did these projects develop?

The question of representation is addressed through the demonstration of the two cases.

- From a pragmatic perspective, how could these explanations be represented to support action, given the question of reconceiving these projects more usefully within the context of the 21st century city?

It is important to note that the empirical study seeks to demonstrate the speculative proposal in practice, through combining the pragmatist approaches in an attempt to make the Cosmopolitical (Stengers 2005a) context of practitioners apparent. As the inquiry is informed by the ANT approach, it adopts the language of ANT. Central to ANT are the narratives of the actants—those who make others act—and how they stabilise into functioning relationships with each other.

The final section reflects upon the inquiry and moves towards the reassembly of the smart city; one that is in a continual state of becoming a smarter city. This part addressed the following question:

- What outcomes can be made of this research that could support smart city related action in the 21st century city?

This question is pertinent for a pragmatist research paradigm, as pragmatism is concerned with the practical effects of holding ideas and their relation to experience. Therefore, if nothing comes of this research in practice, then the research has not attended to what it means to create and embody a pragmatist research paradigm. This is a reflexive challenge, which is explored in great detail through the second half of this thesis.

Thesis structure

The thesis is divided into three parts for simplicity of argumentation:

- **'Part A: Suspending the smart city':** presents the literature review of cities, smart cities, their challenges and design practices that shape them. The part concludes with an outline of the developed suitable methodology and the 'visual histories' based on that review.

- **'Part B: Two cases':** is the empirical section containing the development of empirical studies of the development of transport information systems, and the application of the 'visual history' method. These were carried out on the cases '*Responsive Transport Environments*' and '*Real-time Applications*'.
- **'Part C: Reassembling a smarter city':** is a synthesis of the thesis, it concludes with a discussion of how the smart city might more usefully be conceived for the challenges of making cities in the 21st century.

I now explain the thesis structure in more detail. We have started with the introduction which is followed by the three parts. Figure 3 is a visual representation of the thesis, in chapters and parts. Important to note, this thesis includes two very large format 'visual histories' of the cases[1]. These are important to be viewed at the commencement of Chapter 6.

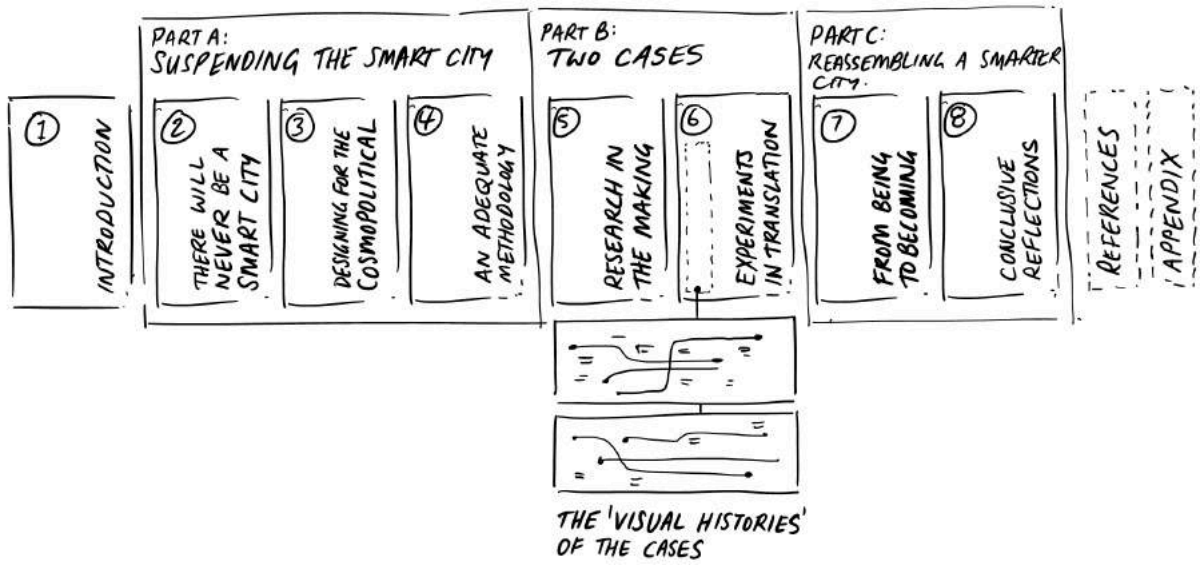

Figure 3: A sketch of the thesis structure. Source: author.

PART A: SUSPENDING THE SMART CITY

Part A includes three chapters, 'Chapter 2. There will never be a smart city', 'Chapter 3. Design in the Cosmopolitical', and 'Chapter 4: An Adequate Methodology'. These three chapters

[1] These pdf files are viewable for examination purposes on the USB attached to the front cover of this thesis. At a later date (end 2018), these will be publicly available online, subject to participant approval (see http://www.timtompson.com).

problematise the interrelated issues which influence the ability to create pragmatic smart city knowledge. There are several questions that must be answered to create a strong rationale for the speculative 'reassembly' of the concept. The smart city is outlined in consideration of the context of contemporary urbanisation, the nature of design for smart city discourse, and the ability of academia to produce pragmatic knowledge for this context. Each of these topics is explored using a pragmatist epistemology. 'Chapter 4. An adequate methodology', includes an outline of the most suitable methodology to embark on the challenge of returning to experience and situate the ill-defined smart city: Actor-network theory (ANT). This section concludes with a proposal for a 'visual history' method subsequently used to describe the empirical cases.

PART B: TWO CASES

The two chapters in this Part explain how the research was developed. They also detail the case studies, including the findings. Part B also consists of two large-format visual representations of the cases, the 'visual histories'[2], where the data from the empirical cases is arranged for use in practitioner discussions. 'Chapter 5: Research in the making' proposes a pragmatist approach to explaining smart city initiatives in practice. It is divided into four parts that explain the use of methods and why certain decisions were made in the research process: context, content, conceptualisation and form. The chapter concludes with a description of how the research was conducted, as a process of reflecting-in-action towards shifting goals in pragmatic process. This process is not one that has been rationally planned, as little was known about the context at the beginning. Instead, the process reflects the very nature and ontology of the smart city initiatives being studied (Fendt & Kaminska-Labbé 2011). 'Chapter 6: Experiments in Translation' outlines the final form of the visuals, provides some descriptions of the variety of actors and how they each shaped each case, and includes some discussion about what the pragmatist perspective and methodology meant for the description of these cases.

[2] To reiterate, these pdf files are viewable for examination purposes on the USB attached to the front cover of this thesis. At a later date (end 2018), these will be publicly available online, subject to participant approval (see http://www.timtompson.com).

PART C: REASSEMBLING THE SMART CITY

Finally, 'Part C: Reassembling the smart city' attempts to draw some implications for practitioners and researchers acting in relation to the smart city. 'Chapter 7: From Being to Becoming' argues that the generation of pragmatic knowledge of this thesis is largely due to the use of the pragmatist approach. Underlying this is a process ontology, which is a useful way to consider urban, academic, ecological, personal design and experimentation. The final chapter, 'Chapter 8: Concluding reflections', draws the thesis to a close. It provides an overview of each chapter's conclusions as propositions. It reiterates the limitations of the research and explores what opportunities there are for further research. Ultimately, the smart city as a discourse is reassembled to be more relevant to the challenges of 21st century cities.

On using personal pronouns

This thesis makes use, when relevant, of personal pronouns. In doing so, I present the pragmatist empirical perspective that all knowledge is derived from experience. In later chapters, this perspective helps me explain the emergence of the research project as experienced. As Brodkey (1987, p. 26) notes; 'experience is not—indeed, cannot be—reproduced in speech or writing, and must instead be narrated'. In order to achieve this emphasis on lived experience, I use personal pronouns to refer to myself at relevant moments in this thesis.

My personal perspective plays a critical role in the unfolding of the empirical study, in which I acted in relation to the context in which I found myself. The intent of this approach is to lead the reader into the situation—into the perspective of someone practising with pragmatism—rather than the role of the passive observer. The interpretations are inseparable from the context that created them, thus the context is more simply expressed through the thoughts of someone experiencing it.

Pragmatists emphasise the agent's perspective as experienced rather than that of the spectator. Dewey in particular rejected the 'spectator theory' of knowledge (Festenstein 2005). The insights gained into the smart city related practices draws parallels to Yaneva, where for her, '[g]aining ethnographic access to this field required me to 'live' in the architectural office,

confronting various enigmas in the design process' (Yaneva 2009a, p. 3). My 'living' was occasionally likewise, in architectural offices, but also in the spaces of designers, researchers, app developers, government employees—these are all spaces enmeshed in the process of making digital inventions for Sydney's transport system.

Contemporary ethnographic methods encourage greater use of personal reference in all types of scholarly writing (Spigelman 2004, p. 11). Further, '[t]he ethnographer's intrusiveness in the study setting and his or her biases and interpretive stance are all foregrounded' (Brodkey 1987, p. 26). Worsham (quoted in Spigelman 2004, p.11), notes that 'since the personal is first and always political (and therefore transubjective), personal pronouns may sometime service a collective function'. At the same time, the personal has been used to raise consciousness, and to oppose oppressive pedagogies, department politics and research practices (Ritchie & Boardman 1999).

While this is not the traditional academic approach, pragmatism deconstructs this metaphysical distinction, which in science, is prevalent between theory and practice. The pragmatist does not privilege, nor appeal to, objectivity. A fact is only relevant for its ability to create practical effects. Any written account must be judged on its usefulness in action and not on *a priori* defined values. I believe that a pragmatist narrative should be told from my perspective as this usefully enacts pragmatist epistemology.

Ultimately the use of personal pronouns is a question of voice in relation to the research. By using personal pronouns, I assert that my voice is valid to the research subject. Personal pronouns allowed me to speak in an unmediated way about my experience. It is asserted, principally in Chapters 4 and 5 that this experience of stabilising relations between different elements has strong parallels to the practitioners developing smart city initiatives.

Scope and limitations

In this thesis I describe the pragmatic, everyday processes that renew cities through immensely diverse experimental practices. In doing so, the interplay is revealed between actors such as architects, managers, politicians, app developers, citizens, and the roles of technology, media, reports and policy. Because it is a study based primarily on pragmatist methods, it provides a unique interpretation of these processes in the context of the smart city discourse. To

pragmatist philosopher Richard Rorty (1989), a philosopher should aim for difference in the description. Rorty (p.39-40) argues for '...a shared ability to appreciate the power of redescribing, the power of language to make new and different things possible and important – an appreciation which becomes possible only when one's aim becomes an expanding repertoire of alternative descriptions rather than The One Right Description'. My account is a different account in many ways; it is socio-technical, it is visual, it opens the smart city into multiple interpretations. However, as such, I know my account is fallible. It is not 'The Right Description', but hopefully useful to some ends.

It is important to note that pragmatist evaluation does not generate immutable criteria. In pragmatist inquiry, criteria change, as objectives become more or less relevant in response to the amount that is known about the research context and what is trying to be achieved. This is the pragmatist notion of contingency (Rorty 1989). All generated knowledge is contextual to this specific inquiry. However, knowing that my thesis needs to make sense as an entire document, its structure is designed to bring clarity to the final conceptual argument, rather than merely to explain the research activity from start to finish.

There are limits to time and resources. But in the classic project management diagram (the trade-offs between time, cost and quality), it is time that, in hindsight, is abundant. The PhD is 'officially' an individual project, which proves challenging in an innately transdisciplinary context. Undoubtedly, far more would have been achieved if this research project was undertaken by a transdisciplinary team; one that knew a little more about each of the disciplines that informs this thesis. These disciplines include social science, science and technology studies, social studies of science, information systems, media and cultural studies, design, architecture, human computer interaction, urban planning, transport planning, engineering, information technology, politics, geography, organisational studies, business strategy, political theory, systems thinking and philosophy. This research did, however, have the fortunate circumstance of having access to experts in many of these fields, and they have been included as participants in workshops, interviews, the review processes and amongst audiences of conferences where this material was presented.

I will now expand on the earlier introduced discussion of cities and their challenges of the 21st century, in order to begin to rethink what purposes the reassembled smart city discourse might address.

PART A: SUSPENDING THE SMART CITY

Chapter 2. There will never be a smart city

The dream deceives; it leads to confusions; it is illusory. But it is not erroneous.
(Foucault 1988, p. 104)

Chapter 2 takes the form of a literature review. It is the first of three chapters that problematise a pragmatic reassembly of the smart city discourse. It questions the premises of the ideological smart city, exploring the salient points of contention in literature, seeking hopefulness towards a re-conception that will be more pragmatic towards the addressing of contemporary problems. It proposes a speculative approach to this reimagining, in the aim that the discourse provides more useful solutions, leads to more prudent practices in the urban context, and is better prepared to meet the challenges of our time.

In order to become more relevant to the situated practices of practitioners, the smart city cannot remain ideological or universalising. Instead, the smart city must be grounded in experience and reimagined from practices; continually seeking relevance in practice. This chapter, therefore, conceives the city itself as a pragmatic technology; as an incomplete whole; one that is always *in the making* through experimentation. In pragmatist experimentation, there is no end point; nor is there a clear beginning. Even the city itself increasingly evades definition; a position reasoned here as critical to the long-term success of cities, as they

continue to provide habitation and functionality for the social, technical and political natures of contemporaneous civilisations.

It is this perspective that is then used to reconceive the smart city discourse as one that needs to facilitate more experimentation with a wider variety of actors, experimenting with a far greater range of elements, if it is to remain of use to developing cities that are of the time, rather than those holding onto ideologies. This re-conception is argued to be best enacted through the politicisation of the concept, to enable greater debate, and even allow the voices of those who do not speak into the ecologies of practice. Such an enactment is outlined in Isabelle Stenger's (2005a) 'Cosmopolitical proposal'. The approach to the smart city reassembly is informed by the Cosmopolitical: to reassemble the commons of the smart city discourse as more diverse, to include a broader range of ways to know the city.

We must stop chasing 'modern' utopias

Before embarking on the literature review, this chapter first explores how pragmatist inquiry can be utilised in understanding the related literature. The discussion starts with the evolution of pragmatism, namely 'new' or 'neo' pragmatism (hereafter neo), and work led by Richard Rorty and Hilary Putnam. Rorty and Putnam's ideas differ to those found in the works of Peirce, James and Dewey, and some two-thirds of a century divide them. It can be argued that the works of the early pragmatists were developed in a simpler time, before postmodernism reshaped the social science landscape in the second half of the 20th century. The pragmatist approach taken in the literature review is informed by postmodernism, particularly the deconstructivist processes used in the social sciences.

As pragmatism did, the postmodernist movement also challenged many of the tenets of 'modernity'. Modernity is variously described as the progressive era from the Enlightenment or the Industrial Revolution to the present; its perspectives, inscribed in modern institutions, technical objects, and language, seen as the prevalent mind-set. The modernist perspective can be linked to distinctly western dominant ideas, shaped by the combined influences of the Judaeo-Christian tradition (Tonning et al. 2015), and to scientific rationalism (2016). The metaphysics of 'the moderns', as Latour has described them, have influenced almost every aspect of life and organisation in Western nations, and much further abroad (Latour 1993). The West has exported its metaphysical perspective through the processes of imperialism and

colonisation, science, corporations and globalisation, and by providing dominant language to describe the experienced and common world. This dominant language has predisposed minds to what exists, and the ordering of that reality. One aspect characterising this broad period is a distinct separation between the symbolic self and the physical self, or the mind and the body. This separation is a form of dualism, stemming from ideas established by René Descartes, a French philosopher and mathematician, in the 16th century. Dualism is also manifest in categorisations of theory and practice, culture and nature. Modernist thinkers have long been concerned with an accurate representation of phenomena, through ordering and categorisation. Yet modernist perspectives have been critiqued as limiting by postmodern theorists. Jean Francois Lyotard (1984a), Ludwig Wittgenstein (1953) and Michel Foucault (1995) offered significant cultural critiques between the Second World War and the end of the 20th century that signalled the 'end of modernity'. These perspectives became widely adopted as 'postmodernism', a term that theorists associated with the movement used to mark a new cultural epoch in the West. For Lyotard (1984, p. xxiv), the postmodern condition was defined as 'incredulity towards metanarratives'; a loss of faith in science and other emancipatory projects, such as Marxism, within modernity.

The title of this chapter is appropriated from Latour's *We Have Never Been Modern,* in which he states: ''No one has ever been modern. Modernity has never begun. There has never been a modern world' (1993a, p. 47). Marxist literary theorist Fredric Jameson (1991) famously argued postmodernism was 'the cultural logic of late capitalism', by which he meant post-industrial, post-Fordist, multi-national consumer capitalism. This cultural period has accelerated Western liberal democracy that, coupled with increasingly extractive 'neoliberal' capitalism has, since the 1980s, spread throughout the world via digital communication systems, shared media and an increasingly homogenous city model.

Indeed, the smart city, in its most reductive interpretation, can be perceived as an attempt to achieve an elusive modernity; an attempt by humanity to create categories and to purify, to place order upon, and conquer the randomness of urban happenings. Through the use of technology, the smart city attempts to put humans in control of the complex nature of urban relations. To take this view seriously is to believe that such attempts can succeed. Yet, what do the long histories of technology use in cities reveal? With every new installation of a technological solution, other problems arise. Therefore, an alternative, pragmatist view would

be to imagine new ways of thinking about humanity's place in relation to technology. It would take an ecological perspective, enabling us to imagine what it would be like to *become with*, rather than *seek dominion over*.

So, whilst pragmatism (and particularly neopragmatism) has similarities to the postmodern movement, it is also different in many respects. As an epistemology, it is equipped to conceive of the period as an 'end of modernity' because as Livingston (2010, p. 33) argues:

> [Pragmatism] gives up 'modern' subjectivity, that is the historically specific compound of assumptions, ideas and attitudes that convenes each individual as a set of *radical discontinuities* (e.g., mind versus body) that are in turn projected outward, as language and work, and which meanwhile confers an *ontological* priority on the individual whose freedom resides in release from identities and obligations determined by the past (that is, by historical time). (emphasis original)

Pragmatism, like postmodernity, represents the break-up of cultural and religious authority; the turning away from any simple or stable definition of truth; a shift from totalising systems and unified narratives to a more fragmented plurality of perspectives (Dickstein 1998). Pragmatism has been described as 'post-postmodernism', particularly the ideas found in Dewey's work, which actually pre-empted the French postmodernist movement (Hickman 2007).

Latour's rejection of the achievement of modernity is consistent with pragmatist approaches. He critiques one particular aspect of 'modern' thought, discussed earlier: that of the dualism between nature and culture (Latour 1993a). This chapter borrows this language as it explores the smart city, noting that the study of the phenomenon tends to align with the divisions caused by dualism. As was described in Chapter 1; dualist divisions are prevalent in the smart city discourse: progressive versus regressive, bottom up versus top down, physical versus digital, public versus private. In other words, some champion the discourse as progressing cities, others hold top down and bottom up perspectives. Furthermore, some are predominantly technological, and others are predominantly social; some are physical, others are digital. The discourse is clearly marked by dualisms; the creation of largely false dichotomies or categories. They may assist explanation, on some level; however, as diametrically opposed views, they do little to support practitioners, to whom such categories are not as prevalent in practice.

These dualisms are the antithesis of pragmatic thought because it arranges experiences before they have been had. In the context of the challenges of 21st century cities, these dualisms exacerbate the problems of our time. These categories create 'others', leading to more compartmentalised views of the city. Therefore, rather than adopting *a priori* and utopian ideological positions, the approach taken is to situate the smart city, seeking to present the diversity of its experimentations in context. In an exploration of the pragmatic consequences of the smart city, one must contextualise the smart city. Before I explore what more useful smart city framing may be, I will (drawing on Dewey) firstly introduce the city as a type of pragmatic technology. This perspective, mindful of pragmatism's concern with action, entangles the discourse in terms of its practical effects in the urban context.

A pragmatic exploration of the technology of cities

The city can be regarded as a pragmatic technology, only able to be studied via its 'multiple open-ended, and often conflictual urban assemblages' (Blok & Farias 2016b, p. 227), rather than a knowable 'city' understood through the dualism of technological 'nature' and humanity, or 'culture'. An assemblage-based approach rejects these modernist categorisations in favour of more useful ways to understand 21st century cities. Therefore, under this approach, the urban context refers not only to physical space and infrastructure, but also to the social, political and technological nature of the city. As Blok and Farais (2016b, p. 228) argue, 'the empirical' and 'the conceptual' are inherently unstable, and they move about and come together in continuous variation. This exploration in this section will, from a pragmatist perspective, frame what cities are, and then propose what new discourses the city may need in the 21st century.

A technology of all technologies

As discussed in Chapter 1, cities have always defied clear definition even though, subjectively, people have a strong sense of what they are. Whilst some have argued that the city is humanity's greatest technology (Brynjolfsson & McAfee 2014), it again depends on how one defines 'technology'. Technology, too, defies clear definition; yet, the pragmatists offer useful perspectives. These perspectives cannot be easily generalised, so this section will use a

definition offered by John Dewey, an early American pragmatist. Philosopher of technology Don Idhe describes Dewey as 'par excellence, the American 'father' of the philosophy of technology' (in Hickman 1990, p. viii). Dewey's philosophy enables a more nuanced understanding of the city as a technology.

To begin with, Dewey viewed human experience as transactional with, and within, its various overlapping contexts (Hickman 2009). According to Hickman (2009, pp. 43-44), a leading contemporary scholar on Dewey, the contention is that 'all inquiry or deliberation that involves tools or artefacts, whether those tools and artefacts be abstract or concrete, tangible or intangible, should be viewed as instrumental: in other words, as a form of technology'. As Dewey himself stated (1930 [1998], p. 24):

> [T]echnology' signifies all the intelligent techniques by which the energies of nature and man are directed and used in satisfaction of human needs; it cannot be limited to a few outer and comparatively mechanical forms. In the face of its possibilities, the traditional conception of experience is obsolete.

It can therefore be concluded, under Dewey's interpretation, that the city is a technology. However, as a technology, it is not just an arrangement of the tangible tools, machines and factories that can be instrumentalised. The city as technology also involves the abstract thought and cultural practices that provide the contexts for these tangible things and make them possible. Framing the technology in this way is to see the city not only as evolutionary, but as co-evolutionary between people and nature. It allows an understanding of the complexity and relationships within the city, far beyond the reaches of what one person can experience. Indeed, the city contains an infinite number of other discrete and assembled technologies: microchips, signage, keyboards, glues, cables, fasteners, linings, wheels, and so on. It is an endless list. These technologies compose the city's sub-systems of transport, healthcare, and economic and institutional organisation. The next question, therefore, asks: What use is describing interventions at a city scale? For Hickman (2009), Dewey's understanding of technology opens inquiry into technology in four ways. Namely, by:

- Contributing understanding of the genetic analysis of conceptual tools as evolutionary;

- Seeking to understand the discontinuities between the adjustive activities of human beings and those of other natural organisms (Dewey argues for the understanding of the co-evolutionary processes of people and nature);

- Recognising technologies to always have externalities, and regardless of the narrowness of a scope of inquiry, there cannot be any certainty

- Providing a stable platform for the improvement of situations that are not how we would wish them to be.

With this framing in mind, philosophical inquiry can be seen as a means for tuning up technology (Hickman 2009). In this view, cities as a technology, are always incomplete. They are in 'perpetual beta' (Sassen 2015b, p. 253). Sassen argues that using the metaphor of the city as an open-source technology can enable understanding of the city as both a product of complexity and incompleteness. As Sassen (2015a, p. 1) states, 'this mix of complexity of incompleteness has allowed cities to outlive more formal and closed systems, such as republics, kingdoms and corporations'. Pragmatism supports Sassen's notion (2014, p. 1). of incompleteness, precisely because '…[in] this incompleteness lies the possibility of making – making the urban, the political, the civic, a history, an economy'. As James (1909, p. 263) described: 'what really exists are not things made but things in the making…[p]hilosophy should seek this kind of living understanding of the movement of reality, not follow science in vainly patching together fragments of its dead results'. In turn, the notion of experimentation is also supported; a notion of holding the most recent hypothesis lightly. Holding lightly means never overcommitting when other solutions are yet to be tested and contexts are changing at a rate far beyond the speed at which the city is being adapted. Technology, climate change, demographics, and resource changing will reshape cities in perpetuity. Experimentation carries with it a sense of fragility; a sense of being unfinished; an openness to change.

A 'naturalised' technology

Whilst the immense complexity of the city is unquestionable, unless you are in a planning profession, this city-wide urban scale is never thought about outside of language. Living in a city, one doesn't tend to notice or have concern for these complexities. Individuals only interact with a tiny and subjective fraction of technologies of cities. The sheer number of people, technologies and systems that enable day-to-day life would cause cognitive overload if

considered *en masse*. Thus, to spare cognitive effort, humans widely 'naturalise' these technologies. Naturalised technologies are those that we are not really aware of (Nordmann 2008). As Nordmann (2008, p. 173) states: '...technology dissolves into nature and becomes uncanny, incomprehensible, beyond perceptual and conceptual control'. Without questioning, we may assume they have 'always been there', and they fade into the background of our lives. In reference to the smart city infrastructure that exists all around citizens, Townsend (2013, p. 321) states that:

> It lives underground, inside walls, hides in our pockets, and rides airwaves around us. But when a jack-hammer wielding crew peels back the hard asphalt of a city street, the guts of the metropolis are revealed. Among the sewer pipes and gas lines laid many years ago, a digital nervous system now resides.

In general, humans don't pay attention to how these systems work; rather, each person grasps at the agency of these technologies. It is only in instances of controversy and failure, that the workings of systems become more exposed (Latour 1987). Most technologies are in this sense 'black-boxed'. Black-box is a term from cybernetics (Ashby 1956), that has been used extensively in Science and Technology Studies (e.g., Latour 1987). It labels a technology where inputs and outputs may be understood, but greater detail is not known until the occurrence of an event that exposes the inner system and its constituent parts.

The post-human city and the recognition of urban others

Technology may be largely invisible, however, humans depend upon it every day. Part of what makes it easy to live in cities is that many tasks are easier than they would be otherwise: study, job-hunting, healthcare, having fun, transport, fast internet, and so on. The amenity provided by large cities, as economies of scale depict, gives access to the widest options (Glaeser & Gottlieb 2009). Indeed, some human cognitive and physical functions are being superseded by technologies.

Notably, the ubiquitous smartphone is continuing to redefine human-technology relations. 50% of the world's adult population now have smart phones (Poushter 2016). They have been demonstrated be increasingly interlaced with human cognitive function (Wilmer, Sherman & Chein 2017), for example by reducing everyday attention (Paul, Baker & Cochran 2012), and leading to poorer working memory (Cain & Mitroff 2011). These are examples of what Edwin

Hutchins (1995) has described as *distributed cognition*. Hutchins (1995, p.394) proposed that human cognitive processes take place both inside and outside the mind. At the time, these claims were contrary to hegemonic cognitive science. Yet, two decades later, dependence on technology is now so pervasive that 'thinking-with' technology is an idea that is difficult to challenge.

Recent studies show that smart phone users in the USA average 2.3 hours using their phones per day (ComScore 2017). The findings of such studies, along with others that demonstrate human reliance on technology, naturally lead to questions about the 'biological individual' as the base sociological element. The base definition of what constitutes a human is being challenged in areas such as immunology, evolution, development, anatomy, and physiology (Gilbert et al. 2012). The human may be better understood as a symbiotic system of mutually-beneficial relations, dependent on interactions with millions of microbes, air particles, heat and warmth. Furthermore, it can be increasingly argued that those mutually-beneficial relations stretch to technologies.

According to Pickering (2001), posthumanist social theory is 'one that recognizes from the start that the contours of material and human agency reciprocally constitute one another' (Pickering 2001, p. 173). The theory provides an understanding of the temporary processes that emerge between humans and technologies, rather than an understanding of each as a reified or static entity. Pickering elsewhere describes the emergent enmeshed relations between human and nonhuman agency as the 'mangle of practice' (Pickering 1993; Pickering 1995). Pickering (1993) states that this concept is closely aligned to Latour's *ecologies of practice*. Pickering's (1993) 'mangle of practice' holds that, in the construction of cities, entities are heterogeneous and temporarily held together. This is a notion also found in the work of Deleuze and Guattari (1987) and within Actor-network theory (Latour 2005b), and often referred to as assemblages.

Defining the 'city' is not so simple; at least, it is not easy to point at, objectify, or even grasp. It becomes a slippery concept of material and human agency, as temporary as it is stable. Reification is the process of making something concrete or real. For example, 'culture' is a name given to patterns of behaviour, but it does not exist outside of language. Similarly, the terms 'organisation', or 'society' hold different meanings for individuals, as they are a label given to assemblages of cumulative experience and material entities and processes.

The notion of post-human assemblage can be a useful way of thinking about the city as a real entity, rather than as an abstraction. The city, as an assemblage, nudges towards acceptable practices and behaviours. Each suburb, street and house have their own unique culture. Winston Churchill's (1943) often cited statement, '[w]e shape our buildings and afterwards our buildings shape us', still holds import. Churchill was speaking about the re-design of the English parliament, implying that shape created an environment that invited debate; calling for a building design conducive to a more constructive type of political discourse. If humanity is constituted by our technologies then the city is one of the most powerful technologies in shaping human, and now ecological, outcomes. Hutchins (1995, p. 394) saw culture as a process, rather than a collection of tangible or abstract things and, under this reading, technologies of the past coexist with the new, each forming a scaffold for the next, both as ideas and material.

But there is another major shift taking place in how humans think about the notion of human agency: climate change. Nature is further challenging the notion of 'the moderns' agency to define their own futures. What is now widely known as the Anthropocene, is the recognition of humanity's impact on every aspect part of the Earth's ecosystem. But again, how pragmatic is it to just name the problem in using the same language that created it? When thinking about practical effects, would it not be better to begin to use language that is capable of resolution, such as alternatives proposed by Haraway (2016a). Climate change and its effects will reshape the ways that cities have to work in the 21st century.

These two forces, of technology and nature in the 21st century are compelling reflection on how humanity sees itself, and challenges 'the moderns'' perceived dominion over them. This is making the re-addressing the anthropocentrism of urban discourse is critical, not just because we are beginning to recognise the role of technology in shaping the city. But nature and technology are beginning to exert far greater agency on urban life. The 'enlightenment' conception of 'the moderns', that promotes human agency and autonomy is being questioned by the unprecedented entanglement with relationship with nature, climate change, and the rise of intelligent machines with Artificial Intelligence.

The pragmatic smart city

The already existing smart city

The field of 'ubiquitous computing' has already been introduced as having laid much of the foundational language for the smart city. As discussed, much of this language is anchored in the future. Bell et al. (2007) found that, in the period between 2004 and 2007, 47% of ubiquitous computing papers used the 'proximate tense'. The proximate tense is one of being almost present; not quite complete or there. This future-oriented language is not adequate for projects that already exist and operate. The smart city is already here.

Since the 1970s, and earlier, there have been innumerable projects installing digital information systems into cities. Automated traffic lights were first installed in Cleveland, Ohio in 1914 (Sydney Morning Herald 2015). The first parking meter was installed in Oklahoma City in the US in 1935 (Popular Mechanics 1935). As early as 1880, the installation of telegraph and power networks has shaped the functionality and communication capability of cities. Arguably, the smart city needs to lose this future-oriented language and ideology.

The records of projects that do exist tend towards canonical cases (Kitchin 2015). As examples of canonical cases, Singapore, New Songdo (Korea) and Masdar (UAE), arguably have technologies that are considered smart, installed and working. In the case of Singapore, a business island was developed with the financial support of Siemens. This business-dominated concept, although widely described as a smart city exemplar, is argued to be limited by having a contractual agreement for services with Siemens as a single provider. New Songdo, in South Korea, is also prevalent in the discourse, but the project has failed to create a diverse attractive city (Mesmer 2017). Masdar, a city in the UAE, was developed as the poster smart city, but it, too, is criticised for its liveability. Richard Sennett (2012a), using Masdar as an example, argues that 'the danger is that this information-rich city may do nothing to help people think for themselves or communicate well with one another'. All of the downsides to these 'canonical' examples could well have been understood in advance. While many of these issues are surfacing now, after construction, an experimental approach could have led to a slower roll-out of these initiatives, and to a more honest description.

Furthermore, these three cities are either greenfield or brownfield sites; either sites that had not yet been developed or sites where new buildings were constructed in the place of older ones. Both of these involve the creation of completely new developments, not just the modification of existing city areas. How much use are these cases to other cities? The vast majority of activity happens outside of these famous exemplars.

Typically, within the smart city literature, projects are either considered successful or not recorded at all. However, where failures are discussed, the smart city discourse succumbs to the bias of management research; normative studies that seek to describe what worked or what didn't work within a narrow scope. Luque-Ayala and Marvin (2015, p. 2105) have argued that: '[smart urbanism] discourses are deeply rooted in seductive and normative visions of the future where technology stands as the primary driver for change'. Normative studies differ from descriptive studies by focusing on how the object of study can be improved. Thus, the majority of smart city material tends to focus on improving the implementation of smart city initiatives, without questioning the rationale, or the embedding systems, or providing any sense of holism for practitioners. The canonical cases and benchmarking accounts lose the micro-relations of projects; the material and political contexts; the actual actions and decisions of practitioners.

Indeed, there are many other cases of cities that fit more comfortably in 'mediocrity'. No Australian examples are canonical, yet every Australian city has initiatives, including regional cities such as Newcastle, Wollongong and Ballarat. There have been, undoubtedly, relevant projects that are relatively successful but less flashy, and perhaps so targeted in their nature that they do not even warrant or seek the attachment of the 'smart' name. Their existence raises questions about the necessity of qualifying initiatives. It can be argued that we have already attained the level of 'smart' that we hoped for in the past. In 1995, we could not have dreamed that citizens, through mobile devices, would have immediate access anywhere in cities to most of the world's information. Mobile computing technology has come a long way. Yet 'smart' is a term that always refers to that which is beyond the normal. As smart phones move towards 100% of the market, they just become phones. Chasing utopias can be useful, but misguided.

Understanding the smart city 'in practice' necessitates an alternate line of inquiry. This thesis proposes to enquire into unremarkable projects that are far from internationally recognised. Practice-based enquiries may be useful in understanding the smart city projects that do exist, successful or otherwise, for several reasons. Firstly, practice-based research tends toward more

narrative-based descriptions of stakeholder activities, and are highly dependent on qualitative methods, such as ethnography, interview and observation (Schatzki et al. 2001). Secondly, in the case of the smart city, practice-based research would remove the ideological aspects of the discourse; it would refer only to what has already translated into action.

What the smart city is smart for

It can be asserted that those who most benefit from the existing smart city discourses are those who are the most established. Arguably, there is one significant problem with this assertion. The establishment represents an outgoing model of centralised capitalism. Cities need to be experimenting on the fringes, beyond this established model, if they are to remain relevant and responsive to changing urban needs.

This section deliberates on the usefulness of the smart city discourse, given the sobering reality of 21st century challenges, some of which have been discussed earlier in this thesis. It explores the ability of the smart city to become a Trojan horse; to create enabling conditions for other speculative practices. It then examines the current dominance of neoliberal economic theory, identifying its implicit inclination towards control, before presenting the need to distribute the discourse, acknowledging that the smart city is not a strategy in and of itself.

The Trojan horse

The smart city, like any agenda that can command significant civic budgets, creates much attention. As an urban imaginary, it enrols many actors in the definitions of problems and their suitable solutions. In this way, the concept can be used to mobilise alternative views of the future for cities. The smart city can even be viewed as strategic; creating a space in which to have conversations with local governments. One finds it difficult to argue that they don't want a smarter city; however, questions follow about what exactly the label 'Smart' means. Vanolo (2014) argues that cities become trapped by 'smartmentality':

> Cities are made responsible for the achievement of smartness—i.e. adherence to the specific model of a technologically advanced, green and economically attractive city, while 'diverse' cities, those following different development paths, are implicitly reframed as smart-deviant. (Vanolo 2014, p.889)

Dan Hill, urban theorist and practitioner, uses the metaphor of the Trojan horse; the design of an artefact that carries 'hidden' strategic elements including language (Hill 2012, p. 58). The smart city is so broad and dominant a concept, and label, that virtually any urban development project can be leveraged through the conversations enabled by it. The result is that technology companies enter into organisations, bringing strong visualisations and narratives about the future. These early interactions may use smart city's benchmarking epistemology, leading to the assumption that cities can be easily simplified and compared. As Vanolo states, the smart city produces 'docile subjects' and 'mechanisms of political legitimation' (Vanolo 2014). Yet, the metaphor also suggests that smart city can achieve many other things. Not least, it creates useful language for those who initiated the conversation; a language that shapes the environment in which to design things.

'Privatisation' and 'control' and the smart city discourse

Koolhaas (2014) argues that planning of the urban domain has been taken away from architects and given to the technology providers of the smart city. It is a pattern he describes as 'the ¥€$ regime'; a regime in which the city has been given over to the triumph of the market economy. Is the smart city for the private sector or the public good? This question carries one of the greatest dualisms in the smart city literature. The smart city is clearly deeply intertwined with neoliberal economics (Vanolo 2014); an economic model that has arguably run its course but has, nevertheless, largely defined the last thirty years in Western democratic capitalism.

Put simply, neoliberalism calls for the reduction of government ownership and service operation in favour of market-based private operations. Representing a new form of liberalism, no longer interventionist or seeking to control the violent swings of the market, neoliberalism rests on the 'pervasive naturalization of market logics' (Peck & Tickell 2002, p. 394). In urban development, lean governments are privileged, along with privatisation, deregulation and foreclosures (Peck & Tickell 2002, p. 394). Corporate entities get the best of both worlds: tax cuts and open markets. Neoliberalism presents an extractive model of capital, away from the cities that use the technology towards foreign ownership. Foreign based organisations that pay little or no local taxes extract value from cities. In this paradigm, cities could become homogenised through this dominant market-based ideology.

Neoliberalism exults the ability of unregulated markets to optimise human relations; yet, ironically, operationalises this in a complex system of rules and measurement (Graeber 2015). Smart city benchmarking, for example, can be understood as a neoliberal technology (Bruno 2009). The importance of measurement and standardisation for contemporary systems of control is an enduring theme of modernity (Weber 1978; Foucault 1990; Scott 1998). Max Weber's instrumental rationality, more than ever, dominates the ways in which complex organisations operate and are managed, particularly public-sector bodies.

Bureaucracy, metrics and managerialism have always been a central aspect of the modern paradigm of control. Bureaucracy can be viewed as decision-making by a codified set of regulations, rather than by the judgments of individuals. In a similar vein, metrics are the use of formal quantitative analytics to make evaluations. Managerialism is the use of bureaucratic procedures and metrics whereby the activities of individuals and groups is controlled by individuals not performing these activities. All these instruments are often believed to increase efficiency; yet, there have been several critiques demonstrating their limits, including those lamenting the loss of more heterogeneous aspects of community, value and imagination (Graeber 2015; Graeber 2001; Alexander 2013). Ulrich Beck (1992) describes a modernity in which society organises itself in response to risk. In this modernity, organisations now accommodate risks associated with environmental concerns, terrorism, fraud, public safety, negative press, intellectual property, and so on. The result of these processes is the continual reduction of individual agency; replacement with systems and measures that are put in place to prevent these perceived risks.

More recently, 'Big Data', real-time data and the emerging 'Dataism' are manifestations of the latest suite of technologies employed in the search for control. The internet age has changed communication across the world and left businesses open to disruption; however, the dominance of the control metaphor still permeates all elements of business. Capitalism's basic institution, the corporation, has remained relatively unchanged. Hierarchy, vertical integration, and bureaucracy—hallmarks of the industrial age—still reign. The obsession with data for data's sake has become a kind of philosophy, or ideology, driving development; an ideology with many assumptions, including that data is the best overall measure of any given scenario, always producing valuable results.

From this discussion, one can infer that the smart city exudes a narrative of the possibility of centralised control through increasingly privatised systems, paradoxically through a narrative of 'open' and 'networked-based' technologies. These 'control' measures are now based on the assumption that the city can be known through data, whilst advocating both top-down and bottom-up approaches to the city. Yet, the challenges that cities face cannot all be solved by the data alone. It is unlikely that the richness of urban politics will ever be able to meaningfully be reduced to software.

These processes reduce diversity in ways to know the city, the ways cities are serviced, and ultimately right to the city. They risk increasing inequalities between extractive global organisations and local citizens, also creating a reduction in diversity of urban experimentations from which they create their longevity.

One can distribute the smart city discourse from its narrow epistemology of closed, objective city comparisons and data driven knowing by embracing counter perspectives. These may be the open and transdisciplinary, the subjective interpretations, and social relations. These are ways of thinking that pragmatism promotes. The dominant ideologies of Western organisation need to be challenged. Indeed, there have been several attempts to speak up for those sidelined in the smart city discourse. These include approaches that are 'citizen-centric' (Hemment & Townsend 2013; Foth et al. 2015), 'city-centric' (Sassen 2013b), and 'ecological' (Fry 2014). This same bifurcation presents the two sides: the top-down, capitalist, control-seeker dominion, and the bottom-up, community-based, left-wing protester. The more qualitative, common experience of these broader urban 'stakeholders', provides grounds for collaboration and reformulation towards a new commons for understanding the nature of smart city practice.

Perpetual cosmopolitical experimentation

This section now turns to outlining a proposal for how the smart city discourse could be more pragmatically described; a post-ideological understanding of the development of smart city initiatives. It argues that the smart city contains, within its amorphous boundaries, much of what is required to future-proof cities, but it is no silver bullet. Like all other means of building cities of permanence, the smart city is subject to ongoing processes of innovation. Indeed, cities are constantly challenged, as has been the case throughout human history. In this light,

cities might be viewed as in a permanent state of incompleteness, 'in the making'; permanently proximate to the 'smart' label, yet lacking the stability it suggests. This section argues that this is a stronger, more resilient conception of the city; one which embraces diversity and experimentation. Experimentation is one aspect of its permanency, providing a means to find solutions and a way out of trouble. Yet experimentation requires that ideological values are stripped out of the smart city. Ideological values do not support their challenge and modification; a shifting from the universal to the plural.

The smart city, through pragmatism, can be opened up to be without ideology, and inclusive of the many perspectives that constitute cities; akin to cosmopolitanism. However, the original concept of cosmopolitanism derived from Kant and Locke is problematic when brought into the pragmatist paradigm. The cosmopolitan ideal is universalising and ideological. For example, scholars have criticised moral cosmopolitanism questioned the ambiguity of cultural cosmopolitanism (Delanty 2006, p. 28), and have seen political cosmopolitanism as a mask for the imposition of narrow sets of values (Fine 2007, p. 20).

Towards a cosmopolitics of the smart city

Isabelle Stengers (2005a) proposes the notion of the 'Cosmopolitical'—modelled on the ideal scientific method that considers all assumptions and facts as being open to question—that reintegrates the natural and the social, the modern and the archaic, the scientific and the irrational. In this way, the Cosmopolitical exhibits a pragmatist view of truth. The Jamesian inspired approach has been referred to as 'cosmopolitical pragmatism' (Meyer 2015). *Cosmopolitics* describes the nature of understanding the social world to be constituted of many forms of politics and is disentangled from any reference to claim to a universal human truth. Stengers applied this notion to the development of science in her two-part *Cosmopolitics I (2010)* and *Cosmopolitics II (2011)*.

The Cosmopolitical is an ontological politics about what is real. It explores what has the right to be represented, described, enacted, and included as part of our definitions and discourses. The approach is suggested as a means to expand the discourse, by deliberately introducing what is generally excluded. It is suggested that the Cosmopolitical is not only open to plural thinking, but it provides for the material and natural; a platform for many voices, even those who do not usually speak.

This form of politics recognises the necessity to understand ecologies of practice *in the making*, and a recognition of their unavoidably political nature. In her own practices, it was not about Philosophy of Science or Epistemologies, rather 'it was about learning how to become a philosopher while not accepting the usual philosophical positions about sciences' (Stengers et al. 2013, p. 173). In speculating towards forums for deliberation in relation to publicly significant projects, Isabelle Stengers (2005a) outlined the 'Cosmopolitical proposal'. As the proposal denotes, there is a necessity for forums in which all aspects of issues are represented, and which can be discursively approached between its relevant actors, making present the *matters of concern* to be conversed with. It is not, as she argues, a proposal for generalists. It is rather for concrete situations in which practitioners operate. The proposal, she states is 'to 'slow down' reasoning and create an opportunity to arouse a slightly different awareness of the problems and situations mobilizing us' (Stengers 2005a, p. 994). Stengers does not wish to create just another theory, with implicit authority and generality. Rather, she speculatively proposes a means to change mainstream practices, those that presume hierarchies of information and exclude many critical voices from partaking in the making of their futures. The subordination of application of 'theory' to practitioners is another process Stengers wishes to avoid. The challenge is to produce political ecologies. She conjures the Gilles Deleuze's character, 'the idiot', as the one that 'resists the consensual way in which the situation is presented and in which emergencies mobilize thought or action' (Stengers 2005a, p.994). Putting politics into Science, Stengers (2005a, p. 995) suggests a that we 'slow down, that we don't consider ourselves authorized to believe we possess the meaning of what we know'. Stengers (in Stengers et al. 2013, pp. 179-180) also states:

> Slowing down…is multi-critter thinking, caring for entanglement, learning the art of paying attention. And it is also a matter of joy, sometime dolorous joy, but joy indeed, when you feel your thought and imagination affected, put into (e)motion, attached to what was previously indifferent.

The Cosmopolitical remains deliberately ill-defined, but Stenger's adherents have already grounded the concept in the context of the built environment (Blok & Farias 2016; Tironi & Criado 2015). It is not a matter of finding agreement; a common good. Rather, the intent is to respect the plurality of contexts, and understand their relevance. Elsewhere Stengers argues against the objectivity of science for a pragmatist conception of 'relevance'. As Haraway comments: '[w]hat happens when human exceptionalism and bounded individualism, those

old saws of Western philosophy, and political economy become unthinkable in the best sciences, whether natural or social?' (Haraway 2016b, p. 30).

Stengers (2005a, p. 1002) poses a twofold question:

1. How to design the political scene in a way that actively protects it from the fiction that 'humans of good will decide in the name of general interest'? How to turn the virus or the river into a cause for thinking?
2. But also how to design it in such a way that collective thinking has to proceed 'in the presence of' those who would otherwise be likely to be disqualified as having idiotically nothing to propose, hindering the emergent 'common account'?

These three questions are proposed by Stengers as an art of staging by design; a matter of artfully taking a part in the staging of the issue. It is important here to avoid talking in stereotypical roles. In this fabricated environment, she designates two roles: that of the expert and the diplomat. The experts, she proposes, are those whose practice is not threated by the issue under discussion, since what they know is accepted as relevant. Their role will require them to present themselves and what they know. By contrast, diplomats are there to provide a voice for those whose practice, whose modes of existence, and whose identities, are threatened by a decision. As she puts succinctly: 'If you decide that you'll destroy us' (Stengers 2005a, p. 1002). In the smart city discussion, the lines of division in the anthropocentric city is redrawn as one. Under such a concept the idea of there being a common good, an ideal utopia with universalising practices, must be rejected. In Stengers' world, the cosmos is the operator of 'putting into equality' in opposition to any notion of equivalence, in 'slowing down' rationality, avoiding leaping to conclusions and technocentric interest groups. Taking this extreme approach will require enquiries and descriptions that are markedly different, it is towards the necessity of this challenge that I now turn.

Designing towards a new 'conceptual' normal

The concept of normality, in theory, is that which is accepted by a community of scholars, such as those acting within Kuhn's (1962) paradigms or Foucault's (1995) epistemes. As mentioned earlier this chapter, 'normative' studies are those that seek to improve an idea that exists, rather than question its premises. 'Normality', more generally, is the state of being normal; as ordinary, usual and what is to be expected (Normality, 2018). For Sardar (2015), the 'normal' is:

> ...that which is frequently encountered: what is accepted as the dominant way of being, doing and knowing, conventionally seen as the standard, dictated by convention and tradition, backed by disciplinary structures and scholarship and what we are able to predict and control.

Yet, in the contemporary condition, our beliefs are beginning to be challenged through experience. We now have feelings of uncertainty, coming from the gap between what is known in well-established modes of thought and what is experienced. In the case of neoliberal ideals, statements such as 'leave it to the market' and 'don't let government intervene' have been popular since Thatcher and Reagan, but these ideals no longer hold with our experiences.

Humanity now faces great uncertainty, when little can be trusted enough to give confidence. Because our existing ideologies are increasingly incoherent with the needs of our systems, unable to provide for the future, one can reflect on the idea of the 'postnormal' (Sardar 2010).

One may carry this argument to design. Like our ideologies, design is invisible until it fails (Mau & Leonard 2004, p. 1). People may be beginning to understand our most naturalised technological systems as products of our own creation: the nature of the economy, nation-states, religion, language, the media, gender, race, and assumed 'universal values'. The belief in many stabilising systems of the 20th century have now begun to erode, not only in the eyes of scholars, but amongst an increasing consensus of the populations. Futures theorist Sardar (2010) follows this assumption to its end, arguing that 'all that is normal has evaporated'. Sardar (2010, p. 435) describes the current period as 'postnormal' times, characterised by its uncertainty, rapid change, realignments of power, upheaval and chaotic behaviour; a period 'where old orthodoxies are dying, new ones have not yet emerged, and very few things seem make sense'.

Postnormal analysis requires postnormal methodologies. Yet, what is pragmatic in practice is often what is normal; the shortest path between two points. Daily choices are largely habitual, not requiring cognitive effort to achieve them. Only a small fraction of daily decisions are consciously made (Kahneman 2011). Sometimes, a pragmatic approach is one that breaks with 'normal' ways of doing; particularly when these practices prove insufficient and no longer attend to what is being experienced.

Is the smart city a new normal, or is it merely a perpetuation of enduring ideas? Undoubtedly, it is a combination. However, how it be framed to be most useful to 21st century cities?

I have explored already many of the questions around the existing smart city discourse. It is still debated. The contention in the discourse, some have argued, is that the smart city is yet another manifestation of an ongoing urban debate, started in the early 1960s between Jane Jacobs' (1961) bottom up citizen-centric view and the rational top-down economic planning approaches of Robert Moses (Gratz 2011). Yet, as discussed earlier, wherever these ongoing debates are taking place, the technology refuses to become 'black-boxed'. In this sense, the smart city is discursive; it brings together disparate groups through its own political controversies. Importantly, where values are disputed, the pragmatist perspective seeks the tangible from the intangible. In other words, it examines practices and not the product of the smart city.

This point in the discourse can be described as 'liminal', a term which may add further, useful detail to Sardar's description of the postnormal. Liminality, in anthropology, is derived from the Latin word *līmen*, meaning *threshold* (Teodorescu & Calin 2015). Liminality is the quality of ambiguity, or disorientation, that occurs in the middle stage of rituals, when participants no longer hold their pre-ritual status but have not yet begun the transition to the status they will hold when the ritual is complete. As Teodorescu and Calin (2015, p.97) describe, '[i]n the liminal space, the individual is confronting three stages: the uncertainty or the ambiguous state, the possibility to adapt to new norms, rules and values and the third stage is the pre-integration'. During a ritual's liminal stage, participants 'stand at the threshold' between their previous way of structuring their identity, time, or community, and a new way, which the ritual establishes. The smart city, as a set of practices, will undoubtedly play a role in transitioning cities and individuals into a new urban normal.

Perpetual experimentation

If the contemporary condition is 'postnormal', the city is clearly in the liminal space. The city has always been the place to develop new ways of conceptualising and relating to the world. For centuries, cities have had the strongest research institutions, most educated and entrepreneurial minds, most advanced technologies, and the greatest circulation of ideas, resources and connections to other locations (Florida 2003). Cities might be understood as urban laboratories; a notion that has become widespread in recent years. These laboratories have become constructed sites for knowledge production (Karvonen & van Heur 2014). They can be successful in carrying out pragmatic inquiry in three ways: being situated in real urban

contexts, being oriented towards change, and by embracing contingency (Karvonen & van Heur 2014, p.7-10). Karvonen and van Heur (2014, p.11), describe the urban laboratory, as the 'frontline of new economic, cultural, political and societal configurations in cities', necessary to understand what works in the given context. This view is coherent with the view of cities as continually in the making, on the move, and fluid (Guy 2009).

Indeed, over history, the only thing to destroy cities has been an inability to remake themselves. Cities destroyed in war tend to be rebuilt. Alternatively, those that have disappeared, whether due to migration or disaster, have had some similarities. They were cities no longer able to provide enough resources for their people, or incentives for mobile populations to remain. The historic failures of many of the Aztec cities, many of which perished, can be attributed to an over-commitment to a particular way of life and industry. This commitment drained resources, without adequately providing for future needs. Today, American cities like Detroit, Cleveland, Buffalo, and Pittsburgh have experienced enormous decline, largely due to an over-commitment to manufacturing; an industry now unable to deliver former levels of employment and income, in a global and increasingly automated world (Hartley 2013). In Eastern Europe, some cities are in decline as younger, mobile demographics look for opportunities abroad, leaving an aging population with little ability to support itself and further driving the exodus.

Indeed, the commitment to any particular form of knowledge and practice is, in fact, counter to the pragmatist ideas of *radical contingency,* which supports the notion that the future cannot be predicted. *Radical contingency* is useful in planning cities; it recognises that predictions are only sometimes accurate. Indeed, central to Dewey's imagination of the role of public governance is the notion that the relevance of urban services and systems is never optimal, moreover, that it must constantly be challenged. A pragmatic fear for the smart city, is that the use of single or limiting data-driven epistemology is highly risky in its disregard for all other types city-knowing. Knowledge must be recognised as valid in local contexts; to contribute to academia, it must also be recognised as valid in non-local contexts. As earlier described in Chapter 1, experimentation is a core tenet of pragmatist thought. In this way, cities are treated as agglomerations; the result of a process of being built-up, collecting in a mass, a heaping together, or cluster. Some of the sub-systems of the city get stronger, others grow weaker, some disappear, and some flourish. Renewing practice can be understood pragmatically as a process

of perpetual experimentation, where renewed ideas, practices and technologies maintain a city's relevance in their context.

One useful way to think about the governance of the city is through the cybernetic concept of *requisite variety*. Cybernetics is the field of study generated to create a meta-discipline; one model that represents all discourses. Cybernetics provides, a means to talk about and understand systems, regarding their self-governing abilities. Cybernetics is often incorrectly viewed as a reductive engineering approach (Dubberly & Pangaro 2015) *Requisite variety,* is a cybernetic concept, the idea that all system governance requires at least as much variety in its control system as is needed to attend to the states of its environment (Ashby 1958). As an example, companies making analogue cameras and mobile phones in the early 2000 needed the means to attend to disruption from digital platforms, and an ability to understand software systems. The examples here are obviously Kodak and Nokia, companies who famously missed serious changes in their environment.

Geoghegan and Pangaro apply a similar notion to the language of organisations, which are essentially human communication systems. They argue that organisations reduce variety of language over time, to enable them to become more efficient (Geoghegan & Pangaro 2009). A discursive vocabulary creates words for the more detailed naming of important central concepts to the organisation, but also reduces the ability to understand what is outside of these central concepts. A level of conversational dialogue is developed, only as complex as the environment in which the designed system must function. Within language, there must then be sufficient variety across the organisation to deal with the complexities of the context in which it exists. Such is the tension in management; a tension between efficiency and relevance to its operating environment. The judgements made, as a result, are eminently qualitative, described by Gatti (2016, p. 184) as 'coherence' between organisation and context.

> The focus on coherence has an important effect: it shifts the object of strategy away from either identity or from context. The object of design in strategy is coherence. Incoherence, therefore, is the risk.

The argument here is that cities are a powerful technology; however, their strength comes from their diversity. Coherence, as Gatti argues (2016), is the ability of an entity to match its context. Following this argument, any processes that reduce the city's ability to be aware of its own complexities can be viewed as risky. Some may argue that smart city technologies actually

enable the viewing of urban happenings in real-time. Other perspectives argue that the data-driven epistemology of smart city governance creates a very narrow perspective of what the city 'is', and arguably what is attended to. In this limited epistemology, governance is likely to exclude many aspects of city making; other ways of knowing that may be important to the future success of the city, in ways not presently understood. The canonical smart city examples, discussed earlier, in many respects actually failed to become successful cities. Their world-leading technology did not guarantee vibrancy or liveability. As architect and urban theorist Richard Sennett (2012a) states:

> [A] city is not a machine; as in Masdar and Songdo, this version of the city can deaden and stupefy the people who live in its all-efficient embrace. We want cities that work well enough, but are open to the shifts, uncertainties, and mess which are real life.

Cities can find strength in their diversity; in holding many ideas lightly. Pursuing universalising commitments is detrimental to their very fabric; it makes many assumptions about what the future will be like. The *radical contingent* view of pragmatism necessitates the varieties of perpetual experimentation. In support of this view, and to these ends, the following three sections will explore the literature to better support a productive experimentation.

From universalising ideologies to ecologies of practices

Latour encourages, we must not 'modernize' but 'ecologize' (Latour 2007). By this Latour means we must understand concepts as embedded in relational networked contexts, rather than in modern rational categories. As Latour (2007, p. 249) states:

> [P]olitical ecology cannot be inserted into the various niches of modernity. On the contrary, it requires to be understood as an alternative to modernization. To do so one has to abandon the false conceit that ecology has anything to do with nature as such. It is understood here as a new way to handle all the objects of human and non-human collective life.

For the Smart city, what is hidden from the discourse of glossy reports, and academic commentary could perhaps be found in newspapers or instruction manuals, in conversation, in phones and on street corners, in the everyday material agencies of digital devices and their users. A logic of emergent smart city practices, rather than the observation of finished effects is a radically different proposition. The smart city is experienced by practitioners and its publics as 'in the making', rather than in teleological terms in its objectives and results. Yaneva (2017)

argues for an ecology of practices for architecture, borrowing this ecology of practices from Latour and Stengers. In quoting Latour (2007a), 'ecology' means an alternative to modernisation and emancipation. Yaneva (2017, p. 33) describes:

> To view architecture as an 'ecology of practice' means to redefine the complicated forms of associations between all of its beings: habits, skills, buildings, sites, city regulations, designer's equipment, clients, institutions, models, images, urban visions, and landscapes. 'Ecology' dissolves boundaries and redistributes agency. It is not a naturalizing metaphor, but rather a politically sensitive concept to capture and understand contemporary design practice.

By studying the fabrication and circulation of objects such as scale models, renderings, videos and drawings, we will be able to gain access to the ontology of what is real (Yaneva 2017). Stengers (2005b, p. 185), advocates for an '…ecology of practice as a tool for thinking through what is happening, and a tool is never neutral'. To participate in these 'political ecologies', the researcher is '…required to 'construct present what they know in a mode that make them 'politically active'', engaged in the experimentation of the difference that what they know can make in the formulation of the issue and its envisaged solutions' (p. 998). Stengers insists that '[m]emory or experience cannot build up if the concern for relevance does not dominate' (p. 998). It is relevance that constitutes others in their own practices: '[t]he common world must be free to emerge from the multiplicity of [stakeholders'] disparate links, and the only reason for that emergence is the spokes that constitute in another's wheels' (p. 998). Stengers proposal provokes imagination to think through what a political enactment might be what I know about the smart city context.

Pragmatists believe the world contains plural realities, however what is pragmatic is not always representative of this conception. What is required is to not adopt a universal ideological agenda, as this creates an agenda without pragmatic purpose; without the ability to translate the ideas and actions of actors into the larger networks. This co-shaping represents a semiotic plurality, and the respect of the participant's ontology. It is not only that these entities mean different things: there are also different entities that know and experience their cities differently.

From the universal to the plural smart city

This thesis makes a very different and bold proposition. Universal values are at stake; their very premise undermined by the argument that there can be no universal common good in the city. Any sense of atemporality is also replaced with one of temporariness; conclusions that are fleeting and momentary. It makes a proposition for pragmatic enquiries that support the pluralities of a category-free experience. It does not attempt to represent the smart city, or to bring the concept under the same knowledge system, as the modernist project proposes. Rather, it seeks to weaken the development meta-narrative, and enquire into cities as ecologies of practices; only knowable to some degree because they are in flux, and can be observed in infinite ways. This understanding will afford a greater ability for experimentation, as it rejects a completely rational view of the city that can be objectively 'tamed'.

This chapter has outlined the importance of the continual renewal of cities, and how the enormous pressures faced by governance organisations are hoped to be resolved through economic and technologically deterministic approaches, well encapsulated in the corporate perspectives of the smart city. The smart city is but one umbrella term for these processes; one that has been successful in its ability to enrol many actors into its problem definition. The problem, however, is that this model represents only some interests, and forgoes the essential variety of both ontologies and epistemologies to both manage the rapidly evolving context and, crucially, evade existential disaster. A structured ability to manage the range of variables in systems thinking, also termed 'requisite variety', is required to address the [what?] of the city. Prudent action is to distribute access to the knowledge required to change the city though the plurality of actors that co-exist in the city.

Synthesising reflections on the smart city discourse

This chapter has positioned the smart city as a recent manifestation of a vast history of urban experimentation with emerging technologies. What is 'smart' will continue to evade the existing categories, always referring to nascent technologies that are never fully implemented. True judgement of what is useful for the future can only be assigned, correctly or incorrectly, in retrospect. The smart city discourse does create a vehicle for widespread and diverse

experimentation. This chapter, as more than a critique has sought to unfold the ideological concept into a flattened view, a form that intertwines with the actions of real people, places, climates and robots, and thinks about their futures together. What has been unfolded are the necessities of city renewal in the tense times of the Anthropocene. The capitalist illusion of unlimited growth, still evident in the rhetoric of the smart city, is a continuing cause for concern. Consciousness needs to change. The smart city has been reconceived more broadly, offering clues as to how humanity needs to think and relate to their context, if they are to reintegrate into ecological thinking.

Towards making a Cosmopolitical smart city commons

What forums could empower all, and not only those usually included in the bureaucratic public decision-making forums? The public, as Dewey argues (1927, p.15-16), are those who are implicated in decision:

> The public consists of all those who are affected by the indirect consequences of transactions, to such an extent that it is deemed necessary to have those consequences systematically cared for. [..] Since those who are indirectly affected are not direct participants in the transaction in question, it is necessary that certain persons be set apart to represent them, and see to it that their interests are conserved and protected.

Those implicated in the decision, in the contemporary context, are not only people, but also the air, oceans, cockroaches, satellites, plastic bags, fertilisers, phones, coal, the sun, and bacteria. It is no longer enough to expect these actors to be present enough, when humans make decisions regarding their futures, as they are intertwined with our own. The Cosmopolitical proposal works as a useful heuristic to present the range of variety of experimentation relevant to the continuing development of the discourse. It is outlined here as a speculative position to be worked towards, in the context of the smart city.

Tironi and Criado (2015, p.90) have applied this concept to the smart city, demonstrating that the 'smart city is being 'opened up' for scrutiny through manifold experimental projects, developing digitally mediated sensing practices of either a specific or broad kind'. Their account provides a counter to disembodied versions of the smart city projects through the deployment of manifold ontological politics of its 'urban assemblages'. Therefore, in taking this approach, in which the agency of non-human actors could be considered, this research slows down in order to consider the much broader relevance of these concepts.

In specifics: what is the cosmos and whose politics does the notion speak of? The pragmatist perspective of the public, is that it is continually in the making through its controversies, it doesn't just exist by itself. As Marres (2005) explains, drawing on Dewey, the public is constituted through disagreement. This is the view, adopted by Actor-network theory (ANT) scholars (Latour 2005a). This perspective is relevant to this inquiry, as this suggests, that to change the discourse of the smart city, one must create new publics with new language. This new public must be enacted.

From issues like health care and immigration reform, to debates over trade, war, welfare, euthanasia and the nature of marriage, our common life as a people is played out and shaped by these conflicts. Stengers (2005a) is careful not to describe in detail exactly what a solution might be for the Cosmopolitical; rather its intention. In this approach, she confers a pragmatist perspective, focusing speculating on consequences. Tironi and Criado (2015), have discussed the concept of the application of the smart city through Stenger's conception of cosmopolitics, outlining the various dimensions and contestations of the term. However, the role being defined here is a pragmatist reading of the concept in order to be useful *in action* for practitioners. Can making new enactments catalyse a new cosmopolitical sense of cities? This chapter has gone some of the way to explain what a reassembled smart city political cosmos may be constituted with.

Latour (2004d) asks for clarification when we wish to enact a plural conception of an issue. So, what exactly are we talking about? I now to turn to these specifics, to define how the specifics of the 'smart city in the making' can be known. This emphasis is for reimagining of the smart city discourse as derived from the specifics and complexities of grounded experience, rather than appealing to abstractions and ideologies. The following chapter introduces a methodology capable of describing the practice of smart cities in two cases, and subsequently, a proposal for how these descriptions might perform this cosmopolitical into being.

Chapter 3. Designing for the Cosmopolitical

This chapter explores the dimensions of a wider discourse of experimentation through design at the city scale. It looks at the broad role of design in order to formulate such experiments, but also the ways in which design is shaped by the dominant worldviews that it seeks to displace. It explains the pragmatic practice of design, in Yaneva's terms, by making 'the social hold' (2009b) through combinations of elements that create the material artefacts and the arguments for changing the existing context.

In doing so, it outlines the challenge of how this might be effectively supported; the constructed cognitive and material spaces must be populated with ontologies of a greater variety of practices. Thus, the designer is afforded a greater optionality, in both the description and formulation of courses of action, through the generation or stimulation of a variety of language. This chapter outlines design in the urban context and, as situational complexity increases, its need to move away from more traditional, western rational models of planning and intervention.

A discussion follows of the challenges in providing pragmatic knowledge to these ends to those practising design. Critical and speculative design is described as a useful discourse to prefigure the ontologies of practitioners wanting to create smart city initiatives. In conclusion, this chapter provides cases that explain the complexity of design practices in the urban context, and the challenges of making useful research for their situated purposes.

This chapter is exploratory, exploring the challenging and unresolved dimensions of what may be useful towards designing the cosmopolitical interpretation of the smart city.

Public problems and design

The cosmopolitical proposal treats the smart city as a public problem, not one to be solved behind closed doors by experts. The pragmatist perspective, particularly Dewey's, is one of democratisation (see Dewey 1927). Yet, one cannot help but contemplate the systemic implications for a far broader network of stakeholders. As discussed in Chapter 1, pragmatist truth is socially constructed through use. It relies upon the creation of many contemporaries who endorse a common understanding. If a greater number of stakeholders become enrolled in defining the problem, the inquiry has been successful.

Being an emergent category and largely incomplete as a concept, the smart city discourse provides an opportunity to mobilise citizens, practitioners and organisations to contribute to urban development in new ways. These innovations do not just provide consultancies and technology companies with sustained work and a growing clientele. They create more pragmatic discourse around city renewal in the context of 21st century challenges.

Pragmatism and planning discourse

The smart city concept is becoming more distributed; many subgenres and peripheral projects have made it more open to interpretation in recent years. Taking a pragmatic lens to planning smart city initiatives, nevertheless, presents a challenge.

The paradox of planning and development on any scale is that there will always be downsides. Planning has never taken place in an apolitical landscape; it always inscribes future value for certain constituents over others. Indeed, pragmatism has always been central to the actions of politicians, often wielded to achieve a narrow scope of desired outcomes. 'The means justifies the ends' is a pseudo-planning manifesto; an argument in vulgar pragmatism for doing whatever it takes to reach a goal. At its worst, vulgar pragmatists have put their faith in the outcomes of economic models or market fundamentalism, co-opted ancient cultures into more market-friendly alternatives, created wars, and killed millions: all courses of action deemed to have been 'worth it' to maintain the status quo. Pragmatism can be brutally violent.

The smart city concept can be useful to those advocating a technocratic agenda, in order to allocate vast amounts of resource to city-rebuilding. Sassen (2015a) describes the privatisation of public space as having 'deep and significant implications for equity, democracy and rights'.

One need only look to the sponsors' brands on the front of a project's report to see who pragmatism serves in some smart city initiatives. Examples include Global financial organisations (see the World Bank, the Development Bank), technology companies (Cisco, IBM, Siemens) consultancies (see Deloitte, PwC, Arup), and national governments (see, The UK, India, USA and the Netherlands) are the main advocates, proponents and benefactors of the reports that are produced. They are the agencies who have the most to gain; whether it be through selling consultancy products around the world or by becoming an obligatory passage point (OPP) for cities and nations problem-solving (Söderström et al. 2014). In a global market worth trillions of dollars, urban contexts have no shortage of problems to solve or solutions to sell. In fact, in planning, pragmatism removes the idea that there *is* a common good; that there are unanimously-agreeable goals that can be worked towards. Goals instead are relative, and a question of scope.

The idea that the smart city provides 'control' is therefore paradoxical, on many levels. On one hand, the concept promises centralised, tighter control of the city; on the other, the concept promises data that will make the city more open, and more apparent. On one hand, the smart city is conceptualised as a place for higher engagement; on the other, the most connected, the highest users of social media have increased levels of depression. If planning is considered to be a form of instruction and control, one can use the simple example of a recipe. The recipe, as a set of instructions, is a complex semiotic arrangement between elements. The conditions of the recipe's creation are assumed to be controlled, consistent from kitchen to kitchen for example. Yet, in the city, no such control exists, contexts can very very different. Every word can be loaded with seemingly infinite intepretation. Terms such as 'government', 'the city', 'the public', 'citizens', 'innovation', 'data', 'technology', 'developers' and 'systems' hold little in the way of the same absolute meaning. Each through the pragmatist lens is socially constructed in different groups, in different places and at different times. Each is a significant actor; yet, each manifests and relates to other actors through different assemblages within different ideologies.

PRAGMATIST CONCEPTIONS OF 'THE PUBLIC'

Pragmatism may be an increasingly useful perspective in the definition and addressing of public problems, but how does it align with existing processes? Chapter 2 outlined how pragmatism relates to urban planning discourse. This section furthers the discussion in relation to the design of public policy, beginning with pragmatist conceptions of 'the public'.

In 1927, Dewey's *The Public and its Problems* (1927) described the challenges of making democracy work in an era of modernisation. The seminal publication terms the 'public' as the often-incoherent body of citizens who elect the state; a public called into being through negative externalities, such as the perception of loss and subsequent desire to control consequences (Dewey 1927, p. 126). This may be more easily understood as any controversy in which interested parties object to a certain view, such as government use of private metadata or plans for a highway near residential areas.

More recently, pragmatic definitions of what constitutes 'the public' has been developed through object-oriented politics, derived from an early 20th century debate between Dewey and Walter Lippman, another pragmatist writer. Dewey arrived at the argument that complex issues actually enable public involvement in politics; therefore, politics should no longer be about subjects but the sustained discourse around objects of debate (Dewey 1927).

Lippman's view was that individuals could no longer be left to make democratic decisions in a technological society (Lippmann 1922). In contemporary cities, the rise of populism, the 'death of expertise' and post-truth (Nichols 2017) may support and further Lippman's earlier views: that the average citizen should be disassociated from decision-making. Such technocratic views, reject notions that pragmatic improvement of the public by way of community and citizen participation.

Pragmatic planners should see design as 'the ongoing historical process of social and political construction' not as 'the elegant idea' (Forester 1993, p. 43). The work of planning analysts might be better appreciated as a form of organising (or disorganising), rather than map-making or organisational-chart designing (Forester 1993). For Forester (1993, p.43), the planning analyst 'selectively asks questions of program policy possibilities and so calls and directs attention in particular ways – and so, too, shapes the actions of others and thus the ongoing process of design'.

Object-oriented politics holds that it is only through this discourse, discourse surrounding controversy or major events, that the 'public' is given form (Marres 2005). It is through this perspective that the design of the Cosmopolitical is relevant — an ability to make multifaceted issues the object of discourse. The Cosmopolitical seeks to 'make object' what might otherwise be incommensurable concepts, events, memories, and politics.

As outlined in Chapter 2, Stenger's proposal infers the Cosmopolitical must be designed (Stengers 2005a; Yaneva 2015); it is not apparent to us through nature itself. These hidden subjects need 'explication' (Harrison & Harrison 2015, p. 223). Latour encourages us to ecologise rather than modernise; to understand concepts as embedded in relational networked contexts as a 'new way to handle all the objects of human and non-human collective life' (Latour 2007, p. 249).

This preference of ecological thinking is central to the pragmatist tradition (Blok 2013). For the smart city, hidden subjects are perhaps found in newspapers, in conversation, on street corners, or in digital devices. A post-human understanding describes the agency of individuals and nonhuman entities across the city and beyond; including software, buildings, telecommunications infrastructure, boardrooms, sidewalks, published media and report recommendations. Yet, how does one give voice to actors who do not usually speak, and who are rarely spoken for?

To explicate subjects the Cosmopolitical must be performed into being (Harrison & Harrison 2015); a practice that involves weaving in the 'fictionalised' voices of those that do not speak for themselves. Stengers' (2005a) argument for diplomats, whose role is to represent those that vulnerable or without voice, presents further questions around design, inclusion and efficiency. Around these questions, publics form (Marres 2005); new publics capable of reconceiving the urban cosmos as made up of people, technologies, materialities and politics; a dense assemblage.

Yaneva (2009b) argues that design is 'not just a way to render objects exotic, desirable or pleasurable' but 'a way of producing additional attachments that make a variety of actors congregate, forming different groupings and assembling social diversity' (Yaneva 2009a, p. 282). As Yaneva contends, through speculation, the capacity of design unfolds the Cosmopolitical, as an *otherwise* site of political action and imagination (Yaneva 2015, p. 151).

Experimentation and inquiry by design

Variety in experimentation, across all forms of city organisation and contexts, can create rapid transformation of cities; an aspect of urban development that should be supported. So, what will it mean to treat experimentation as a cosmopolitical problem within the context of multiple politics? How might we establish a suitable framework that provides for the political and natural? Furthermore, the cosmopolitical appears to refer to a socio-material perspective; 'the constitutive entanglement of the social and the material' (Orlikowski 2007). How can this too be included? It is necessary to explore particular practices supported within the broad conception of experimentation.

Design practice is the productive art that can guide investigation and has been described as a discourse for understanding the processes of experimentation towards goals. This happens in multiple ways. Krippendorf (1989) states that design is 'making sense' of things, which can be read in two ways. The first reading is that products of design can be 'understandable or meaningful to someone'; the second that design can be a 'sense creating activity' (Krippendorff 1989, p. 9).

Design in the 20th century, and earlier, was understood to refer to the physical products or objects of design. Exemplars include the architectures of Frank Lloyd Wright or Zaha Hadid, the furniture of Charles Eames or the graphic design of Paul Rand and Massimo Vignelli. There is a comprehensive list of wide-ranging fields that employ their own iconic designers, from fashion to engineered systems and infrastructure. Each design process occupies its own niche, and employs various degrees of understanding of problems, foresight, creativity and technical expertise. Each follow the same broad design process, in Simon's oft-quoted words (1996, p. 111), of '...[devising] courses of action aimed at changing existing situations into preferred ones'.

For Simon, design solutions are an attempt to make nature more intelligible, they are 'sequences of actions that lead to possible worlds satisfying specific constraints' (Simon 1996, p. 124). Under this view, design is a special kind of science. Although informed by the natural sciences, and 'concerned with how things are' (Simon 1996, p. 114), it is a 'science of the artificial', dealing with artefacts and processes created by humans. The object of design (what *can* be designed) is anything 'artificial'; it cannot occur without human intervention. Objects of design are all technologies in the 'classical sense'; the Aristotelian sense.

Yet humans also design ideas, language, thoughts and knowledge systems. These are technologies in the Deweyan sense (Hickman 1990), as outlined in 'Chapter 2, There will never be a smart city'. Therefore, design must also be viewed as the practice of transforming 'heterogeneous and uncertain domains of knowledge' (Bergman et al. 2007, p. 547). Whilst not using the word 'design', Dewey (1938, p. 104-105) defined inquiry as;

> ...the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole.

Along these lines, 'to design' is, in Dewey's terms, 'to inquire'. Let us consider the significance of the notion of design and its relation to experimentation.

In pragmatism, Dewey's notion of inquiry is similar to Latour's notion of 'reassembly', which he described as to 'gather together', or as Yaneva describes, to 'make the social hold' (Yaneva 2009a). To *de-sign* is to relate together; to signify how things relate together; to give warranted assertion of their relevance. 'Warrant', for neopragmatist Rorty, is that which is used to assert a claim (Rorty 1989). The purpose of this research is to assert that these new relations should hold. It offers investigation of problems and speculative solutions and develops a plan of action towards rethinking the manner in which design is implemented in relation to the smart city discourse.

A rational history of planning and design

Planning has always been dominant in the urban context. It is traditionally understood as a process of rationally inquiring to understand a context, then making decisions, implementing long programs of work, and eventually measuring their impacts. Yet there is good reason for breaking with this rationalist tradition. Beauregard argues that the complexities of planning are understood to be greatly reduced in more traditional rational perspectives (Beauregard 1995).

As design theorist Ezio Manzini (2015, p. ix) contends, 'multi-disciplinary and transdisciplinary methods are necessary to meet contemporary design demands, and to overcome contextual challenges'. Manzini maintains that, in the past, demands on design were simpler. Rational models may well have served in the earlier era of Fordist mass production; yet, rationalism falls over in progress and complex design challenges.

Complexity has now created the need for many disciplines to reassess their rational methods, such as in urban planning (Lindblom 1959; Alexander 2007; Rittel & Webber 1973), organisational theory (Stacey 1995), Strategy (Chia & Holt 2009) and Operations Research (Ackoff 1979).

As Manzini (2015, p. ix) explains:

> [O]bjective changes in the world are giving rise to substantive challenges of increasingly ambiguous boundaries between artefacts, structure and processes; increasingly large-scale social; economic; and industrial frames; an increasingly complex environment of needs, requirements and constraints; and information content that often exceeds the value of the physical substance.

Nevertheless, the 20th century saw mass experimentation with rational models of policy; a shift to governance by numbers and the rise of New Public Management. These policies have reduced perspectives of public labour to rational data points, and the smart city to an objectifying imaginary. Since the 1960s and 1970s there have been mounting arguments against the dominance of rationalism in public planning. As Simon (1983, pp. 7-8) states in *Reason and Human Affairs*:

> Reason is wholly instrumental. It cannot tell us where to go; at best it can tell us how to get there. It is a gun for hire that can be employed in the service of any goals we have, good or bad.

Rational paradigms assume that facts and values can be separated (Klosterman 2007) and represent an institutionalisation of the division between thinking and action (Friedmann 1995); yet Dewey ([1916] in Menand 1997) argues against binary separation Designers are now acting to bridge the limits of modern conceptions of organising and thinking, revealing a desire for temporal, dynamic and inter-organisational functionality. These conceptions can assume discrete components of knowledge and further perpetuate the modern ideals, as the ways we theorise the world tend to reflect hegemonic paradigms of the systems being studied. Professional design practice now requires more advanced knowledge (Manzini 2015). Connective, qualitative information, brings objectivity towards experience.

An ‘arationality’ of smart city problems as wicked problems

As planning issues, the difficulties of Smart Cities can be defined as wicked problems. This perspective, mentioned in Chapter 1 and 2, is largely excluded by the current smart city

discourse. Wicked problems cannot be 'solved' through rational approaches. Rittel (1972) sets out a definition of wicked problems through the following points:

1. There is no specified expertise in addressing them, as wicked problems are complex, and complex fields do not have representative experts. Their response calls for unique, emergent approaches
2. They have no definitive formulation so therefore, it is impossible to understand the problem and then solve it as there are simply too many inputs and outputs, all of which are constantly changing;
3. Problems and solutions are interconnected; therefore, each solution is a reframe of the problem;
4. There is no end point, or stopping point, as each solution creates new problems, which must be dealt with;
5. Conceptions of truth or falsity are not relevant, as each solution is simply better or worse;
6. Each problem has multiple possible causes, and it is often impossible to trace a problem back to its single root cause;
7. Every problem is a symptom of another problem, the retroactive line of problems is infinite;
8. Every problem is unique and context-dependent. 'Best practices' are irrelevant, as each problem exists within a unique context.

The smart city discourse presents non-problematic proposals that run counter to almost all of these points. Such a discourse features the stereotypes of traditional management literature, which, as Lissack (1999, p. 110) describes, 'tends to speak of an objective world where interactions can be described in linear terms, where words have singular meanings, and where prediction and control are paramount'.

Lissack's perspective concurs with Rittel's (1972, p. 391), identified as a 'first generation systems approach', in which problem-solvers may follow a series of steps to achieve an optimal outcome. These steps are: understand the problem, gather and analyse information, generate solutions, assess the solutions, then implement, test and modify the solution (Rittel 1972, p. 391). To address wicked problems, the smart city discourse requires an acceptance of the messiness, obduracy, and social and material politics of the urban form; a context that planners and architects have been dealing with for millennia. Designing for wicked problem contexts requires an arational way to conceive design (Wendt 2018). Wicked problems cannot ever be fully resolved, nor can they be objectively known. Arational approaches reject Scientific rationalism's realism and appeals for truth, as well as the Cartesian rationalist preference of thinking over action.

The Cosmopolitical proposes an arational pragmatist to enact planning practices in which facts and values are enmeshed. Such an approach can contribute to the politics and reasoned

development of the smart city. It is a way of dwelling on the wicked problems of cities without an immediate jump to a solution. The Cosmopolitical is a non-linear process of making present what would otherwise be ignored, at no point guaranteeing any sort of outcome.

Reconceiving the dissolving smart city discourse

Returning to the smart city. In the period between 2012 and 2014, the smart city discourse appeared to be waning. Perhaps this brief decline may be attributed to several issues with the smart city's canonical projects. Rio de Janeiro's Centre of Operations (COR), was meant to create omnipotent visibility over the city using sensors and CCTV (Singer 2012), yet during this time Rio has had massive waves of violence (Londroño 2017) and could be labelling people as suspects for crimes they did not commit (Sadowski 2016). Songdo in South Korea, the canonical greenfield 'smart city' has been described as sanitised and soulless, only managing to attract a wealthy demographic to the area (Mesmer 2017). LinkNYC, a public phone, Wi-Fi and information plinth has creating hotspots for the homeless and drug use, far from its intentions of promoting tourism and late-night safety (McGeehan 2014). Masdar in the UAE has been critiqued by Sennett (2012b) as a conception of the city on 'Fordist terms', where 'urbanites become consumers of choices laid out for them by prior calculations…'. Reports from one conference read like a smart city obituary, predicting that 'it was over' (Poole 2014). Anecdotally, colleagues at university were making remarks along the lines of 'we don't talk about that anymore', preferring to use other pseudonyms. Academic discourse shifted towards the 'intelligent' or 'ubiquitous' city, or at least Smart Urbanism. The discourse sought to move beyond technologically-determined visions, prefigured by the technology giants, critical that some believe may limit democratic rights (Poole 2014).

These very same criticisms may have breathed life into the smart city concept. Indeed, agnostic perspectives, such as those offered by Townsend (2013a), and Marvin & McFarlane (2015) give the discourse a renewed depth through multi-perspectival explanation. Foth, Brynskov and Ojala (2015) have urged to reclaim the citizen's right to the city, from the technology proposals at the urban scale. They argue that there is a 'wealth of knowledge, wisdom, and experiences collectively and privately held by each urbanite' (Foth et al. 2015, p. vi). This perspective follows earlier examples that highlighted the notable lack of the citizen in the discourse (Hill 2013; Hemment & Townsend 2014).

In the last few years, the smart city appears to have grown into a 'catch-all' discourse for new urban development. The term now appears to define very little. Regardless, there appears still increasing interest in the concept. Smart bins, smart street lights, wifi-enabled public spaces, open data sets, and government-led hothouses for application development are just some of the initiatives being rolled out across Australia. In other countries smart city initiatives are gaining in momentum. More customer centred perspectives appear to be making their way into projects. In Australia and the UK, appear more measured in their approaches, with local governments working closely with universities, and avoiding lock-in contracts with their technology providers. Meanwhile Sterling (2018) argues that we 'stop saying 'smart cities':

> The term 'smart city' is interesting yet not important, because nobody defines it. 'Smart' is a snazzy political label used by a modern alliance of leftist urbanites and tech industrialists. To deem yourself 'smart' is to make the NIMBYites and market-force people look stupid.

Perhaps the ongoing lack of definition of the smart city has created a beneficial space in which to debate its meaning, particularly in the contexts of its application. As discussed earlier, if the smart city was an uncontested concept, it would have already become 'black-boxed'; where the inner workings of the system is not a concern and rendered silent. Yet, the lack of definition means that the smart city is constantly debated. Indeed, after more than two decades of rhetoric, the earlier notions of the 'smart city' have already come to fruition. This may be described as a process of 'dissolving' the discourse; the narrow concept, as it was originally conceived, is deliberately weakened. As more and more projects are developed, cities create their own agendas, and more types of organisations and individuals become involved in broadening and challenging the practices.

Towards an 'upstream' and 'weak' design

If we conceptualise the smart city by using a logic incapable of providing systemic improvements to cities, what are the implications for design practice? What if we are to treat design interventions as experiments of all forms, towards future unknowable states? The smart city discourse has been demonstrated to be limited; its confines configured by the endorsement of capitalist logic (neoliberalism), expressed in Cartesian and scientific rationalism; using a limiting city-as-data-based ontology; and by the dependence on benchmarking practices between cities to resolve problems that are idiosyncratic to their own

city contexts. These restrictions, in terms of problem definition, are issues that lie further 'upstream' of the smart city discourse.

As described at the beginning of the last chapter, there are two discernible thinking styles of 'modern' and 'postmodern' in contemporary theorising in human sciences. The term *postmodern* cannot be understood to supersede modernity, rather it is to parallel the modern way of thinking. Different scholars have defined the dimensions of these terms in different ways: as 'systematic' and 'edifying' (Rorty 1980); 'representing' and 'intervening' (Hacking 1983), 'modern' and 'postmodern' (Lyotard 1984; Cooper and Burrell 1988); 'downstream' and 'upstream' (Latour 1987); 'strong' and 'weak' (Vattimo 1988); and 'representational' and 'anti-representational' (Rorty 1991). In Latour's terms, to operate 'upstream' is to operate before categorisations, definitions and hierarchies are set in place. Pragmatism, likewise, operates in this upstream space where there are no categorisations to frame experience.

As a practice of 'making and remaking society', design needs to provide for the thinking style of both the modern and the postmodern. 'Postmodern' design has been well articulated by Harrison (2014), who explores the nature of design in relation to wicked problems, and the engagement of 'weak thought' (Vattimo 1988) which enables designers to look more objectively through the lens of nihilism at the make-up of their contexts. Harrison (2014, p. 192-193) argues:

> Designer deliberation is no longer to be that of the liberal bargain, a neutral and neutralizing force. Instead, it is to be a weak force weakening on behalf of the weak. All this points to the way in which designers and design thinkers might come to resolve the wickedness inherent in their own practices: by devaluing the *arche*, the highest value, whether God or the subject, designers can free themselves to perform an immanent trans-valuation of modern values by means of their general art.

Harrison illustrates his point through the work of Gianni Vattimo (1988), who names 'weak' and 'strong' design. Harrison explains that 'weak' design allows for an understanding of democracy freed from the order of official politics, and an understanding of conversation freed from the order of official dialogue. As Latour describes, in order to translate a context, one can avoid the politics entirely. Chia (1996a, p. 191) states:

> [U]pstream deconstructive thinking requires a thought style that is entirely at odds with modernist representational thinking. Moving upstream involves the vigilant uncovering and subsequent

> dismantling of the key conceptual oppositions which serve to sustain the project of logocentrism in Western thought.

To dismantle the 'city', and subsequently the 'smart city', discussions pertaining to neoliberal economics and the epistemologies and rationalisms of data-driven ontology are necessary, such as the discussion undertaken in Chapter 2. Following on from these discussions, it is the role of the 'weak' designer to continually deconstruct these concepts; to challenge the hegemony of non-thinking. By weakening categories, even those such as 'project' or 'organisation', meaning may be reconstituted from practices rather than ideology. In this sense, as Chia (1996a, p. 191) summarises, meaning is 'context-bound' and '[a]ny word, because of the essential instability in its meaning, acquires a slightly different sense each time it is used in a new context'.

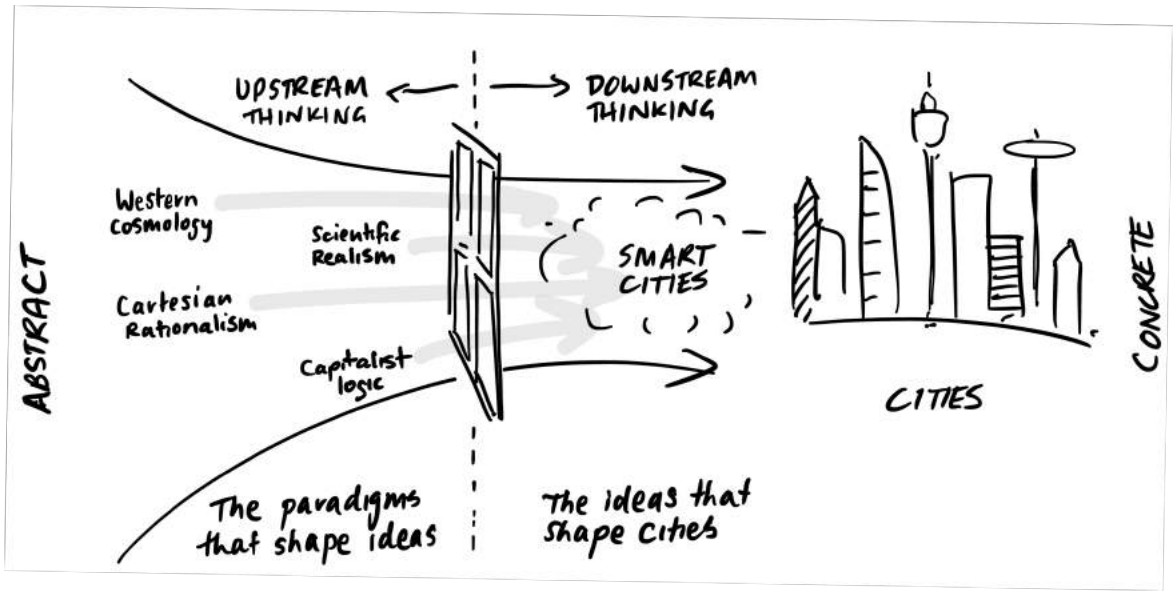

Figure 4: How 'upstream' and 'downstream' (Latour 1987) thinking might apply to smart city discourse. Source: author.

Figure 4 depicts the upstream and downstream concepts of the smart city discourse. The same practices take place in moving upstream ready-made scientific facts, as described in Chapter 1. When we treat the development of science as a practice rather than a product, the observations are moving upstream, back to where concepts may be disputed, before they were widely published and recognised as entities of their own.

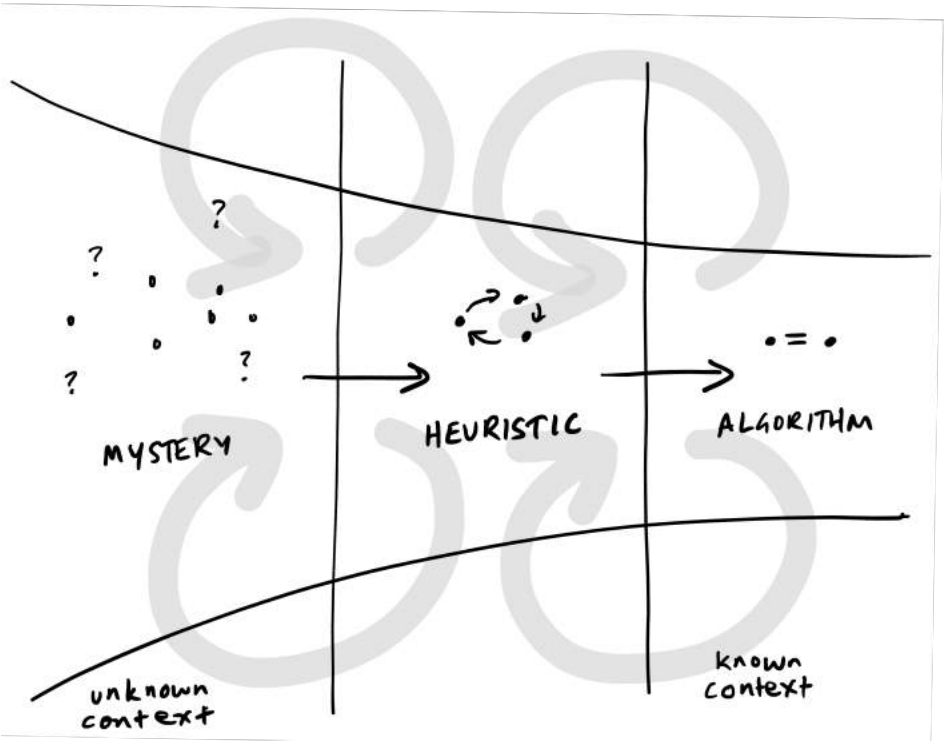

Figure 5: Challenging existing concepts, adapted from Martin (2009): the arrows represent design practice in challenging existing concepts by moving from 'upstream' or 'weak' concepts (left) to 'downstream' or 'strong' concepts (right).

Figure 5 presents a diagram from strategy and management theorist Roger Martin (2009). Martin's diagram articulates how a business service idea moves from a mystery, towards an eventual codification at its most profitable. The arrows articulate how a designer or researcher moves concepts between these upstream and downstream categories; as they broaden and contextualise concepts; then reduce them again, once an adequate means of description is found. The algorithm is the finished science; what Latour would describe a 'cold unproblematic black box' (1987, p. 4). Geoghegan and Pangaro (2009) argue that it is through the reduction of language, in the algorithm phase, that organisations leave themselves most open to disruption, with clear parallels in the challenges of urban planning. Rorty has argued that language is what changes paradigms; it is not paradigms that change language (Rorty 1989). Therefore, the move to upstream design necessarily involves the introduction of more language outside of the hegemonic upstream practices. Consistent with this view, Wahl (2016, p. 129) states; '[d]esign is either consciously or unconsciously an expression of our theories about the world – our culturally dominant worldview'. But this relationship is bilateral, as Wahl (2016, p. 131) confirms, '[d]esign follows worldview and worldview follows design'. For design practitioners to increase their language and conceptions about matters in urban context, would

be to begin to recognise the necessary diversity of the city and the specificity of its context. Further, design can play a role in shaping this worldview.

Design theory, practice and understanding

This section is a discussion about providing pragmatic knowledge for designers as a means to translate the Cosmopolitical proposal into smart city design practices. This approach aims to broaden the range of possible actions through their exposure to the richness of the experience of practice in smart city initiatives. Practitioners who create initiatives and applications and solve those problems in the urban context are the target audience for this research. As the pragmatist conception of 'truth' confirms, an idea's quality is a function of its usefulness. Therefore, this approach must not treat that any generated theory as useful to those practitioners, this experience must be designed to be useful.

Pragmatist design theory: negating the theory and practice dichotomy

In this upstream-downstream continuum, theory can play a role at any point. Karl Popper (1934) held that theorising involves the specification of universal statements in a form that enables them to be tested against observations of what occurs in the real world.

There is widely considered to be a dualism between theory-practice, resulting in a dichotomy. This derives from Cartesian thinking, which preferences the mind over the body. The 'theory-practice' gap is a perpetual philosophical challenge. Theory and practice are often problematised about the understanding of practitioners in practice, framed as an issue of knowledge transfer. Such views are limiting when compared to pragmatist perspectives. Pragmatic approaches do not match theory to observations; theories are not discovered but constructed, in order to support action. What matters is their usefulness toward action.

This thesis holds a pragmatist perspective on the practice of theory making: theory is dependent on usefulness. Description can be said to be theory, as it has an economy of language. However, this does not account for its pragmatist usefulness. Latour's perspective is

that a good description is a written text that is useful in another location (Latour 1988): if it is used more than once, then it is a useful description.

A strong explanation becomes necessary when someone wishes to *act at a distance* (Latour 1987), but, in a view that is distinct from mainstream social research practices, Latour (1988, p. 175) does not see 'explanation' as anything different to 'storytelling'. Such a stance is a rejection of ontological realism; of the understanding that there is an objective 'world out there'. Pragmatism rejects the dichotomy between realism and anti-realism, and in doing so rejects that theory ever reflects the real world.

Since design theory has to *be* designed, a question arises: how can the generation of theory actually support a practitioner's action? It is suggested that the answer may lie in understanding mental models; in supporting practitioners to reflect upon and refine their own models of how smart city initiatives work. Designers—those who practice the arrangement of the matter of reality—are subject to their own prefigured worldviews may have difficulty conceiving any alternatives. They may even lack empathy with others of a different perspective. It is therefore proposed that the view of the rational 'moderns' as a dominant means of thinking, should be recognised and objectified. The objectification of worldviews is central to decolonising design discourse and, it is argued, better prepares designers for the contemporary, postmodern, complex and heterogeneous contexts of design.

Pragmatism has been described as a means to escape from epistemological deadlock (Friedrichs & Kratochwil 2009). It is imaginative and derives new relevant interpretations of concepts. In its promotion of propositional thinking, pragmatism promotes abductive thinking. Abductive thinking is the development of a possible explanation for an incomplete set of observations, where both hypotheses and explanations are formed and evaluated. Abductive reasoning, however, is closer to everyday design practice: decisions are made employing incomplete knowledge about a context and outcomes. This way of thinking about problems can be creative, intuitive or revolutionary. Designers make connections between seemingly disparate observations and cohere them together as ideas, concepts and artefacts; as more coherent wholes.

Donald Schön (1983), in his description of 'reflecting-in-action', radically rethought the epistemology of design. This view sees practice as the embodiment of the competence and artistry of architects and designers. It opposes the extraction of knowledge, in which knowledge

is understood as rational, linear and scientific. Schön (1988, p. 181). grappled with the question of how knowledge of design expertise can be made explicit, recognising the need for understanding 'designers' *tacit* knowledge' as well as 'how they *hold* it, or get access to it when they need it'. As Schön (1988, p. 181) held:

> Designers are usually unable to say what they know, to put their skills and understandings into words. On rare occasions when they try to do so their descriptions tend to be partial and mistaken; myths rather than accurate accounts of practice. Yet their actual designing seems to reveal a great deal of intelligence.

Schön contributed to many areas of the understanding of the design process. Ontology deals with what entities exist or may be said to exist: their groupings, hierarchies, similarities and differences. Design practices are clearly influenced by what a practitioner thinks exists, and therefore arranges. Schön (1988, p. 9) describes this as the 'design world': 'the naming and framing of things, qualities and relationships'. Fry (2017) states that '[o]ntological design at its most general is a way of understanding the dynamic designing relations between the world, things and human beings'. Shaping ontology, therefore, represents a design process further 'upstream', in which a designer reflexively shapes their conception of 'what there is' based on the practicalities of the design task.

Personal knowledge makes up a large part of this *design world* (Schön 1988). Polanyi's (1962) description of tacit knowledge, where creative acts are charged with personal feelings or commitment, includes the notion that people hold 'passions' which take the shape of informal guesses and hunches, and which are used to move toward goals. As Polanyi states: 'we know more than we can tell' (Polanyi 1966, p. 4). The number of concepts that an individual or group can draw on is a function of their knowledge, preconceptions and worldviews. For Weick(2005, p. 463), theory 'cannot affect practice directly, it can call attention to ideas, which may call attention to certain actions, which people may then enact'. This thesis presents research that is intended, in this way, to be useful to practitioners. It requires an alternative perspective to the widespread, universalising, positivist research on the smart city. Entrenched processes and 'ways of doing' need to change to allow room for the introduction of any alternative. As problems cannot be solved using the same level of thinking that created them, alternative ways of conceiving reality that are outside the traditions of western thought are proving of practical use in managing contemporary complexities.

Theorists have long had problems in voicing context: overlooking constraints, taking the wrong things for granted, overestimating control, presuming unattainable ideals, underestimating dynamism, and translating comprehensible events into incomprehensible variables. The task of creating practical theory is a perpetual challenge. In keeping with Latour, what forms of description can serve an experiential understanding of the smart city; one of situated context?

This research describes socio-technical practice. It takes a descriptive, ethnographic approach to inquiry; an approach consistent with recent studies in Information Systems development, which seek to understand the networked and unknowable complexities of contemporary operational contexts. It is proposed that practitioners be given an experience of smart city initiatives, as they are understood in practice. Beyond this, the account should be formulated to facilitate the initiation of the Cosmopolitical interpretation of the smart city. Actants that are not usually noted need to be made present. By viewing the smart city as situated practices, ideological perspectives can be lost, as Latour has similarly noted in the field of science: 'Science is situated as a practice, not to be confused with knowledge or reason' (Latour & Miranda 2016, p. 326).

Design in context: practice and enactment

As established, pragmatic theory is the theory that is useful in action; the theory that is useful within the specificity of context. Mattern (2017) equates 'city-making' with a simultaneous enactment of 'city-knowing', one that 'cannot be reduced to computation'.

For Flyvbjerg (2001, p.8), it is art, literature and narrative that help us to understand the realities of life; 'what science does not reach'. If practice is indeed an act of 'thrownness' as Weick (2005, p. 458) has articulated, it is a 'mixture of unknowability, unpredictability, and enactment''. Within the field of IS, Lyytinen (2004, p. 224) calls for a design space that is 'continuously cocreated *[sic]*' through 'anticipations, theories, and imaginations of what can be or what is possible in our language, social order, and technological world.'

Yet Lyytinen argues that these processes of 'imagining, shaping, and enacting different communities of world and social order' do not actively feature in the discourse. Indeed, 'the publics', who enable this discourse, need to be designed. As Latour states '[w]e have problems, but we don't have the publics that go with them' (Latour 2012b, p. 515). Would it be possible to create forums in which the Cosmopolitical can be enacted, without prescription? This thesis contends that before programs of work should be initiated, or indeed designed, they need to

be framed. This framing should not just take place in theory, but in action, severing the long held Cartesian preference for thinking over doing. Expert knowledge is highly contextual, thus, context, time, space and temporality matters. Kierkegaard (1843, p. 306) has the summation of this perennial problem, proposing that life 'must be lived forwards'.

In scientific rationalism, we cannot analyse the present before it is the past; yet we cannot access the past or the future. Expert practitioners know more through their tacit knowledge than they can possibly tell; indeed, in applying the theory of history to history itself, one intrinsically selects those events or trends—those patterns—to fit into one's own pre-understandings. This raises issues for the study of history itself, and its relation to memory, and the range of suitable actions that one enculturates when one must respond to a situation.

Scripting a use of design 'theory'

The act of designing theory requires an understanding of future contexts in which it can be used. The challenge is that, most of the time, designers do not know their individual users. Designers can, however, apply principles to give their designs the best chance at usefulness.

The concept of 'scripting', developed in science and technology studies (1992), is an interesting notion for design practices. It speaks succinctly to the need for designers to understand how their designed artefacts will be used. Technical artefacts and science have been shown to be enacted by the same socio-material practices (Latour 1990). Scripts, as explained by Akrich (1992), are created when technologists define the characteristics of their objects in the process of planning, design and implementation. They make assumptions about the entities that make up the world into which the object is inserted. Designers of systems, services and artefacts define actors with 'specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science and the economy will evolve in particular ways' (Akrich 1992, p. 208). A well designed technical object enacts these networks when put into the world. A poorly designed technical object, does not enact the script or scenario it was planned for: *de-scription* as described by Akrich.

Scripts are an important framing, as recent understanding of contemporary practices of design are moving away from models in which a designer knows something about the future, and then tailors a solution towards that future. Design practices have erroneously been attached to the idea of 'future-making', an approach criticised by Storni (2013) as a potential form of colonisation of the future. Storni (2013, p. 58) argues that '...this approach is potentially

dangerous, and fails to achieve a truly democratic design process where the categories and limitations of the present are not imposed on the future uncritically'. Surety, particularly in the space of digital technologies, is radically reducing. The assumption that the future is fundamentally 'unknowable' is a radical departure from product and architectural design practices of past decades.

So, not only does the social shape technology, technology shapes the social (Hutchby 2001). Grint and Woolgar (2013), to this end, have also argued that 'users' themselves have to be made or configured along with the devices that are to be used. This represents a bilateral shaping of both users and technology. The act of putting something into the world is both an act of prediction (a script of how it will be used), and an act of persuasion (a script of how this is to be used over other options).

Design practices are now addressing far more complex circumstances, necessitating approaches that can no longer adhere to linear rational steps to address problems. These alternative, arational approaches, include alternate dispositional conceptions of design process, for example, earlier mentioned wicked problems (Rittel & Webber 1973; Buchanan 1992), reflecting-in-action (Schön 1983). Practitioners must contend with limited time, resources, attention, and politics; they are unable to completely analyse their changing context. It is suggested that the transfer of more complex, situated knowledge is best achieved through narrative; a narrative that makes explicit the situated nature of expert knowledge. What is challenging about this approach to addressing the smart city is that the research inquiry is a composite of research *into design* (critical interpretations and histories of design), research *for design* (documentation of action research via projects innovating materials and technologies) and research *through design* (investigations, contextual or instrumental in preparation for making) (Frayling 1993; Tonkinwise 2014).

Narrative and pragmatic history

The last section outlined the difficulty in providing 'theory' or, at least, useful 'descriptions' to designers in practice. This section extends the hypothesis for narrative as a means to convey situated expert knowledge to practitioners in other locations.

Narrative and complex knowledge

It is asserted that design practices should draw more on the rich history of the social sciences. Sense-making can be considered a retrospective process, as sense-making with new information is largely a process of assimilating it with memory, and other existing materials. Foucault, inspired by Nietzsche, employed the Nietzschian concept of *genealogy* (Foucault 1977). Genealogical accounts explain how things become what they do. Foucault was particularly interested in this perspective for it enables one to say different things about the present time. Genealogy, Foucault states 'requires patience and a knowledge of details and it depends on a vast accumulation of source material'(p. 140). Foucault focused on seeking genealogical explanations of morality through the exploration of amorphous subjects such as cruelty, punishment and love. But Foucault distanced himself from the simple explanations genealogy can afford, arguing it 'rejects meta-historical deployment of ideal significations' (p. 140). Foucault's emphasis on non-reductive genealogies is evidence of the type of narrative that would be useful in the reassembly of the smart city. Moreover, the genealogical perspective is coherent with the pragmatist evolutionary perspective. As Colapietro states, 'John Dewey's pragmatism is no less genealogical than Michel Foucault's genealogies are pragmatic' (Colapietro 2012, p. 188).

Kitchen stated that the smart city has a '...lack of detailed genealogies of the concept and initiatives' (Kitchin 2015, p. 132). Designers may find this perspective instrumental to understanding the development of their own theories of change, and therefore how to apply their own efforts towards desired ends in the obdurate socio-technical urban context. How does one use narrative to change the way practitioners think about context; to increase the range of what is available to practitioners?

In comparison to more traditional logico-scientific studies, narrative offers a more suitable approach into studies that emphasise meaning, personal experience, experiential concrete and context specifics, historical, paradoxical and ironic accounts (Tsoukas & Hatch 2001, p. 983, citing Bruner 1986, p.11-43). From these characteristics, it can be asserted that narrative is useful in imparting expert knowledge. As Linde (2001 p. 160), states, '[n]arrative is a mechanism by which social knowledge can be conveyed'. Narrative can be understood to provide a bridge between the tacit and the explicit knowledge, it enables this tacit social knowledge to be demonstrated and learned through example (Linde 2001).

Turning to historical narratives, Mason, McKenney and Copeland (1997, p. 307) state, '[h]istory helps one understand the sources of contemporary problems, how they arose and how their characteristics unfolded through time'. Neustadt and May (1987, p. xv) state that '[s]eeing the past can help one envision the future'. Creating history for purpose, can make the past pragmatic. History can remind us of the richness of human experience, stimulate the imagination and reveal new possibilities.

The pragmatist perspective may eschew normative academic practices, in the pursuit of research effects. As Latour (1988, pp. 172-173) argues:

> Since no amount of reflexivity, methodology, deconstruction, seriousness or statistics will turn our stories into non-stories, there is no reason for our field to imitate those few genres that have gained hegemony in recent time. To the few wooden tongues developed in academic journals, we should add the many genres and styles of narration invented by novelists, journalists, artists, cartoonists, scientists and philosophers.

In order to make compelling texts, Czarniawska (2008, p. 17) has encouraged that researchers emulate the authors that they most like to read, stating that 'painters too, begin their training by imitating their masters, then rebel against them in order to create their own style'. The methods and form accounts take matter to how they are conceived and ultimately perceived by readers. Narrative accounts of smart city project histories could provide a way to convey pragmatic perspective of smart city projects.

Idiographic Anthropological narratives

Creating situated accounts, wherein we understand the decision-making contexts of designers, requires an approach that individuals can relate to; constituted by a level of detail that makes these accounts appear realistic. In terms of research processes that inform design, smart cities are dominated studies which seek to draw universalising laws from many cases. These types of studies have been described as 'nomothetic' (Hempel 1965). Nomothetic studies create highly reductive, general laws; in contrast, idiographic studies aim to present the richness of experiences (Marciel 1977). These varieties are noted below (Table 1).

Table 1: Summary of types of inquiry (adapted from Mason et al. 1997, p. 308).

METHOD ASSUMPTIONS	ONTOLOGICAL ASSUMPTIONS	
	People and events are alike	People and events are unique
Nomothetic – selective examination of many subjects	Nomothetic and alike Statistical research yielding central tendencies	Nomothetic and unique Cluster or factor analysis, outlier examination
Idiographic – intensive examination of just a few subjects	Idiographic and alike Comparative case studies	Idiographic and unique Historical research

Historical research is quite often in the form of 'case studies' within organisational studies, that describe an instance or example of an actual state of affairs. Outside of the smart city, there is a robust history of these types of social and technological studies, including in Anthropology and Organisational Studies. Across both of these fields, ethnography has facilitated the study of individuals and groups in their locations of practice and helped to account for the ways in which people negotiate everyday situations. In design practice, ethnographies are useful ways to get closer to users and to key actors.

In keeping with notions of 'idiographic study', anthropologist Clifford Geertz (1973) developed the concept of 'thick description': the explicit detail that assists readers to understand the lifeworld of ethnographies. Geertz also identified the layer of interpretation that both researcher and reader place on any photograph, video, quote or description of behaviour that features within the ethnography. Ethnomethodology outlines the methods used in ethnographic studies (Collins & Makowsky 1978, p. 232) and compels the researcher to adhere to the words and descriptions given by participants. Rawls and Garfinkel (2000, p. 146) argue that social orders must be visible in micro-processes, otherwise they do not exist. This is a crucial aspect of understanding the smart city from pragmatic experience rather than from ideological perspectives.

Incomplete, plural and non-linear narratives

The French postmodernist and poststructuralist movement developed the concept of *meta-narratives. Meta-narratives* are narratives about historical meaning, experience or knowledge which offers legitimation through the anticipation of a not yet achieved master idea. Lyotard (1984) was a strong critic of the *meta-narrative*. He believed postmodernity signified their rejection. Meta-narratives include such concepts of development, such as 'great dangers', 'great voyages' and 'great goals' (Lyotard 1984). Also, considered against meta-narratives, Foucault revealed that against hegemonic discourse, in studying history, one reveals that not everything is better in contemporary western society, and that contemporary life was understandably worse for some groups of society than in previous times, such as the mentally ill (Foucault 1988) and prisoners (Foucault 2012). This was part of Foucault's critique against *meta-narratives,* in which he compared current situations in 'developed' society to earlier periods (Foucault 1995). There are situations, he argued, that were better in many ways than the present. He sought to reject this meta-narrative understanding that everything was the best it has ever been at the time of his writing.

Once the smart city's meta-narrative of technological advancement is stripped away, what will narratives of practice look like? Can description cohere with the plural experience? Like cities, there is a common notion that narratives are also incomplete. Language is a means of conveying information, but it only partially conveys what the writer or speaker was intending. Every reader will have variety in their interpretation of meaning.

The implementation of new technology is typically described in prescriptive literature as a rational-linear process, which has been the subject of criticism (McLoughlin 1999). Written narratives can also give false impression that causality can be traced in an unproblematic, linear fashion. Such storytelling is incongruent with the understanding that '…organizational life is a multiplicity, a plurality of stories and interpretations in struggle with one another' (Boje 1995, p. 1001). However, there are alternatives, including forms developed for Deleuze and Guattari's (1987) notion of the *rhizome*. The use of this metaphor, which is developed through roots, stems, radices, bulbs and tubers, allows narrative forms to trace all events and instances to all others. It is for this type of system that Boje has developed a form of narrative telling; a complex system that designers need exposure to.

A rhizomic system has its own unique typology that can be understood by its principles, the first being *connection, heterogeneity* and *multiplicity*. While 'any point of a rhizome can be connected to anything other, and must be' (Deleuze & Guattari 1987, p. 7), the system cannot be reduced to a single perspective, with 'no unity to serve as a pivot in the object, or to divide in the subject' (Deleuze & Guattari 1987, p. 8). Under the principle of *asignifying rupture,* it is impossible to separate or cut across a single structure, as '[a] rhizome may be broken, shattered at a given spot, but it will start up again on one of its old lines, or on new lines' (Deleuze & Guattari 1987, p. 9). Lastly, the rhizome has principles of *cartography* and *decalcomania* where '...a rhizome is not amenable to any structural or generative model...a stranger to any idea of genetic axis or deep structure' (Deleuze & Guattari 1987, p.12).

Boje's rhizomic *antenarrative* seeks to cohere with irreconcilable differences found in practices of plural storytelling. Vickers (2005, pp. 2-3) holds that 'postmodern antenarratives encourage the possibility that there may be no story to tell, only fragments that may never come together coherently'. The antenarrative reflects the process that 'unravels narrative', a 'dynamic weave of differences' (Boje 2007). As Boje (2007, p. 224) maintains: '[a]ntenarratives are self-deconstructing, fragmenting, emergent, and networking among polyphonic characters; they are not at all static and linear. They are also incomplete; they 'never quite get there' and 'unravel as fast as coherence is applied' (Boje 2007, p. 224).

Plurivocal (many voiced), polysemous (rich in multiple interpretations) and intertextual (dialogic), antenarratives stands obverse to the diffusion model of explanation or to the heroic story of a brilliant innovator who champions a technology and makes it successful (Latour 1993b, p. 119). Such perspectives may enable engagement with multiple voices and multiple realities; offer constructs to those seeking to incorporate and understand multiple positions (Gergen 1991, p. 85); and provide evidence of the 'micro-practices' of organisations that reflect the spontaneous, aggressive and expansive, as well as the countervailing, taming and remedial (Boje 1995).

Enacting antenarrative experience

As Schön (1988) has stated, 'we make worlds in which we live'. This sentiment affirms the intent to design the Cosmopolitical of the smart city. Through the lens of performative theory, the smart city discourse is constantly being enacted, through stabilising relationships and definitions that actors are enrolling others into. The cosmopolitical framing of the smart city

will seek to enact different, more diverse relationships in its conception. Rhizomic approaches to descriptiion, such as the antenarrative proposed by Boje, are not linear or conclusive, but are coherently with a cosmopolitical commons, open and networked.

Like the Cosmopolitical, approaches such as antenarrative allow for conflicting and unresolved perspectives to remain in what is said about a problematic situation. For example, Boje and Rosile (Boje & Rosile 2002) have applied this approach to the Enron collapse, noting that there are multiple narratives at play to explain what happened (illustrated in figure 6).

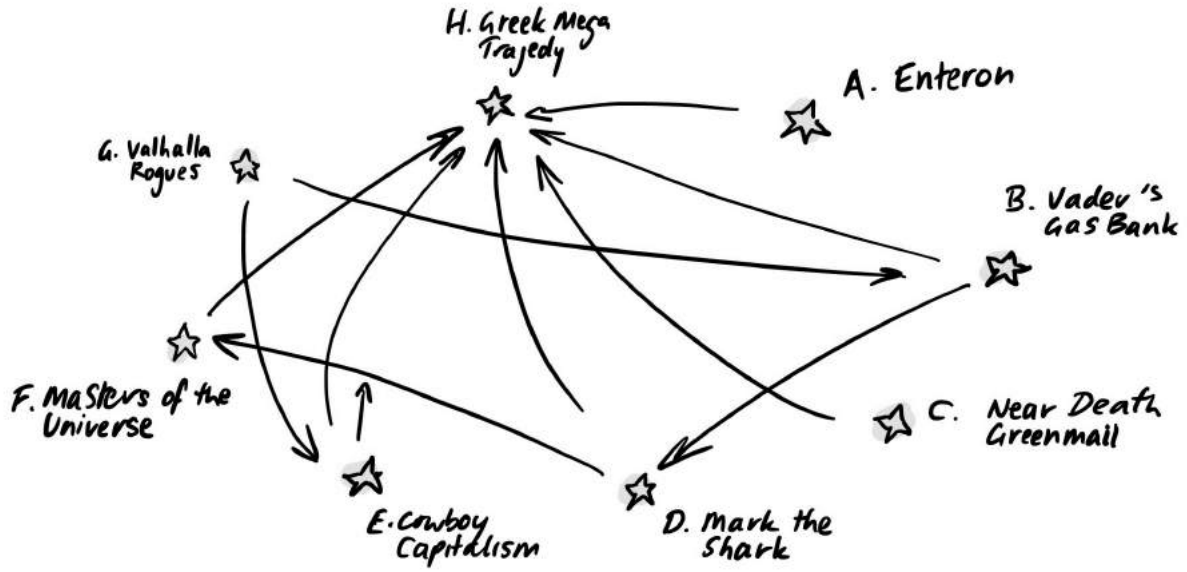

Figure 6: 'Antenarrative clusters and trajectories' for the Enron case. Adapted from Boje et al. 2004, p.8.

Meta-plot narratives range from 'villians did it', to 'evil corporations did it', to 'it's the political system' or 'it's capitalism'. Each of these has different plots for each interpretation. This notion of multiple, competing narrative explanations is useful to conceive the smart city, as it too, is not readily explained from one perspective. None of these perspectives are the objective truth, nor are any of them fully accessible. They are story fragments that need to be held together in non-linear relationships. They are stories that can also remain in conflict with each other. This perspective problematises simple universalising explanations of cases.

Making smart city narratives cosmopolitical

This section outlines the use of narrative to provide situated explanations of decisions in context. Through seeking to create new ontologies of the smart city cosmos, experience must be reimagined; opening up the designers' sense of 'what there is' to include socio-material obduracy and the richness of what exists beyond formal political discourse. To facilitate the Cosmopolitical, material actants such as technological and natural, take equal place in the discourse. The following is a speculative proposal for how this could take place, in creating experiences for design practitioners to expand the range of reasonable action.

Revisionist histories

There are no truly accurate representations of social events. A video, an audio recording, present single perspectives, a single viewpoint; they have a start and finish, whereas an event has traces that extend far beyond these arbitrary boundaries. Detached from the complex realities from which they originated, they tend to lie within modernist abstractions, simple reifications and *a priori* categorisations which have for decades dominated business literature.

The smart city literature, as discussed in Chapter 2, tends to look favourably on those who write the cases and reports; yet, all histories, whether intentionally or not, have bias. In a research context, it is preferable to explain any bias that the researcher may have and align this with the objectives of the research. History may be used for pragmatic ends, to serve purpose, rather than just seek *the* 'truth', or find out 'what really happened'.

Of relevance is Clark and Rowlinson's call for a 'historic turn' (2004); the integration of more historical research into management and organisational studies. As an ongoing discourse, the 'historic turn' has provided many proposals on the issue of bias in academic studies. In their contributions, for example, Smith and Russell (2016) have pointed towards a 'polyphonic constitutive historicism'. This historicism represents a shift to understanding how competing versions of the past are developed within and shape organisations; an approach that seeks to avoid singular and uncontextualised perspectives of the past. The concepts of 'social memory' (Smith & Russell 2016), as well as 'collective memory', influence the investigation of how the historical ideas of non-academics influence behaviour in the present (Klein 2000).

Reconstituting narratives of the past may provide resources for speculating alternative futures. The rewriting of history from various perspectives has long been a crucial task in feminist studies and post-colonial studies, where dominant accounts exclude or neuter the perspectives of certain segments of the population or natural systems. Writing back into history what has been oppressed is one approach, traditionally applied to identity politics and, more recently, to technology and natural systems (see Haraway 1991). In Science and Technology studies, histories are revised to give a more dominant role to technology's agency in shaping present day systems; an area that is still largely ignored in western thought, despite the clear logic of the argument. Foucault's (1980) understanding, that power is everywhere, demonstrates that the mechanisms of oppression are found within language and discourse. Through an understanding that the past preferences certain actors, demographics, world-views and paradigms, one may extrapolate forward; examine how the biases of the past may distort understanding of present problems.

Histories of cityness and urban variety

By applying the principles of revisionist histories to urban studies, specifically the way the 'city' is conceived, one can reveal how the ontology of the smart city is misleading. Purporting to be about data and systems that control the randomness of urban happenings, the dominant perspective does not speak to complex social processes or to a socio-technical understanding of innovation. These processes must be understood. The obdurate nature of the urban environment is easily forgotten in the sweeping solutionism of technology determinism. However, as decades of innovation studies have shown, the best solutions for some are often detrimental to others. The way technologies become successful is both a matter of design and chance. As mentioned in Chapter 2, the city's longevity depends on an immense variety of experimentation. Hence, the city can be constructively conceived as incomplete (2013b; 2014; 2015a). We can usefully consider a city as constituted of tentatively held assemblages that are continually being made and remade through continual experimentation. This serves as a metaphor of complexity that draws attention to alternative ways of understanding (Rorty 1989). A metaphor for the city that is deeply embedded in an ontology of process. But how can this ontology be represented? Some notions of design are more useful than others in dealing with what is both political and emergent.

Designing for discourse: critical and speculative artefacts

Two clusters of critical design practice, referred to as Critical Design and Speculative Design, have emerged since the 1990s. Critical design practices offer a more rhetorical notion of design: design is 'discursive' (Tonkinwise 2014). Design finds a role in increasing societal awareness in motivating and enabling political actions (DiSalvo 2009). It has an ability to construct publics and mobilise debate (Malpass 2013). For Buchanan (1985, p. 6), the designer is a speaker within this rhetoric, seeking '...to provide the audience with the reasons for adopting a new attitude or taking a new course of action'. The artefacts developed are less about practical function, and more about predisposing minds for educational and artistic purposes.

Importantly, critical design objects are non-rational; critical design operates with ambiguity. The object is placed in context through mechanisms of narrative storytelling and allegory. Ambiguity is used in relations between entities and contexts in what is used, creating conditions for a personal projection of imagination and values onto a design.

In Speculative Design, design has a role in raising public awareness of social agendas that have been little explored. As DiSalvo and Luken argue, Speculative Design '...emphasises inquiry, experimentation and expression, over usability, usefulness or desirability' and is '...thus exploratory and suggestive of what might be' (DiSalvo & Lukens 2009, p. 2). Often situated between emerging scientific discourse and material culture, Speculative Design typically focuses on the domestication of emerging ideas in the sciences and applied technology. Yet it is also concerned with futures research and project possibilities; the projection of sociotechnical trends and developing scenarios for products in new use contexts (Malpass 2013).

Objects of Speculative Design also tend to be non-rational. They do not fit with expectations of existing products, and as such, they not are likely to be immediately understandable or assimilated into the collective imaginary. The object and its use are dependent on the fabrication of an external narrative to contextualise it. While the aim of constructed narratives is to make sense of the object, some level of ambiguity is still necessary in order to provoke debate. The purpose of the design may be mysterious, impressionistic, or otherwise uncertain; importantly, people are compelled to join in the work of making sense of it. Such objects are not meant to become mass market products, but rather are intended to stimulate

conversations. Dunne and Raby (2001, p. 75) note: 'Designers cannot always solve problems … Although we cannot change reality, we can change people's perceptions of it'.

As DiSalvo (2009, p. 48) questions: '[h]ow does, or might, design contribute to the construction of publics?'. DiSalvo (2009, p. 49) argues that this process is about '[m]aking visible and known the complex situations of contemporary society', reiterating Latour in making discursive publics for our already existing problems (Latour 2012b). If we apply this notion to the smart city, the challenge is then to design things that are capable of structuring and facilitating the conversations that are not being had inside the existing discourse. These are Deweyan technologies in both senses: potentially functional artefacts, but principally artefacts to facilitate discourse.

Prefiguring cosmo-politics

According to the Merriam-Webster (2018) definition, prefigure is 'to show, suggest, or announce by an antecedent type, image, or likeness'. It is derived from the Latin, *pre,* meaning *before*, and *figurare*, meaning *to shape or form*. Thus, to prefigure is to show in advance a shape or form of something. Design has long been deeply associated with shape and form and prefiguring can make available references which increase the range of variety to the designer. In terms of the smart city, variety can be seen as a serious consideration of the influencing elements that lead viable initiatives. The visual is presented to enact a 'prefigurative politics'; to perform new social and relational values into being, making them apparent when they may otherwise go unnoticed.

Boggs (1977, p. 100) originally defined 'prefigurative politics' as 'the embodiment, within the ongoing political practice of a movement, of those forms of social relations, decision-making, culture, and human experience that are the ultimate goal'. Yet Boggs' Marxist critique failed to provide pragmatic means to move towards a new political reality. DiSalvo (DiSalvo 2016) argues that the concept of 'prefigurative politics' outlines another set of possibilities for political design through design research. He proposes 'a Research-through-design approach', one which produces 'prototypes of artefacts, systems, and environments through which we could experience possible political conditions' (DiSalvo 2016, p. 34).

In the case of this inquiry, the social relations are those that have been experienced by practitioners in cases; relations that have not been adequately articulated in the project's public recorded histories. These detailed social relations are unlike those that are described by those

of the hegemonic smart city discourses. The intent is to enact this divergent view of smart city initiatives in practice. This difference between the practitioner accounts and what was already publicly recorded histories will be explained in more detail in Chapter 5.

This remaking of the ontology of the smart city may be considered an application of design as 'ontological designing' where; 'we design our world, while our world acts back and designs us' (Willis 2006, p.70). A decentring of the agency of the designer, to where 'neither object, process nor agent is granted primacy' (Willis 2006, p.86). Thus, following this thread, the cosmopolitical politics of the smart city can be prefigured. A re-enactment of a project history to inform future designs. In doing so, an artefact is created that presents an alternative ontological, epistemological, and languaged space from which to design. In conclusion, this prefiguring seeks to build the repertoire of resources for designers in the urban context as an artefact to think with, analogous to what Schön has described as the 'design world' (Schön 1988). As Schön (1988) describes, the number of concepts that an individual or group can draw on is a function of their knowledge, preconceptions and worldviews.

A pragmatic history-making

Historical perspectives on existing smart city projects may be pivotal in reorienting the discourse towards pragmatism and in explaining existing cases that have already happened. Since they relate to real action in real contexts, these cases would be well defined and less ideological. Historiography, the field of 'history making', presents a genealogical approach largely missing in the smart city discourse, yet core to pragmatist thought. Indeed, historical accounts are still fringe knowledge in fields closely related to the smart city, such as management studies and IS.

In management studies, historians experience isolation and marginalisation (Taylor et al. 2009). As outlined by Bell (2013), there are four interrelated claims supporting this assertion: historical research is not acknowledged in scholarly debates, history is not well represented at conferences, few academic posts mandate historical teaching in lectures, and history is poorly represented in textbooks informing the management field. In IS, there have been promotors of the historical perspective (McKenney et al. 1995; Mason et al. 1997; Bannister 2002; Land 2010), but it remains a neglected field (Bannister 2002).

Nevertheless, learning the lessons from failures and successes is common rhetoric in organisations, governments and industry. Clark and Rowlinson (2004, p.400) state: '[h]istory

is about lies, not truth. It is a struggle for domination acted out in a play of wills'. This historic turn should therefore be understood as 'part of a wider transformation that is alluded to in terms such as the 'discursive turn', deconstruction and postmodernism' (Clark & Rowlinson, 2004, p. 331). It is the displacement of the 'scientific attitude' with a 'rhetorical perspective' (Fay 1998).

As no historian has access to events in the past, other than what is recorded or remembered, all history is a fabrication. The past is produced through our efforts to create history. Because history is often associated with nostalgia, the production of history may not serve a clearly pragmatic purpose. Yet, in contrast to this perspective, Bradbury (Bradbury 2012, p. 341) outlines the narrative possibilities of the past for the future.

> Narratives of the past may provide resources for articulating future possibilities [..]perhaps nostalgia is not so much a longing for the way things were, as a longing for futures that never came or horizons of possibilities that have been foreclosed by the unfolding of events. Perhaps nostalgia is the desire not to be who we once were, but to be, once again, our potential future selves.

History can be made in ways that enable us to rethink the present and future. Different, more complex narratives could portray very different explanations of smart city cases.

A study by Mitev (Mitev & De Vaujany 2012) found that the majority of IS historical papers confirmed existing theories (supplementarist), rather than extended theories (integrationist) or questioned theories (reorientationist). Yet the authors found that the extension and questioning of theories would have the most potential for creating 'a critical understanding of IS-related organisational changes' (Mitev & De Vaujany, 2012, p. 119). It is the reorientationist perspective that provides the most relevance to the smart city pragmatist discourse. Reorientationist perspectives involves the 'extensive use of historical data and historiography to deconstruct existing theoretical frameworks' in order to 'propose new ones', and challenge theories with a 'critical stance' (Mitev & De Vaujany 2012, p. 112).

So what is history? To Deleuze (1995, p. 171) 'history amounts only to a set of preconditions, however recent, that one leaves behind in order to 'become', that is, to create something new. Similarly, Runia (2014) argues that history is not a gradual linear progression, rather momentous incidents in history are those where people choose to induce a radically alternative model of social relations to prevailing hegemonic discourse. Runia (2014 p.198) describes this

process of abandoning established facts as 'fleeing forwards'; as a compulsion driving people to create 'cascades of improvisations', diverging from the threats of established ideas.

How could one create histories that explain this? Causality in the pragmatist perspective is ecological, it is not a chain of events, rather an accumulation of all experience dispersed across contexts and multiple actors, or context that creates rupturing action.

The challenge of practice in the smart cities' proposed networked, relational systems, is by its very nature, a different paradigm to the lineage of municipal governments and traditional urban governance organisations. These institutions have for the 20th century and prior, been in a privileged, respected position of stability. Can contemporary histories reorient these practitioners towards the emerging paradigms that shape cities?

Prefiguring variety in urban ontologies

Always design a thing by considering it in its next larger context - a chair in a room, a room in a house, a house in an environment, an environment in a city plan.
Eliel Saarinen (quoted in Hill 2012, p. 93)

Prefigurative politics, as has been described in the previous section, outlines the ability for activists to enact the relations they wish to see in the world. However, it is asserted that the Cosmopolitical can be performed for the purposes of making present to designers what would otherwise not be present. This section offers a pragmatic prefiguring for designers who are enacting the practices of smart city experimentation.

Making towards a new 'normal'

Postmodernity is a late arrival to predominantly 'modern' organisations such as public-sector organisations, corporations and local councils. They are still largely rational organisations based on the old principles of Taylorism and humanism; principles incongruous with contemporary expectations, particularly in relation to the smart city. The smart city challenges centralised control systems in these traditional organisations. It is important that we do not see postmodernity as a replacement of modernity. Rather, postmodernity is an upstream activity to the modernising activities of categorisation, ordering and hierarchy. It was Latour (1993a) who argued that 'we have never been modern'. How can interventions relating to the

smart city discourse—the way we talk about it—change the practice into one that is more pragmatic in the 21st century context?

In the first instance, these we need to think about the smart city as evolving from what already exists, as evolutionary. Second, we need to treat experimentation as the way to develop more useful interventions. Third, the ideological meta-narratives of the smart city must be ignored to describe without priori metaphysical distinctions. Third, and following, understanding must essentially involve the removal of unnecessary categorisations, such as Cartesian rationalism. And lastly, the smart city must be understood as part of a relational ecology. It is only then that we will have an understanding of the phenomenon, a means to adequately describe what it is without appealing to any higher order explanations. But how can one mobilise such as reinterpretation?

As mentioned earlier, in recent years there has been renewed interested in Dewey's constructivist perspective of the public, none more so than in the fields of science and technology studies (Latour 2005a; Marres 2005), and more recently, design (Ehn 2008; DiSalvo 2009; Bannon & Ehn 2012). In these object-oriented politics the emphasis is on the assembly of human and nonhuman actors (such as objects, artefacts and devices) around issues. Central to this notion is the performative agency of material artefacts, technology and nature to construct and structure publics and their discourses. Speculative design, as mentioned earlier, does provide a means to enact the rhetorical understanding of design (Buchanan 1985). Can the politics into the smart city be made more public? To do this, traditional planning processes would need to be circumvented. This is part of the ongoing democratisation of urban processes.

Organising contemporary complexity

Planning activities are acts of design to create a course of action most suited to context. What will eventuate tomorrow cannot be completely predicted today, however, individuals and organisations are called upon to make choices in relation to what will happen (Schwartz 2012). Thus, organisations are dealing with unprecedented complexity in planning, decision-making and operations (Conklin 2006; Mintzberg 1994). Many planning processes within industries across the globe are undergoing radical changes; the language is changing towards sense-making processes and more widespread use of tools that are appropriate for these contexts (Snowden & Boone 2007).

Complexity becomes a way of thinking about the world, rather than a new way of working (Snowden & Boone 2007). A recognition of complexity underscores the incompleteness of all models; an incomplete understanding of the world and how things will unfold over time. In the Cynefin framework (figure 7), Snowden and Boone outlines ontologies of problems, articulating the notion that there are chaotic and complex categories. These categories stand in contrast to the dominant organisational ideology that assumes there are underlying relationships between cause and effect, with examples including the 'three-year plan, the commission investigating past failure and scenario planning' (Snowden 2005, p. 47).

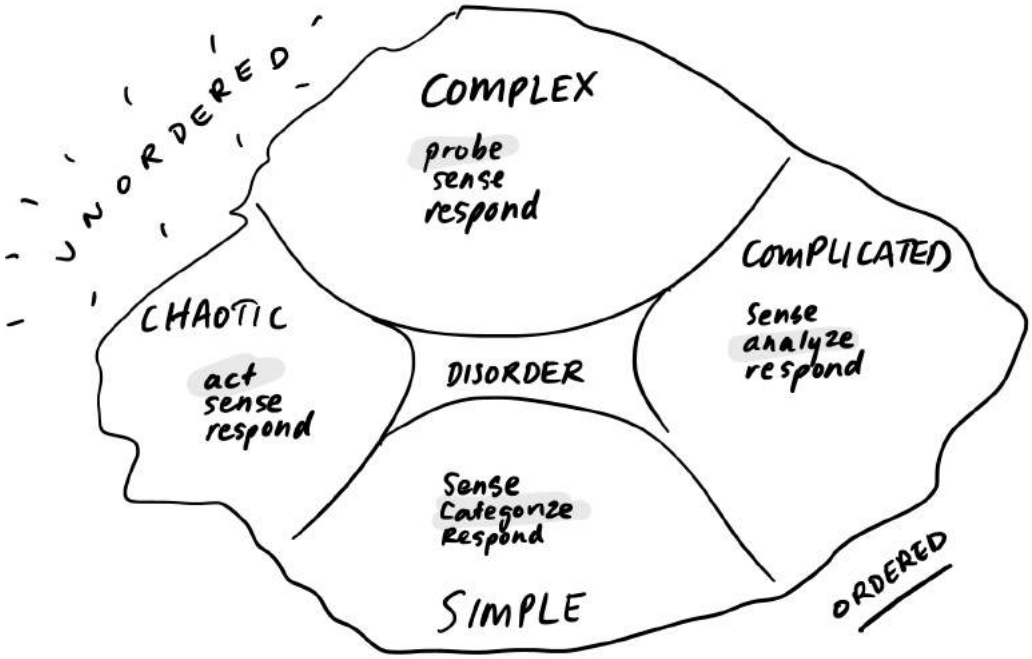

Figure 7: The Cynefin framework. Based on a graphic by Debera Johnson in Snowden & Boone 2007, p.4.

The Cynefin framework also outlines subsequent approaches that must be taken to address the typology of the problem. These approaches involve new forms of interaction outside of rational models which are unable to deal with the chaotic and complex categories of a situation. What is important to note, is the responses proposed by Snowden and Boone are different depending on what type of problem it is, if the smart city treats the city as complicated, analysis will be seen as the best way to deal with the problem vs complex, where the best way to act is to probe into the environment to guage effects. Framing of these types of problems matters. It is critical for practitioner understanding that the narratives that are told about smart cities depict the same

ontology of problem and does not simplify it for communication. As Kitchin (2016) states, cities are full of 'wicked problems', wicked problems are in the category of complex problems.

Cities are complex systems have innumerable interacting elements; interactions are nonlinear, with small changes producing disproportionately large consequences. These models of thinking, are crucial for thinking about emergence in cities. No matter how much planning takes place, outcomes and implications are unpredictable, and discursive and contingent practices are the most appropriate means of dealing with this emergence. How can all of these more complex understanding of emergence be made more apparent to designers in the context of smart city initiatives?

Experiencing/Enacting contemporary complexity

Chaos and complexity are metaphors that propose new connection and draw attention to what we could not see before (Rorty 1989). According to Snowden and Boone (2007, p. 7), responding to inadequate habitual responses, complexity is about 'being patient and allowing time for reflection' and 'using approaches that encourage interaction so patterns can emerge'. These are more 'performative' aspects of research. The approaches, answers and contexts cannot be simply given to practitioners. Rather, actors must generate their own courses of action, suited to their unique contexts. The actors must enact the theory themselves. Performative models of theory have grown rapidly in academic practices in recent decades; they are becoming more popular in the context of understanding socio-material relations that are coherent with complexity thinking. Performative theory is more coherent with the multiplicity of complexity and its emergence.

Performative research focuses on an outcome beyond representational models of knowledge. As Orlikowski (2006, p. 460) explains: '[f]rom this perspective, knowledge is not an external, enduring, or essential substance—but a dynamic and ongoing social accomplishment'. To Barad (2003, p. 802), '[a] performative understanding of discursive practices challenges the representationalist belief in the power of words to represent pre-existing things.'

Using a performative notion of research adheres to the propositional nature of pragmatism, through its concern with the effects of research in response to real contexts. A normative approach would be to develop, deliver and distribute research knowledge through journal articles that succinctly argue salient points. But would this be enough? Are journal articles the best way of developing knowledge for designers? Latour and the artist Peter Weibel have curated a series of exhibitions to demonstrate the various dimensions around particular issues, such as the use

of image in science, religion and art in *Iconoclash* (see Latour & Weibel 2002); democracy and the construction of public in *Making Things Public* (see Latour & Weibel 2005), and an anthropology of 'the moderns' in *Reset! Modernity* (see Latour & Leclercq 2016). These series of workshops, publications, experiments and culminating exhibitions employed the use of artists, academics, and fiction writers. Around these themes, each exhibition builds up a body of work that is arational by nature. The last, *Reset! Modernity* (Latour & Leclercq 2016) was the culmination of five years of research and a series of earlier publications (Latour 2013a; Latour 2013b). In these exhibitions Latour and Weibel, and various artists, engage with a wide variety of world making exercises to create models of complex systems, photo montages, film, experiences that involve artists, designers and academics to create narratives to form catalytic activities. Some of these activities are speculative, some not, but the conception is largely critical. Another project, MACOSPOL, discussed in the following chapter, also created an aesthetic sense of public controversies. The process, developed by Latour, enables a through-mapping; a tracing of design practices attentively, rather than explaining causality away by 'social processes' (Yaneva & Heaphy 2012). This 'cartography of controversies' is an exercise to describe debate, especially around technoscientific issues (Venturini 2010); it is an approach also used to 'make public' the politics of architectural projects and infrastructure development.

Unfolding the smart city Cosmopolitical for designers

Schillmeier (2011) situates: '[t]he political endeavour demands a constant and thorough rethinking of the politics of imagination, power relations, norms and normativities...that have brought the very realities of the social (cosmos) into being'. As Domínguez Rubio and Fogué (2015, p. 9) have argued, design has the capacity '...to reorganize what counts as political in our everyday lives'. Design has the means to create political action through things; to control physical and technological elements that silently shape actions and thoughts, outside of the spheres of formal politics (Domínguez Rubio & Fogué 2013; Marres & Lezaun 2011).

DomÍnguez Rubio and Fogué (2013, p. 1039) make the proposition that '...the transformation of the subpolitical worlds of infrastructures and nature into fully public and political worlds not only offers a new understanding of urban space but also the possibility of new forms of civic participation and engagement'. Sociomaterial practices of the city not only offer the chance to redefine philosophical and social science, but also open a different course of action for architecture and public spaces (Domínguez Rubio & Fogué 2013, p. 1041). The smart city, beyond

this, includes far more organisational practices that too can be transformed by a sociomaterial understanding.

Domínguez Rubio and Fogué (2015) explain the difference between practices of *enfolding* and the more suited *unfolding;* a key difference for cosmopolitical performative research. The former *enfolding,* as Domínguez Rubio and Fogué argue, is for critical practice. The latter, *unfolding*, is for the propositional nature of research; it is a making of something new. Abductive design practices are thus required.

Stengers' use of the Cosmopolitical is not about attempts to create a unified common world, but rather the ongoing project of exploring and expanding the repertoire of possible common worlds, as Domínguez & Rubio (2015, p. 148) states: '…not about unifying the world but multiplying it'. Ontology deals with what can be said to exist. Thus, the designer's knowledge of 'what there is', particularly in relation to their purpose, is critical for their optionality in a given context. When designers enter a new context, they must adopt, or at least be aware of, the ontology of that context. For example, working in healthcare or transport, designers must adopt completely new language to understand their context. The smart city is a confluence of many ontologies, ranging from information technology, engineering, urban studies, policy, governance, management and sociology. Each practitioner that initiates or contributes to practices will each have their own set of language and concepts that will have differences to many others. The Cosmopolitical is about introducing new ontologies to those already present in the conversation and introduces other stakeholders others that are not usually present. This plurality of ontologies denotes what designers attend to in their environment of action. Such a proposition is ambivalent towards the realism/anti-realism dichotomy by focusing on discourse.

Personal memory makes up a large part of the designer's *design world* (Schön 1988). Critical and speculative design have a role in making and expressing new design worlds; in provoking rhetoric and challenging designers. Hinchliffe, borrowing from Latour (1998), argues for the creation of 'wild things': 'Wild things become real as people engage and learn with them' (Hinchliffe et al. 2005, p. 643). This is a congruent perspective with speculative and critical design practice.

Harrison and Harrison (2015, p. 224) note: 'fictions must present the cosmos'. Yet, the thought leads to questions: What are the right fictions? What are the right biases for narratives? Latour's (2004a) 'political ecology', Heise's (2008) 'cosmopolitanism', Moreton's (2013) 'hyperobjects'

and Whatmore's (2002) 'hybrid geometries' ask the same questions. Harrison and Harrison (2015, p 224) posit that 'each of these writers proposes a form of collective thinking and action that risks disagreement, [and] in doing so, resist prescribing a single solution regarding how humans should behave toward nonhumans'. They continue: '[o]ngoing debate or relation-making activity – continually reforms the issues as new human and nonhuman actors are incorporated into politics, shifting the content and parameters of discussion' (p. 224). These fictions are open to interpretation but arouse a new consciousness of plurality, difference and a way for people to relate to amorphous larger systems.

In addressing the act of performance, Harrison and Harrison (2015, p. 237) state:

> The act of performing alternative worlds has implications for ecological practice. Performance represents an immediate action, yet one that, not driven toward a holistic solution or consensual world-view, makes visible and preserves a plurality of voices. By constructing fictional worlds in which nonhuman actors are manifest, ecological theory melds with the pragmatic enactment of provisional relationships, which, once performed, may have the potential to be reproduced and built upon outside of the realm of the performance event.

It is this understanding of context, both of the urban and now of design, that we take into the framing of the empirical study of smart city initiatives. This chapter has begun to outline a methodology; a methodology capable of performing complexity; a methodology to open the range of actions available to designers in order to facilitate an altered consciousness of socio-material relations; a methodology capable of escaping the limits of rationalism.

As we now are aware, cosmopolitics is a politics that is 'worked out', without resorting to old binaries of nature and society. It necessitates a removal of divisions between nature and culture, and a rethinking of anthropocentric dominion over nature and technology. This perspective also involves a move away from rational models of knowledge and static entities, and a rejection of reified societies and publics, cities and cultures. This is possible through performative and pragmatic approaches to reconstitute the meaning of things in, and for, action.

In summary, the Cosmopolitical is realised through making the technological and natural actors political; by making usually invisible actors present in discourse to prompt cognition and awareness. This cannot be achieved by explanation nor representation alone; rather, by enactment in practice. What is required is to design the Cosmopolitical to facilitate action. It is to this action that this thesis now turns its attention.

Chapter 4. An adequate methodology

In a multiplicity, what counts are not the terms or the elements, but what there is 'between', the between, a set of relations which are not separable from each other. (Deleuze & Parnet 1987, p. viii)

Method is 'a way of doing'. The term originates from the Greek etymology of *meta* (after) and *hodos* (a travelling way). The term 'methodology', more broadly, refers to the branch of scientific knowledge associated with ways of doing. It defines the research 'way', such that the production of knowledge can be replicated by other researchers. This chapter concludes the first part of this thesis, 'Part A: Suspending the smart city', by outlining the methodology used for the empirical study; also, a subsequent means to reassemble the smart city from practice. It is a methodology developed to understand smart city practices in context, as socio-material practices; it is also concerned with the use of the research to create practical effects.

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In Sassen's articulation of 'analytic tactics', she asks that the researcher has time to position themselves vis-à-vis the research context before selection of research method (Sassen 2013). Through pragmatist inquiry 'we can learn to examine situations from the point of view of their possibilities, from that which they communicate with and that which they poison' (Stengers 2011c, p. 12). This chapter is the development of a methodology to reassemble the smart city

with this care of their possibilities. Stengers (2011c, p. 12) argues succinctly that 'pragmatism is the care of the possible'.

The title of this chapter, *An 'adequate' methodology* stems from the pragmatist understanding that what is useful is good enough. Adequacy is a necessary concept from design practice, where design is never optimal in the proper sense, but the best attempt given the constraints of time, information and resource (Lindblom 1959). Adequacy accepts context as never completely knowable, however, decisions must still be made. This is a more arational understanding of design practice (Teal 2010; Wendt 2018). In other words, judgements are made with insufficient information. Dewey (1997) argues that there is an intimate connection between the judgement and inference. Nelson and Stolterman (2012, p. 140) contend 'the intention of inference is to terminate an adequate judgement (which is equally a good judgement) through the interpretation of facts'. Therefore, at the time when decisions are made there is an assemblage of dispositional perspectives that may be the most suitable available solution with what information is known at the time. Whilst design decisions draw on rational thinking, which includes systems science, disciplinary thinking, and the scientific method, they are not simply rationalised logical processes. Nelson and Stolterman argue there is also the imaginative, intuitive, feeling and emotional aspects of practice that are pragmatic in the context of information overload (Nelson & Stolterman 2012, p. 98). Thus, adequacy is the ability to synthesise this context, as effectively as constraints allow, towards action. The overarching methodology is outlined in this chapter *without* attention to the emergent local processes and their contingencies, which will be described in the following chapter.

This chapter is divided into subsections:

- Actor-network theory (ANT) is outlined as an appropriate approach to understand city and technology development in pragmatic ways conducive to the Cosmopolitical environment. The methodology must mirror the same complexity and perspective that is to be enacted in the context of the smart city.
- This chapter will explore existing case applications of Actor-network theory that have been used to explore these topics – focusing particularly on three examples that are used as exemplars:
    - Latour's (1996c) *Aramis: or for the love of technology;*
    - Albena Yaneva's (2009a) ethnographic studies of architectural practices; and
    - The MACOSPOL (2007a; 2007c) project; Mapping of Controversies on Science for Politics

- These are then discussed and refined into a new method tailored at the pragmatist explanation of smart city initiatives in practice.
- Finally, this describes further challenges of research enactment through media and culture studies. Specifically, the role that artefacts and communication technologies play in inscribing certain relationships and ways of being and interacting – in Marshall McLuhan's *medium is the message* thesis. This leads to the proposal of using infographic visualisation to represent the cases, closely inspired by the three exemplar's earlier mentioned Latour's *Aramis*, Albena Yaneva's architectural studies, and MACOSPOL.

None of these discussions recommend exact prescriptive processes, but rather endorse more dispositional forms of methodological approach, focusing on unfolding research practices. The following chapter *(5) Research in the making* will outline exactly how the research was conducted.

Usually academic results are communicated just through prescriptive academic practices. These are usually in conferences, journals and books. However, with the emphasis on practical effects of this research in the smart city discourse. The research inquiry is extended to attempt to make this research directly available to practitioners in a digital visual format.

Actor-network theory: tracing relations of objects, practitioners and systems

As an analysis tool, ANT became central to the understanding of the research data. It is critical to explain this in detail, as it was an enormous influence in shaping the pragmatist research outcome.

This section outlines the rich examples developed in the lineage of Actor-network theory (ANT) and how they may relate to a reconceived discourse of the smart city. As a methodology, ANT suffers from an ability to explain itself simply. It must be explored in depth. As a performative theory, ANT is best explained through practice. Its creators insist that it can only be explained in context, through illustrative cases (Law & Hassard 1999). Deep exploration is crucial to the discovery of its challenging tenets and its relevance to the task at hand. To this end, this section will attempt to outline ANT; its language and treatment of science and technology. The explanation is followed by example cases from other authors that have studied design practices.

An introduction to Actor-network theory

Actor-network theory is the analytical methodology of this thesis. It is a pragmatist approach to social theory. It is known as a 'material-semiotic' approach; an advancement in relational materiality. This material extension of semiotics, which presupposes that all entities achieve significance in relation to others, is the study of how meaning is built. However, in the case of ANT, word 'meaning' is taken in its original context as a nontextual and nonlinguistic interpretation (Akrich & Latour 1992, p. 259). Law (2009, P. 141) notes: '[i]t assumes that nothing has reality or form outside the enactment of those relations,' and '[i]ts studies explore and characterize the webs and the practices that carry them'.

A principal difference between ANT and most other social research methodologies is that it treats nonhuman actors on equal terms as human actants. ANT is a method of social description; 'social' in an expanded sense, including human *and* nonhuman actants in its definition. This is named the 'principal of generalised symmetry' (Callon 1986a). ANT therefore rejects the Cartesian bifurcations of the last centuries that have dominated social science and the western philosophical canon. These include mind and body, culture and nature, thinking and acting and theory and praxis. The rejection of Cartesian dualisms aligns with the pragmatist perspective. Dewey (1929 [1981], p. 186) states that Cartesian dualisms 'formulated recognition of an impasse in life, an impotence in interaction, inability to make effective transition, limitation of power to regulate and thereby to understand'. ANT is considered is a feminist theory approach to nature (the natural and technological/material), where ANT scholars seek to describe networks as putting nature back into the 'social'. Relating to information systems, Walsham (1997, p. 466) summarised:

> [ANT is] concerned [with] investigating the social and the technical taken together or...with the creation of coextensive networks of human and nonhuman elements which in the case of information technology include people, organisations, software, computer and communications hardware and infrastructure standards.

Like pragmatism, ANT is not just one approach. How it began in the 1980s is not what it is considered to be today. To Law (2009, p. 141): 'Actor network theory is a disparate family of material-semiotic tools, sensibilities, and methods of analysis that treat everything in the social and natural worlds as a continuously generated effect of the webs of relations within which

they are located'. Importantly for this inquiry, ANT enables pragmatist thinking across the five tenets described in Chapter 1. These will be explored in this chapter.

Actor-network, from the French '*acteur reseaù*', embodies a tension between these two terms (Law 1999). One cannot exist without the other. One cannot talk too much of either. Actors are network effects, and at the same time, networks are effects of actants. The term actor-network in ANT's name conveys the idea that the actor does not act 'on his own' but only under the influence of a complex network of material and semiotic influences. The name signifies that an actor is any human or nonhuman entity that makes other actors do things. These actors are part of a network that exists together, and as such, neither the actor nor network can be analysed as a discrete entity without the other.

It is important to note, three aspects related to the name often create confusion when trying to understand ANT (Latour 1996a). Firstly, rather than the original term 'actor', the term 'actant' is now preferred by ANT's founders (hereafter actant and actor are used interchangeably, depending on the preference of the authors I am discussing). The word 'actant' better explains what they actually *do*, 'an actant makes others act' (Latour 2005b). Secondly, the term 'network' now carries the burden of decades of digital networks, which have changed the semantics of the word from its original translation. The word 'network' was translated from the French word *reseaù,* which is actually more like a fishing net: all links. This is important as ANT is relational; it speaks to elements as if they have no *a priori* definitions outside of the network in which they are being described. And thirdly, it must be noted that ANT 'is not a theory of anything'. In other words, ANT has no predictive capability. Instead, it tells the story about 'how' relations assemble, or not. However, valid predictive capability in the social sciences is still limited, some arguing that it unlikely to ever achieve (Unger 1987; Flyvbjerg 2001).

Translation is the central tenet of ANT. It is based on on Michael Serres' original concept translation (see Serres et al. 1982; Brown 2002). To translate is 'a verb [that] implies the transformation and the possibility of equivalence, the possibility that one thing might stand for another (for instance a network) (Law 1992, p. 386). Law later (1999, p. 8) contends: '...translation is the process or the work of making two things that are not the same, equivalent'. For example, Latour's famous example 'sleeping policeman' translates the role of actual policeman, into an object that performs the same effect of slowing cards sown.

ANT is interested understanding and describing how networks become stabilised between actants. A 'successful' network is one that manages to enrol many more actants in its definition of a problem, through processes of *translation*.

The unique vocabulary of ANT

Akrich and Latour (1992) wrote a short contribution detailing core terminology of ANT entitled '[A] summary of a convenient vocabulary for the semiotics of human and nonhuman assemblies'. This unique terminology enables the description of complex situations through tracing the relations between actants. It is a vocabulary particularly suited to describe socio-technical assemblages. Note that, as this is the first exposure to the suite of ANT terminology, it is not expected that the reader will remember these terms. Terms will be reintroduced when they are used to explain a relationship. Most of this language was first articulated by Callon (1986a) in what is now widely recognised as the first ANT paper. The paper focussed on the unlikely topic of scallop fishing in Saint-Brieuc, France. Callon described the relationships between scallops, fisherman and researchers in collectively defining the nature of the 'social' network. Much of the language he used has endured, including through more recent expressions of ANT research (Law 2009).

ANT terminology is referred to as 'infra-language' (Latour 2005b) in the quite specific terms that ANT uses to describe the way that actants interact and form networks, grow and deplete. *Infra-* is preferred to *meta-* as the language is not intended to be more significant than the action of actants in any hierarchy. This language includes important performative language used in this thesis: translations, scripting, inscription and description. Table 2, below, is a list of the key vocabulary as deemed most useful to the reader in understanding this inquiry. Table 2 is derived from my reading of the ANT literature. Some of these terms are directly from references; what is not referenced are my interpretations from reading multiple sources. Many of the words in this vocabulary are used in the 'visual histories', which appear in Chapter 5 and 6 of this thesis. This list has been assembled from multiple sources across the ANT literature. The list here is reduced to include only the most relevant. A complete list can be found at Appendix B.

Table 2: ANT infralanguage and vocabulary.

Vocabulary	Definition	Examples relating to empirical studies
Actant (actor)	'Something that acts or to which activity is granted by another…an actor can literally be anything provided it is granted to be the source of action' (see Latour 1996a, p. 373) 'Whatever acts or shifts actions, action itself being defined by a list of performance through trials' (Akrich & Latour 1992, p. 9).	Examples include a train, driver, bus ticket, passenger, policy, or sign.
Assemblage	A group of objects of different or similar types found in close association with one another. What is assembled.	A train station – consisting of trains, platforms, information systems, conductors, ticket machines, customers, lighting systems etc.
Black-box	A technical term for a device, system or object when it is viewed in terms of its input, output and transfer characteristics without any knowledge required of its internal workings (Callon 1986a). 'The way a scientific and technical network is rendered invisible by its own successes' (Latour 1999, p.304).	How the train system functions, to most people. They get on and off the train with no concern for the engineering and systems that ensure the train performs its role.
Description	To unfold, process from a technical artefact, a returning to the network that constitutes it. Inverse, or use of a *script*. To enact a scripted action.	When a user holds the hand rail above their head on the bus, this action has been a scripted interaction by the designer of the bus interior.
Enrolment	When other actants in the network accept (or get aligned to) interests defined for them (Callon 1986a). Similar to co-optation, but relating to a focal actant. Contemporary ANT does not tend to have focal actors (see Mol 1999).	Transport system converting trips from motor vehicle or walking trips to using buses and trains.
Heterogeneity	The principal that networks contain both human and nonhuman actants, equivalent to Deleuze and Guattari's (1987) definition.	The transport assemblage contains many different types of actants, such as hard drives, handrails, buses, toilets, bureaucrats, bus drivers, government announcements and smartphones.
Inscription	The creation of artefacts that would ensure the protection of certain interests (Latour 1992).	Turnstiles prevent (most) people who have not bought a ticket from entering the station platforms.

Vocabulary	Definition	Examples relating to empirical studies
Irreversibility	The '[d]egree to which it is subsequently impossible to go back to a point where alternative possibilities exist' (Walsham 1992, p. 42). While decisions are always reversible, irreversibility is similar to the concepts of 'lock-in', and 'path dependence' from management and systems theory.	The agreement of application developers and government agencies to use the data standard GTFS, which means all subsequent design and infrastructure decisions are made for this standard. Other examples would be the commitment to use railway guage in New South Wales of 1435mm (4ft 8 ½ in), and driving on the left side of the road.
Obligatory Passage Point (OPP)	An OPP is a situation in which all of the actants have to achieve their interests as defined by the focal actor (Callon 1986a).	When a government agency makes all stakeholders sign their confidentiality agreements, ensuring all information to be published goes through their media department first.
Script	To enfold, process into a technical artefact (Latour & Akrich 1992). Inverse of *description*.	When an architect designs a bus stop with a long seat, enfolding the planned use case of being able to accommodate up to four people seated at the same time.
Social	Consisting of relations between both human and nonhuman actants (Latour 2005b).	A social relation may be one between a bus passenger and the LED screen informing them which stop is next.
Speaker	Those that speak on behalf of other actants as spokespeople or nonhuman actants, such as reporting systems (Callon 1986a).	When a transport minister publicly speaks to the media to make announcements on behalf of the assemblage of the transport system and government. Or when pixels on the screen of a phone, speak for a train and the transport network by detailing the arrival time for a train.
Transcription	How meaning is moved from one mode of script to another (Akrich 1992).	A static printed bus timetable can be replaced by a mobile application containing the same information.

This set of vocabulary has much to do with process, movement and change. This reflects the central tenet of *translation*; the possibility that one thing might stand for another. ANT is not about providing a single description, but multiple interpretations. The vocabulary enables

rapid movement between frames of reference. The following section will outline the transition of ANT from its beginnings in the 1980s to its contemporary definitions and uses 'successor projects'.

ANT and pragmatism

Actor-network theory (ANT) emerged from, and is an integral part of a science and technology studies, a field known today as science, technology and society (STS) (Law 1999). ANT is also a post-humanist theory, recognised part of the 'new materialisms', a series of movements criticising anthropocentrism and challenging subjectivity through the emphasis on the role of nonhuman forces (Connolly 2013). For ANT, reality exists in the multiplicity of lived experience and practice. As such, and as described in the previous chapter, practice is difficult to translate or express as a series of steps. Likewise, doing ANT research cannot be explained as a series of steps, as it is a way of describing that can only really be experienced in its application. As John Law (2006, p. 47) states, 'one might represent actor network theory by performing it rather than summarising it'. It is a dispositional way to encounter a situation, thus it forces a practitioner to perform it, to become part of the network, rather than just apply it.

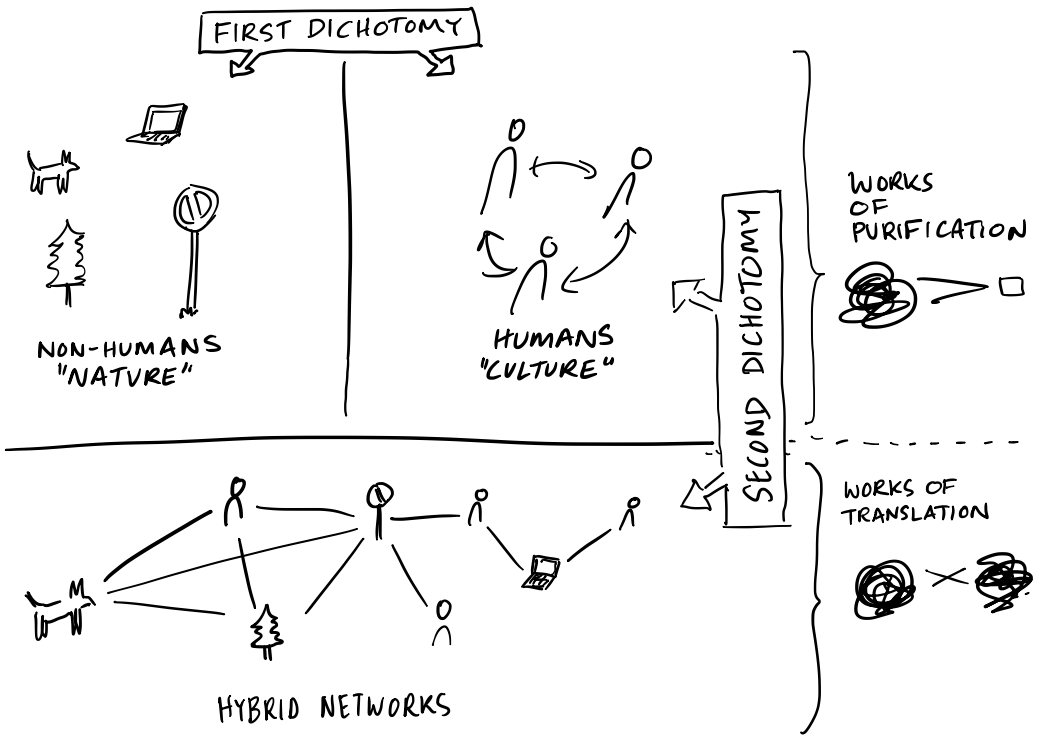


Figure 8: The dichotomies of description relating to ANT. Adapted from Latour 1993a, p.11.

ANT relates to the lower half of the image above (figure 8): the term hybrid networks describes the treatment of human and nonhuman actants with the same apparatus, and creates works of translation, rather than purification. ANT also shifts towards an ontology of movement, in being process-relational. This is a shift, from the dominant western metaphysics' *being* (that reality and concepts are inherently stable) to *becoming* (that reality and concepts are inherently unstable) (see Tsoukas & Chia 2002; Whitehead 1931). ANT moves definitions of entities from essentialist to relational. Efforts of problematising actants are made, in order to enrol actants in maintaining the stability of the network and meaning.

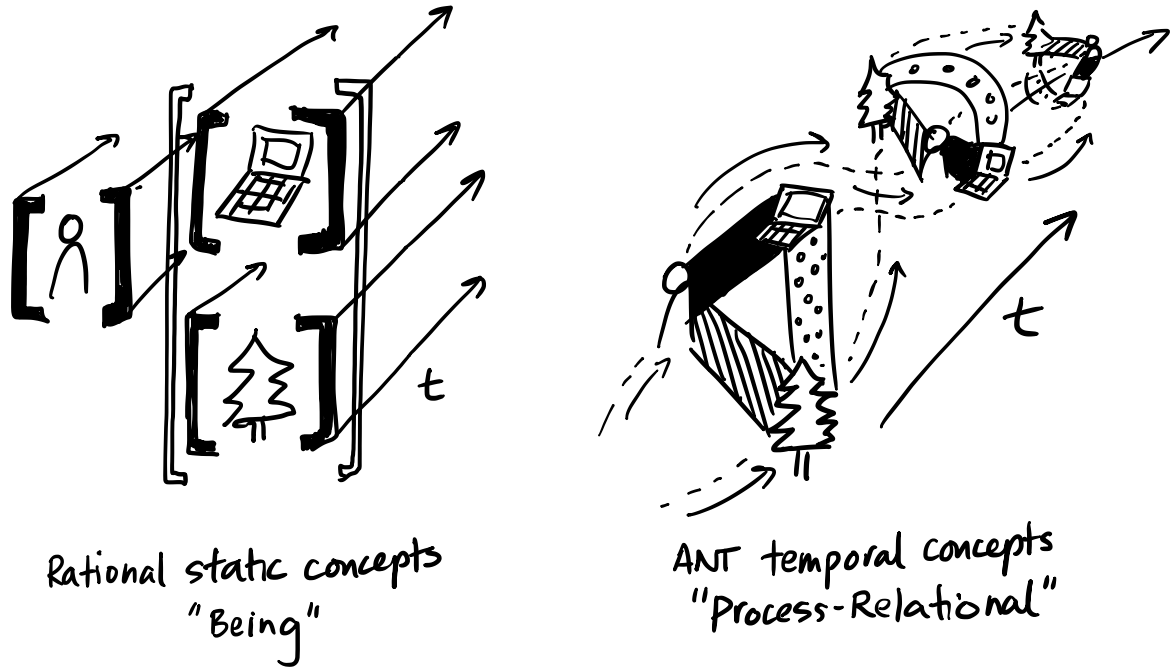


Figure 9: How conception of time impacts description, from rational concepts to ANT. Source: author.

In figure 9, the left, rational model focuses on *a priori* categorisations of elements that are atemporal, whereas ANT focuses on the actual relations between actants rather than any definition of the actant itself. The actant is always viewed in relation to a specific network and relations, as actants exist in multiple networks simultaneously.

As it does for Rorty, and pragmatists in general, anti-essentialism informs the conceptual frame through which networks are examined. This is an agnosticism that advocates the abandonment of any *a priori* assumptions about the nature of networks, causal conditions, or

the accuracy of an actants' accounts. Interpretations are flat, in the sense that no perspective should be privileged.

Latour (1996a p. 3) explains that ANT is a change of metaphors to describe essences and topography: 'instead of surfaces one gets filaments'. Latour likens this to Deleuze and Guattari's 'rhizome' discussed in Chapter 3.

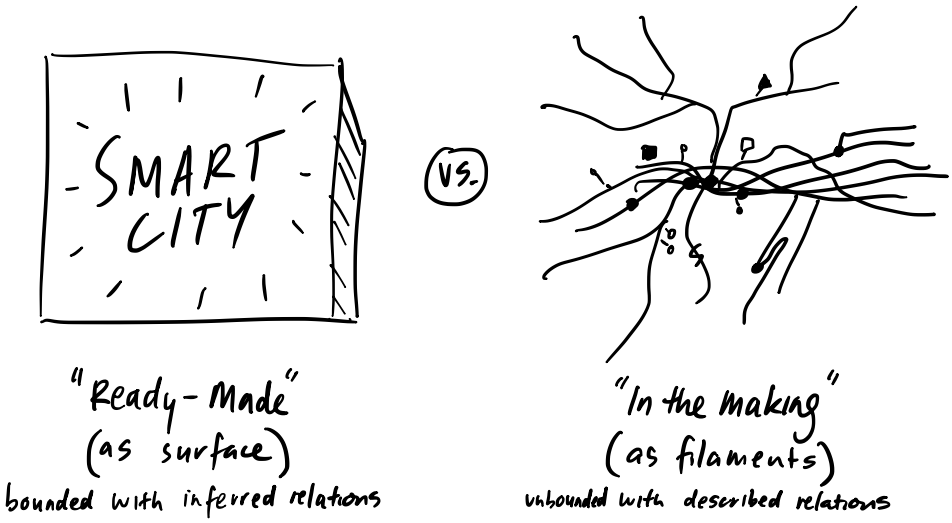


Figure 10: Depicting key differences in thinking: as a surface; or as filaments. Adapted from Latour 1996a, p. 3.

Figure 10 depicts the conception of the situation. The former 'ready-made' as a bounded entity that infers its relations are given, *a priori*, and has a sense of permanence. The second, the pragmatist 'in the making', is coherent with the assemblage-based perspective, with no sense of permanence. Relations must be described or traced and they are recognised to be temporary.

Table 3: A comparison of rational approach with ANT. Source: Author

	Rational premises	**Actor-network theory premises**
Ontology	Being (static)	Process-relational (temporal-movement)
Reality	Universal (positivist, objectively knowable)	Plural (constructivist, only partially accessible)
Perspective	Cartesian division between Nature or culture	Symmetrical treatment of human and nonhuman

ANT and before and after: Facts, technologies and performativity

From its beginnings in Science and Technology Studies, ANT has always been a suitable method for inquiring into practices of technology development. ANT has also arisen at a time when complexity and the interwoven nature of social, political and technological aspects of systems are increasingly inseparable in analysis. If judged by its own epistemology, it has demonstrated success. Its language and concepts have been adopted by many researchers over the last three decades.

However, the enactment of ANT has also changed over time. As mentioned, ANT is not just one defined approach. The ANT of the 1980s is not like its successor projects, which have moved from a focus on semiotics to a focus on relational materiality and performativity (Law 1999). As Law (1999, p. 5) states: '[f]or, like some kind of monster, the term 'actor-network' grew, and it started, like a theoretical cuckoo, to throw the other terms out of the nest'. Law notes previously prominent ANT terms such as 'enrolment', 'traduction' and 'translation' has become displaced (Law 1999, p. 5).

Callon (1986a) was the first to outline the concept of translation in detail. In the latter 1980s and early 1990s, ANT was used to tell stories, to put elements together, but there was a relatively linear and fixed structure to how the narratives were told. They speak of a focal actor who problematises, who defines the terms on which the other actants will be enrolled. That focal actor brings those actants in through the process of *interessement* and the actants become a stabilised network. A few other canonical examples are worth noting: electric vehicles (Callon 1986b), and failed transport projects (Latour 1996c).

In the 1990s and 2000s, ANT became widely used outside the strictly the field of STS. For example, in the fields of Information Systems (e.g., Walsham 1997; Underwood 1999), geography (e.g., Graham 1998), economics (e.g., Callon 1999), organisational analysis (e.g. Lee & Hassard 1999), healthcare (e.g., Mol 2002), urbanism (e.g., Graham & Marvin 2001) and anthropology (e.g., Oppenheim 2007).

The 'ANT and after' literature (see Law & Hassard 1999), marked the first turn away from the early structure that attempted to create central focus in accounts. One of the key contributions to the 'and after' ANT literature was Annemarie Mol's *Ontological Politics* (Mol 1999) and

subsequent *The Body Multiple* (2002), which looked at the ontologies of medical practice. Rejecting the previous notion of a 'focal actor' in ANT accounts, Mol decentred the accounts of these practices, treating all actants in equivalency. Mol coined the term *ontological multiplicity* (Mol 1999), meaning there are many, if not infinite, numbers of realities being enacted at the same time. Law and Singleton (2014, p. 384) suggest that this was the original supposition of ANT, as '...realities are about relational patterns of association and disassociation in practice', but it had not been articulated in the 1980s earlier literature. Informed by Foucault, Mol (1999, p. 75) describes ontology with *ontological politics*, moving ontology into 'active mode'. ANT has 'robbed the elements that make up reality—reality in its ontological dimension—of its alleged stable, given, universal character'. She states: '[w]e exist in *ontological multiplicity*, where the organisation is constructed through assemblages of ontologies' (1999). It is this view that began to start to elucidate more of a Jamesian pragmatism of subjective realities in multiplicity.

In its few decades of history, ANT has been a useful tool to challenge hegemonic practices, of science, technology development and recently for reconceiving historiography in management and organizational studies (Durepos & Mills 2012b). Historiography is the study of history and how it is written (Cambridge Dictionary 2018). The contexts in which ANT has now been applied are innumerable. ANT is now being applied to many highly complex situations, in which there is no focal actor, no sense of the whole, and no chance to understand the real workings of the network. Instead these accounts seek to tell a diverse number of stories. It is this multi-perspectival ability, and socio-technical focus of ANT that makes it such a well-suited methodology for this research inquiry. Similarly, ANT has been used extensively in describing the processes of Information Systems development (Walsham 1997; Underwood 1999; Latour 1996b; 2004a; Cordella & Shaikh 2003; Underwood & McCabe 2011), which provides precedence for this thesis' empirical study.

Finally, 'contemporary successor projects to ANT and feminist material semiotics now work on *framings,* their *ontological performativity,* and how these *generate possibilities* and *impossibilities'* (Law & Singleton 2014, p. 380). In recent years ANT successor projects have been numerous, and address issues as complex and large as democracy (Latour & Weibel 2005), policy (Law & Singleton 2014) and an anthropology of 'the moderns' (2016). Law (2002a, p. 92) reminds us that '[i]n ANT there are many possible 'modes of ordering' in modernity, not just one'.

The challenges and biases of ANT

ANT has had several critiques since its inception. This is no surprise, as it has represented a departure from humanist social theory that has dominated the last four centuries of social science.

Walsham (1997) challenged ANT's concept of generalised symmetry, in which human and nonhuman actants coexist, contending that it should be analysed with the same apparatus. This has perhaps been the most contentious aspect of ANT, drawing many criticisms (eg. Collins and Yearly 1992; Bloor 1999). It is undoubtedly an extreme position to take against the background of a long history of social theory that has privileged human agency. However, one now in company with many related approaches of posthumanism (Pickering 2001).

ANT is also noted in being difficult in illustrating a case in shorter than book length formats (Walsham 1997). As the theory emphasises the importance of detail, Latour (1996b) articulates its ability to reduce to express research an unlimited number of entities that grasp one another in limited ways.

ANT has been further criticised for its masculine 'warlike' and 'competitive' metaphors, of conflict and dominion, creating a 'biased view of the victors' (Leigh-Star, 1990, p. 33). ANT does define networks as by 'successful' through their ability to dominate over other networks, but these criticisms have subsided since Mol's (1999) *ontological politics*. ANT has been criticised as amoral. Relatedly, it has also been criticised for its detachment from the research subjects (Haraway 1991; Akama 2015). Akama (2015, p.267) has reinterpreted this, as 'becoming', as a way to inscribe what differences can be made, and how they can be made together. ANT's has a lack reflexivity (Latour 1988), this is seen as a limit of the methodology by some, but this does not preclude it being combined with other methods to conceptualize reflexivity (Jansen 2007).

How ANT is performed by the researcher, and in what combination with other methods, ultimately decides what it is.

How ANT may be performed for a pragmatic smart city discourse

ANT informs how one may think about constructing the Cosmopolitical. The Cosmopolitical fiction must be produced, equivalency must be brought to actants who are usually excluded. Like the 'Cosmopolitical', ANT must be performed to enact those that do not speak for themselves. Law (2009, p. 141) insists: 'We can only understand the approach if we have a sense of … case studies and how [they] work in practice'. ANT is, as has been stated, difficult to explain in simple terms, given that there was 'no assumption that an assemblage of relations would occupy a homogenous, conformable and singularly tellable space' (Law 1999, p.8). In Latour's explanation of his metaphysics, he characterised *Irreductions* as where, instead of reducing something in order be conceptualised, the researcher must accept they are always in acts of *translation,* making something new (Latour 1993). The dichotomy of realism/anti-realism is disposed as in the concepts of the neopragmatists Rorty and Putnam. Thus, ANT is not about representing, but performing relations into being. One could say 'what elements there are to look for', but in doing so may preclude what might have been found. At its simplest you 'follow the actors themselves' to 'try to catch up with their often wild innovations in order to learn from them what the collective existence has become in their hands' (Latour 2005b, p. 12). It sounds simple enough, but then what? Ethnographies, can uncover the notion Law (1992, p. 383-4) speaks of;

> [P]eople are who they are because they are a patterned network of heterogeneous materials. If you took away my computer, my colleagues, my office, my books, my desk, my telephone I wouldn't be a sociologist writing papers, delivering lectures, and producing "knowledge." I'd be something quite other—and the same is true for all of us. …social agents are never located in bodies and bodies alone, but rather that an actor is a patterned network of heterogeneous relations, or an effect produced by such a network. The argument is that thinking, acting, writing, loving, learning—all the attributes that we normally ascribe to human beings, are generated in networks that pass through and ramify both within and beyond the body.

Specifically, ANT's approach to ethnography is 'ethnomethodology' (Garfinkel 1967), which as described in the previous chapter, is about understanding people in the contexts of their action. The important aspect of this approach is that '[…] it is not the sociologist's duty to decide in advance and in the member's stead what the social world is made of–a very common idea

for chemists, physicists, and naturalists, but it is still seen as provocative in the social sciences' (Latour 2005b, p. 29).

From matters of fact to matters of concern: post-anthropocentric social description with ANT

This thesis asserts that ANT is an appropriate methodology for the pragmatist understanding of smart city cases. How does the inquiry relate back to the intention to create something that is useful for action? It is in the pragmatist perspective. It is not just good enough to describe the social, but it must be a description to 'do something-with'. As the previous chapter explained, 'instruction' is not all that relevant for experienced practitioners in this context. This discussion has been leading to making explicit the actor-networks involved in smart city initiatives.

Making public the work behind the *'design of actor networks',* is linked to concerns about democracy and co-habitation (Storni 2015, p. 171). Unfolding practices behind the development of 'smart city' systems, is a complex practice, requiring, as Storni (2015, p. 171) suggests:

> [t]his calls for an explicit and renewed interest in documenting and account practices that; integrate the rich array of tools, techniques and methods used in [co-design and participatory design] and extend the recent call for annotated portfolios to include maps, glossaries, timelines, thick descriptions, multimedia public repositories etc.

But how does one generate the voices of those that don't speak? Ethnographies follow people, as Yaneva (2009a) has done in her considerable ethnographic studies of architectural practices. However, these accounts are 'social' in the ANT sense. As Latour (1996a, p. 72) notes: 'the innovator has to weave humans and non-humans together by imposing the politest possible behaviour on both' (Latour 1996a, p. 72). This is a precursor to Latour's 'compositionalist manifesto' as the means to hold together the two worlds of modernism and postmodernism (Latour 2010). Latour later describes 'composition' as a possible term for the many bubbles, spheres and networks of arts and science. What 'can no longer be modernized, what has been postmodernized to bits and pieces, can still be composed' (Latour 2011). That which has been missing in design is identified by Latour (2008a, p. 12):

> Now here is the challenge: In its long history, design practice has done a marvellous job of inventing the practical skills for drawing objects, from architectural drawing, mechanic blueprints, scale

> models, prototyping etc. But what has always been missing from those marvellous drawings (designs in the literal sense) are an impression of the controversies and the many contradicting stake holders that are born within with these [*sic*].

It is this aspect of the practice of smart cities that the pragmatist interpretation of this thesis explores. To reinsert what has not been recorded of the smart city 'in the making'. Latour (2008, p. 9) reiterates several aspects of the arguments that have been made over the last chapters:

> So here is the question I wish to raise to designers: where are the visualization tools that allow the contradictory and controversial nature of matters of concern to be represented? A common mistake (a very post-modernist one) is to believe that this goal will have been reached once the 'linear', 'objectified', and 'reified' modernist view has been scattered through multiple view points and heterogeneous make shift assemblages.

However, Latour here proposes the use of visualisation to make social worlds appear. The visual is another project of Latour's, which plays a large part in his work (Latour 2011; Latour 1986), and his collaborations with many artists such as Pieter Weibel (Latour & Weibel 2005; Latour & Weibel 2002). Likewise, Dewey (1934) agrees for no separation between the arts and all other forms of practice. Latour (1986, p. 3) notes the 'most powerful explanations are the ones that do the most with the least', and 'take writing and imaging craftsmanship into account'. He advocates a practical explanation that is modest yet pervasive: 'so close to the eyes that they escape attention' (Latour 1986, p. 3). This is a non-reflexive perspective, where the researcher makes no attempt to distance the reader from the explanation. 'Each [powerful explanation] deflates grandiose schemes and conceptual dichotomies and replaces them by simple modifications in the way in which groups of people argue with one another using paper, signs, prints and diagrams' (Latour 1986, p. 3). For designers, what is needed are apparatuses to reveal concealed procedures:

> What is needed instead are tools that capture what have always been the hidden practices of modernist innovations: objects have always been projects; matters of fact have always been matters of concern (Latour 2008, p. 9).

Latour's language of 'matters of concern' is a departure from 'matters of fact', an explanation he has made earlier (Latour 2004c). He argues that the role of social research needs to change to create matters of concern, and assemblages around matters. In Latour's opinion, those who

have tried to portray sciences as matters of concern so often failed to convince readers (Latour 2004c). The distance between the reader and the object has become too far, by sticking to matters of fact, and putting objects 'down the hall' from the natural sciences. This form of object-oriented politics is a pragmatist perspective of the public that has been introduced earlier in this thesis (Dewey 1927; Marres 2005; DiSalvo et al. 2011).

So what does this mean for the project of designing, and for designers in a now cosmopolitical context? Storni (2015) points towards a richer sense of what practice means for designers, being more aware of ontology, epistemology and methodology. The smart city design context would include those ontological elements of the city, government, management, and their associated 'tools, techniques and methods'. This perspective affirms that as design increasingly moves out of the studio and into public explorations 'in the wild', it becomes more difficult to understand the scope and limitations of design (Storni et al. 2015).

Schön's *design world* (1988), is a means to think about the space from which a practitioner acts. Schön makes no reference to ontology or the design world in *The Reflective Practitioner* (Schön 1983). However, he explains that we have been bound to a particular epistemology that creates selective inattention to practical consequence and professional artistry (Schön 1983, p. vii). Schön argues for an epistemology of practice. ANT could be considered a posthuman extension to Schön's proposal. Making the familiar strange, and the strange familiar, by giving what would normally be ignored in a 'representation' its own voice and ways to approach the world to understand the preconditions for design. It is descriptive, however Lyytinen, (2004) describes the relationship between ANT and design as concerning 'inscription', where designers make '...technical artefacts [that] behave in ways that induce people to follow them and associate with them'.

The posthumanist, new materialist perspective as enacted through ANT involves can be comprehended through three principal elements: the symmetry of human and non-human actants; process-relationality; and the multiplicity of realities. These three aspects of ANT are pragmatist, maintain considerable departure from hegemonic social research, and are arational perspectives. Latour's *Aramis: or for the Love of Technology* (1996c), proposes a means to bring these perspectives together in a translated account. Latour wrote the account as a detective murder mystery in which we know *Aramis* (the automated, monorail like, transport system) has been killed. Latour traces the inquiry from quotes from interviews and excerpts

from newspapers and reports. He ties these together with the voice of a professor in discussion with a trainee researcher, who probes the professor continually with the materials that have surfaced. Ultimately, Latour (1996c) introduces *Aramis,* the technology project, as a personified voice, who exclaims its frustration at the fact that the project failed, thus denying it of a life. Aramis itself is given a voice, that speaks for itself. (Latour 1996c, p. 296-299). This is an excerpt (Latour 1996c, p. 293);

> You modified me from top to bottom, but to turn me into what a mini-VAL, a more compact version of my elder brother VAL. I was willing, I would have been quite prepared to come into existence in that form…they wanted to keep me pure of all compromise!…Well too bad for them, since because of that insistence on purity, what am I? Nothing but a name!

Aramis laments the loss of never being able to come into existence, and Latour is able to reaffirm many of the messages about pragmatist socio-technical innovation through the voice of Aramis. Such as in the above quote, genealogy of its family, and the rejection of translation in not allowing the model to change, meant the model could never come into existence.

This is a novel approach in itself, what Latour describes as *Scientifiction*. Latour (1996c, p. ix) states that by using fabricated voices he wanted to '…come close enough to reality so that scientific worlds could become once again what they had been: possible worlds in conflict that move to shape one another'. Luckhurst (2006, p. 12) summarises that *Aramis,* 'presents a cacophony of voices: political, financial, and technological interest groups'. Scientifiction is has been described as a 'way to understand the complexity of the moment in which we now find ourselves, a moment when technology's role as an actor is becoming more obvious and pronounced' (Brown Jr. & Johnson 2015, p. 311). By doing expressing context in this way, Latour argues that he is able to '…restore freedom to all the realities involved before any one of them could succeed in unifying the others' (Latour 1996c, p. ix). Other researchers have since adopted this approach, finding that it is easier to follow technologies when you hear their 'voices' (Kennan et al. 2010). Allowing technologies to be scripted as 'speaking' may allow them to be better enacted through the process of description. Latour's approach has been widely recognised as a novel method across a variety of fields including organisational studies (Stone 2001; Czarniawska 2008; Cardoso 2013), feminist theory (Squier 1999), science fiction studies (Luckhurst 2006), Information Systems (Sarker 2007) and urban studies (Harle 2015) However it has not been adopted beyond a couple of examples (Brown Jr. & Johnson 2015;

Kennan et al. 2010). Kennan et al. (2010) concluded it is easier to follow technologies in narratives when you hear their 'voices'. Kennan et al. (2010), believe that it is possible to give nonhuman actants voice based on the researcher's experiences of the nonhuman actants' world and interactions with actants, including the researcher themselves.

This concept of giving non-humans voice is an extension of anthropomorphising of products in design (Moggridge 2007). Anthropomorphism is the process of 'showing or treating of animals, gods, and objects as if they are human in appearance, character, or behaviour' (Anthropomorphism 2018). As has been mentioned, in earlier chapters this could play a critical role in the post anthropocentric city (see DiSalvo & Lukens 2011; Forlano 2016) and will play a role in the performance of the Cosmopolitical.

At the same time, products are now spoken to; from phones to digital personal assistants; Siri, Amazon Echo, Google Home, and Microsoft Cortana. Now voice activation is moving into cars and other environments, making this whole approach seem less strange. How can they be fabricated? In social science research human voices have been fabricated to make fictional or fictionalised conversations happen between stakeholders. Examples include; an imaginary meeting between scholars past and present discussing the limits of language in doing systems work (Boland, Jr. 2000), another exploring the limits of language in doing systems design (Boland & Lyytinen 2017) and Latour's fictionalised Socratic dialogue with a student (Latour 2004a). These accounts are easily understood in a form of quite natural dialogue.

This is a way of representing technology, that ties well into Stengers' Cosmopolitical, by giving voice to actants that may otherwise be ignored. This concept will be developed further later in the chapter.

Controversies and cartographies

I will return now to Latour's and colleagues' visual conceptions of practice in actor-networks. Earlier, Deleuze and Guattari explained how maps are part of a rhizome (Deleuze & Guattari 1987). Creating a visualisation in ANT's conception, is more than just a 'representation'. For ANT, a map becomes a new actor itself, something with its own agency, which can furthermore, create its own actor-network. A map creates a translation, a new alternate instance of that what it references. This section will explore this thread and draw on some

related projects that in recent years, have investigated the diverse and temporal material-semiotic politics of complex projects. Many of these have been urban projects. This section explains the nexus between enacting the Cosmopolitical, their controversies and potential cartographies.

Cosmopolitical enactments

Latour's (1996c) 'Scientifiction' in *Aramis* is certainly moving in the right direction for a Cosmopolitical enactment. In its narrative there are advocates and experts all presenting themselves in their own words. However, these are inscribed into text, in a form that does not lend itself to performance beyond an individual reader's imagination. It is a powerful expression of the arational nature of the development of technology, where causality is untraceable. Latour's conclusion is that nobody killed Aramis: simply, nobody loved Aramis enough (Latour 1996c, p. 4). Latour's account however, is 'probably hard for beginners to follow' (Czarniawska 2008, p. 14). Do the 400 pages of *Aramis* make this narrative largely impenetrable, hidden in the realm of science and technology literature? Who should this be designed for? As Czarnawska (2008, p. 17) muses:

> One of the myths of academic writing is that it should address a specific audience. Nothing could be more wrong. As Flaubert pointed out, all writers of consequence wish to create their public, and at the outset they want to be read by everybody.

Once again the intention is a 'creation of publics', for this is the intent of ANT itself– to study and create its own publics; to enrol others in the practice of describing again. This perspective certainly accords with contemporary conceptions of science. Namely, Post-normal science (Ravetz & Functowicz 1991; 1992), and *Mode 2* knowledge generation (Gibbons et al. 1994), where researchers must deal with uncertainty and develop research across a variety of disciplines, practices and knowledges. This transition to performativity forms part of increasingly commercialising university practices. As Barnett (Barnett 2000, p. 411) specifies: '[a]s universities become increasingly inserted into society, epistemologies change: knowledge becomes performative in character and loses its power to enlighten'. Figure 11 is a sketch showing different types of knowledge representations. This study takes the perspective of the third, the performative.

Figure 11: Comparing knowledge types, representational (scientific rationalism), rhizomic (Deleuze & Guattari 1987) and performative (as used in ANT).

This performative nature of research is presented through scripting, or enacting. The anthropologist Erving Goffman (1959, p. 72) contends '[a]ll the world is not, of course, a stage, but the crucial ways in which it isn't are not easy to specify'. A reminder: we follow scripts in every interaction we make, e.g., how we communicate, sit and type, have all been scripted by earlier practices.

DiSalvo (2012a) has argued for antagonism in design practice by presenting alternative perspectives that take the form of design to challenge beliefs, values and what is taken to be fact. This is the realm of the political, not just of 'politics'. Politics, DiSalvo states, is the means by which an organisation, municipality, or state is put and held together; politics is a series of structures and mechanisms that enable governing. DiSalvo (2012, p. 8) argues that this is a too-narrow view to understand the 'political';

> Different from these means, the political is a *condition* of life, a condition of ongoing contest between forces or ideals. This condition is expressed and experienced in the dealings between people and organizations in a multiplicity of ways including, debate, dissensus, and protest. The condition can also be expressed and experienced through design.

This is a strong theme in recent design literature; that every design act evokes relationships—acts that are always political—transforming the understanding of the role of the designer in making publics (Yaneva 2017; Björgvinsson et al. 2010) and environmental impacts (Fry 2010). We have earlier discussed the 'prefiguring' of the political space as performing relations into

being (DiSalvo 2016), which offers a confluence between speculative design and this political notion.

Kim and DiSalvo's (2010) proposition of speculative visualisation is a means to enact these politics that coheres with the pragmatist perspective of an explanation for action. Speculative visualisation is an extension of the earlier described speculative design. Kim & DiSalvo (2010, p. 2) argue: 'Speculative visualisation is a particular group within speculative design that tried to achieve the thought-provoking work by using visual representation methods'. Theirs is a perspective reiterated by Schoffelen et al. (Schoffelen et al. 2015), in arguing for participatory discourse on issues through 'readable' visualisation. They ask '[h]ow to visualise the dynamic backstories of an issue in a readable way, in order to engage people in a participatory process around this issue?' (Schoffelen et al. 2015, p. 180). In referring to Latour (2005b) in 'making things public', Schoffelen et al. (2015) argue that to allow participation there are three aspects to gain understanding of readability;

1. attracting people to engage with a visualisation,
2. affording the public to make sense of available perspectives, and
3. enabling deeper reflection that allows people to formulate valuable opinions, even those that they did not think of before being exposed to the visualisation, which in turn allows them to participate in debates on the issue.

As Shneiderman (2008, p. 36) points out; '[t]he purpose of visualisation is insight, not pictures'. From these perspectives, the Cosmopolitical smart city needs to be acted out by design.

To reiterate, visualisation a good hypothesis for representing the a cosmopolitical perspective of the smart city because of what it affords; people can absorb more data using their visual capacities (Larkin & Simon 1987; Tversky 2005); further support mutual understanding in groups (Morgan 1997); switching between perspectives (De Bono 2010); and represent complex relations by demonstrating dependencies (Mengis & Eppler 2006). As the hypothesis is to demonstrate actor-networks, this point is very relevant. These are all useful towards making the alternate pragmatist reassembly of the smart city.

To maintain coherence with the pragmatist ontology, any portrayal of the reassembled smart city must be done in accessible, engaging way. Through a medium that encourage prolonged

open post-anthropocentric discourse about smart city initiatives. These nonhuman centric perspectives are currently being marginalised. A medium should facilitate insight, about how these projects work in practice.

Controversy mapping

ANT's successors have explored other means of enacting their works beyond usual 'academic' accounts. Storni (2015, p. 171) notes that '[i]n addition to textual risky accounts, ANT has begun to produce diagrammatic and graphical maps to account for stakeholders' concerns, agendas and the way in which they relate to each other as a controversy unfolds'. Controversy mapping was established by Latour in the 1990s 'as a method to train students in the observation and description of sociotechnical debates' (Venturini et al 2015). A more recent project expanded this concept: 'Mapping Controversies in Science and Technology for Politics' (MACOSPOL). This project was led by Latour and other ANT successors, including Albena Yaneva and Tomaso Venturini. MACOSPOL was a collaborative research project funded by the European Union involving several European university research centres. The intention of the project is as stated (CORDIS 2007):

> In modern societies, collective life is assembled through the superposition of scientific and technical controversies. The inequities of growth, the ecological crisis, the bioethical dilemma and all other major contemporary issues occur today as tangles of humans and non-human actors, politics and science, morality and technology. Because of this growing hybridisation complexity, getting involved in public life is becoming more and more difficult. To find their way in this uncertain universe and to participate in its assembly, citizens need to be equipped with tools to explore and visualise the complexities of scientific and technical debates. MACOSPOL's goal is to gather and disseminate such tools through the scientific investigation and the creative use of digital technologies.

The MACOSPOL series of research enquiries aimed at describing controversy in techno-scientific projects. This project's legacy has persisted, with many of the scholars continuing the practice of mapping controversies. It has created several streams of subsequent work including *Mapping Controversies in Architecture* (Yaneva & Heaphy 2012). The focus of the projects was on digital tools for mapping these controversies. Projects studied such 'controversies' as the design and construction of Sydney Opera House. and the design and construction of the London Olympic Stadium (Yaneva & Heaphy 2012). As was written in the

unpublished MACOSPOL consortium agreement (in Yaneva 2011, p. 121, emphasis in original) explains:

> The word "controversy" refers here to every bit of science and technology which is not yet stabilized, closed or "black boxed"...we use it as a general term to describe *shared uncertainty*.

Venturini (2010; 2012) has, as an outcome of this work, been able to explain both how to observe controversies, and how to represent the complexity of social debates in legible form. Since its inception the 'cartography of controversies', as this project has been otherwise known, has served as an educational version of ANT, 'unburdened of some of the theoretical subtleties' (Venturini 2010, p. 258). The cartographic practice was aimed at what was more practical but expressed the same ideas about collective existence (Venturini 2010, p. 269). The cartographies project, importantly, embodies a transition between 'cosmoses' and 'cosmopolitics'. This transition, Venturini argues, is the letting go of the underlying 'objective reality' of the dominant ideology of western culture. This is central to the idea of scientific rationalism; that there is a truth out there to be discovered. This approach constructs the common world. 'A common world, if there is going to be one, is something we will have to build, tooth and nail, together' (Latour 2004d, p. 455).

It is actors themselves who decide on how to address controversies, and scholars have no right to impose solutions (Venturini 2010). But even description is political. Important to note in making maps, a researcher displaying their opinions; '...should pay greatest attention not to hide others' (p. 268). How are controversies defined by MACOSPOL? Venturini (p. 261-262) outlines some characteristics of controversies, they:

1. involve all kinds of actors
2. display the social in its most dynamic form
3. are reduction resistant
4. are debated
5. are conflicts

These points, mirror much of the ANT discourse. Just as ANT actors in mapping controversies (actants) are heterogeneous, dynamism is created through observing plurality and conflict, and reduction resistance comes from an inability to abstract from the controversy without losing its contextual significance (Venturini 2010, p. 261-262). The last two points, however, are notably different from what has already been discussed about ANT. Controversies arise 'when

things and ideas that were for granted start to be questioned and discussed' (p. 262). They become larger as more and more objects are discussed by more and more actors (Venturini 2010). Controversies need to be understood as are conflicts where:

> [t]he construction of a shared universe is often accompanied by a clash of conflicting worlds…[a]ctors will take quarrels very seriously, for they know that social order and hierarchy is at stake…[c]ontroversies both decide and are decided by the distribution of power…[and] are struggles to conserve or reverse social inequalities (Venturini 2010, p. 262).

What does a researcher do in creating one of these maps? Venturini (2010, p.259-60) maintains that in 'just observing' collective life, as Latour instructs his students, there are three major considerations;

1. It requires no specific theory or methodology – stating 'surprise and curiosity should inspire' how the observation should be done.
2. Researcher's cannot pretend to be impartial just because they comply with some theoretical or methodological guideline – 'researchers are never unbiased', as 'no observation can escape its origin'; and
3. Researchers are obliged to reconsider their attitude towards their subjects of study – 'participants to social phenomena may be as informed as investigators' and 'social cartographers must have the greatest respect for the actors they observe'.

As cited by Venturini, Latour (2004b, pp. 108-116) has outlined four requirements of social cartography to;

1. not simplify the propositions to be taken into account in the discussion;
2. make sure that the number of voices that participate in the articulation of propositions is not arbitrarily short-circuited;
3. discuss the compatibility of new propositions with those which are already instituted in such a way as to maintain them all in the same common world that will give them their legitimate place; and lastly,
4. once the propositions have been instituted, you shall no longer question their legitimate presence at the heart of collective life.

The commandments, derived from Latour's sense of necessity in ecological politics, stand alongside Venturini's as stronger positions. These perhaps have less practical consequence. But importantly, Venturini (2010, p. 263) reminds us that 'if the cartography of controversies is complex, it is because collective life itself is complex'. Controversies are best if they are hot

(strong debate), current, bounded (at least restricted), and at least partially public (Venturini 2010). Venturni's (2012, p. 808) later discussion concludes that 'these approaches through controversy websites and issue centred representations may become an interesting alternative setting for collective debate, thereby participating in the digital renewal of the public sphere'. As Venturini (2012, p. 810) outlines, several scholars of the ANT approach believe that current inadequacy of political representations is 'largely due to the difficulty of negotiating modern controversies within the existent public forums'.

Yaneva (2011, p. 118) further argues: 'Mapping Controversies implies an out-of-the-studio way of learning *about* design, which is simultaneously an out-of-the-auditorium mode of questioning the multifarious connections of architecture, society, economics, culture, and politics' (emphasis original). The controversy mapping process makes design accountable (Yaneva & Heaphy 2012). As Yaneva & Heaphy (2012, p. 35) state, '[m]apping a design controversy is not about telling a story with a happy ending, it is about tracing a tentative trajectory and accounting for the whole process of design transformations'. This mapping approach has been used to describe cosmopolitical situations. Venturini et al. (2015, p. 79), argue that in order portray the cosmopolitical not just the cosmos, elements must be included to show 'what controversies are about, who fights them, and how they join or oppose forces' but additionally, 'cartographers must also show how all of these elements evolve over time'. This temporal nature must be factored into smart city reassembly.

Urban controversies

Whilst there are several contributions to the urban context in the MACOSPOL project, attention must be drawn to a few others. In the ominously named essay, *'Give me a gun and I will make all buildings move': An ANT's view of architecture*, Latour and Yaneva (2008) explain the actor-networks around the complex negotiations in the design and construction of buildings. Their metaphor is of the 'photographic gun', a camera designed to rapidly take photos. This camera was designed to take photos of birds in flight. They use this metaphor to explain that a building in ANT terms is 'not a static object but a moving project' (Latour & Yaneva 2008, p. 80). Latour and Yaneva (2008) outline local contingent negotiations with councils and local governments, clients, public perception, and media coverage, and the architects themselves that shape what buildings become. As is quoted by Latour and Yaneva, pragmatist James argued we live in a 'multiverse' not a universe. Concurring with James, they

argue that outside of Euclidean space, a building is not one thing, but a multiverse. Yaneva (2005a, p. 535) has previously argued '[t]he building is an assembly of assemblages, pluralistically constituted, genuinely additive, marked by manyness [*sic*]'.

Therefore, to study these local negotiations is to study the actor-networks that shape these buildings. There are immense parallels with smart city initiatives, down to the very same stakeholder groups and relations between media and the public, creating controversies that flare up within 'publics' around the projects. Albena Yaneva has taken an ANT and ethnographic approach to study various forms of architecture and planning that represents a different perspective to the Cosmopolitical urban as has been introduced (Blok & Farias 2016b). Outside of her mapping controversies projects (Yaneva 2011; Yaneva & Heaphy 2012), Yaneva is more anthropologist, specific in her explanations of the relations of individual people, places and materials. Yaneva's studies have included a longitudinal ethnographic study of Rem Koolhaus' OEM studio following the development of an extensions to the Whitney Museum in New York (Yaneva 2009a), museum interactivity (Yaneva et al. 2009), and a study of the role of images in planning practice in Manchester (Yaneva 2016). These inquiries have led to conclusions such as understanding the architectural prototypes of buildings as holding a multiverse of local realities (Yaneva 2005a), and that process of development from abstract to concrete in architectural design practice is not gradual and linear, rather they rely on surges, jumps and returns (Yaneva 2005b). Following traditional stable objects of architecture as controversies enabled practitioners to see 'architecture in a non-stabilised state where all is melted' (Yaneva 2011, p. 127). It is the intention of this research inquiry to represent smart city practices in the same way.

A rationale for visualised cases

The mapping controversies of the MACOSPOL projects, Yaneva's pragmatic ethnographies of architecture (Yaneva 2009a), and Latour's *Aramis* (1996c) all pose viable options for a speculative Cosmopolitical.

Visualisation as a medium has many different affordances to written text. The concept of affordance and constraint originated with Gibson (1977) and, in design, was brought into mainstream discourse and practice by Norman (1988). Affordances, as discussed in previous chapters, is the notion that certain designs and arrangements can make it easier to think or act

in certain ways. Conversely there are constraints that do the opposite: make harder, or limit completely, options. Both can be considered in Akrich's (1992) scripting. The designer enfolds into the design of an artefact, service or system, these potentials. This is a useful heuristic to think about these approaches in this section. There are of course, downsides to everything. The ANT notion of translation from its etymological origins, contains two meanings: 'traduction' (translation) and 'trahison' (betrayal) (see Law 2006). In every transposition, there is displacement. In every transformation: deformation. The 'betrayal' represents what is lost from the former actants that have been translated in the new assemblage. Something is always given up. In research this may be depth, breadth, accessibility, or perhaps common language, making a study available for broader comprehension.

Visualisation as a medium has many different affordances. Conversely, there are constraints that do the opposite: make harder, or limit completely. There are many more, such as visualisation, which conversely have several cognitive benefits, such as the increased input of data through visual capacities (Larkin & Simon 1987; Tversky 2005) or the enablement of reframing and switching to new perspectives (De Bono 2010), as characterised by the tracing of certain actors and their respective associations. Visualisations afford better and more exhaustive comparisons by expanding working memory through holding and manipulating more concepts concurrently (Norman 1993; Alexander 1964). Visuals assist in mutual understanding in groups (Morgan et al. 1997), or between groups' communication as boundary objects (Star & Griesemer 1989). Visuals as synoptic representations enable tracking (Bechky 2003), and show interdependencies (Mengis & Eppler 2006). Large scale visuals create involvement and engagement. Visuals can also create convincing communication (Horn 1998), through the twin advantages of easier recollection and sequencing (Kraut et al. 2003). In terms of validation, visualisation also quickly surfaces any areas of disagreement (Whyte et al. 2008).

Three examples of inquiry and enactment of the urban 'in the making' are discussed below; MACOSPOL, Yaneva's ethnographic approach (2009a), and Latour's *Aramis* (1996c);

MACOSPOL

Mapping, according to Yaneva, '…is an epistemological tool for underlining ontological singularities; for deploying, not just describing, phenomena' (Yaneva 2014a, p. 235). in the

complex visuals of the MACOSPOL projects, these technological approaches, while good for sociologist to play with, had little impact beyond this sphere (MACOSPOL 2007a; Venturini et al 2015). The more 'bleeding edge' and bespoke software is used, the less compatibility these will have across systems, and the less likelihood these systems will be available long term. The MACOSPOL project has had a lasting legacy in what these inquiries have translated into, but have any of these representations been of use to practitioners? What did they do for the contexts they described? The various MACOSPOL maps were all largely produced on proprietary software, which unfortunately means that these were not easily viewable online. The website on which these were posted is now defunct, only viewable using internet archives that saved older versions of the website (such as webarchive.org). There are some records in existing, accessible papers, however, the impact of these projects could have been broader, as Latour states in the conclusion of the project. As the final report states (MACOSPOL 2007a, p. 10):

> Many problem [*sic*] remains as to how the public may make use of the available tools. Our two tests showed that no matter how easy to use the tools assembled on the platform, considerable additional work had to be made to make use of them, to learn how to articulate a position, and to dig [into] the necessary information (especially when the issue is complex). From the feedback received during the last of the two dry run [*sic*] (the Venice one), it is clear that the equipment we devised might be much heavier than what is needed for journalists and administrators usually to reach a conclusion. It is obvious that no tool and no platform will ever replace the properly political and scientific work necessary to get interested in an issue and then to want to dig into it.

Clearly, there are issues in scripting the use of these artefacts. As the report mentions above, additional work is required to make use of the platforms, and the software is too complex for their intention. There are, however, the advantages of being able to represent the systemic nature of knowledge, and update data live through the visualisation software, which is suited to current controversies. This case demonstrates effective means for showing the inherent tensions in complex projects. Getting stakeholders to engage with these digital maps has remained a problem. As Venturini et al. (2015, p. 74) confirms that 'the main challenge for the method [of Controversy Mapping] was to engage with actors of the controversies'. In the beta-test of the MACOSPOL maps, a group of journalists and policy makers 'could make little use' of the maps (p. 74). They faced the challenge of creating maps that were rich in content, but hard to read, or easy to read but poor in content (Venturini et al. 2015). I believe that by reducing the reliance on complex systems, and maintaining the visuals as printable 2D poster

format, detailed design can ensure that even complex information retains legibility through information hierarchy that provides a clear structure to the reader.

YANEVA'S ETHNOGRAPHIC APPROACH TO ARCHITECTURE

This approach (Yaneva 2009a), whilst the most accurate and detailed, involves much time spent dwelling on the inner workings of architecture studios is time consuming, and would be difficult to apply across various locations. Yaneva, visualises these accounts through photography and written form for the OEM architectural studio, including a number of photos of the architects working, plans' sketches, renderings and models. The focus of her study was the trajectory of action for the Whitney Gallery buildings development in New York, a project that was eventually lost to another studio. This case is effective in demonstrating the pragmatist perspective. Yaneva (2009, p. 282) has explained elsewhere, and fittingly for this proposed study, 'that an ANT approach to design would be to would consist in investigating the culture and the practices of designers rather than their theories and their ideologies'. And moreover, 'the pragmatic content of actions, not discourses, is constantly prioritized' (p. 282). However, with emphasis on action, this approach does not provide rapid access into the account, without reading it from the beginning. Visualisation could address this aspect, to make the accounts more rapidly available to practitioners. I believe that this approach can be adapted to a visual format.

LATOUR'S *ARAMIS*

Likewise, in the earlier mentioned Scientifiction of *Aramis* (Latour 1996c), Latour narrates the story of a project that did not eventuate. It is a very long textual compositional account, yet, but brings to life the multiple worlds of actants involved in and relating to the project. Latour uses the fabricated voices of the professor and the junior researcher to orient the reader through the context. This account is, however, effective at demonstrating the complexity, diversity and ultimate indeterminacy of technological development. This account is considered difficult to understand (Czarniawska 2008). I believe that a visualised spatial infographic version of this approach could help it become more useful.

COMBINING THESE APPROACHES

This thesis asserts that a hybrid of these will suit the development of a cosmopolitical smart city construct. The following chapter will describe the exact approach and process used describe the smart city cases drawing on these examples.

Defining a new 'visual history' through pragmatism

This section will outline the argument for the creation of a new way of visualising smart city cases, which argues to be a means to bring together the various threads that have thus far been discussed. Illustrating the changing politics of the smart city cosmos over time (Venturini et al. 2015) represents a way of visualising the cosmopolitical nature of the urban cosmos; a way of visualising that is useful towards the action of practitioners, showing how things *did* work, rather than appealing to ideology of how things *should* work.

Each of the cases discussed in the last section, construct the present and the past via means that are intended to be more useful for present practices, through giving a more accurate pragmatist representation of social relations. These studies of ANT, and the recent cartographies of controversies, have provided a useful positioning of such plural discursive research aimed at providing input into political and experimental praxis. In rethinking the past, we can better understand the future possibilities (Neustadt & May 1986). Reassembling the past reassembles a social construction of the present, and subsequently the future. The smart city, as an inherently future-oriented discourse (or, in the words of Bell & Dourish (2007), 'proximate tense'), there is a lack of depth in narratives of what already exists, and little thought to constructing these narratives outside of normative descriptions (usually promotional).

In following these examples, visualisation is proposed as a way to be consistent with the theoretical underpinnings of pragmatism; a method concerned with practical effects. The concluding section of this chapter argues that the choice of *medium* to represent this practice is as important in shaping the way of thinking to address these complex problems, as is the content itself. This section will draw on pragmatist media culturist, Marshall McLuhan, to

articulate the significance of experimenting with other modes of communication and will articulate a proposal for a new model of historiography of smart city projects that is more pragmatic to the design of cities in the 21st century.

How pragmatic media studies understand the visual medium

Pragmatist aesthetic theory is also *in the making*, allowing one to become creator and not simply an observer. A complete pragmatist approach cannot discount the forms of media that are used to both represent and distribute the research accounts. My emphasis on the discourse of the smart city, how the it described and represented and through what mediums. This is a critical aspect of the reassembly of the smart city discourse.

Generally, the philosophy of media studies holds the main objective of attempting to rewrite the history of philosophy, creating an understanding of the human, of culture and of politics, through the prism of media. It seeks to comprehend the role of media in human perception and thinking. We enter here into media studies to bring out one particular thread, that of the work of Marshall McLuhan. His approach was essentially pragmatic, as he himself insisted, since he developed his perceptions without preconceptions or fixed positions. McLuhan's pragmatism however, is more like that of C.S.Peirce (Theall 2001, p. 14). Peirce, the first to mention 'pragmatism', created the pragmatic maxim. However, Peirce's accounts are unlike those of Dewey and James, who have already featured heavily in this thesis. Peirce coined 'pragmaticism' as a semiotic approach.

Whilst McLuhan had an anthropological approach to his media theories, believing that media could be understood by the way that they are used, he took a semiotic approach. Such an approach does not mean that an individual's experience of using a medium in a specific instance is the full picture. McLuhan (1964, p. 19) argues '[o]ur conventional response to all media, namely that it is how they are used that counts, is the numb stance of the technological idiot'. There are parallels to McLuhan's questioning of the repeated experience of engaging with a form of media, rather than the more general approach of focusing on discrete programming. As McLuhan (1964, p. 7) notes: 'the personal and social consequences of any medium - that is, of any extension of ourselves - result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology'.

In attempting to position academic writing as an ecosystem with practical effects, McLuhan's approach is a useful framing of media as an 'extension of the self'. McLuhan speaks of scale, which is what he describes as the ability of a medium to enable humans to interact with the world in a different way, in changing 'scale', 'pace', and affecting 'association' and 'action' (McLuhan 1994). This perspective confirms pragmatist conceptions of Dewey's *pragmatic technology* (Hickman 2009), Hutchin's *Cognition in the wild* (1995), and ANT's premises of *material-semiotic assemblages* (Latour 2005b), that the human is beyond their body, in action, cognition and definition.

McLuhan (1964, p. 8) reasons: '[f]or the "message" of any medium or technology is the change of scale or pace or pattern that it introduces into human affairs'. McLuhan uses the railway as the example: '[t]he railway did not introduce movement or transportation or wheel or road into human society, but it accelerated and enlarged the scale of previous human functions, creating totally new kinds of cities and new kinds of work and leisure'.

McLuhan (1964, p. 9) states that it is '...the medium that shapes and controls the scale and form of human association and action'. If a medium creates effects on human action, it is of pragmatist concern to carefully consider their selection and design. McLuhan argues that the content of the medium has less effect in shaping human association and action than the content itself. In his own words; '[t]he content or uses of such media are as diverse as they are ineffectual in shaping the form of human association' (p. 9).

There are ethics bounded by these technologies. As an example, obstetric ultrasound as a technology enables parents to make decisions about their child's future based on what the medium enables (Verbeek 2008). In ANT language these mediums script a certain type of interaction. Verbeek (2006) states; 'this implies that engineers are doing 'ethics by other means': they materialize morality' (Verbeek 2006).

In this way, and with the politicised nature of design we have discussed earlier (DiSalvo 2012), we can reflect on academic practices. As researchers normatively produce journals, they further inscribe through repetition these 'associations and actions' of human interaction. The vast majority of papers end up behind paywalls, although there is a trend away from this with more researchers posting their own materials on personal websites (such as 'academia.edu' or 'researchgate.net'), as well as an increasing number of open access journals. There is clearly a

question about the appropriateness of journals as being the correct medium to convey this information to practising practitioners. This links to this Chapter's earlier discussion of ANT scripts (Akrich 1992; Latour 1992). As Latour states, designers—in this case researchers—inscribe processes in terms of 'delegation'. A researcher delegates to human and nonhuman actants specific responsibilities; such as a publishing house to hold and communicate research, or to the reader the responsibility to interact with the research in terms of a written document. Researchers do this because of the system, in which they seek the research rating associated with their work appearing in a highly ranked journal. As McLuhan ([1964] 1994, p. 9) observed: 'Indeed, it is only too typical that the 'content' of any medium blinds us to the character of the medium.' Journal subjects are diverse, but they inscribe the same forms of interaction and human association, and limit what kind of information can be communicated.

I will turn this discussion now to the construction of publics around academic research, particularly those directed at smart city practice. Academic processes are changing into an emerging paradigm of uncertainty (Ravetz 1992), and the transdisciplinary nature of research practice where edges are blurring between universities and industry (Gibbons et al. 1994). McLuhan's concepts are relevant to these new interpretations. In these contexts, what is the best way for information to be presented? What is the best way to create the desired response?

Academics create for, and are exposed to the 'medium' of academic journals, as the primary means to communicate and understand research. How does this shape the way knowledge is thought about? Today, however is not like previous decades. Digital transfer of journals is unlike the experience of accessing paper-based journals. Researchers can now access millions of journals at once. Does this lead to less browsing and more pointed searching? I there now less chance of finding different research?

Reflecting on universities' outreach through their production of peer-reviewed journals, and theses, it is patently clear that for Universities to remain relevant they should be experimenting with various media, as well as content. While journal articles differ greatly, they are communicated across the same medium, analogous to changing the channel but still watching TV, or reading the sports section of the newspaper instead of the finance section. All of these lock in the same kind of action, positioning the viewer or reader in the same way in relation to the content. While having used the example here of the journal, the thesis, whilst valuable, has many of the same limiting scripts. Many of them will never be read from start to finish. It is

contended that there is a need to experiment with medium as well as form in academic research as, arguably, the journal inscribes a continued 'expert' role of academia that is already at odds with 21st century academic practices. The scale of the Cosmopolitical is not so much a longer distance, but rather a depth. It would be ungraspable in short forms other than to allude to the cosmos, but attempting to enact a discursive practice through a one-way communication that is read by an individual, appears ineffective.

Medium and message on the internet: a pragmatist experience

Whilst the internet was a technology that McLuhan could never foresee, its radical departure from previous technologies follows his hypothesis. While McLuhan was more speculative in his approach than others, such as Sandbothe, he draws attention to the fact that the use of media is socially and historically constructed, so this is how it is used. Individuals understand mediums through habitual use, through which they can learn to differentiate them from other mediums. Through their difference in experience they are defined. As Sandbothe (2005, p. 135) states, '[a]s such…[they are] not perceptive technical extensions of sense organs, but rather of social constructions'. This, Sandbothe (2005, p. 135) argues, is 'the socially habituated means of using media, users construct what a medium respectively is (in relation to another medium)'. These can then 'stand in' certain relationships as perceptual habits, defining what we call our 'senses'. Everyone can now produce media, and media is now consumed at an individual level, asynchronously. Snapchat, Facebook, Twitter, YouTube, Medium, and online newspapers, all propose different perceptual habits. A pragmatist approach could consider the practical affordances and constraints of each medium. What are the mediums that will enable deliberative discussion in the multi-disciplinary forums? McLuhan (McLuhan 1994) did not witness the internet but predicted a 'global village' that individuals enact with each other as 'after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned'. As Bolter (as quoted in Sandbothe 2005, p. 137) states;

> The internet shapes the community hypertextually. A network community is a web of links…Perhaps individuals who use the internet begin to perceive themselves as hypertextual - as the sum of links of all the different communities to which they belong at a certain point in time.

Representations in ANT terms are inscriptions that translate into other actants or assemblages that will be performed. They can, in some forms, be what is known as an immutable mobile

(i.e. a fixed semiotic device which can travel and be used in other contexts). A text is immutable as far as the same message is conveyed every time it is transferred; however, it can always be interpreted differently. The researcher has no control over who will read the text, but depending on the way that an account is created, control is possible over who is *likely* to read the text. Latour argues that quasi-actants are those more ideological aspects of networks that may not show up in the direct experiential understanding of a network. McLuhan (1964) claims that genres reorganise consciousness, as such a material-semiotic genre that presents the agency of the variety of actants is crucial. On reading text on the internet, Sandbothe's argument (2005, p. 142) holds different meaning:

> The handling of written text in the world wide web's hypertextual sign-space is not the same as the interaction with text that we are acquainted with from reading books. Hypertextual movement in the net - i.e. clicking on links, programmed sign-sequences that point to other documents - can lead to a more pictorial, tactile interaction with texts. The text then no longer directs us only within the horizon of its meaning and the connected spheres of our understanding inwardness, but prompts participatory and extrovert activity, activity directly involved in the networked textual event and so 'tactile' in McLuhan's sense.

This is unlike academic normative practices that flatten text, usually in pdf formats. Sandbothe (2005, p. 143) continues:

> To a large extent, linearly textual facilities of this kind function simply as digital copies of printed text. In the conditions of the internet's mass mediatization, against a background of corresponding routines transferred from print use to the internet, these services can stabilize a theoretically distanced attitude that recognizes the written text as an authority which is not to be questioned. This attitude is reflected in the reverence that many net users show towards the 'global knowledge' supposedly represented in the internet.

In the age of the internet, this 'reverence' of written text has authority that is not questioned. This is counter to the discursive space that must be produced for the Cosmopolitical smart city. The one directional nature of communication of information is also not conducive to discourse and, as Sandbothe describes, attempts to establish superiority from the communicator. A reorganisation of consciousness could be conceived through design that affords the Cosmopolitical, as suggested by the earlier cases of MACOSPOL and Yaneva. Digital forms of communication have rapidly become the norm since the widespread use of the internet.

Stepanov (2013, p. 91), using Dewey's (2005; 1958) philosophy of experience, formulates some principles for a pragmatic philosophy of media: arguing for pragmatic media that '...encourages new approaches to the environing and the unity of various elements of experience', that 'should not be hemmed in and idolized in absolute formulas' (Stepanov 2013, p. 91). Pragmatic media should not be seen as static, but 'as processes of their work in direct communication with the human, continually developing process of action and change' as an experience of the media (Stepanov 2013, p. 91).

A pragmatist and material-semiotic approach would be remiss not to question the medium itself and its role as an actant. Mediums are 'machines' of transformation, not to be understood as mechanisms but as practice, production and poesies (making) (Stepanov 2013, p. 91). A more visual and experiential medium is possible to describe a more pragmatic smart city discourse.

Massaging the medium: making a cosmopolitical 'visual history'

Whilst in general, an academic researcher may think they are exercising choice in regard to their research output, they are playing with the content and not the medium. Academic researchers will ultimately write succinct journal articles to explain their findings. Industry researchers will ultimately tell the narrative they have been employed to tell. But what good is this form of scripting for the practitioners in more uncertain contexts?

Research for the 21st century has been reframed as Post-normal science, where researchers face extreme uncertainty of methods in complexity yet are still expected to deliver rapid outcomes (Functowicz & Ravetz 1991; 1992). Contemporary research has also been described as *mode 2* knowledge generation, where research is generated increasingly by and with private sector and industry rather than research being privileged fiefdom of universities (Gibbons et al. 1994). Normal science, through complex feedback systems, inscribes ways of doing that dictate forms of representation that create the best outcomes for the researcher. Stengers (2011b) has urged that we slow down research, resisting the commercialisation forces put upon it.

To departing from 'normative' smart city representational discourse outlined in Chapters 1 and 2, the proposed methodology of inquiry hopes for a different interpretation, one that is

focussed on the experience of practitioners. It does so on the assumption that, unless the world is conceived to be heterogeneous, in multiplicity and as processes, the smart city has little to offer in perpetuating concepts that are already out of date, and has scant pertinence to the open, networked, connected visions the smart city discourse itself espouses. It is not a dialectic argument of 'this' or 'that' between technology and the city, or technology and people, corporations and citizens, regressive and progressive, public and private, or bottom up and top down. Different more spatial rather than linear relational epistemologies will require new forms to represent them.

The method must match the complexity of the context. Pragmatism is an epistemology of our liminal times, as is its contemporary descendant, ANT. These are methods that are designed to return to experience, when long running heuristics, ideologies, and processes are no longer useful in action. Nagy used unconventional materials in his artworks that were themselves always at the fringes. ANT recognises the processual, heterogeneity and multiplicity of what exists together. However, as described in the MACOSPOL project, using fringe technologies to convey information is not always pragmatic either.

This chapter, following on from the previous two, has described ANT as a useful pragmatist methodology to understand context. ANT can only describe what already exists. To explain the back story of events visually (Schoffelen et al. 2015a) is to pragmatically ground them in their genealogies. ANTi-history proposes a means to use ANT to create revisionist histories. As Latour (1988) has explained, the representations of the future will comprise a multitude of creative methods. He has also explained the ability of visualisation to say things in far simpler terms than what otherwise could be (Latour 1986). He leaves space for imagination, creativity, and the artistry required to create something compelling that makes the point succinctly.

Can a sense of holism be achieved to a study of the smart city? When something is 'a whole' '...it is a complex ensemble of relations, connections, and an underlying unifying force or principle – that causes things to stand together – that when taken together results in emergent qualities' (Nelson & Stolterman 2012, p. 93). As earlier mentioned, Dewey's (1938, pp. 104-105) pragmatist definition of the outcome of the inquiry is similarly to move 'an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole'. The ANT successor projects have no centre, but they have familiarity across the ANT principles. Design is intentional,

therefore design intention is also intentional (Nelson & Stolterman 2012, p. 121). Intention directs us towards certain data or issues. Design is about bringing things into the world that have not existed before. A new visual culture redefines what there is, and what there is to see. Speculating towards other mediums for representing the smart city, there could be mediums closer to Sassen's *cityness,* as 'an instrument to capture something that might easily get lost' (Sassen 2005, p. 1). The affordances of the popular media—journal article, PR for consultancies, government media announcements—are limited. Journal articles, for example, have a very specific structure, language and limited audience, media covers particular perspectives that are most interesting to public, Consultancies and governments tell the stories they want people to hear.

In reviewing these three examples, the MACOSPOL project demonstrated an attempt to enact, in Latour's words, the 'the publics that go with our [problems]' (Latour 2012b, p. 1). However, ultimately, the visuals were unable to enrol the publics that were desired by the researchers (Venturini et al 2015). The pragmatist studies of architecture of Yaneva (2009a) represent another perspective on architecture, not an ideological perspective or building-in-use perspective, but rather, the building-in-the-making. This approach is also counter to the smart city as a state perspective.

What might be the Cosmopolitical publics to explain smart city projects? If they are to exist, they must be designed.

I propose that stories can be told of projects past that ground the ill-defined and ideological smart city in practice. Depending on the detailed study of the sociomaterial practice, this process can be treated as emergent. As previously noted, ANT has been applied to historiography as an alternative method for studying organisations in context, named ANTi-history (Durepos & Mills 2012b). Drawing on ANT, this approach turns the explaining of organisational histories towards the already discussed heterogeneity, multiplicity and as processes. The work of Durepos is widely acknowledged as a significant contribution to the field of historiography by introducing the ANT perspective. Table 4 shows the central tenets of this exploration of creating history with ANT (adapted from Durepos & Mills 2012b, pp. 210-219). The visual history, as adhering to ANT as a means to enact history, sustains these same tenets. These are also coherent with the five tenets of pragmatism.

Table 4: The central tenets of ANTi-history and the 'visual history' method. Adapted from Durepos & Mills 2012b, pp. 210-219.

TENET	EXPLANATION
Problematise history and the past	reject the priority of a dominant universalising (singular) past.
View history as unfolding, not a linear series of improvements	refuting ontological realism as a viable means to construct history; knowledge of the past that accurately mirrors the past is untenable; ANT seeks to disassociate the past from history.
Accept no beginnings or ends	progressive notions of the past understand the progressive states of history to rise out of the old. ANT conversely views this process as folding; all new states enfold that which has come before, e.g. the entire history is translated into the present.
Understand knowledge of the past as constructed	in rejecting the concept of completely stable states, there are therefore no defined entry points on or off these. Process is continual. ANT is more focussed on how these states transform into another.
Enact the activistic nature of historical work	knowledge of the past is dependent on being generated by social actants as they navigate their terrain. Knowledge grows out of localised networks.
Reflect the communal, distributed and partial nature of knowledge	knowledge is active; not something that actants have, rather something they do. Actor-networks negotiate their past through politics, as successful definition of the past may end up relegated to a *history text.*
Locate knowledge of the past as situated and positioned	knowledge of the past cannot be understood from, or by, one human mind. This position accepts that this knowledge is dispersed amongst the collective situated actants.
Give all actant accounts the same curiosity	all knowledge of the past is an *effect* of the sociopolitics of actor-networks. How the past comes to be known is influenced by the specific circumstances of its time and place.
Celebrate multiplicity in historical approach	no judgement *a priori* of the value or significance of an account.
Problematise the *a priori*.	Do not begin by assuming what you wish to explain. ANTi-history does not impose a re-given plot to order the traces of the past. ANTi-history follows the actants and lends voice so their motives can be heard.
Perform the associations of the social past.	Let the actants guide what is performed; how they made sense of the social past, and how they spoke of it.

TENET	EXPLANATION
Situate the historian (spatially, temporally and ideologically).	A researcher's position shapes the telling of history.
Understand the historian as an effect of the actor-network.	Researchers engage in political work, in the creation of the history, on the premise that their network will support their cause.

The approach to understanding the present in a pragmatic way is thus translated as understanding the past; to translate these assemblages into *medium*; to script a type of interaction that will afford a cosmopolitical discourse. That is to say, a way of interacting with that content has been pre-defined to be discursive in heterogeneity, multiplicity, and as processes. This is the intention that will be explored in the following Chapter, together with an explanation of how exactly this unfolds.

Concluding PART A: Suspending the smart city

Chapters 2 and 3 have outlined the necessity to understand and support the experimental processes that are continually remaking cities through both material and semiotic proposals. This chapter has explored the context of university knowledge, assemblage, and Actor-network theory, leading to an outline of a speculative proposal. It recommends enacting cosmopolitical 'visual histories' to ground the smart city in a pragmatic sense of practice.

This section, *Suspending the smart city*, has provided a pragmatic argument for making more useful knowledge in the context of the smart city discourse. The methods of the 2000s are assemblages and actor-networks, surpassing the dominant concerns of the 1990s; of language and representation. As Haraway (2014) has described;

> That we need to take seriously the acquisition of that kind of skill, emotional, intellectual, material skill, to destabilize our own stories, to retell them with other stories, and vice versa. A kind of serious denormalization of that which is normally held still, in order to do that which one thinks one is doing. It matters to destabilize worlds of thinking with other worlds of thinking. It matters to be less parochial. If ever there was a time, to need to be worldly it is surely now, and I think all of us lack many of the skills.

In reflection, this entire research project could be summarised as a total application of method–pragmatic epistemology. The outcomes are methodological, arguing for practitioners to take a different dispositional approach when facing the 'messy' and the sociomaterial; a disposition currently at odds with the way smart city projects are undertaken by many municipalities. The universalising, utopian vision of the smart city must be rejected. In accordance with Stengers, to think in terms of the cosmopolitical smart city is necessary to abandon the dream of a final reconciliation. The cosmopolitical smart city is to discard the idea of a discourse oriented to consensus. The cosmopolitics requires is a fostering of a multiplicity of discourse of agonistic confrontation.

The following chapter returns to experience to explore initiatives of the smart city from the perspective of—heterogeneity, multiplicity and as processes —and explore the role of design in both performing and scripting these practices. Having set the context of the theoretical and methodology frame. I now explain in detail how particular methods were chosen and how they were used. If practising ANT is 'to live, to know and to practice in the complexities of tension' (Law & Hassard 1999, p. 12), this will require sufficient explanation.

PART B:
TWO CASES

Chapter 5. Research in the making

The historian is shaped by her positioning and influences the telling of the story.

(Durepos & Mills 2012a, p. 218)

This chapter is a reflective account on the research undertaken, leading to a visualised history of two smart city cases. It begins with an introduction to the cases, followed by a chronological account of the research with reflections on these events. It will describe the individual methods chosen as they arose to explore two case studies: *Responsive Environments* and *Real-time Applications*. The chronological arrangement of the account is a description of the way the research was conducted; the methods, processes, of observations, interviews, and workshops. The chronological account is divided into four categories: context, content, conceptualisation and scripting. 'Context' outlines how I came to be involved in both cases, 'Content' describes the epistemological challenges and methods deployed in attempting to know the development of the project. 'Conceptualisation' describes the use of ANT as a theoretical apparatus to make sense of the abundance of data that had been generated. Lastly, 'scripting' outlines the creation of a useful artefact from these findings to both validate, and then enrol, more actants in the research network. There are reflective sections within this narrative, which are examples of what Schön refers to as *reflecting-on-action* (Schön 1983). See figure 12 for a diagram outlining this later chronological arrangement.

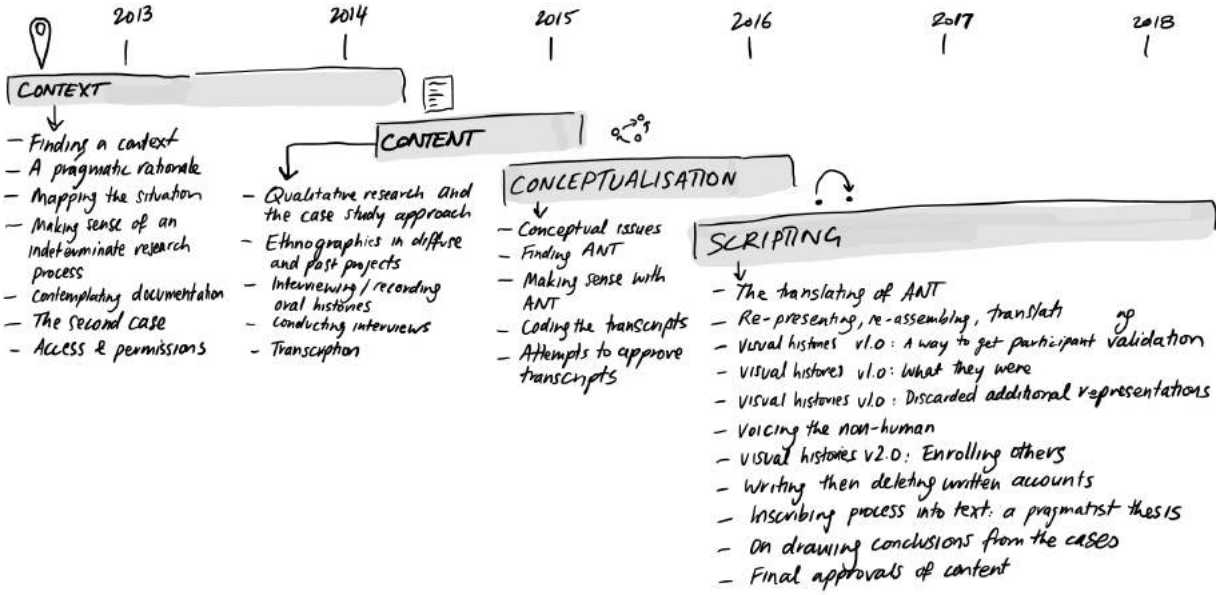


Figure 12: Image outlining the structure of the 'research in the making' account over a timeline. Source: author.

The account is in first person, emphasising the empirical experience of doing this pragmatist research. This chapter explains the messiness and contingency of the research practice, where I made decisions based on limited information about what to do next to progress the inquiry. In a way this expression is messy, but this is how the research evolved in response to the context. Like the narrative in the cases, I was not able to rationally plan a process for that which I did not yet understand. This account explains the narrative of my learning in action; about the research context, pragmatism and Actor-network theory (ANT). The account emphasises those aspects derived from the methodology as describing; the context as comprised of heterogeneous actants, being cognisant of this interpretation as just one of multiple, and understanding these as ongoing processes in the making. It links to the evolutionary perspective, the experimental, challenging meta-physical perspectives, rejecting dualisms and ecological thinking established in Chapter 1 as the core tenets of pragmatism.

In the previous chapter ANT was presented as the methodology to explain pragmatist smart city relations as social assemblages. This chapter explains how this application took place. It is important to note that whilst the pragmatist epistemological approach was employed from the initiation of this project in mid-2012, however, I did not fully appreciate ANT as an appropriate methodology until late 2015. During this time, I was attempting to study and describe the

practice-based approach that, through successive questioning of context and action, resulted in this total inquiry

Consistent with ANT perspectives, this chapter also introduces some of the heterogeneous actants that have agency in the trajectory of this inquiry. To make the research possible, a researcher must enrol actants in the creation of a research network. The researcher uses artefacts that are considered 'theory' in their practices. The practice of this research needs to be spoken about in terms of 'in the making', which is to reject the notion of science as producing 'whole' or 'finished' entities. In doing so, this account of ANT introduces the actants that stabilised the network of research. It is an explanation of what made this research coalesce into something that can be coherently described.

Two cases

The cases can be understood in ANT's language as *assemblages*; the human and nonhuman arrangements that enacted two projects into being. It is crucial not to think of these cases as static, bounded and objectively observable. Rather, the cases and their assemblage of human and nonhuman actants interpreted and in continual change and comprised of many controversies that have different interpretations. Yaneva (2009a, p. 75) has referred to this in her study of the Office of Metropolitan Architecture as recollecting the project's 'trajectory'. This chapter presents the trajectory of design practices in developing digital information systems within the public transport network of Sydney, Australia, although the focus of the study covers the period of 2012-2015. This chapter contains my interpretations of these events. Whereas, the other human actants perspectives are better captured on the visuals that are the research outcome of this process, there is a full explanation of how these were made in this chapter, and an explanation of them in the following next chapter.

In this chapter I provide the reader with simple explanations of the projects, as they might usually be told; as a summary. However, I also attempt to convey how these cases shift and change, moving through an immense variety of politics; the result of actants interacting, enrolling or rejecting the advances of others. Furthermore, the research itself moves in the same way.

Case 1: *Responsive Environments*

The first case, *Responsive Transport Environments*, hereafter *Responsive Environments,* was the university-led project that sought to develop digital information system prototypes for use inside transport environments such as bus stops, train stations and other transport interchanges. This project was introduced at the beginning of this thesis as an Australian Research Council Linkage Grant (LP110200708) (Haeusler et al. 2010). Researchers from the University of Technology, Sydney (UTS) and the University of Sydney submitted the project proposal in November 2010. It was approved in 2011 and commenced in June 2012, now with the additional participation of the University of New South Wales (UNSW). Several government and industry partners were involved. These included the NSW Department of Transport (later Transport for NSW) and Railcorp (later split into Sydney Trains and NSW Trains), the City of Sydney council. The project received in-kind contributions of time and resources from each of these organisations. Two consultancies firms, Grimshaw and Arup, also participated, providing additional financial contributions. Total cash funding for the project was $45,000, with an additional $205,650 of in kind contributions from these partners (Haeusler et al. 2010, 19).

The project proposed the experimental development of several prototype digital information systems for public transport, using a methodology of action research. The aim was to develop interventions that would improve customer and operational aspects, primarily at Central station. The station is one of Sydney's busiest interchanges, with over 12 million annual passenger movements. The project was completed in June 2015, after the development of several prototypes. These included a 1:1 scale 'responsive' bus stop, which could deliver transport information, including real-time information through three different digital interfaces. A student concept for this 'responsive' bus stop is pictured on the following page (figure 13). Both the cases, relate to the same need for real-time transport information to be made accessible to customers.

Figure 13: A student prototype from the Responsive Environments *Project: ACTIVE (2014) concept, which proposes a larger-scale bus stop that integrates a range of real-time service information and wayfinding digital displays. Image and concept by Vivyan Wu, Nailah Masagos & Alyanna Agda.*

Case 2: *Real-time Applications*

The second case, also based in Sydney, was the development of 'real-time' customer transport applications. Sydney has a highly complex and constrained transport network. In parts of the city, multiple train lines share single tracks. Buses often share roads with motor vehicles. Some delays are inevitable, where arrival times deviate from the scheduled timetable. The *Real-time Applications* project undertook a process of making that arrival information immediately available and accessible to customers on their smartphones. It ran concurrent to *Responsive Environments* and involved some of the same participants. Several government agencies were involved, including Transport for NSW, Railcorp (Sydney Trains), as well as contractors for bus services across 15 Sydney regions, ferries (Thalys), and light rail (Transdev).

The project also engaged third-party application developers through a series of 'hothouse' competitions, first run in November 2012 with bus real-time data. Each hothouse was run with the support of professional services consultancy, PricewaterhouseCoopers (PwC). Developers pitched for one of six positions to gain exclusive access to the real-time feed. The process

involved repurposing legacy transport information systems to meet customer information needs. The following April, train real-time data was also made available, using the same hothouse process. Figure 14 demonstrates the interface of the 'Tripview' app before and after real-time data was added. At this point, existing developers received access to the feed, as well as additional winners. By mid-2014, both ferry and light rail information was also made available to developers. Relationships had now been established with seven new external application developers and organisations.

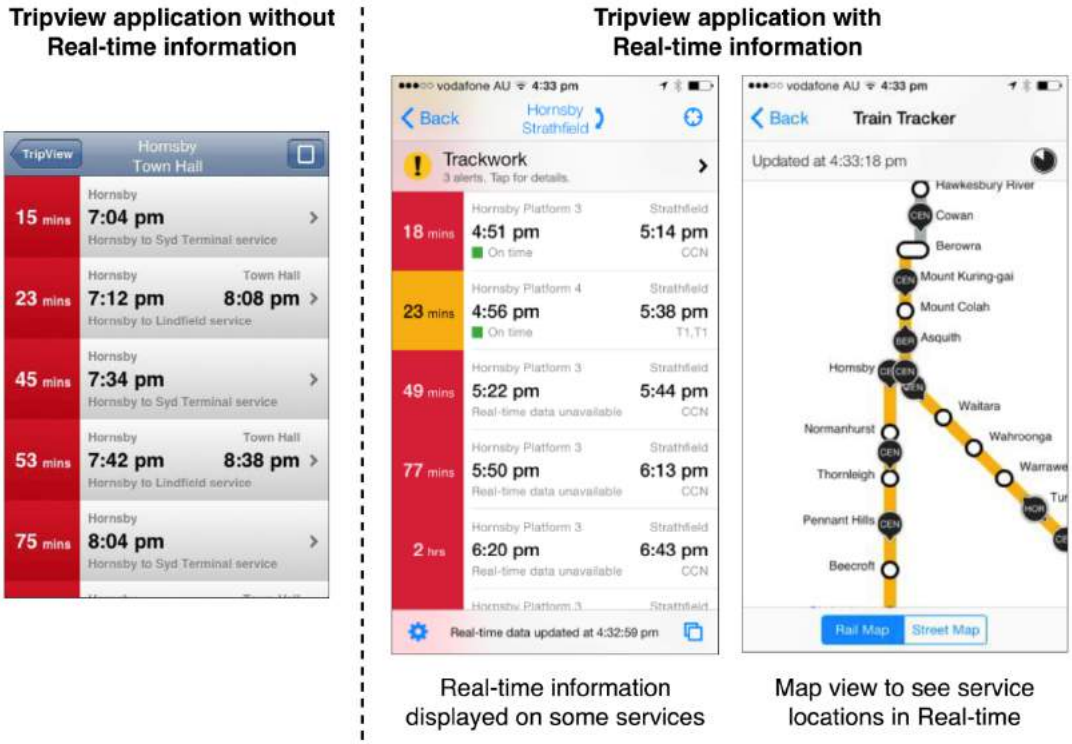


Figure 14: Two versions of Tripview *transport application on iPhone. On the left is prior to March 2013, on the right is July 2015, where real-time data was available. Images © Grofsoft 2015. Images used with permission. As presented in Tompson 2015.*

Why these cases are relevant to a reassembly of the smart city discourse

Since the early 2000s, there has been a rapid emergence of intelligent transport systems (ITS), and a global trend to make information available to customers in real-time. In transport, many of the propositions of the smart city are already well established. Both cases, *Responsive Environments* and *Real-time Applications* use digital information systems for aspects of urban

management; to improve the efficiency of the city through digital systems that involve citizens in digitally-mediated relationships. Ironically, the term 'smart city' was very rarely mentioned in either project, aside from academic observations that nobody uses the term anymore. Yet they are examples of smart city initiatives in an existent, well-developed city. It can be argued that Sydney has an entrenched and obdurate physical form, but it is also the evolutionary result of a complex assemblage of politics, presenting challenges that necessitate experimentation with organisational forms, decision-making, artefacts, and communication practices. The two cases are indicative of complex smart city initiatives involving many stakeholders and emergent goals and practices. They experiment with addressing locally-situated challenges.

In efforts to return to action, I sought to understand the politics of these initiatives in an effort to make the two cases available to a wider audience. Adhering to the pragmatist epistemology in description, I wanted to describe the evolutionary nature of the research project by adopting a detailed genealogical perspective (as suggested for the smart city by Kitchin (2015)) and reject the nature/culture dualism by adopting a socio-technical perspective (as suggested for the smart city discourse by Meijer & Bolívar (2016). The rationale of this study is a desire to explain its outcomes, and to explore what participants identified as the responsible practices, trajectories and outcomes of the project.

Sydney's transport system: part of a smart city?

When the research study began in late 2012, the population of Sydney had reached 4.5 million. To service such a large population, Sydney's extensive public transport system operates across trains, buses, light rail, ferries and taxis. It also incorporates related infrastructure such as railway stations, bus stops and park-and-ride services and, at the time, the planning of new light rail lines, bus lanes, train lines and roads. A 2012-2013 survey revealed some interesting statistics on Sydney's dependency on the system. Between Monday and Friday, the city's population made 16.7 million trips each day; an average of 3.7 trips or 81 minutes travelling per person on weekdays (BTS 2014, p. 1). Importantly, 11.4% of weekday trips used public transport (p. 2). Transport was used slightly less on weekends; but still an average of 14.6 million trips a day, or 3.2 per person (p. 1). The survey found that public transport had increased by 21% in the previous decade, with private vehicle travel only by 5% (p. 1).

As an illustration of this rate of growth, public transport capacity would need to double roughly every 40 years if these trends in transport use continued unabated. Yet rail capacity, at the time, was above its limits. Agencies were looking at means of providing more services, and strategies to spread the morning peak times between 7:30 and 9:00am.

Sydney has a 'hub-and-spoke' transport service: tracks and bus routes radiate out from the central business district. The landform of this central 'hub', and its proximity to Sydney Harbour, present several challenges for transport planners. It is surrounded by water to the west and north, and parklands to the east. These physical constraints limit transport mobility around the city. In response, recent years have seen greater emphasis on developing other city centres such as Parramatta, in the west, and Chatswood in the north (Masterplan 2011). In 2012, plans were in the making for several large-scale road and infrastructure projects; nevertheless, indecision had left Sydney's public transport without significant improvements for decades.

It is not since the 1980 and 1990s had the NSW state government seriously invested in developing its own ITS technologies (see Sydney Coordinated Adaptive Traffic System (SCATS) (Sims 1981), opting instead to purchase existing solutions from contractors (Garry Glazebrook 2014, personal communication, 1 September).

Like all cities, urban development in Sydney is highly political, frequently drawing the attention of media, and widespread discourse about decisions and prolonged deliberations. In June 2011, state elections saw the replacement of the Labor state government that had been in power for the previous eight years. The new Liberal government, with newly-appointed Transport Minister, Gladys Berijiklian, led sweeping reforms to government transport agencies. These reforms saw the dismantling and restructure of the Department of Transport and Railcorp, and new customer-centric service policies.

A new emphasis on information systems fed into several of the government's visions for future transport systems. A 'customer-first' emphasis envisaged the design of the system around the needs and expectations of the customer; growing patronage by making public transport a more attractive choice (Transport for NSW 2012, p. 9). It is within this context

that the cases developed, amidst major transport infrastructure projects but also growing interest in mobile technologies and cloud-based data storage systems. These technologies, amongst other actants, will be explored in relation to the emergence of the two cases.

Importantly, *Responsive Environments* and *Real-time Application* each had a narrative which, in a reductive sense, was highly accessible. In media announcements, reports and tweets, each project appeared as simple and clean; the result of rational planning. However, in both of these cases, that reductive, rational narrative would be highly misleading. It would misrepresent the practice of design in the urban context of Sydney.

Introducing the actor-network of the researcher

Research as a network effect

This chapter is not structured around theoretical constructs; rather, it presents discussion of method enmeshed with action. This is coupled with reflections on these events. Schön's (1983) description of a 'good process of design' is one where the designer has reflective conversation with the situation. Where the designer, in observing the what the situation 'talks-back' they 'reflects-in-action on the construction of the problem, the strategies of action, or the model of the phenomena...' (Schön 1983, p. 79). This chapter will outline how the problem was constructed and why action was carried out the way it was. The process of how I reflected and acted in response to what my research context was saying to me.

Scientists bring their own generalisations, assumptions, habits, and a general or more implicit world view (Kuhn 1962). Through description of these more anthropological notions of Science, it too is localised to material practices, where researchers 'do not dominate their materials through knowledge; instead they engage in rather symmetrical open-ended and performative dances of agency, trying this and that in their struggles with machines and instruments' (Pickering 2009, p. 198). Moreover, they carry an actor-network to the inquiry (Latour & Woolgar 1979; Latour 1987). They bring an actor-

network of libraries, professional contacts, administration staff, computers, funding, their track record and publications, desks, websites, phones, emails, objectives, sneakers and sandwiches. Additionally, in the study of the cases, the actants included industry professionals, sensors, bus stops, contracts and newspaper articles. Each of these actants shaped research practice as I acted in relation to them.

The research objectives of a project are played off against the myriad other actants vying for attention. Indeed, the research inquiry is only ever part of the researcher's total activities. Nelson and Stolterman (Nelson & Stolterman 2012) spoke of 'adequacy', Lindblom (1979) of 'muddling through', and Simon's (2013) concept of 'satisficing'. Each described the pragmatic researcher; one who understands there is never enough time or resources to finish anything to an 'ideal' state. A project almost always ends with the expiry of time, money or resources. Yet, the forces of these constraints are not one directional. A researcher also shapes the network through processes of translation, enrolling more actants into the cause of research. It is a process of adaptation. As Alexander (1964, p. 19) has described: 'adaptation is a mutual phenomenon referring to the context's adaptation to the form as much as the form's adaptation to the context'.

This is a pragmatic account of research 'in the making'. In accordance with the rejection of dualisms, both theory and practice are represented as inseparable. The account is presented as the unfolding of my actor-network as researcher, in order to demonstrate the situated nature of academic research as not outside practice, but a willingness to create a strong actor-network in itself.

Contrary to widespread understanding, what a researcher studies, how they study it, and why they study it, are all subject to the situations in which the researcher exists. Their outputs punctuate and black-box the complex social relations that brought them into being. Unfolding the 'black-box' of research 'in the making' means that the researcher becomes responsive to contingencies as tensions of performance in the network become apparent. Research is presented as an emergent process of making with insufficient information on the same terms as the development of the smart city initiatives.

Explanations of emergent design practice

In the context of this inquiry, it is insufficient to describe the development of my inquiry as a series of delineated steps. It would be counter to the pragmatist perspective that has been argued. Under the pragmatist experimental perspective: 'reflection and action are intertwined as hypotheses and conceptualizations are informed by, directed at, and tried out in practice' (Dalsgaard 2014, p. 149). What the designer may hold as criteria for their design is subject to change. Through experimentation, the research situation will change, including the designer themselves (Dalsgaard 2014). Even those original criteria are likely to change, as the designer learns more about the situation. In the pragmatist perspective, to externalise the context of an experiment has consequences. These are consequences in relation to relevance; consequences for the ability to understand the contingencies changing situated relations (Dewey 1938). While ANT is critiqued for its lack of reflexivity in diminishing individual voice and dissolving agency (Jansen 2016), my emphasis on pragmatist paradigm and other qualitative research method draws this to the fore to explain this process. The research design was shaped by the emergent context.

Attempting to explain this process is challenging. Situated expert accounts of practices do not lend themselves well to written accounts. As described earlier, such accounts know more than they can tell (Schön 1983). Even so, the design process has been variously described as a series of steps.

The given number of steps ranges from as little as three (see Doblin 1987; Simon 1996), all the way to 229 step processes (Archer, 1969). Breaking the process into steps is rationalising of a more complex process. However, not all design process definitions are rational. For example, Alexander's (1964) model of fitness between form and context is an arational concept. It is not prescriptive of the potential ways in which 'fitness' can be achieved.

Many other designers have also attempted to explain design processes. Lurås, among others, uses an arational visual model; spatial explanations of the relations between practice and context (figure 15).

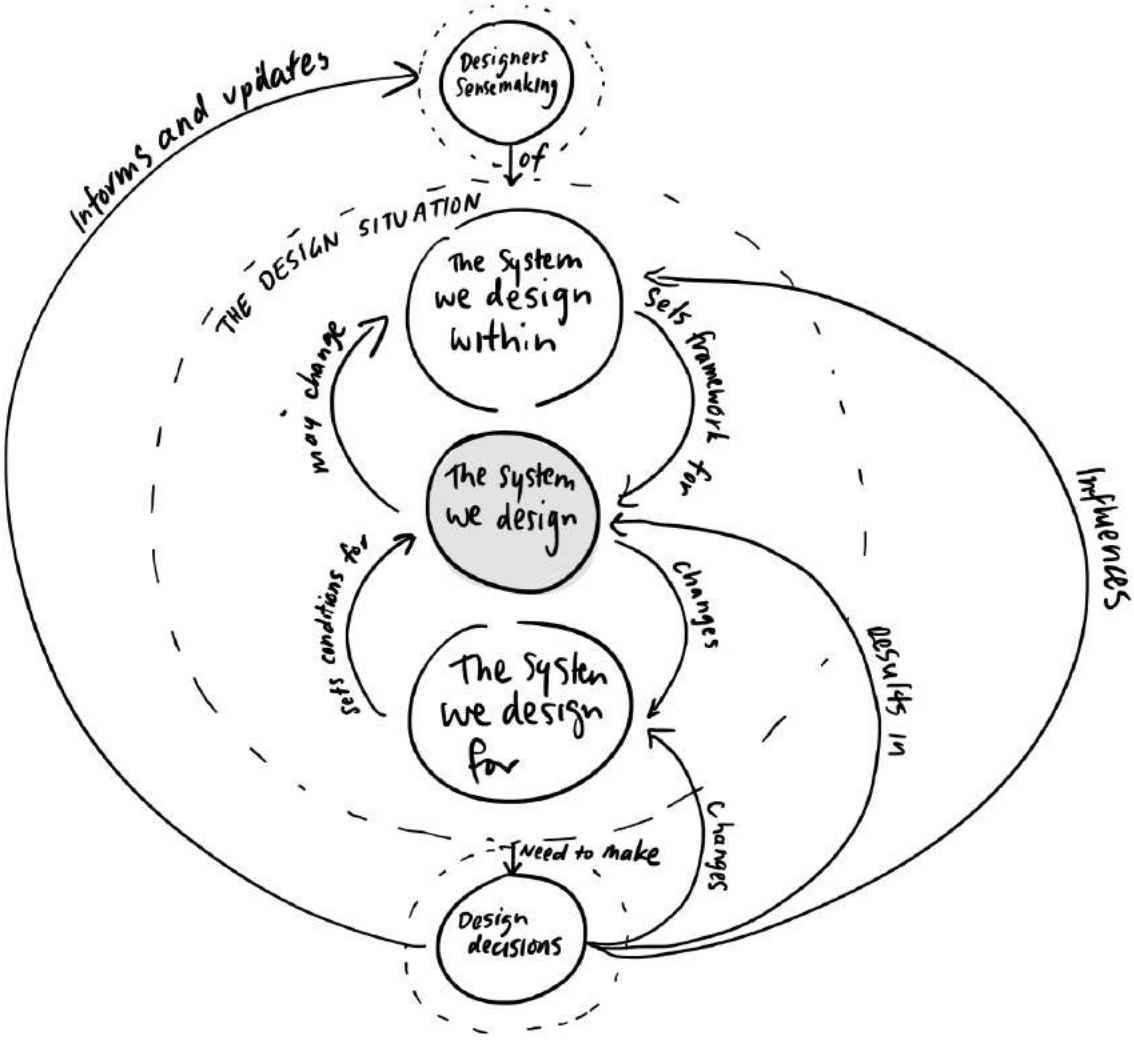


Figure 15: 'A systemic model of the design situation including relationships between the design situation and the designers' sensemaking and design decision'. Original in Lurås 2016, p. 39.

Lurås (2016, p. 35) attempts to explain the 'design situation' using a more system-oriented approach, drawing on sources such as soft-system theory (Checkland & Scholes 1999) and cybernetics (Beer 1966). Lurås notes that her model is just an indicator of the different tensions on the researcher. Highly reductive in itself, Lurås states that her model 'is a construct to help designers consider the situation in which they find themselves' (2016, p. 35).

Importantly, Lurås's model draws distinctions between the systems we 'design within', 'design' and 'design for' (Lurås 2016). The system I design within, in the case of my own inquiry, is my actor-network of university, supervisors, the research grant, industry stakeholders and colleagues that have agency in the research practice. Yet, an inquiry with ANT

extends this system to the material actants referred to earlier: computers, software, books, desks and so on. The system I design, in this case, is the research itself. It is the way in which I arrange elements, my methodological approach, the act of doing the research and my representation of it. Again, extending ANT, the system I design for is the process of scripting; my anticipation of the future uses of that script.

There are even simpler versions, such as the iconic Eames' model of interest and concern (Neuhart et al. 1989), which describes the interests of society as a whole, the concerns of clients and the design office, whilst stating that it is in the overlap that the designer can work with 'conviction and enthusiasm'.

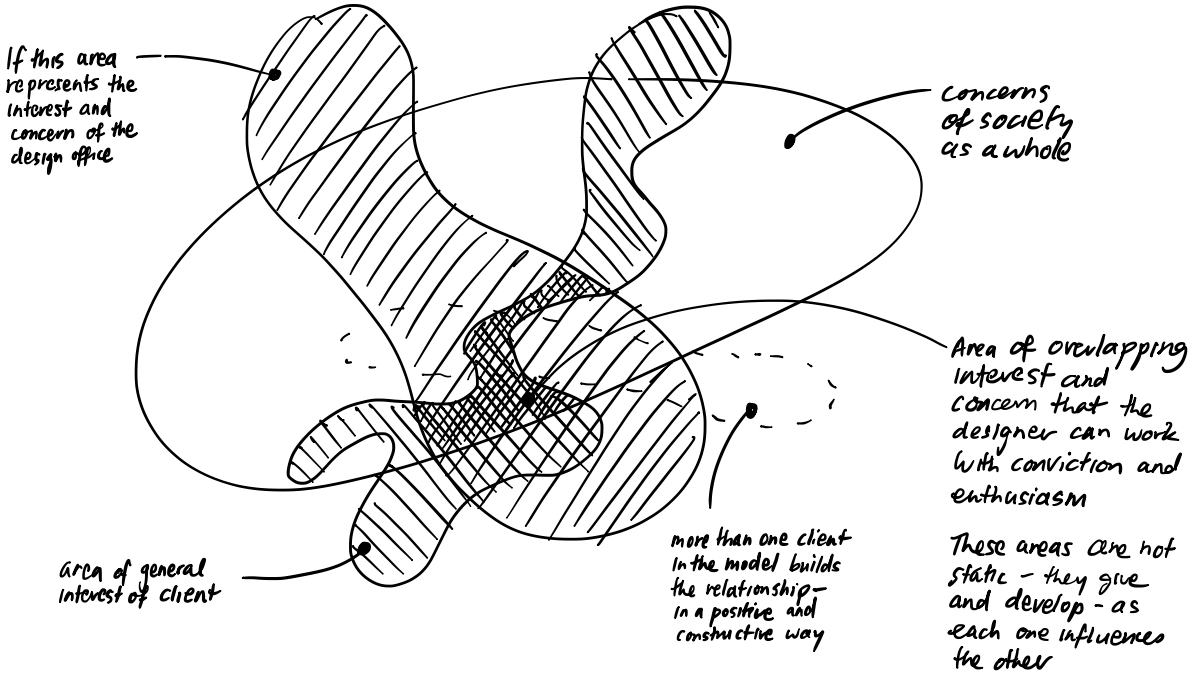


Figure 16: Eames' model of interest and concern of the design office, client and society. Adapted from Dubberly 2010, p. 76. Original in Neuhart et al. 1989.

The Eames' model (figure 16) infers process spatially, through the gestalt of overlapping fields of interest.

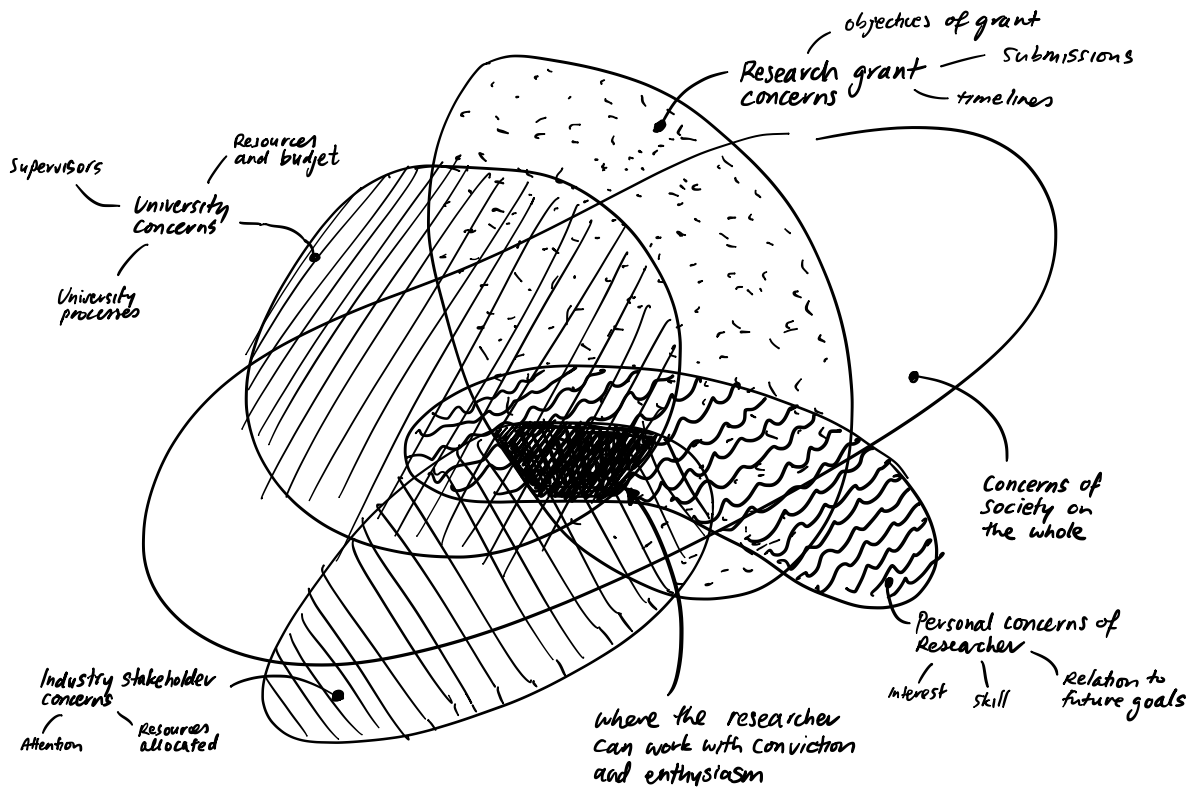


Figure 17: A pragmatist approach to this research inquiry. Source: author.

Figure 17 reinterprets the Eames' model of interest and concern for my research inquiry. It has been adapted to explain the tensions of the research process; tensions that lie between grant objectives and contracted work, and between researcher, industry stakeholder, university and societal concerns. All of these categories, useful here for illustrative purposes, had their own affordances and constraints on the emerging research. For example, the initial area of research was dictated by the grant. While beginning as a broad topic, opening communication with industry, the research area narrowed as further constraints were applied in order to ensure useful outcomes for stakeholders. My personal concerns interplayed with stakeholder concerns, as I worked to maintain the attention of industry stakeholders; to elicit a willingness from those stakeholders to contribute towards and validate the research.

No model can capture the variety, complexity and dynamism of actants that impacts a designer or researcher as they practice. Yet, there are two more diagrams worth mentioning, particularly because they speak to this complexity and to the temporal orientation of design practice. The

first is the 'squiggle' (figure 18). This diagram represents the seeming randomness of events, slowly convening into process that appears simple.

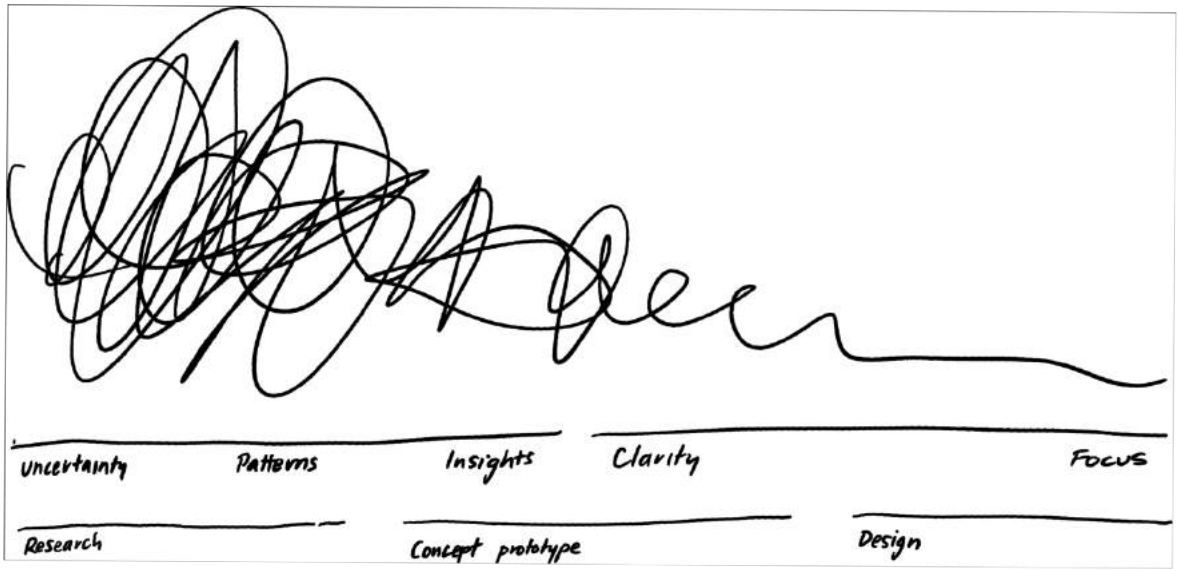


Figure 18: The design process. Adapted from Damien Newman in Stickdorn 2011, pp. 125.

Figure 18 is a popular visual to represent the design process in a non-linear and arational way. The representation does not try to impose a structure onto the process; rather, it speaks to the experience of moving from apparent randomness to order. It is a move, as Vattimo (1988) may describe, from 'weak to strong concepts', or as Latour may describe (Latour 1987), from 'upstream to downstream'. The following (figure 19), is more representative of the narrative of my inquiry. I do not attempt to resolve the complexity, rather just describe it more simply.

Figure 19: An interpretation of the design process of this thesis. Adapted from Damien Newman in Stickdorn 2011, pp. 125.

This thesis, for example, is represented by a slight reduction in complexity, but maintains a level of complexity through the design process, as new challenges are addressed as they become apparent through research. My inquiry intends to leave the reader with less indeterminacy; to move indeterminate elements into a situation which is more determinate, as stipulated by Dewey's theory of inquiry (Dewey 1938). It does this, partly, for communication purposes. But it does not pretend to be able to remove all indeterminate elements, as this would incorrectly infer that such a removal is possible.

On the form of this explanation

This is a constructivist perspective reflecting on my experience: what was influencing practice at the time; what decisions were made; and what theory and methods were applied. In creating a written account, the worlds of experience from five years of practice must be reduced to just a few thousand words. Once again, I turn to pragmatism to think about what the most salient points are to make. Whilst I cannot convey the complexity of these experiences, I present these summaries as fictions. These fictions 'offer us imagination we would not have had without them' (Latour 2013b, p. 240). This chapter reduces what were four largely concurrent streams of work into a linear sequence. The time periods are not to be read as distinct phases; they are divisions useful for communication purposes. The headings may guide the reader through; however, they post-rationalise what is a heterogeneous and unbounded context. The principal message of this thesis is the necessary process thinking required to understand and intervene in the world as it is experienced.

There is no desire to go into 'reflexive loops', nor attempts to distance myself from the context, as Latour (1988, p. 173) has warned against. Kobayashi (2003, p. 348) also warns '...reflexivity has no meaning if it is not connected to a larger agenda...'. Reflexivity is presented as a kind of dialogue between the chronological and reflexive.

Events are described, and then considered in sections called 'reflections'. This method of explaining in present tense and reflecting on these with hindsight, draws on Latour. In part, it traces Latour's (1996c) approach in *Aramis*. Specifically, this chapter refers to the discussion between the training researcher and the professor: posing questions and then explaining and contextualising how each was achieved (Latour 1996c). It follows the approach that Latour has

also employed elsewhere, in which the professor explains the process to an inquisitive information systems student (Latour 2004a). My questions that I was considering at the time mark where certain issues had been at the front of my mind. These demarcate the course of inquiry that derived in practice and is explained through reflective discussion. During discussion of this case this thesis will compare my understanding of a naïve, beginning researcher with reflections on this activity drawn from now five years' experience.

The way of describing also draws on Yaneva's (2009a) approach, informed by her ethnographies in inclusion of research material and anecdotal explanations of exact events and situations (Yaneva 2009a). I include many photos and parts of reports and documents that were relevant at certain times.

In the intention is to change discourse to create a different form of action. The research does not claim to generate any assertions that are indisputable, or conversely, that are entirely disputable. Nonetheless, nothing is 'made up', but grounded in empirical experience.

Researching with ANT is considered to be a reflexive application of design itself. It is not enough to designate design by saying what it is not: it must be designed intrinsically, without referring to external or transcendent causes. Rölli (2016) demands a consolidated description of empirical activities, including their various relationalities and their combined methods. The elaboration of structures that emerge in various designs due to their interconnection of actants demonstrates that only the recognition of ill-defined situations become problems. This inquiry has found ill-defined situations through research design and has attempted to make them more determinate. Like Rölli, my approach taken denies 'Scientification', or the process of 'making scientific'. However, inescapably, this denial is limited, as the account of research must be converted to a reduced and sequential 'academic' written account. This research and intended to create action.

Context

Finding a context

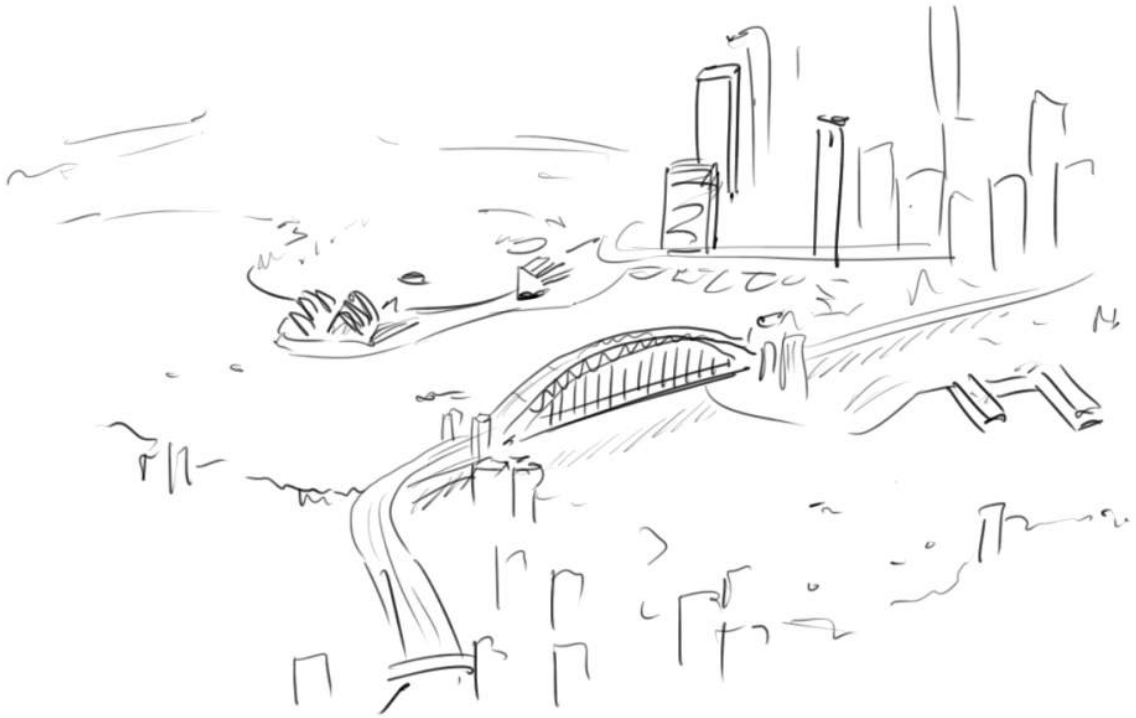


Figure 20: Sydney. Source: author.

In late 2010, a grant proposal was written for the *Responsive Environments* project between researchers Tom Barker, Martin Tomitsch, Matthias H. Haeusler (Hank), Michelle Zeibots and Nathan Kirchner (see Haeusler et al. 2010). Tom was a professor at UTS, and Hank was a post-doctoral student working with him. Martin was a lecturer at the University of Sydney, at the of School of Architecture, Design and Planning. Hank and Martin had been working together exploring their joint interest in digital information and architecture. Michelle was a researcher at the Institute of Sustainable Futures at UTS, and Nathan was a senior lecturer in robotics, also at UTS in the Faculty of Engineering and IT. They had met each other through the various networks in which they were all involved and shared an interest in exploring transport information systems. I became involved in this research project in early 2011.

'What else is out there?' I was asking myself.

While working as a service designer at a strategy and design agency based in Sydney, Australia, I had begun looking for post-graduate opportunities. One morning, I had a conversation with a former colleague, Garry Glazebrook. Garry was also a former professor at UTS. He had given advice on my graduation project in 2009; a project focussing on the creation of a demand-responsive bus service.

Garry outlined a grant that he was working on. He was a Partner Investigator, though his current role as transport policy manager at the City of Sydney. The team had assembled and was still looking for a PhD student to utilise the grant. 'Just think of the intellectual freedom,' Garry encouraged.

The project was beginning in just a few months, scheduled for June. I decided to meet some of the research team: Hank, Michelle, and Martin. Only Martin and Hank had worked together before. During this first conversation with the team, some 18 months after the original proposal had been written, I was unsure if they were interviewing me or if I was interviewing them.

Part of our discussions centred on structuring the inquiry through a participatory process; redefining the original grant proposal, as it was now two years since the proposal was written. The context had changed. It was a necessary step; the newly-formed Transport for NSW had already started working on most of what had been outlined in the original proposal. As part of the new government's customer-centric approach, this included work towards the development of transport information mobile applications.

By the end of our meeting, a diagram on the board had been produced that aptly articulated the design process. Alongside it, my sketched-out hypothesis about how each member of the research team could work together in this process (figure 21). The various skillsets present in the room were identified and discussed, including ways in which all team members could contribute to solving the requirement to address the context had been pinpointed. However, the problem we could address was still missing, without input from all partner organisations.

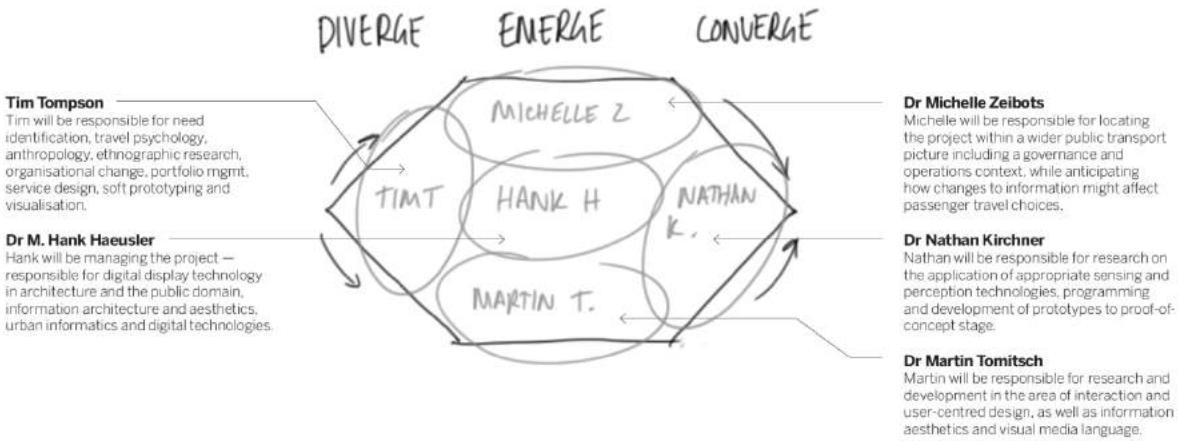


Figure 21: A later adaptation of the sketch from August 30, 2012, created at the Kick-off workshop report.

Shortly afterwards, I committed to the PhD position. I began my application for candidature with UNSW, meanwhile phasing out full-time work with Second Road.

A pragmatic rationale

'What are we designing? For who? And why?' our team was asking as the project began in September 2012.

On 30th August 2012, representatives from all of the partner organisations attended a 'kick-off' workshop, organised and facilitated by our team. The agenda of the afternoon was as shown at figure 22. The scope of projects outlined in the grant were now different and, from this position, the design challenge was immense. A growing number of projects were underway within Transport for NSW, including the complete renewal of the wayfinding system across the whole transport network. Wayfinding is critical in the transport context, as it is the signage and layouts that ensure people can orientate and find their way to the right places. Our team was now discouraged from creating prototypes for Central station; instead, encouraged to 'start small' elsewhere.

Agenda

Time	Session	Activities	Who is involved
12.00	Lunch	Sandwiches and refreshments will be served at Transport for NSW, meet and greet	All
1.00	Introduction to the session	Introduction and project background	
1.10	Introduction to the participants	Introductions to everyone in the room	All
1.40	Understanding the state of play in real-time customer information in Sydney's transport?	One or two representatives from each organization to present for 5 minutes per org (as defined in accompanying email) followed by conversation	Representatives from organizations – All in conversation
2.30	Break		
2.50	Identifying how the ARC Responsive Transport Environments Research Project can be most valuable	Break out session around how to best utilize this unique group and resources. Re-group, capture key insights	All
4.30	Identifying the process and logistics of working together	Discussion and decisions around, contacts, confidentiality, expectations etc – action plan	All
5.00pm	Break – go for drinks/dinner	We will be having drinks and dinner at Freda's - 109 Regent Street, Chippendale (this will have to be paid individually for those who attend)	All are invited

Figure 22: Agenda for the Kick-off workshop, August 30, 2012.

Following the first workshop, I proposed rebranding of our team. Rather than the 'responsive transport environments research group' or 'ARC grant research team', the group now identified as 'Encircle', and cohered into a more unified approach. Figure 23 shows our first brochure to promote the project.

Figure 23: The cover of the Encircle flyer for project partners.

The research grant itself stated that the project would be using action research. As the research grant proposal (Haeusler 2010, p. 9) states;

> The main method is action research, allowing the team to evolve their approach at each project prototype stage. User-centred design is a nested method within each of the prototype stages themselves, taking an experimental iterative approach to context, requirements, solutions and evaluation. This leverages the ease of adjustability of responsive systems in an experimental situation.

Haeusler et al. (2010, p.9) also stated that 'the methodology is expanded in a new way through the inclusion of two observational methods: one by machine and one by people', as a way of demonstrating that sensing and computational technologies would play a role in this learning process. As Lewin described it, Action Research uses 'a spiral of steps, each of which is composed of a circle of planning, action and fact-finding about the result of the action' (Lewin 1946, pp. 38). I found it difficult to conceptualise the research as spirals, as ongoing

communications with Transport for NSW seemed to re-instigate different routes, requiring our team to second guess the intentions of each stakeholder, and therefore modify trajectories from conversation to conversation. It seemed that intuition and conversation was the only means of learning about design possibilities in this context, rather than the ability of finding any useful, accessible academic knowledge for the cause.

There was a broad set of stakeholders involved, and no real defined problem to work with. Rather than dialectic, it was more of a dialogic process in which the research team had to adapt to the existing system and stakeholders, rather than receiving any concessions for easy access to prototyping environments (Sennett 2012c). Originally coined by Bakhtin (1981), dialogic referred to an author's writing in continuous dialogue with many other texts. The dialogic process attempts to find a win-win between many parties, rather than a successor after arguments are pitted against each other.

Mapping the situation

Our team met regularly. Our grant gave us access to industry partners, Transport for NSW, City of Sydney, Sydney Trains, Grimshaw and Arup. Michelle Zeibots and I developed a participatory approach to communicate with these partners. The intention was to provide a comprehensive study to reveal how the research team could be of 'most value' to the partners. This was a process of need finding through a participatory design process.

Our research process was described as 'Situation Mapping' and it divided into four research tracks across predominant perspectives on the transport context (see Tompson & Zeibots 2013):

- *people* (including passengers, citizens and users of transport environments)
- *precinct* (including those with interest in station environments, such as security and local businesses)
- *provider* (service governance and delivery)
- *policy* (transport policy, and broader related urban policy and long-term planning)

By the end of June 2013, our team had interviewed 34 individuals and held an additional three workshops. From these conversations, it appeared that the research team was a hammer looking for nail. There was no clear problem that our team seemed suited for; little that

Transport for NSW was willing to our team experiment with on the actual transport network. Now that the focus had shifted away from station environments, Sydney Trains had little involvement with our team. Other partner organisations encouraged us to pursue further research. Arup were interested in cutting-edge digital applications. Grimshaw encouraged work on bus stop design; work which could support upcoming bids to win contracts to supply light rail and bus stops in Sydney. City of Sydney looked for support in lobbying Transport for NSW for accessibility and allocation of resources for their residents.

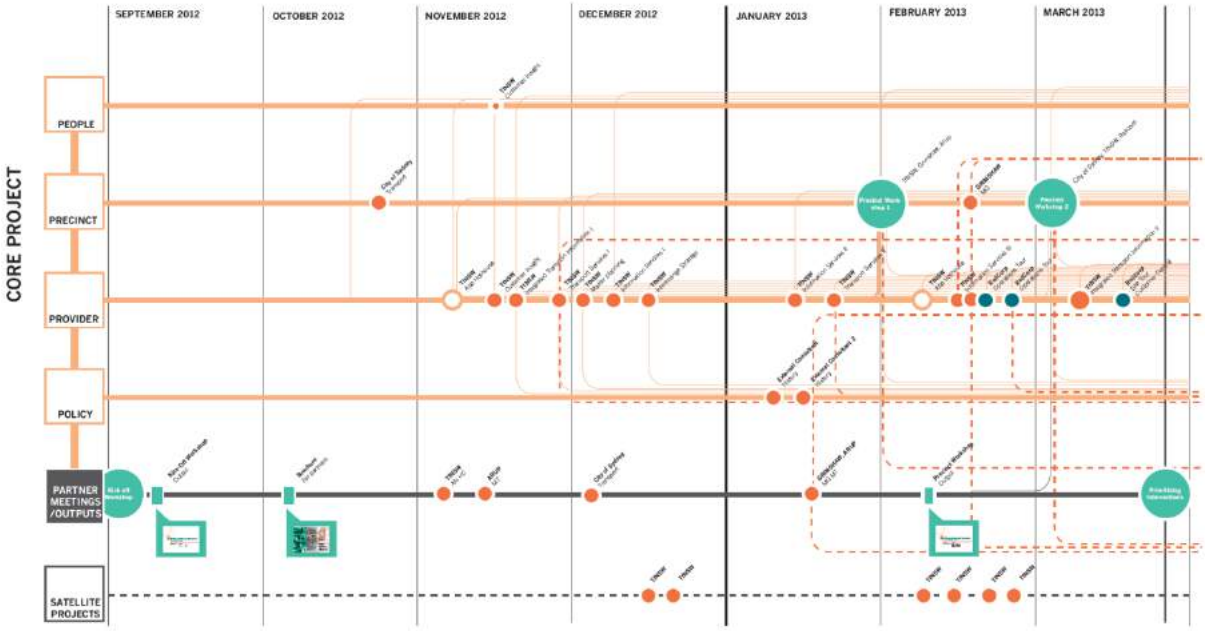


Figure 24: Work carried out in the first 3 months, as presented at the Intervention prioritisation workshop, March 26, 2013, Penrith Room, L2, Lee St, Transport for NSW.

Our team struggled to find topics to which all disciplines could actually contribute. As illustrated in figure 24, an additional 'stream' of satellite projects had emerged that would not fit completely with the agendas of all partners. For example, advanced interventions in sensing and robotics engineering for Transport for NSW, requiring isolated relationships outside of the core project activities.

For the practical team of architects, designers, and engineers, the participatory approach to need-finding was a frustration. As complexity of the design challenge quickly increased, the academic researchers began to map out the different stakeholders. Soft-systems methodology was often cited by Michelle. For example, Checkland's (1999) 'rich picture methodology' was

used in two workshops, which enabled a rapid means for practitioners to express their concerns about the transport system that our team could then roll into group discussions. Rich picture methodology ensures that researchers include their own subjective perspective. Each drawing of a rich picture must include a sketch of the artist themselves, showing where in relation to the problem they position themselves. Figure 25 is my rich picture from the 'Kick-off' workshop in August 2012, explaining my experience of the transport system. I am depicted in the centre, feeling confused about my daily transport choices.

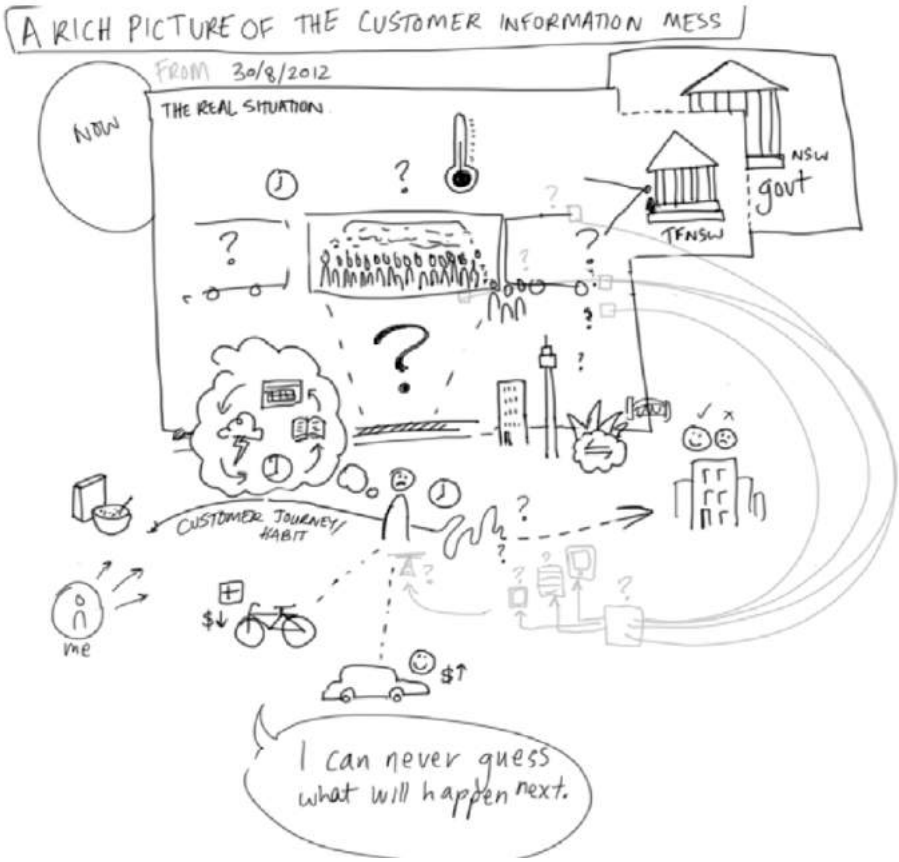


Figure 25: The author's rich picture of the transport problem, August 30, 2012, from the Responsive Environments *'Kick-off workshop'.*

The situation mapping process attempted to get a sense of the transport actor landscape (who did what, and what was everyone working on?). It sought to use the unique position of the university as a neutral third party to have those conversations with, and attempted to bring them all together in unified representations. In that sense, the Action-research was the iteration of representations of the context.

In January 2013, after three months of 'Situation Mapping' our team proposed an 'Intervention prioritisation workshop' in order to decide on which of six emergent projects the group should

pursue. The attendees, through a participatory selection process, ranked 'the bus stop of the future' as the project of focus (figure 26).

Figure 26: After the participatory voting session at the Intervention prioritisation workshop, March 26, 2013, Penrith Room, L2, Lee St, Transport for NSW.

REFLECTIONS

This juncture proved a turning point in the project. As a result of the intervention prioritisation workshop, where 'the bus stop of the future' was awarded the most points, attention turned towards the seemingly more manageable task of bus stop design. This digression into questions of construction largely made Michelle's skillset of transport planning redundant to our team's now central design activity. Additionally, Nathan's principal interest in the project of being able to test on-scale in station environments now looked less and less likely, as he started to move his attention to other cities to prototype his 'satellite projects'. Whilst the members of our team had conducted regular meetings to begin with, each of member of the research team now began to divert energy to other academic pursuits in research and activities not shared by the group. Likewise, I had no personal interest in the architectural design and construction of bus stops. However, I was interested in the emerging complexity in relationships between stakeholders who had influence over what a bus stop can actually be. This emerging list included advertisers, passengers, citizens, nearby residents, bus drivers, maintenance staff, vandals, designers and those who manage the contracts for the bus stops. The project continued, but in a far more focused way, centring solely on the design of bus stops.

Making sense of an indeterminate research process

'What methodologies are we using?' I was asking in early 2013.

As I began to understand what was required of a PhD candidate under an ARC Linkage grant, my attention turned to identifying 'theoretically' what our team was doing. Was it Action Research (Lewin 1946), or one of its later reinterpretations such as Participatory Action Research (Whyte 1991) or Network Action Research (Foth 2006)? I began reading widely. There was no real object of design, or any one thing being tested or developed. Ultimately, I decided we were following an Action Research methodology but, it didn't follow any straightforward prototype and test cycles. It was more complicated, and certainly mixed method. The project was also expanding into various streams of research. Figures 27 and 28 are workshop outputs from the two workshops exploring the "precinct" research track.

Figure 27: Describing the challenges of service provision, Building 10, UTS, February 1, 2013.

Figure 28: Situation mapping of stakeholders involved in bus shelter provision, Building 10, UTS, 14th March 2013.

Contemplating documentation

'Can we describe this process we have been through, can learn from our mistakes working in the complexity of the urban context?' I was asking in late 2013.

Now almost 18 months into the project, Hank and Martin's students were developing prototypes of bus stop concepts. Martin and Briedy Mahar, a project co-ordinator hired in early 2013, had developed several proposals to participate in Vivid Sydney, a light festival held in the city in June each year drawing nightly crowds of up to 30,000 people. A submission, made in October 2013 for the following year, proposed using transport data in combination with a lighting system at bus stops, to inform festival visitors of bus arrival times (figure 29). The concept in this submission followed those of several earlier proposals. Although this final idea seemed the most promising, the application was also unsuccessful.

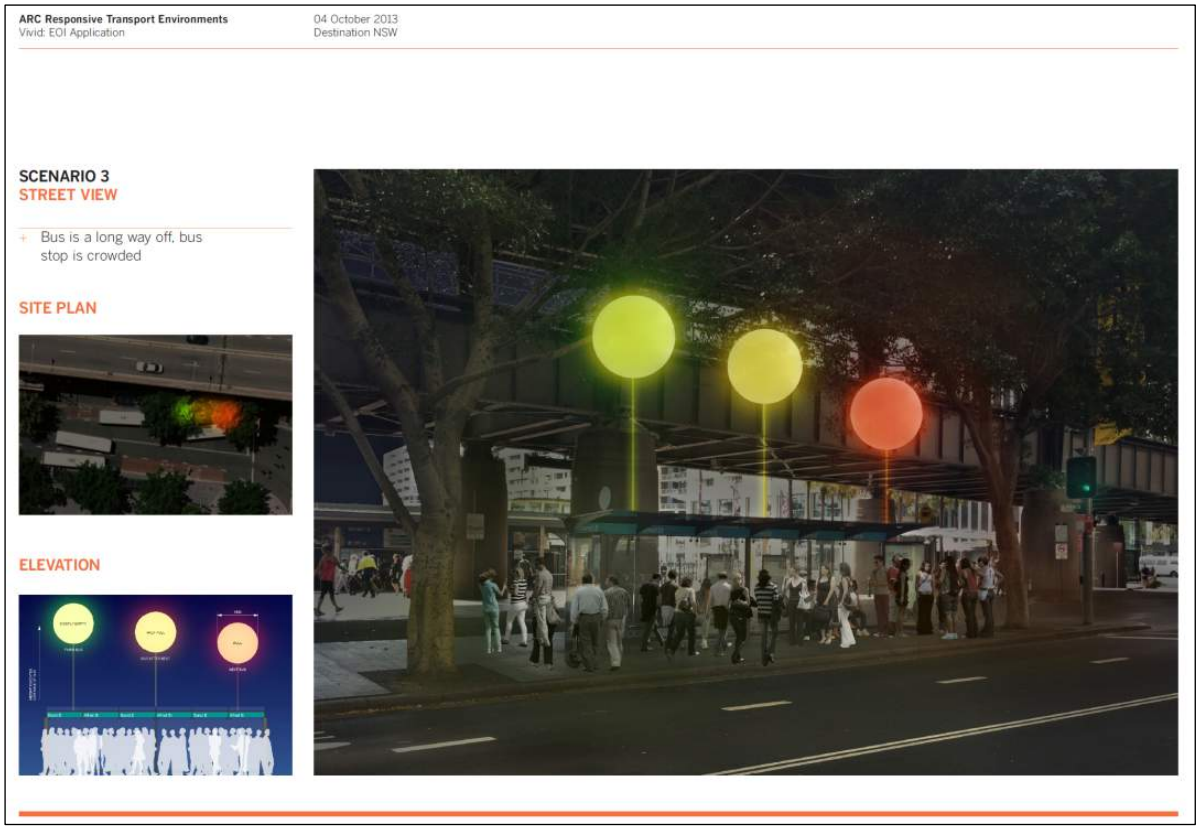


Figure 29: The submission for Vivid light festival, October 4, 2013. Image by Sean Bryan.

Martin and his students' attention now turned to a smaller-scale project. The project involved the temporary set-up of a TV screen and some extension cables at the bus shelter outside his faculty building. This, too, was not able to be tested. Transport for NSW advised against it; they wanted to avoid any confusion with their new wayfinding system, currently being rolled out.

Our team was, instead, encouraged to talk to JCDecaux, the agency that owned and managed the bus shelters across the City of Sydney local government area. In 1998, JCDecaux had won a 20-year contract for bus stop provision in Sydney as part of street refurbishment in the lead up to the Sydney Olympics.

As our team learned more about the context of bus stop designs, further challenges emerged around regulatory requirements and the true costs of maintaining infrastructure. From a perspective of producing actual designed artefacts and completing prototype testing, the project was beginning to frustrate academic participants. The research was producing large amounts of documentation, not least internal communications and online reference materials.

After each workshop, a report was produced outlining what was discussed. The reports did not adequately account for design decisions; why the research had ended up on such a different course. All the charts—the visuals—seemed to give a structure and order that didn't really exist.

'How might I document this process?' I was asking in late 2013.

It was at this point that our group, in discussion with various Transport for NSW managers, found itself relying on Action Research methodology (Lewin 1943); repetitively presenting concepts for their approval. However, we felt our team was really no closer to its intention of testing on the transport network. We turned to try to test the digital interfaces outside of the transport environment.

REFLECTIONS

In reflecting on three rounds of mock-up development that never moved beyond the stage of photoshopping or 3D modelling, Martin and I wrote (Tompson & Tomitsch 2014, p. 55):

> The original intention for the creation of the mock-ups was to seek approval for testing the prototypes in locations on the network, but through the process of engaging with our stakeholders [we] discovered that they led to other types of insights and helped us to define the direction of the project.

That paper revealed the narrative behind using three different mock-ups of information systems with the industry stakeholders. It drew from literature on wicked problems (Rittel & Webber 1973), participatory design (Sanders et al. 2010), prototyping (Johansson & Arvola 2007; Sefelin et al. 2003), systems thinking (Meadows 1999), infrastructuring (Star 1999), and even a naïve interpretation of Latour (1986), to explain that process with the transport provider. Martin and I (Tompson & Tomitsch 2014, p. 56) concluded:

> The academic design team has received information for outlining the barriers to innovation through the rejection or disqualification of ideas, by and on behalf of the wider network of stakeholders. Although the approval of the mock-ups was not successful, the process strengthened the academic research team's position in terms of finding...design opportunities and constraints in the system, leading to a better understanding of what can and cannot reasonably be challenged.

My thinking, at this point, was beginning to change. I was attending less to the frustration of not being able to progress the designs, and more to thinking about ways to inquire and express this context in a manner that would not only satisfy academic requirements, but also be useful to those working in this environment. Simply finding a way to describe the situation would be complex enough. But, in late 2013, my attention turned to how these findings could be made relevant to a broader audience.

At the time, the apparent failings of the *Responsive Environments* project seemed a strange thing to choose to write about. The practice was completely different to what was idealised in the proposal; however, a significant amount of knowledge had been gained in terms of dealing with sense-making in situated urban interventions. In late 2014 I wondered about who would want to read about a failing project, and if this was really what I wanted out of my time doing a Ph.D.

In hindsight, the assumption that the project was 'failing' was made too hastily. Firstly, it was only failing in the ways that I was choosing to judge it. I discovered later that this was by no means the shared perspective of all participants. Secondly, the need to study a 'successful' project was also unnecessary. A researcher enrols actants in their own network in order to advance their cause (Durepos & Mills, 2012a). I had desired a higher-profile and 'successful' project; to give more gravitas to my studies.

The second case

In the same time period, the Sydney media, predominantly the local newspapers, began covering the *Real-time Applications* project. At the time, I believed that this project, the *Real-time Applications,* would provide a good counter argument about a 'successful' project, to one that in the *Responsive Environments* project, I had judged at this point as 'unsuccessful'. Dozens of stories circulated inside the different transport organisations, claiming that it was a 'successful project'. Appreciative of the widespread interest in the *Real-time Applications* project, within both the community and across the public sector, I approached the manager of the project, Dean Leith, who had frequently spoken about different aspects of that project that were not so widely recognised. Those aspects included events that had happened five years in the past; seemingly only of interest to the IT people involved. Dean had a privileged view of the project as he managed the later train, light rail and ferry data phases of the rollout of real-time

information. Dean had already attended three of our team's workshops and had mentioned some of the other people and organisations that had been involved in the *Real-time Applications* case.

The public narratives surrounding this project were different. Speakers at public sector innovation workshops identified the project as the type of endeavour that Australian government departments should be undertaking. There were numerous accounts of the project in newspapers (eg. Saulwick 2011; 2012; Grubb 2013), media releases (eg. Transport for NSW 2013), technology blogs (eg. Stikgherrian 2011), and consultants' marketing materials. Each held a certain perspective and was reductive in a number of ways. They often singled out specific events, such a project launches or workshops, or emphasised the role of one actor. None of these public narratives adequately spoke to the experience of practitioners.

Indeed, several practitioners had tied the project's success to significant earlier events. One event referred to had occurred in 2009, when Railcorp threatened app developers with legal action. Another was a 'hothouse' event, in 2010, which saw real-time bus data taken away only two weeks after its release (Saulwick 2011). There was a clear rationale for a more pragmatic explanation of the *Real-time Applications* project. Here was an opportunity for me to act as the historian; to give a more accurate account of these projects. The account would be designed to be useful to other practitioners.

Access and permissions

At the beginning of the *Responsive Environments* project in late 2012, Hank and I were required to sign a non-disclosure agreement with Transport for NSW. The agreement between UNSW and Transport for NSW prevented us, or anyone from our university, from publicly divulging any privileged transport information without first obtaining written approval from Transport for NSW (figure 30). Quite quickly, this process turned into a complication for the project. We had to email each publication to Transport for NSW with a cover sheet and lengthy details and wait for a reply. This time-consuming process created a disincentive to publish short articles online. Even blog posts required pre-approval, which prevented our team from being able to communicate ideas over our blog about transport-related topics.

Transport for NSW's protocols protected the organisation from ambiguously-worded terms, or anything that could otherwise reflect poorly upon them. Perhaps this position was justified,

given the low trust between the parties at the initiation of the project. Transport for NSW, as a state government organisation, was careful to not be misrepresented publicly, as any public controversy reflects poorly on the state ministers. As a result, they tightly control their public profile.

ARC Responsive Transport Environments
Project Website and Media Releases

19th October 2012
Transport for NSW Office

What the approval process may be

The following sequences of steps are proposed for approving updates in the above classification scheme:

1. No-sensitivity – green

1. Notice of all material would be sent to Transport for NSW and industry partners.
2. Transport for NSW and industry partners have one day to respond, but a response would not be required for us to proceed with publishing the update.
3. We would not seek written approval to proceed with the publication.

2. Low-sensitivity – amber

1. Notice of all material would be sent to Transport for NSW and industry partners.
2. We would seek approval (e.g. via email response) from Transport for NSW before publishing.
3. Transport for NSW and industry partners are given three working days to respond and suggest modification prior to publishing.
4. If there is no response from Transport for NSW (and where necessary the City of Sydney) within the three-days timeframe, we will contact Transport for NSW (and where necessary the City of Sydney) again (via email or telephone).
5. If there is no response after another two days, we assume there are no concerns with the update.

3. Mid-sensitivity – red

1. Notice of all material would be sent to Transport for NSW and industry partners.
2. We would seek approval (e.g. via email response) from Transport for NSW before publishing.
3. Transport for NSW (and where necessary the City of Sydney) are given seven working days to respond and suggest modification prior to publishing.
4. If there is no response within that time frame, we will make contact with Transport for NSW (and where necessary the City of Sydney) again.
5. This procedure will be repeated until written approval or disapproval from Transport for NSW (and where necessary the City of Sydney) is provided and no publication will proceed without approval from Transport for NSW (and where necessary the City of Sydney).
6. No written approval from the other industry partners will be sought, however they may respond with suggestions for modification to the initial contact within three working days so that Transport for NSW (and where necessary the City of Sydney) can be notified of resulting changes prior to publication.

Figure 30: The agreed approval process for clearing public reports. The levels of sensitivity of information that had to be approved. The principal actant was Transport for NSW, who required all information to go through their media department.

After this agreement was reached, gaining subsequent approvals for the PhD aspects of the research was relatively straightforward. I had to apply separately with Transport for NSW to conduct interviews with the *Real-time Applications* participants, as this was not part of the previous agreement. By this stage our team as 'Encircle' was a known entity, particularly to many of the staff who had attended our workshops at different times. The subsequent approval from the ethics committee at UNSW Built Environment had a streamlined process and took just over a week. From here, a letter was received from the relevant line manager at Transport for NSW, allowing employee participation. Fortunately, the grant had established an open working relationship with these practitioners, many of whom I knew on a first name basis. I

had met many Transport for NSW managers from the departments of Integrated Transport Information Systems (ITIS) and Customer Experience Division (CED). These were the units related to customer service, which included customer information, including signage and wayfinding. I had also met and sometimes conducted interviews with managers responsible for timetabling, master-planning, bus planning, and some app developers. These included Marshall Craddock, who had managed the real-time bus data phase of late 2012, and Dean Leith. Consequently, there was already some rapport between me and potential participants when I committed to studying the *Real-time Applications* case.

REFLECTIONS

In terms of approvals, a list of participants and their chosen approval process can be found in the Appendix D7. Only two participants of 24 wished *not* to be identified. In reflection, the ambiguity of the approval process became an actor in itself, scripting a less controversial account of events. As earlier mentioned, in this process, some surnames were dropped from the visuals, except for those with explicit approval and public figures that feature in the accounts of the two cases. As per UNSW requirements, each subject would have to fill in their own project consent form (Appendix D2 & D3). The form also required input from each subject's line manager. One of the approvals from PwC was never filled in: the one for the line manager. Rob Chan, who I had done the interview with, had moved onto another role.

The subjects were to be anonymised if there was any problem with approvals. Some had already returned their completed form as requested in early 2016. Others had stopped returning emails. This was okay, as the majority of these were working under the jurisdiction of Transport for NSW approvals. Two subjects had wished not to be identified, and they remain under pseudonyms. This approval process probably proved more challenging than the interview process itself, and caused a great deal of delay and indecision in relation to what content to include or exclude. Knowing this process was looming had agency in itself, forming part of my actor-network, influencing the research analysis and representation in the visuals, and ultimately influencing the conclusions of the research, as a number of controversial tensions between actants were omitted, largely due to their personal nature. Had the option been taken to anonymise all of the accounts, the controversies could have been spoken about, but the context of the project would have been lost, and third-party materials would not have been able to be referred to, since that would divulge details of the participants in

order to maintain relevance to context. Therefore, some of these controversial aspects of the project had to be ignored in order to maintain accuracy of location, company and individual names, places and times. As the thesis ended up being predominantly about method, and the application of method, this was a sacrifice that was willingly made. The thesis was placed under a confidentiality clause for two years, to give me adequate time to get final approvals from those organisations' media departments. Methods of making their comments slightly more anonymous, such as the removal of surnames, was deemed appropriate.

Content

This section deals with data gathering. It departs from a discussion of the *Responsive Environments* case alone. The 'data' gathered in this study was not 'discovered' but was co-developed with participants. The 'data' consisted predominantly of 24 semi-structured interviews that were carried out to record participants' recollections of events. After conducting a few of these, I determined they were better described as 'oral histories'. The deep knowledge of the practitioners had already been demonstrated to me during several workshops and off-the-record conversations. Rather than selecting the interviewees in advance, I found myself able to 'follow the actors themselves' (Latour 2005b, p. 12). This was an emergent approach that enabled me to trace these relations without *a priori* presumptions. In addition, a narrative approach proved a useful means of accessing relevant knowledge: the situated knowledge of experts, including their own expert interpretations of events (Linde 2001; Tsoukas & Hatch 2001).

Qualitative research and the case study approach

Qualitative research methods are a common approach for making sense of inadequately understood socio-technical contexts. These are methods '...designed to help us understand people in the social and cultural contexts within which they live' (Myers & Avison 2002, p. 4). Such an understanding is clearly of interest to a research inquiry on situated accounts of practice 'in the making'. The study of Information Systems focuses on the development, use and impact of information technology in business and organisational settings. The case study

is the most common qualitative method used in IS (Orlikowski & Baroudi 1991). It made sense to investigate useful methods from this field.

Yin (2014) defines the case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Case study research, albeit just one way in which to understand my inquiry, is likely to appear in formal research venues. Indeed, it holds a prominent place in many disciplines and professions, ranging from psychology to anthropology to clinical science.

Generally, case studies fall under the interpretivist philosophical perspective, rather than positivist or critical perspectives. However, they can also be framed as pragmatist (Goldkuhl 2004). Pragmatism can be applied in qualitative research, as the intention of most studies is to initiate change. Otherwise, why would anyone carry out studies in the first place? As Goldkuhl (2004, p. 13) explains: 'the basis of pragmatism in human action gives pragmatism an orientation towards a prospective, not yet realised world'. In both of the case studies contained in this thesis, I was interested in explicating the processes that shape these projects, to inform the practices of other designers in similar contexts. It is an appropriate approach for intervening and not just observing (Goldkuhl 2011). Braa and Vigden (1999) have argued that there are three distinct epistemological orientations: research for explanation and prediction; research for interpretation and understanding; and research for intervention and change. This inquiry follows the mentioned reorientationist historical perspective (Mitev & De Vaujany 2012), as described in Chapter 3. This perspective explores interpretation and understanding, and also creates intervention and change in design practice. It employs the extensive use of historical data—in this case constructivist, interpretive data of the past—in order to deconstruct theoretical frameworks and to propose new ones (Mitev & De Vaujany 2012). So firstly, the project was to create the alternative history.

"What is happening? And why is it happening?" I asked in early 2014.

If a researcher is intending to articulate a narrative about people in the real world, a method must have enough complexity within it to be able to articulate the complexities of their narratives. This is analogous to the earlier discussions of form fit and context (Alexander 1964), and the concept of requisite variety (Ashby 1956) discussed in Chapter 3.

Even the methods one uses to collect data end up influencing the type of data collected, and the potential outcomes of the study. The approach being taken in the Encircle project was already a mixed methods approach. But at this point, I created a distinction between what would be the doctoral inquiry, and what was part of the Encircle inquiry. This was the point at which interviews were conducted to develop an understanding of the participant's perspectives on the 'hows' and 'whys' of the project's unique progression.

Ethnographies in diffuse and past projects

How do we know about the past? I asked in early 2014.

Ethnographic research comes from the discipline of social and cultural anthropology. An ethnographer—one who practices ethnography—is required to spend a significant amount of time in the field (Myers & Avison 2002). They 'immerse [themselves] in the lives of people they study' (Lewis 1985). As Beihl (2010, p. 318) argues, there is much use in ethnographic approaches to understand the process in the making:

> Through close attention to people moving through broken institutions and infrastructures in the making and with careful observation always complicating the a priori assumptions of universalizing theory, ethnographic work can make public the constellations through which life chances are foreclosed and highlight the ways desires can break open alternative pathways.

After being part of the Encircle team for nearly two years, I had already spent a lot of time with the subjects of the research. By this time, the Opal smart card (equivalent of London's Oyster card) was beginning to be rolled out. The wayfinding (signage systems) team had quickly grown to over 20 staff, now charged with the task of designing new signs for 178 train stations in New South Wales and around 6000 bus stops in Sydney. I had built up knowledge about each of the industry partners, for example, I knew much about reporting lines and responsibilities within their projects, particularly if they related to customer services. As an example, Figure 31 is a graphic representing my understanding of relationships at the time about ownership and control of bus stops.

I had extensive notes from every interview, workshop, and planning meeting. I had filled four notepads and a Dropbox folder with two gigabytes of project files: agendas, meeting notes, scans of whiteboards, photos, reports, and so on. But while I had observed some of the events

that had occurred in this time, I had not witnessed *enough*. I did not understand their perspectives. I had facilitated six workshops as part of the project, but it was never strictly in an observation role, despite the fact that I had produced detailed reports of each. Yet, at this point, doing ethnographic research seemed a very complex and time-consuming task for both participant and research; a burden for the stakeholders who tended to work alone and only met with other team members occasionally.

The other challenge to an ethnographic approach was that the events I wished to document had already happened. A lot of notes and materials about these events were accessible online, but nobody had captured the individual perspectives of the stakeholders involved. As Law (2004a) holds, ethnography provides a means to see the true messiness of practice.

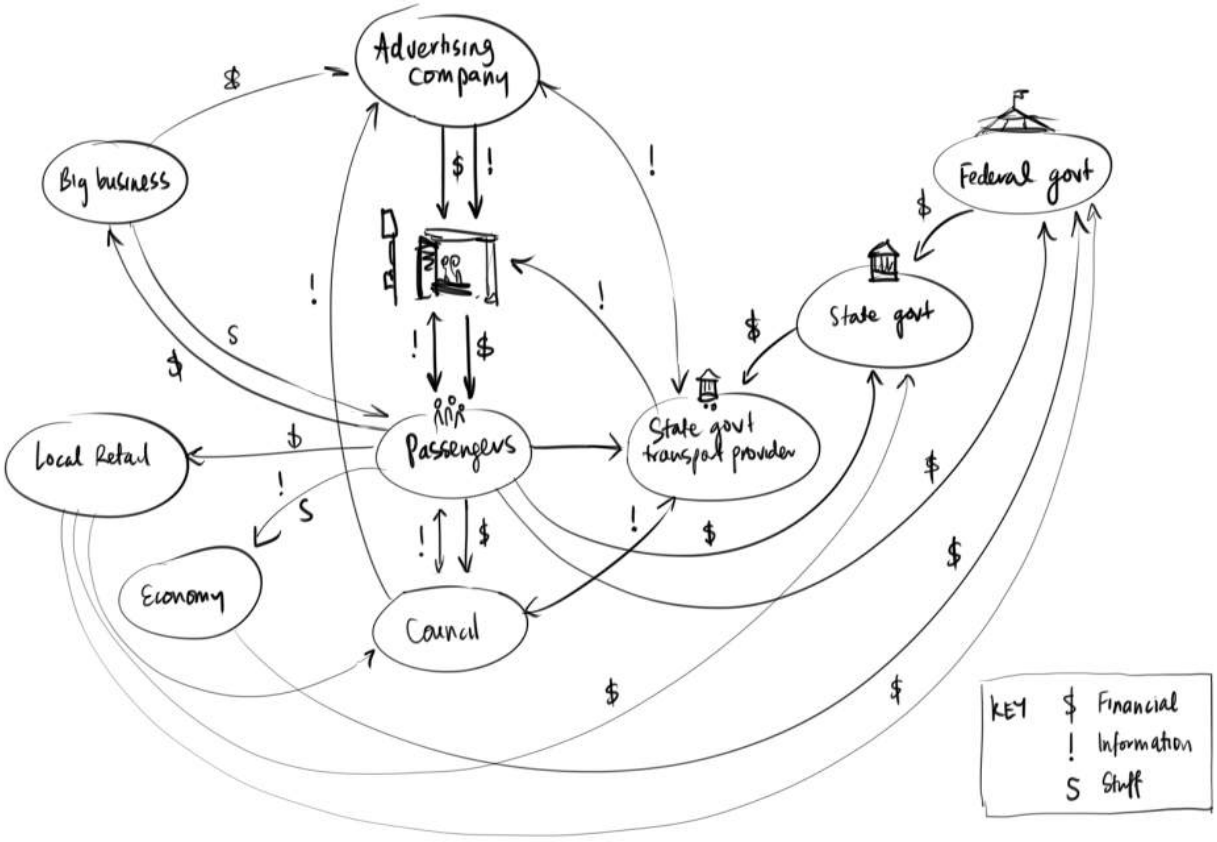


Figure 31: A Customer Value Chain Analysis (CVCA) of some of the relations between stakeholders in bus stop design (see Donaldson et al, 2006). Image by the author, 2014, as appears in Gardner 2014; Tompson 2014.

Interviewing/recording oral histories

'How can we know about past events?' I was asking myself in early 2014.

Qualitative research often relies on in-depth interviews as a primary source of data (Berry 1999). Interviews seemed the obvious choice to derive his information from the participants who had been involved. Kahn and Cannell (1957, p.149) describe in-depth interviews as 'a conversation with purpose'. Interviews provide access to events in the past, but also to individual interpretations of those events, which can be compared across the range of different interviewees.

In previous years, while working as a consultant, I had already conducted an estimated 50 interviews, almost always used a semi-structured format. By the time I commenced interviewing for this research, my previous exposure to the two projects meant that I felt comfortable discussing their complexities. I planned to have one-on-one conversations with relevant participants. Rather than spend too much time on concerns about questions of legitimacy or whom to interview, I adopted a pragmatic approach, and began scheduling interviews.

REFLECTIONS

I originally described them as semi-structured interviews; later, to more correctly describe them as oral histories. Oral histories are individuals' recollection of past events and the oldest form of human history-making. Distinct from other forms of history, oral histories rely on memory rather than texts. One oral history alone is limited, but many oral histories can explain a phenomenon in greater detail. They are a pragmatic means of accessing the past experiences of the practitioners. They are constructivist interpretations too.

The gathering of many oral histories constitutes many individual perspectives of a phenomenon. This approach lends itself to polyphonic and competing narratives, as in Latour's *Scientifiction* (Latour 1996c) discussed in Chapter 4, and Boje's *Antenarrative* (Boje et al. 2004; Boje 2007), discussed in Chapter 3. Historians cannot capture all perspectives in any one study. One must accept that history is about narratives of the past; often defined by a struggle for domination between wills (Clark & Rowlinson 2004). A key intention of oral history, therefore, is to record perspectives on

events that would otherwise remain unrecorded; those perspectives deemed as less significant to the case or explanation of a phenomenon, but which remain affected by it.

To record only positive accounts, often 'heroic' accounts, creates a bias. It can be argued that this bias is common amongst narrative historical accounts, even if largely unintended. Academic researchers are often granted access to some people and not others, creating further bias in the type of accounts created. Some accounts are privileged, for instance, such as the perspective of management. Yet, oral histories can address this bias, drawing from feminist or progressive approaches, in respecting each informant's life experiences and in the quest to preserve the memory of ordinary people's lives (Blee 1993). Alessandro Portelli (n.d. in Hesse-Biber and Leavy, p.149) stated that '[t]o speak is to preserve the teller from oblivion'.

Recent debates in oral history theory have also attempted to dissolve the hierarchy of 'researcher as expert', and 'participant as subject' (Blee 1993). It can be argued that to record someone's voice and to share it enables their perspectives to become immutable; to travel beyond their place and live beyond their years. Storytelling is a natural, central part of the human experience and the communication of meaning through language. It has an almost unlimited history in human civilisation. Oral histories harness this history, despite storytelling's relatively recent transition into a legitimate research method after in the mid 20th century.

An oral history is emergent process, coherent with the process-based perspective wishing to be studied. It gathers information across time, through participants recounting from memory. It is an interpretivist approach; a useful method for capturing an individual, subjective experience of past events. 'Tape recorded recollections' is perhaps a better description (Ritchie 2003). The recording process is the best means of self-protection (Ritchie 2003). Ritchie defines Oral history as one that is recorded and archived in a public way, whereas the approach taken is not completely public, due to the nature of the sometimes-private discussion.

My approach to Ritchie's recommendation is 'always to stop worrying and do some interviews' (Ritchie 2003, p. 16). Even a poor interview offers mistakes, and lessons, from which a project can benefit. There is no uniform way of doing oral history. As Ritchie (2003, p. 16) states: '...unconventional approaches may sometimes work well'. Most oral historians learn by doing (Ritchie 2003).

Conducting interviews

'How should the interviews be conducted?' I wondered in early 2014.

In the case of the *Responsive Environments* project, I found a favourable entry point into the research by interviewing each of the industry partners about their own perspectives on the project. This would function as a participatory means for both participant and interviewer to understand the stakeholder perspectives on the value of the project so far. It revealed perspectives, on a one-to-one basis, that may not be usually shared. These interviews were intended to inform the direction of the project for the following year. My aim was to ask open questions to explore personal perspectives on events. As I made more decisions about the overall narrative and what would be told through the research, the questions asked of the interviewees evolved. I knew I wanted to explain how the project was happening, in pragmatic terms.

The interview process happened in phases. It began with interviews of *Responsive Environments* stakeholders in April 2014, including representatives from Transport for NSW, Grimshaw, Arup and City of Sydney. The interviews were conducted at their offices, or in cafés nearby. All interviews would be tape recorded, transcribed and synthesised. I knew roughly what type of information I wanted, that which told how these projects happened. The intention was always for an interpretivist perspective to inform the Encircle project. The interviews were conducted in the *Responsive Environments* case to help steer the Encircle Project. The interviews were to elicit the views of the partners as to which direction they would like the project to go. More time was dedicated to narrative; storytelling around the participants' involvement in each phase and their interpretations of events. Questions were predominantly about the 'hows' and 'whys' of the projects, see figures 32, 33 and 34. A complete indicative interview protocol that was emailed to participants is Appendix D6.

Here are some example questions of the type of questions he will be asking:

Project questions

- How is the ARC 'Encircle' project going? + -?
- In your view, what has been the value of the ARC Linkage project at this point? Any particular outcomes come to mind?
- What were your expectations of the ARC Linkage project? Has this changed over time?
- Are there any particular topics/conversations that stand out to you?

Figure 32: The first few indicative research questions sent to Responsive Environments *participants in April 2014*

Here are some example questions of the type of questions he will be asking:

Project questions

- How did you originally come to be involved in the project?
- How is the ARC 'Encircle' project going? + -?
- What would you say are the current goals of the project? How have these changed?
- More specifically, what are you trying to achieve within this?
- In your view, what has been the value of the ARC Linkage project at this point? Any particular outcomes come to mind?
- What were your expectations of the ARC Linkage project? Has this changed over time?
- Are there any particular topics/conversations that stand out to you?
- In your own words, how has the project evolved from initial conversations until now? Why do you think it has happened in this way?

Figure 33: The first few indicative research questions sent to Responsive Environments *participants in July 2014.*

Here are some example questions of the type of questions he will be asking:

Project questions

- How did you originally come to be involved in the project?
- Where did this project come from?
- Who were the instrumental parties in its establishment?
- Was there precedence for this project?
- Is this related NSW and federal open data policy?
- Why was PWC involved? What role did they play?
- What would you define as the boundaries of the project?
- What would you say are the current goals of the project? Have these changed since inception?
- What has the project achieved? At what cost? (resource, time, control etc)
- More specifically, what are you/the project hoping this could achieve that it hasn't already?

Figure 34: The first few indicative research questions sent to Real-time Applications *participants in July 2014.*

For each interview, a request was emailed, with the ethics form and indicative questions sent subsequently. For both of the case studies, none of the requests for interview were refused. The interviews were scheduled for less than an hour, but several times the participants were happy to extend.

Figure 35: Transport for NSW Lee St Offices, where many of the interviews were held. Source: author.

In total 24 interviews were conducted totalling 25hrs, 55 minutes. The full participant list for both cases, their roles and relation to the project, date of interview, and length of interviews, and ethics approval category for both cases is Appendix D7. In the interviews each participant gave some broader context to their involvement, for example, how they came to be involved in the projects. They explained how all of the stakeholders, technologies and workshops related to each other over times. They also offered insight as to broader systemic aspects around transport, and anecdotal stories explaining, from their perspective, the meaning of certain phenomena.

REFLECTIONS

The questions I used were more limiting in terms of the ultimate purpose, which was to analyse them with ANT; there was less personal reflection by participants and more information about the contemporaneous dynamics of the project. The intent of the interviews was at the time to gather

information about what to do next in the Encircle project. As such the questions about the past, were directly related to informing the future. More could have been done to tell the past narrative in more detail.

In hindsight, the interviews could have been conducted better for the ANT methodology, which had been decided upon after the interviews were conducted. I was not yet aware of ANT, and parts of my interviews were couched in modernist conceptions that are conflicting with the ANT perspective. For example, I asked to many participants "how is the interface between your organisation and Transport for NSW?", assumes that organisations are bounded entities, rather than more granular relationships. I was also consistently thinking of aspects of the project as good and bad, which I now know is not valuable as it represents a certain perspective limiting my ability to understand other perspectives.

Across all interviews, the research was ultimately useful as opened with questions such as 'how did you originally come to be involved in the project?' and offered the conversations a temporal emergence, a trait closer to the 'oral histories' of the projects.

Importantly, at the end of each interview, I asked the participant who else I should talk to. Some debated as to whether interviewing a particular participant may cause problems. Choosing participants involved judging whether their views would be different enough—or core enough—to the central trajectory of the project's development, or whether these views would be problematic. For example, trouble may arise over concerns about contracting agreements between organisations. This in hindsight may have been limiting and did not treat all potential participants with equal curiosity. The decision to avoid conflict via the selection of participants, did shape the outcome and overall perspective of the research in limiting the variety of views on the cases.

Transcription

'What is to be done with all of this interview data?' I was asking in late 2014.

One of the strengths of interviews is that they yield a lot of data very quickly (Marshall & Rossman 2006, p. 101). However, as the number of participants grew to 24, the amount of data became unwieldy. Interviews were scheduled to be an hour in length, where possible. Some participants requested more time or were very comfortable running over time. One

participant even rescheduled two other sessions, wishing to discuss more of their experiences in relation to the project. Where conversation flowed, a typical one-hour interview yielded 10,000 words of transcriptions, although transcripts varied between 2000 and 20,000 words for each participant. More than 26 hours of interviews produced almost 300,000 words to transcribe. I transcribed these interviews myself, a process taking several months in late 2014 and early 2015. The transcripts were coded verbatim. They included filler words, exact syntax, and notes about sarcasm, laughter and other non-verbal cues. All transcripts were emailed to the participants, with highlighted sections to explain the sections that I would likely quote moving forwards.

REFLECTIONS

Having a complete reference of all of the exact wording of participants including, 'ums' and 'ahs' appeared too casual in many circumstances. I realised later this was not desirable, as the quotes represented professionals in their roles and they were not comfortable with this less eloquent language being included. I knew this from comments from participants when they were later sent the transcripts with highlighted sections I proposed to quote. Only a few of these were ultimately left in the narratives included in the visuals, to give the participants and their comments some character.

Conceptualisation

This section outlines the processes that led to the use of Actor-network theory as methodology to make sense of these cases.

Conceptual issues

'What story can be told?' I was asking in early 2015.

By late 2014, decisions had to be made about what to do with the transcripts. As they neared completion, some clear challenges became apparent. There was too much variety to describe.

There were too many stakeholders. There was an enormous range of perceptions in the accounts of participants. The experimentation, chance, and breadth of influences were huge. What emanated from the transcripts was not a sense of universality; rather, a sense of difference. With all of these perspectives, there seems to be no obvious story anymore.

The original ethnographic interview and oral history approach had assumed a narrative-based approach in explaining the cases. Yet, at this point, with knowledge of the range of literature in the smart city discourse, these accounts told a story that was far more complex than any narrative I had seen. They did not match the glossy brochures of technology companies, governments or funding bodies. They were also different to the more popular book-based accounts (such as Townsend 2013).

On recognition of the data's variety and depth, there were no obvious places for me to start, let alone an understanding of who and what would be included. The original 'success' or 'failure' value judgements were now not as clear. Good things had come out of perceived 'failures'; likewise, several touted 'successes' had been unveiled as mere marketing. Even some of my initial decision making, which was to exclude several stakeholder groups, now appeared in error.

A more subjective understanding of these projects now made me explore alternative approaches to narrative explanations through investigating constructivist perspectives of business history (Clark & Rowlinson 2004), and adopting related approaches that enabled competing perspectives such as *Antenarrative* (Boje 2007),

REFLECTIONS

The findings drastically challenged many earlier assumptions. The research questions continually evolved as I learnt more about the subjects and context. My earlier perspectives, both naïve and modernist, were now much more substantially informed by science and technology studies.

By this stage I had recognised that my earlier desire to study a 'successful' project was uninformed. This desire added to the complexity of my work and did not necessarily lead to better research. As I was investigating each project in more detail, their natures appeared similar. It is only with a cursory view that projects can appear as a simple failures success. Up

close, they are both full of smaller trials, some fail some succeed. It is far more nuaned than I had earlier thought. Interesting narratives can emerge from any part of these projects, at any scale.

Finding Actor-network theory

'What can be said about these experiments?' I was asking in late 2014.

I had by this stage two years of experience working with these cases through the *Responsive Environments* project, and related activities. For the *Real-time Applications* case, I now had interviews and additionally had attended events, such as the app development hothouses, and their monthly meetings. The interviews had proved a useful way to capture the specific individual interpretations of participants. I was at a loss as to how to represent the amassed perspectives in a way that remained true to the non-reductive narrative I was trying to tell.

I first made the connection with Actor-network theory after a conversation with another of my former lecturers, Cameron Tonkinwise. In October 2014, I presented at a conference in Oslo about Relating Systems Thinking and Design. I spoke on applying Donella Meadow's (1999) 'leverage points' to the design of bus stops. Whilst there, I explained to Tonkinwise my predicament in relation to the range of data that had been amassed during the thesis research. In response, he mentioned Latour's *Aramis* (1996c) as a text that may provide some insight to the situation. By that stage, the majority of the narrative interviews as 'oral histories' had already been completed, for both cases.

REFLECTIONS

Aramis (Latour 1996c) did not just introduce me to ANT. It also became a significant inspiration; a creative approach to the problem of explaining technological development. Before this point, I had only two ANT papers in my digital reference manager library; just two of some three thousand articles and references. Latour's (2005b) seminal ANT text, *Reassembling the Social* was added to the reference library, on December 4th, 2014. Since that time, my collection has grown to over two hundred titles. *Aramis* did not explain everything, but I saw the potential of Latour's approach. The

potential was to present the perspectives of practitioners, reports, newspaper articles, and excerpts from meeting minutes all side-by-side. However, the implications of this approach were not yet fully realised. In hindsight, this was a critical juncture, steering the interpretation towards pragmatist theoretical approaches. Before this, I was intuitively using pragmatism, but had not fully connected these ideas together.

Making sense with Actor-network theory

'Who are the actants and how do they make others act?' I was asking in early 2015.

Actor-network theory provides a conceptual apparatus for describing the scale from discrete ideas and conversations, in bounded space and time, into large emergent, complex systems. When I began using ANT, the infra-language (as discussed Chapter 4), was the first thing I used that helped me really understand the approach.

At first, I employed the principal of generalised symmetry to look at relationships between human and nonhuman actants. In early 2015, I submitted a paper for the urban planning conference, *The State of Australian Cities*. The paper was titled 'Developing real-time transport applications in Sydney – A hybrid model' (Tompson 2015). This paper heavily relied on Callon's article on scallop fisherman in Saint-Breuic, France (Callon 1986a). This paper spoke of a principal actant, Transport for NSW, and their problematisation, interessement and enrolment of actants into becoming their allies, in their project definition to create *Real-time Applications*. Figure 36, explains how Transport for NSW became an obligatory passage point, persuading other actants in their problem definition in *Real-time Applications*.

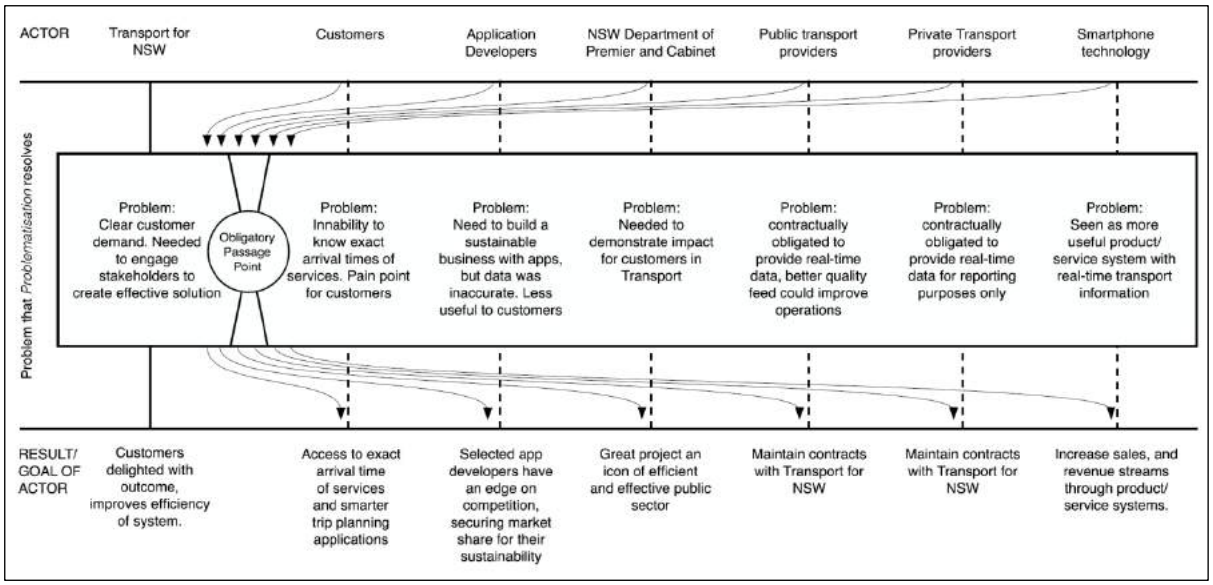


Figure 36: Problematisation and the Obligatory Passage Point (OPP) of the Real-time Applications *project, circa December 2012, as presented in Tompson 2015. Adapted from Callon 1986a, Gunawong & Gao 2010.*

REFLECTIONS

ANT has a long learning curve. My understanding of ANT in relation to the four translations of Callon's (1986a) view, in hindsight, was limited. This perspective referred to early ANT conceptions when narratives had a centre and, as in this case, a focal actant. It was a rudimentary application, when I was yet to grasp the full understanding of nonhuman agency and its multiplicity. This perspective was challenged through the attempted application to *Responsive Environments,* where no single central actant could be seen to be shaping the stabilisation of the project though the translation's problematisation, interessement, enrolment and mobilisation (Callon 1986a). Instead, it was more relatable to Mol's perspective of the *ontological multiplicity,* where many realities were being enacted at the same time (Mol 1999). This change in perspective later aligned much more coherently with particularly Jamesian pragmatism and Stenger's Cosmopolitical proposal.

Coding the transcripts

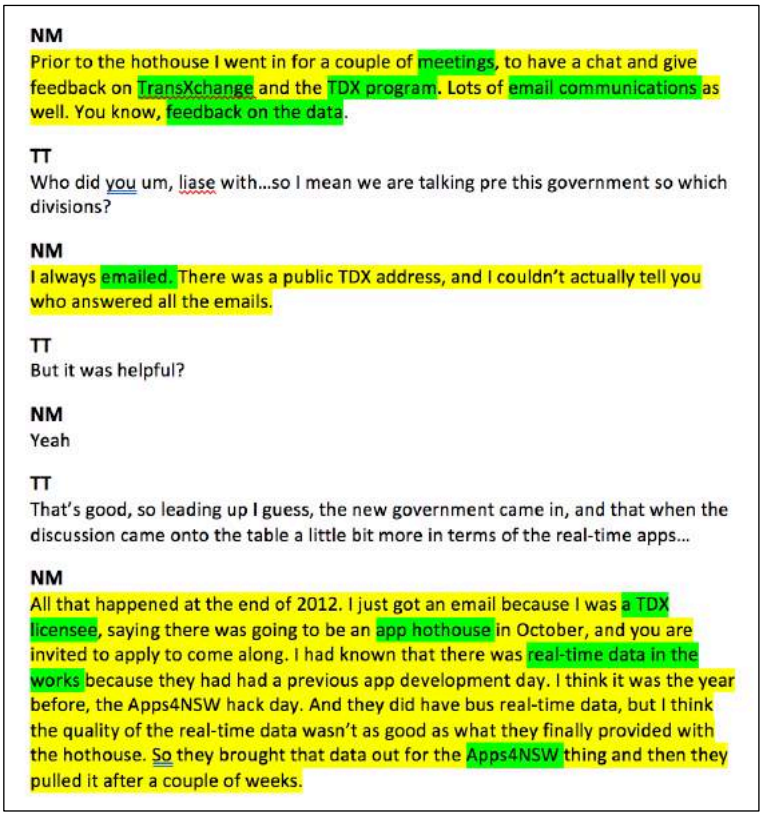
'How can these transcripts be treated for the purposes of ANT accounts?' I was asking in early 2015.

ANT became a liberating approach to explore these transcripts. I took a simple approach to analysing the transcripts, using ANT. The transcripts were analysed, and any mention of an actor was carefully highlighted. Suddenly, there were more than twice the actants within the narrative of these projects. Every paragraph now had 4 or 5 additional actants. These included buildings, phones, seats, streets, satellites, algorithms and reports. I included human actants, such as customers, developers and ministers.

On a second document, each actor was coded, referencing pages on which the actant appeared. I eventually made the decision to include actants based on their agency in relation to the project.

For the most part, this agency was clear. If any potential actant was mentioned as important by a participant, such as a technology, document or event, it was considered part of the project actor-network. Significant actants could also be seen by the frequency of their mentions, either in the transcripts or third-party material. With my experience working with the actants in this environment, I was also able to draw on more personal knowledge. The task became a reflexive process; one of abductive reasoning in which I pulled out the actants, their agency, and their relations.

This approach had multiplied the amount of data rather than reduced it. The lists were still immense. Yet, in using ANT, a researcher should not impose hierarchies and the actants are not reducible. It became clear that the basic structuring of ANT into major translations, as in the *Real-time Applications paper,* would only work if it was reduced to an individuals account of events. For example, any individual can be assumed to be enrolled in the network at a certain point based what they have explained. But if you asked two individuals about those events, their accounts would differ. The cases, had multiple interpretations of events which meant that a simple Callon (1986a) structuring would not be sufficient. The following figure (37) is an excerpt from the interview transcript of Nick Maher. You can see here I have highlighted in yellow, which quotes I thought were interesting, and highlighted in green any actors. Another example page of a transcript can be found at Appendix D8.



NM
Prior to the hothouse I went in for a couple of meetings, to have a chat and give feedback on TransXchange and the TDX program. Lots of email communications as well. You know, feedback on the data.

TT
Who did you um, liase with...so I mean we are talking pre this government so which divisions?

NM
I always emailed. There was a public TDX address, and I couldn't actually tell you who answered all the emails.

TT
But it was helpful?

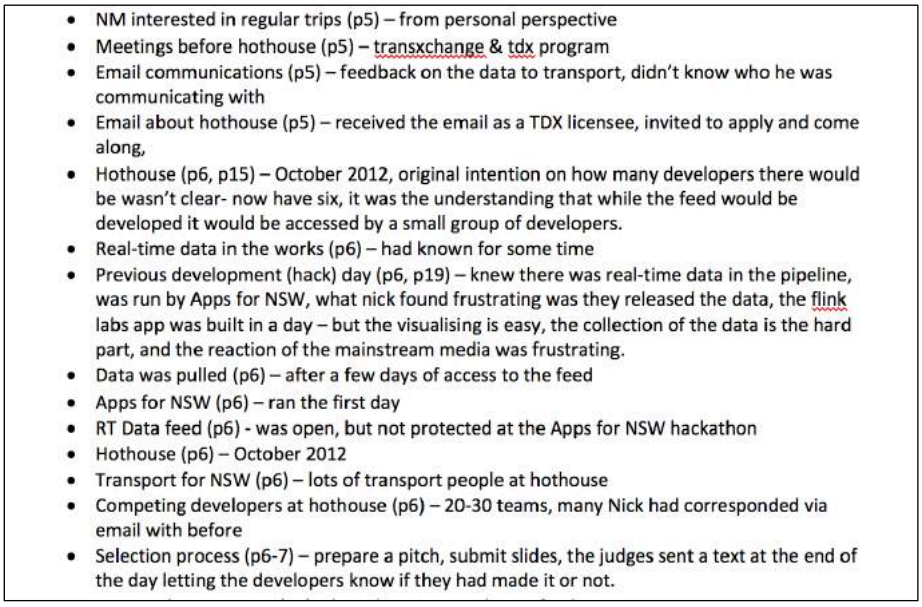
NM
Yeah

TT
That's good, so leading up I guess, the new government came in, and that when the discussion came onto the table a little bit more in terms of the real-time apps...

NM
All that happened at the end of 2012. I just got an email because I was a TDX licensee, saying there was going to be an app hothouse in October, and you are invited to apply to come along. I had known that there was real-time data in the works because they had had a previous app development day. I think it was the year before, the Apps4NSW hack day. And they did have bus real-time data, but I think the quality of the real-time data wasn't as good as what they finally provided with the hothouse. So they brought that data out for the Apps4NSW thing and then they pulled it after a couple of weeks.

Figure 37: Excerpt (page 6) from the coded interview transcript with Nick Maher. This one was edited by the interviewee. The yellow sections indicate sections I may quote, and green were the actants noted in the summary page.

Figure 38 shows the summary of Nick Maher's transcript. I listed actors and then noted any time in the transcript they were mentioned, and what kind of agency they were exerting:



- NM interested in regular trips (p5) – from personal perspective
- Meetings before hothouse (p5) – transxchange & tdx program
- Email communications (p5) – feedback on the data to transport, didn't know who he was communicating with
- Email about hothouse (p5) – received the email as a TDX licensee, invited to apply and come along,
- Hothouse (p6, p15) – October 2012, original intention on how many developers there would be wasn't clear- now have six, it was the understanding that while the feed would be developed it would be accessed by a small group of developers.
- Real-time data in the works (p6) – had known for some time
- Previous development (hack) day (p6, p19) – knew there was real-time data in the pipeline, was run by Apps for NSW, what nick found frustrating was they released the data, the flink labs app was built in a day – but the visualising is easy, the collection of the data is the hard part, and the reaction of the mainstream media was frustrating.
- Data was pulled (p6) – after a few days of access to the feed
- Apps for NSW (p6) – ran the first day
- RT Data feed (p6) - was open, but not protected at the Apps for NSW hackathon
- Hothouse (p6) – October 2012
- Transport for NSW (p6) – lots of transport people at hothouse
- Competing developers at hothouse (p6) – 20-30 teams, many Nick had corresponded via email with before
- Selection process (p6-7) – prepare a pitch, submit slides, the judges sent a text at the end of the day letting the developers know if they had made it or not.

Figure 38: Excerpt from Nick Maher's interview summary page, relating back to the previous figure.

REFLECTIONS

In 2017, following another two years of practice and reflecting on the transcripts, and having acquired a better understanding of ANT and a more nuanced view of what actants are, I concluded that there were many actants missing. While I thought at the point of summary I was being quite comprehensive, many had not been included. However, my understanding also now assumed there are infinite numbers of actants, based on the multiplicity of interpretations. There is no way to comprehensively account for all actants at play in any situation. They exist always in multiplicity and can never be accurate representations of reality. Using pragmatism, what really matters is if the descriptions are useful for something.

Attempts to approve transcripts

'How can I validate these perspectives?' I asked in May 2015.

There was an agreed process, made through the terms of the ethics agreement, which stated that all quotes would be checked with each participant before publication. So I sought approval to use quotes from each participant. Each participant was initially sent their transcript, with the highlighted sections that could potentially be used. I asked participants if they wished to edit their quotes while giving their preliminary approval. Only five of the participants made these edits. After several email requests, and a consistent lack of response, I decided that the task given was probably too much to expect from participants, yet the approval process for these quotes was critical; participants were to be identified using their real names.

REFLECTIONS

The validation process was time consuming and difficult. The choice to use participants' names was problematic. In the end there were several people that I thought it would not actually be relevant to use their surnames. In this process I realised I could give them some anonymity, as in the end their

names were not critically important for the narrative being told. They were those people working in public sector roles that would not ever be publicly quoted for their opinions. Ultimately, in this thesis, and on the visuals, the surnames of those participants have been removed. The full names remain of all other participants: the academic researchers, app developers, consultants and spokespeople for public sector organisations. This will be further explained at the end of this chapter.

Scripting

Having now described the collection and analysis of oral histories using ANT, this section outlines the process of representation of the study in the given context. Developing an adequate 'representation' of the research took much deliberation and experimentation. Later, this approach proved to be wrong. ANT has never been about representation, rather it is about performance of networks.

The translating of ANT

'How do I choose between the multitude of ways to describe these cases?' I was asking in mid-2015.

At this point I was faced with the same predicament that has plagued many ANT accounts: the length of the accounts (Walsham 1997), which, in turn, presents difficulties for drawing conclusions. There was an immense variety of actants listed across both cases numbering in the thousands.

Furthermore, each actant described other actants in different ways. For example, when people referred to Transport for NSW, some would refer to 'the organisation', others to 'the divisions', and still others to individuals. When so many actants are being introduced in nonlinear ways, how can one possibly guide the reader through the account? When the narrative is polyphonic by nature, how can it have any focus at all? I read further into ANT methodology, assuaging my concerns that the research was 'leading to nothing'.

Here was an inherent tension between accurate ethnomethodological perspectives that enabled the reader to fully appreciate an actant's context, and presenting a holistic view of

the now expanded sense of the case. Indeed, simple explanations of these sorts of contexts simply omit complexity from their descriptions. As in Mol's ontological politics (Mol 1999) and ANT successor projects, the multiplicity is an inherent part of the performance of the actor-networks. There are also no centres in the accounts, as Mol's (2002) book, *The Body Multiple* describes.

I deliberated over presenting each of the human perspectives as individual accounts, but once again this relegated the non-human perspectives. I began to experiment with writing up these cases in the style of Scientifiction (Latour 1996c). However, there was a problem with this approach as all relations have to be literally explained, through words. All relations, in terms of the order that a reader takes through the text, are designed by the author. A lot of interpretation goes into these accounts, to extract the agency of non-human actants from the accounts of humans. Yet, at this point, written 'texts' were also categorised as nonhuman. A text is an immutable translation that can carry agency within itself; an agency beyond that of the person who wrote the text. Law's reminder that you must explain ANT through cases was comforting (Law 2006). We can explain *what* it is, through application only; it was up to the case to inform *how* it would be performed. However, my concern about whether I was doing ANT properly was constant.

There was not a clear way to reduce the information, nor even to order it in a non-hierarchical manner, to make it work in a written format. Furthermore, ANT can provide a means to reveal what might normally be hidden (as discussed in the previous chapter). For the designers in this context, I wanted to script a sense-making process in engaging with the research as one conducts in the practice of these projects. Sometimes, these relations were not so explicit.

Re-presenting, re-assembling, translating

'How should this be presented to be of most use?' I asked in late 2015.

Firstly, there was the question of audience. Who is the script written for? What is the hypothesis for the use of this information? I was concerned with how this information could be relevant to other designers, in similar urban contexts.

A visual format thought to be a useful approach because of its ability to convey a large amount of information very quickly to participants. The intent was to get actants to validate their quotes in relation to everyone else's, but they were unlikely to ever read chapters of a thesis. For a workshop scenario, I knew I would only be able to get some practitioners for a couple of hours to validate their research as they are time-poor professionals. I wanted to create artefacts that would enable the participants to validate and importantly critique and build on my interpretation of the cases. These artefacts had to be designed.

An early attempt was made to visualise each actor's account. These early visuals were discrete and lacked temporal dimensions. They did not demonstrate the actants' agency or relations, in 'making others act' at a specific moment in time. The inquiry turned to better ways to visualise these cases (the methodological imperative for this is discussed at the end of Chapter 4).

REFLECTIONS

During the intervening 18 months between the interviews and the resulting visual format, the performative nature of ANT became more apparent. The visuals had to enact something similar to Stengers' (2005a) Cosmopolitical, as this perspective would serve to reanimate 'thick description' (Rankin 2011). Ultimately the visual history approach was chosen, as it could represent these projects as pragmatist through their heterogeneity, multiplicity and processes.

Design, in this case, is what Ehn (2011) describes as 'design-after-design'. As Ehn (2011) explains 'we need to design a thing that opens up for potential design after the actual design in the project has taken place, to defer some of the design until later on'. This practice of 'design for design' (Ehn 2011, p. 46). This approach is critical in the previously mentioned speculative and prefigurative commons

As pragmatists reject the role of theory to mirror nature, ANT researchers treat explanations as translations. They are a new actant in themselves, one that has the ability to enrol actants into another network.

Visual histories v1.0: A way to get participant validation

To validate what I interpreted to be the participants' perspectives, and to build on these interpretations through a workshop environment, the cases had to be rapidly accessible for discussion. The Version 1 (v1.0) of the visual histories were produced for these purposes. One was created for each case. This approach was taken as a result of the poor response to the offer for the participants to validate what they said—an important part of qualitative research— I knew I would have to make the process easy and quick. What had to be conveyed quickly was the timeline. Were the events in the right place? Were the connections made correct?

Each of the two v1.0 visual histories took about five days to put together. It was a process of going through each of the transcripts, pulling out the quotes that reflected each participants' interpretation of actants and their influence on the project's emergence. I tried to emphasise diversity and difference between accounts, but also create a sense of an overall narrative. So as participants read through, they could get a sense of the whole project. Certain events and happenings stood out, as they were repeatedly mentioned by many participants. These became structuring elements that would be visible more clearly than others. The process commenced with the *Real-time Applications* case v1.0 visual history designed in September early October 2015 and was followed by the *Responsive Environments* case v1.0 visual history in October and November 2015.

This way of representing the cases made intuitive sense. The left-to-right timeline is a common layout of timelines, particularly in western examples (Tufte & Weise Moeller 1997) (see figure 39). It offers an ability to represent 'slices' as moments in time, similar to the proposal of Latour and Yaneva's (2008) (see figure 40) and Storni's (2007) ANT inspired visual representations of design practices. The means of representation is open enough for validation, but would be able to be digested and contributed to in a group scenario. The details of the workshop will be held until the following chapter, but the rationale for the design is described here.

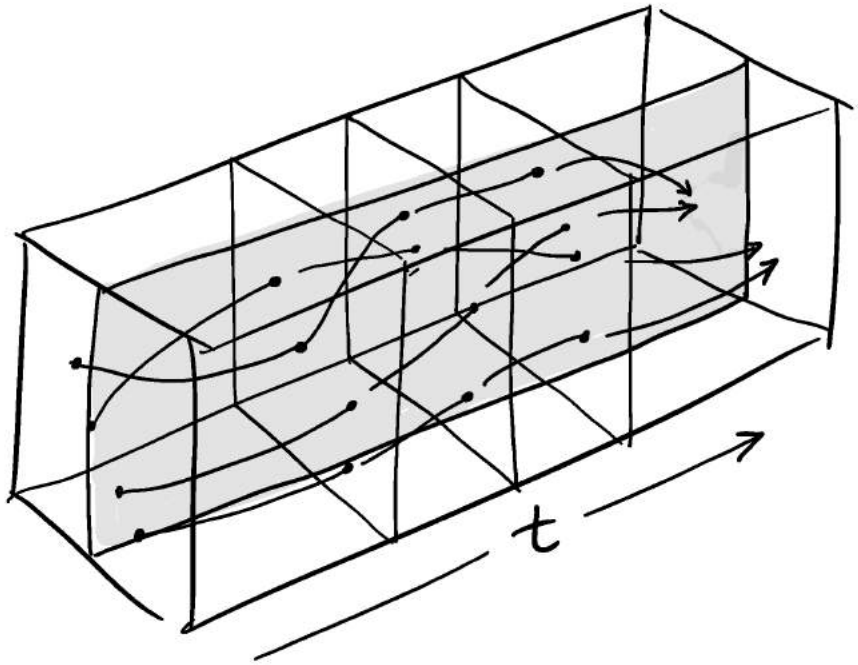


Figure 39: A temporal map, demonstrating across a 2D form the interactions of the actants, inspired by Tufte & Weise Moeller 1997.

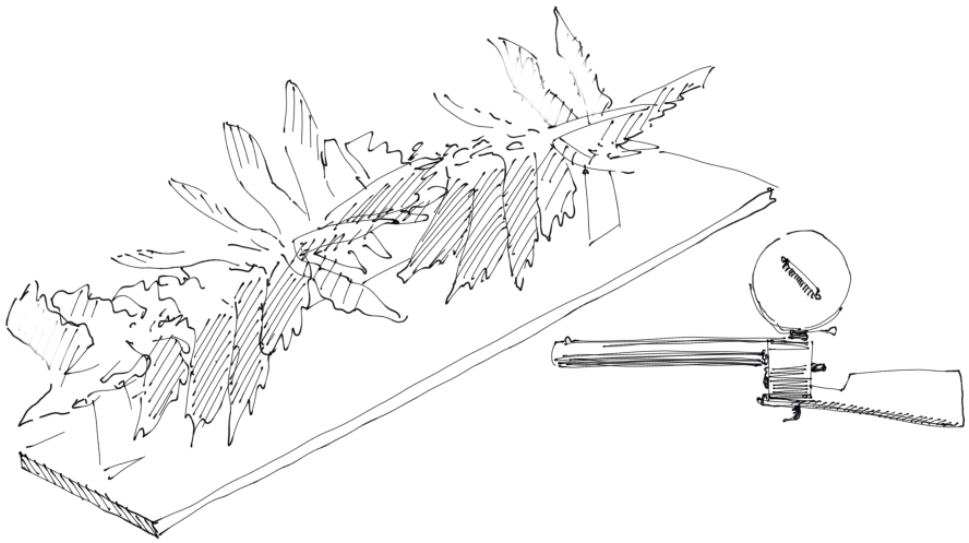


Figure 40: A model bird flying in frames (left), would be captured by the photographic gun (right), as referenced in Latour and Yaneva 2008, p. 80-2.

REFLECTIONS

The pragmatist methodological premises for creating the visual histories have been described in Chapter 4, in learning from previous attempts to represent these emergent, heterogeneous systems as 'in the making' (Yaneva 2009a; Latour 1996c; MACOSPOL 2007a).

Visual histories v1.0: What they were

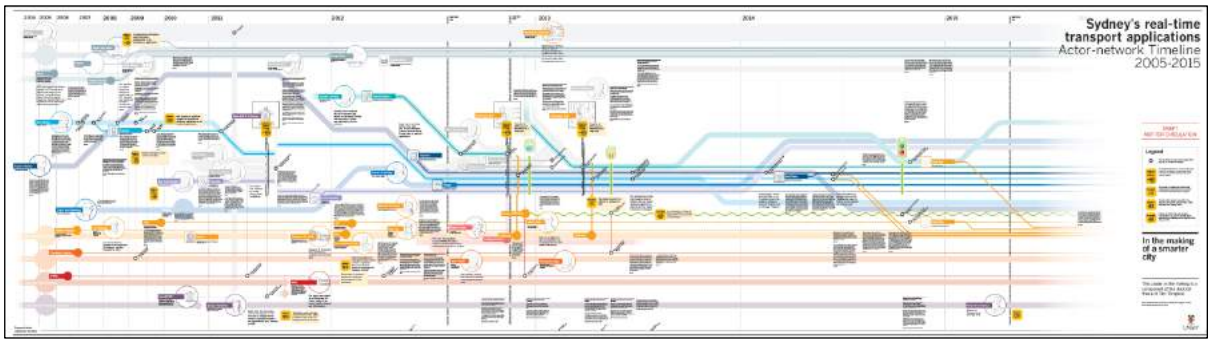


Figure 41: The Real-time Applications *visual v1.0. Source: author.*

Figure 41 shows the first visual iteration visual history for the *Real-time Applications*. The main features are that it is to be printed at maximum size on a plotter. These usually have the dimensions of a maximum 900 mm (0.9 m) or 1100 mm (1.1 m) in height, and each poster can be printed to either 3000 mm (3 m) or 3500 mm (3.5 m) in length. The poster's size enables four or five people to look at different parts of the poster simultaneously. It has a timeline, stretching from 2004 to 2015, where most of the events mentioned by participants took place. These are compressed at each end, to make way for more activity in the central panels of 2012, 2013, and 2014. Clearly, the visual adopts the aesthetic of a transport map; modelled largely off the London Underground 'tube map'. It is a common visual theme to this audience, and the inferred paths of actants over time can be followed intuitively. The paths become closer in some cases to infer closer relations and further apart to denote more removed ones. The centre of the image shows the activities of the app developers, with close relation to Transport for NSW, Sydney Trains, followed by RMS (the Roads and Maritime Services), and the State government. Newspaper articles and media announcements provide another perspective on each of the events. The legend is moved to the right, so that the reader does not necessarily

start on the left. It is intended to be, as Deleuze and Guattari (1987) explain, 'rhizomic', where the observer can enter the history at any point and trace actants throughout. This non-hierarchical spatial reading style is not possible in a written account because it imposes a linear order. Instead, the visual contains human and non-human actants that are not differentiated in their representation other than small sketches I made of each actant. In the background are some thicker, fainter lines that signify organisations. These are actants, but not of an agency that might usefully explain the projects as 'in the making'. These are reified entities that were however often referred to by the participants. These lines do, however, break and move as organisations were restructured, such as the Department of Transport becoming Transport for NSW, and Railcorp becoming Sydney Trains and NSW Trainlink. Along the bottom of the image are the points where I attended workshops or conducted interviews.

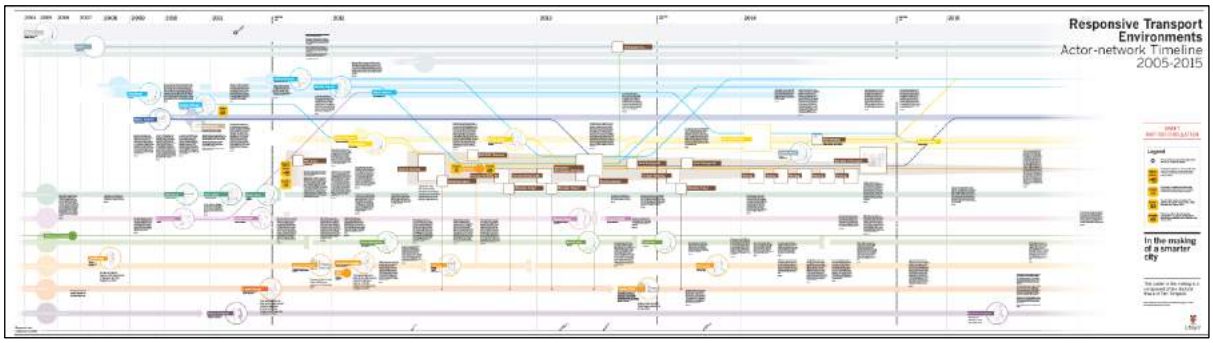


Figure 42: The Responsive Environments *visual v1.0.0. Source: author.*

The *Responsive Environments* visual history v1 (Figure 42), was not as clear to organise, as the central activities were not as in the *Real-time* case, Obligatory passage points (OPPs). There were far fewer inscriptions that perpetuated certain relationships outside of the original grant proposal and there was in place a confidentiality agreement with Transport for NSW. In this case, the central element is the university research activity.

REFLECTIONS

In hindsight, I found myself asking, should the posters use the same visual system? If each project should be its own universe, should its own narrative trace the action in different ways from the other

case? However, a uniform approach could be considered more useful, as it enables the comparison between both cases, with readers only having to learn one system of icons and form of orientation.

Visual histories v1.0: Discarded additional representations

Another three visuals were presented at both of the first validation workshops. These were cross sections, as demonstrated in the image below (figure 43). These were to demonstrate a spatial arrangement of actants at a moment in time.

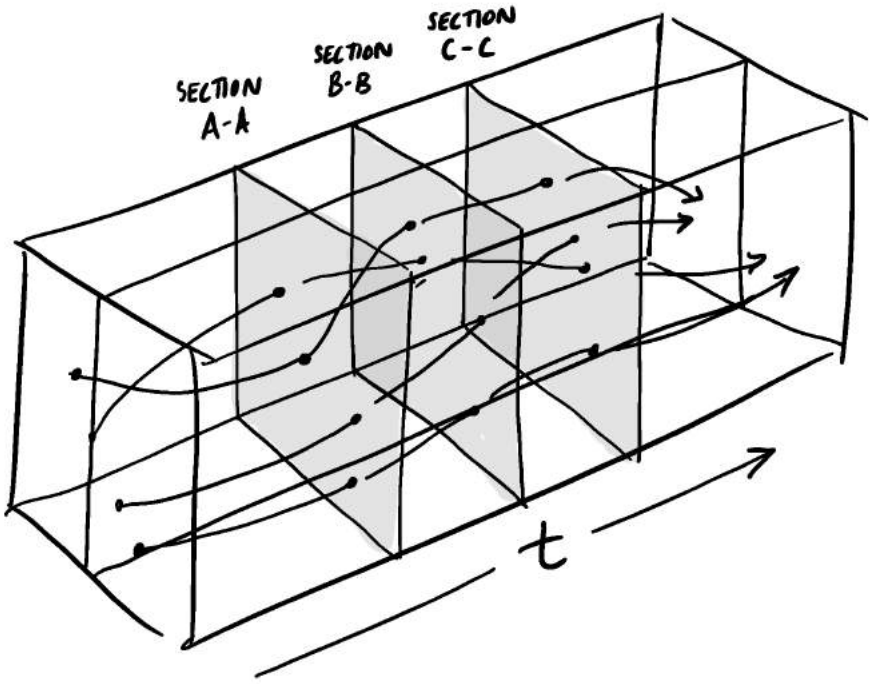


Figure 43; A temporal map, this one instead taking a 'slice' across time, to show the spatial arrangement of actants at a single point in time. Source: author.

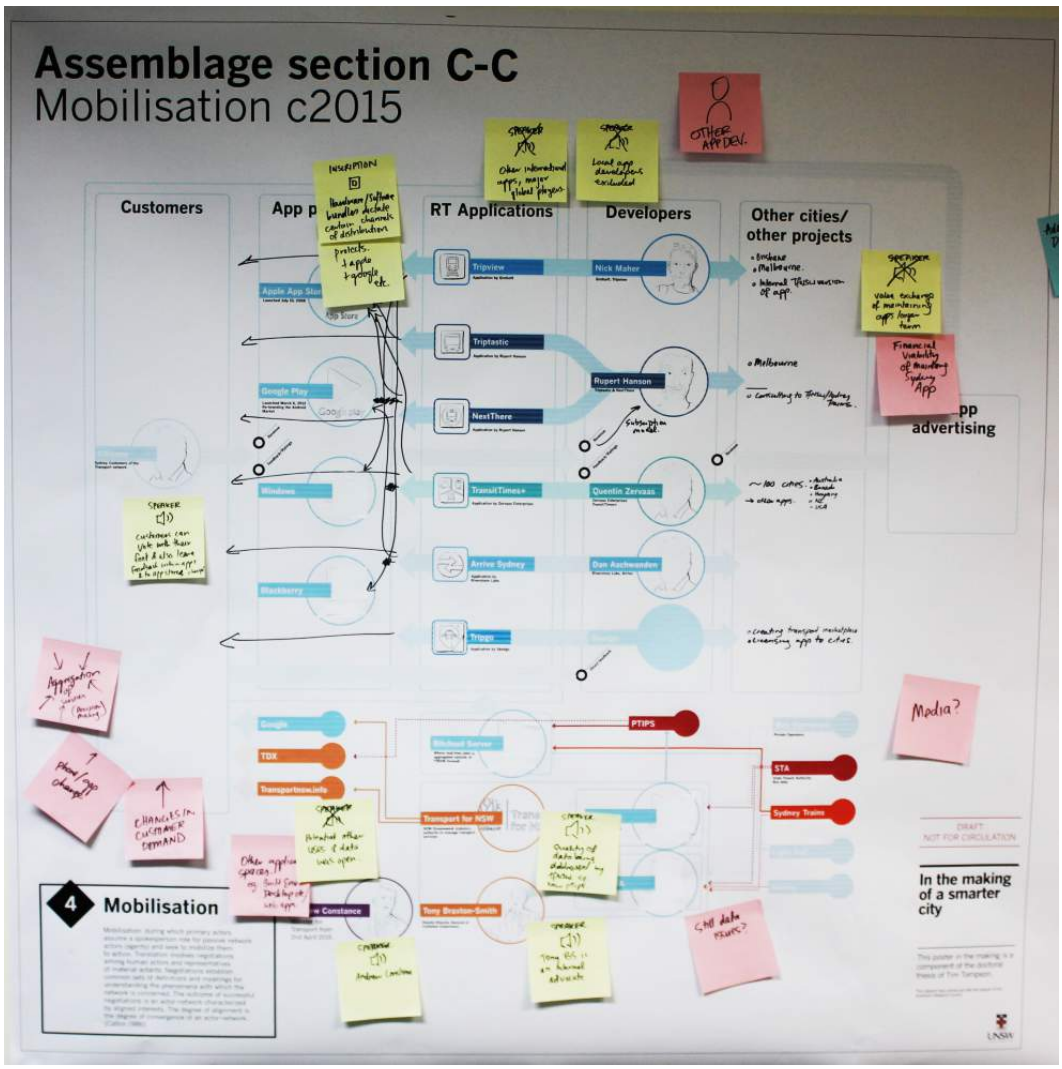


Figure 44: An example of a cross section: section C-C. Source: author.

The above visual (figure 44) demonstrates the working *Real-time Applications* network at a moment in time. This representation shows how the data is translated from the tracks, trains, buses, light rails and ferries through mediators, eventually into pixels in the Smart phones of transport customers. This represented the mobilisation phase of the stable network representative of the network in 2015. Other visuals were related to each of the original ANT moments of translation (Callon 1986a). However, these were discarded as these were limited in centring on a Transport for NSW as a 'focal' actor dominant perspective. As has been described, the multiplicity of ANT means there is no ability to reduce a case to this single interpretation (Mol 1999).

Voicing the non-human

Voicing the non-human actants is a creative exercise, of synthesis and abductive reasoning. I had a brief meeting with ANT researcher Christiano Storni in December 2015, shortly after I had run both of the validation workshops. His feedback, when I showed him the visuals, was that there did not seem to be enough non-human actants.

The question then arose as to how they could be brought into presence, the same way that the humans had. The challenge from this conversation was to rethink the visual format, to enable the representation of the non-humans in symmetry. The answer was through quotes.

ANT's principal of generalised symmetry infers that non-human actants become a source of action. Latour presents a cacophony of voices in *Aramis*: political, industrial, financial, and technological interest groups are cited directly, interspersed with a dialogue between a cynical professor and naive STS students. Furthermore, and perhaps the most interestingly, the non-human also speaks.

The approach taken with these visuals was to think about the agency that the non-human has, and express that through a fabricated quote, where they explain how they have agency on another actant. This approach drew on Latour's *Aramis* (1996c), as discussed in Chapter 4. These non-human actant quotes were often inserted in response to a human quote, so they are frequently located side-by-side. Examples will be described in more detail in Chapter 6.

Visual histories v2.0: Enrolling others

There were many changes that emerged from the workshop, for example, wrong times, wrong people, and quotes that hadn't been checked for syntax and grammar. The quotes were again edited, to make the points that practitioners made clear. For example, I removed repetition, along with 'ums' and 'ahs', and created complete sentences.

There were also many other participants that did not feature enough. Storni had another piece of valuable feedback. I wasn't included on the visuals, and nor were the visuals themselves. These were actants that shaped the network greatly. With these recommendations, and the newly imagined non-human voices, the visual needed a redesign.

In this redesign, it was no longer acceptable to just name the participants. They needed more explanation. The audience for version two was much wider: thesis examiners, academics, design agencies and professionals interested in the smart city or urban interventions of all forms. The visuals had to be made understandable for this wider audience.

The visual is an information system, but the system is also the people, the room, and their assemblages. The next version was intended to stand alone, as an artefact that could be shared, but which links to additional content, if viewed digitally. I included small blue arrows on all articles that could be clicked when viewed as a pdf, which would take the viewer to the online articles where the content had been copied from. The design was for both individual viewing or, again, for a group discourse. The visual now became an actor itself, capable of building a network of its own, through the hyperlinked public materials such as media releases. The pdf file could now travel from inbox to inbox or be downloaded off websites without friction.

Before v2.0 had been fully completed, the posters in v1.0 format had been presented to four audiences beyond the original participants: a workshop with Arup in Sydney, where around 30 people attended; followed by a presentation at Relating Systems-thinking and Design (RSD5), where some additional feedback provided, such as the need to put some larger text with major events as signposts through the visual. They were also presented to two other design agencies in Sydney, each to audiences of three and seven participants. The feedback was added, along with the visuals themselves at the time they were shown to participants. I was included in both visuals, and all edits from the workshops were made, as well as doubling the amount of content, updating the legend and providing instruction on the right, and introducing an orienting strip on the left, which outlines what rough zones each stakeholder is in, for example, citizens at the top, and government at the bottom. As an example, in the initial version, the application developer of the Triptastic and NextThere apps, Rupert Hanson, was shown as attending and winning a position in the first Transport for NSW hothouse in late 2012. However, on revision, he had a full-time job at the time and didn't make it to the first workshop. He was only granted access in the second Transport for NSW hothouse in February 2013. This was able to be corrected in the second iteration of the visual histories (v2.0), shown at figures, 45 and 46.

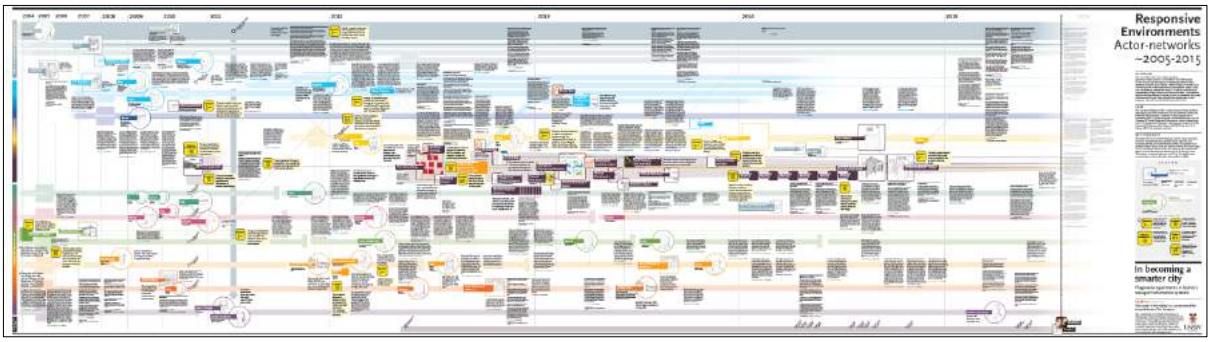


Figure 45: The Responsive Environments *visual v2.0*

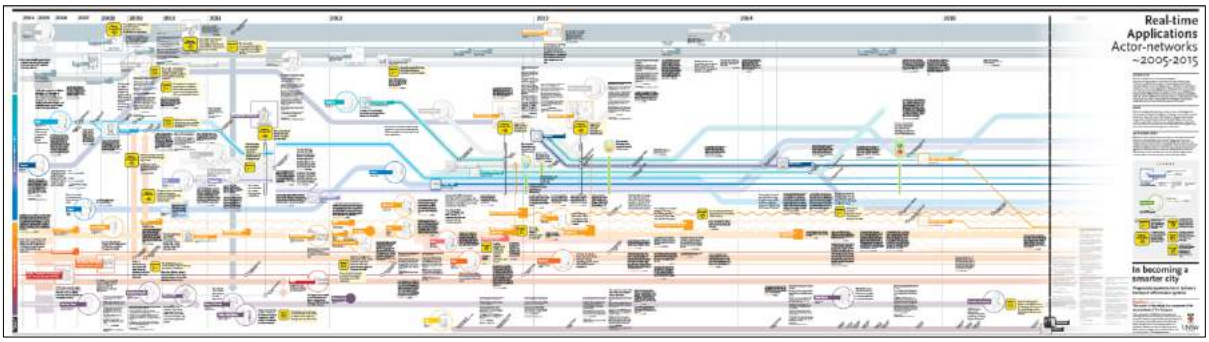


Figure 46: The Real-time Applications *visual v2.0.*

There are too many design decisions that have been made in this iteration to note, as Polanyi (1962) describes, that practitioners 'know more than they can tell', or in this case, explain succinctly. However, the major changes are as follows: The addition of clearer signposting throughout the visual; the addition of non-human voices; and more perspectives represented on each event. These visual histories were scripted to enable viewing by individuals on their own computers, tablets or phones (figure 47).

Figure 47: Viewing the visuals v2.0 on a tablet, 2017. Source: author.

Hyperlinks were added on the media files for this purpose, to enable what the pragmatist media philosopher Sanbothe (2005) argues: that reading text on the internet is different, as it encourages reading fragments. This approach situates the case, by linking real online media that refers to other perspectives or related projects and events. The viewer has to imagine the connection themselves, continuing the sense-making exercise as the designer does in context.

This version is marked as v2.0, but undoubtedly there will be more changes as more people see them and correct more anomalies. The aim, again, is to treat the initiatives of urban information system development, in Latour's words 'not as static objects but as a moving project' (Latour & Yaneva 2008, p. 80). Hence the visual becomes a moving project in itself.

Writing then deleting written accounts

In early 2016, I still had not worked out how this was going to be written up as a thesis. I was keeping the same design audience in mind, but also knew that this had to pass the examination process. Many university stakeholders advised that the visuals should be an appendix; and

instead the cases should be written up fully in the body of the thesis. As such, the accounts were originally intended to be presented in the theses as writing of different formats, in the style of *Aramis* (Latour 1996c); with interviews written in one font, observations in another, excerpts from reports and newspapers in another. However, this still had an order that did not seem to fit. Not only were these accounts misleading, it seemed to reject the premises of the visual form. The ordering and necessity to describe relations was the aspect that eventually made me delete them. Was the account meant to start with events that happened the longest time ago, for example, explaining the invention of the microchip? Satellite technologies? The combustion engine or steam power? To tell the story, the account began to evolve out of sequential order. Firstly, with the action, then diving backwards to trace the technologies' influence in that situation. Quite quickly, these accounts became unwieldy. It was a spatial orientation that would best describe these relational elements between actants. Additionally, a visual form would be able to infer many of these relations without having to explicitly explain them. Controversy mapping takes a non-sequential reading: how can all elements be maintained across the time sequence so they are evenly accessible to the reader? Maintaining this ANT perspective of every moment enfolds the entire history of everything that has come before it. Figure 48 represents how I was thinking about alternative narrative structures.

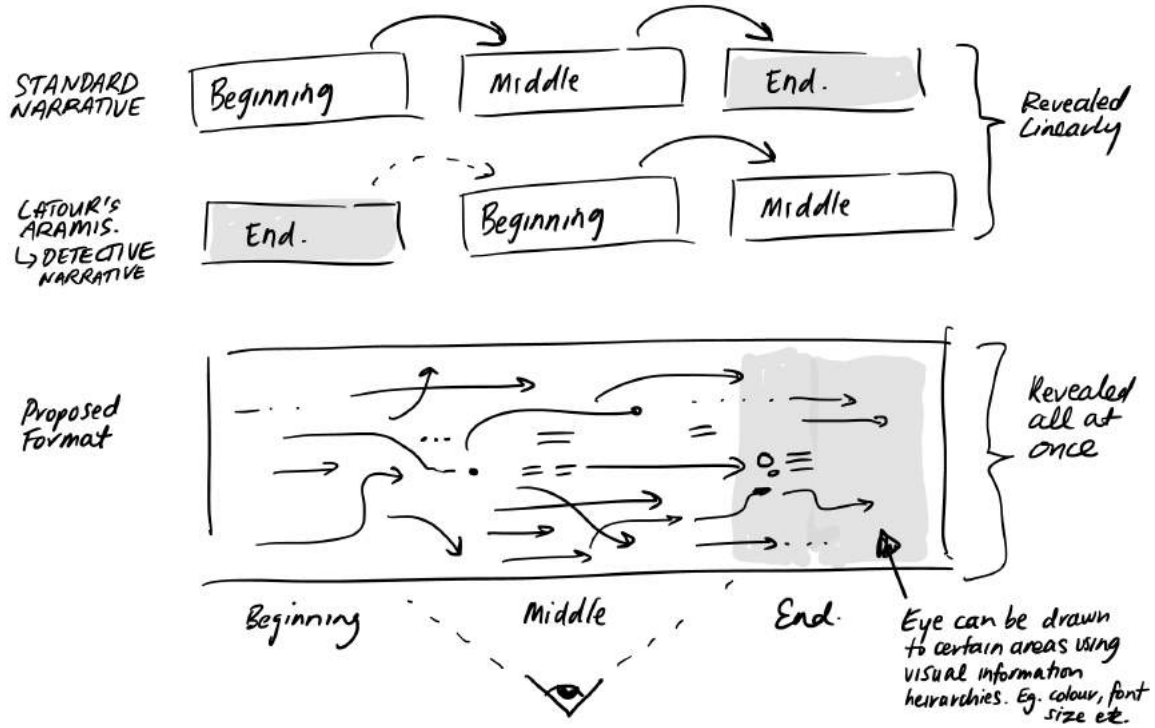


Figure 48: Comparing the representational flow of various narratives. Source: author.

The experience of searching in the visual, trying to make sense of connections, happenstance events, and the relations between, was the exact experience that I wanted to create. The reader has to become a designer through the sense-making process; relating the heterogeneous actants together over time, and understanding their differences that are irreconcilable, and their process into what is ultimately either stabilising or destabilising networks.

This thesis' focus eventually shifted away from presenting the empirical data, and rather discussing the methodological implications of the pragmatist approach. There is finite space in a thesis to explain these aspects, so the decision was made to cut these written accounts of the cases, although most of the *Responsive Environments* case has been explained in this chapter.

Inscribing process into text: A pragmatist thesis

'How does this become a thesis?' I was asking in mid-2016

Following the creation of the visuals this fundamental question arose: How too, could the thesis become a moving project; a rhizome, to show these complex, situated connections? I now had a long, multiyear, very complex empirical study, and a designed artefact, but there was still no cohering, central concept that could explain the whole thesis. There was so much content that had gone into the research. The visuals, which Yaneva (2005a) describes as buildings, were a multiverse of all the relations and constraints of the situated research inquiry. It represents the output of the countless scripts that have been set, and my own scripting, in one continual translation.

The largest challenge was how to arrange this thesis in a way that felt that it was coherent with its central arational argument, but yet made sense, and achieved the necessary elements of the thesis. The structure to explain the underlying literature was challenging, but was arranged to quickly cover all the necessary literature across three chapters, before explaining, as this chapter has, the emergent process of research itself. Below (figure 49) is an earlier arrangement of chapters, that were shorter than these are now. This was before pragmatism was treated as the unifying concept across the whole thesis.

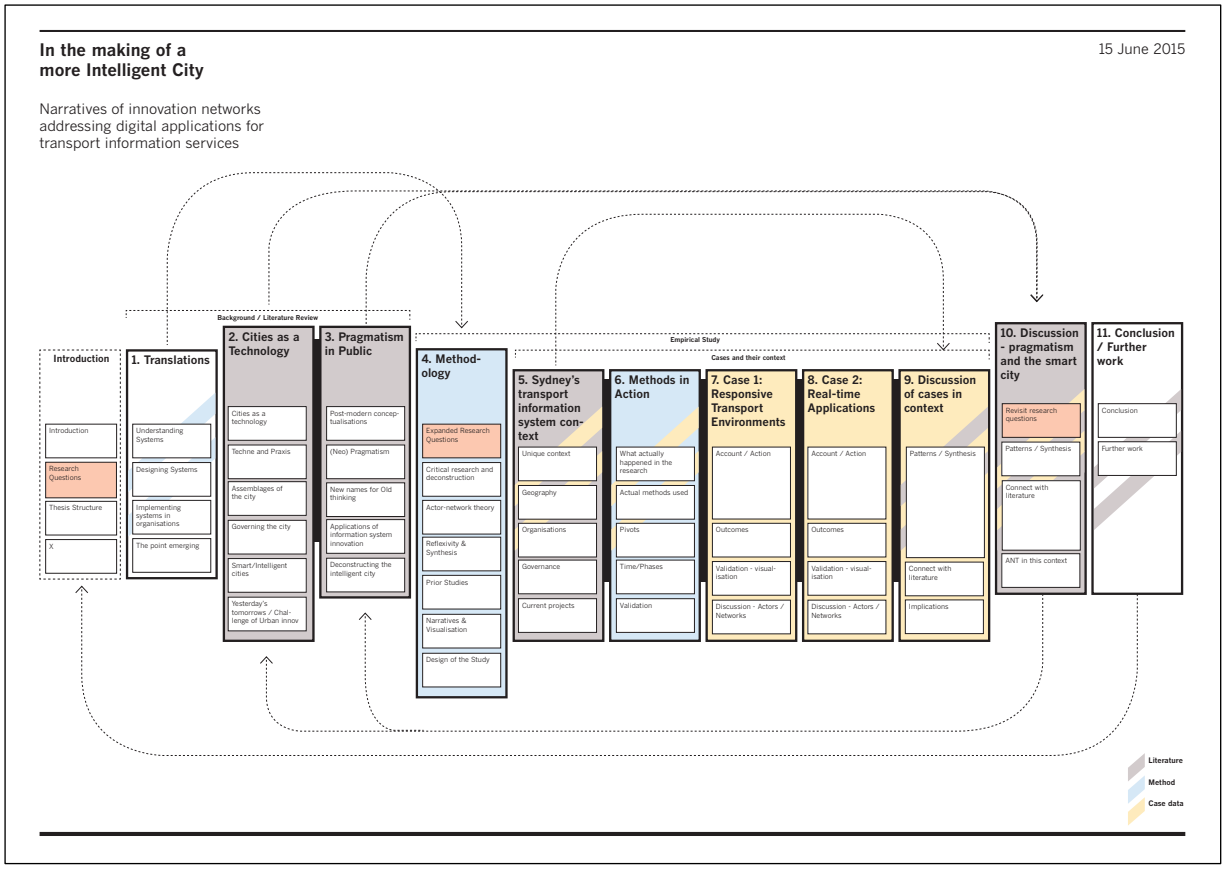


Figure 49: An early design for how the thesis would be named and structured, June 15, 2015.

Additional sources are, or allude to, topics that had been dominant in at least some of the actants involved. Assemblage, on the other hand, reaffirmed the approach and the unbounded, moving nature of the study. It was only towards the end of the study I understood that everything that had been done in the process of the inquiry, and previous *Responsive Environments* work, was in line with the pragmatist tradition, and that my visual history approach, when applied to the more general discourse of the smart city, was a novel and useful perspective.

On drawing conclusions from the cases

'What could really be said about the cases?' I was asking in 2017.

This research is not carried out on the behalf of any particular actant in the cases. This was an ongoing tension to address the different and sometimes competing needs of multiple stakeholders in the research process. No account would be useful to all of them in the same

ways. How, as Durepos and Mills (2012b, p. 216) have stated, could each of the actants be treated with 'the same levels of curiosity'? Some sacrifices had to be made in the desire to conclude, to point to the main narratives, and most interesting parts. In highlighting the 'most interesting' I was, in fact, inserting a meta-interpretive voice into the accounts. The role of the researcher in ANT is to accurately portray the actor-networks, not to interpret on their behalf. The emphasis was one of irony, to show a different, but useful, interpretation; one that challenges the existing perspective on how these cases work. The discussion in the following chapter will explain the variety of actants, the ways in which networks stabilise and destabilise, and how this interpretation can be considered pragmatist. The conclusions are about pragmatist process, what may help designers enact this, and how it can complete a limited smart city knowledge system.

Final approvals of content

'Is the use of the participant quotes still ethical?' I asked in late 2017.

As mentioned earlier, there was a first attempt to get participants to give the okay for the use of their quotes after the interview and transcription process. Secondly the visual VI workshop was a form of validation that I had interpreted the structure of the projects correctly. However, only three participants attended each of the workshops. Clearly, using the names of 24 participants was a complex challenge, due to the fact the research was speaking about them in their professional roles. Additionally, the political nature of this transport work in Sydney means that all of the actants regularly receive work from each other, and in some cases, compete against each other.

Therefore, in the process of constructing the visual and written discussion in the following chapter, there was a continual tension between honesty of accounts and wanting to avoid accounts that were too controversial. In the end, and significantly, many of the more potentially contentious quotes were omitted. This meant that certain narratives and interpretations of the projects were omitted, as these would have made the whole case require anonymity, which would have then become more like every other smart city, academic study without any connection to place, people, and related media.

Figure 50 outlines how the research process unfolded in terms of the use of participant information. These cases were bound by multiple confidentiality agreements and

memorandums of understanding between each of the actants. Examples of the artefacts used in some of these interactions can be found in Appendices C and D.

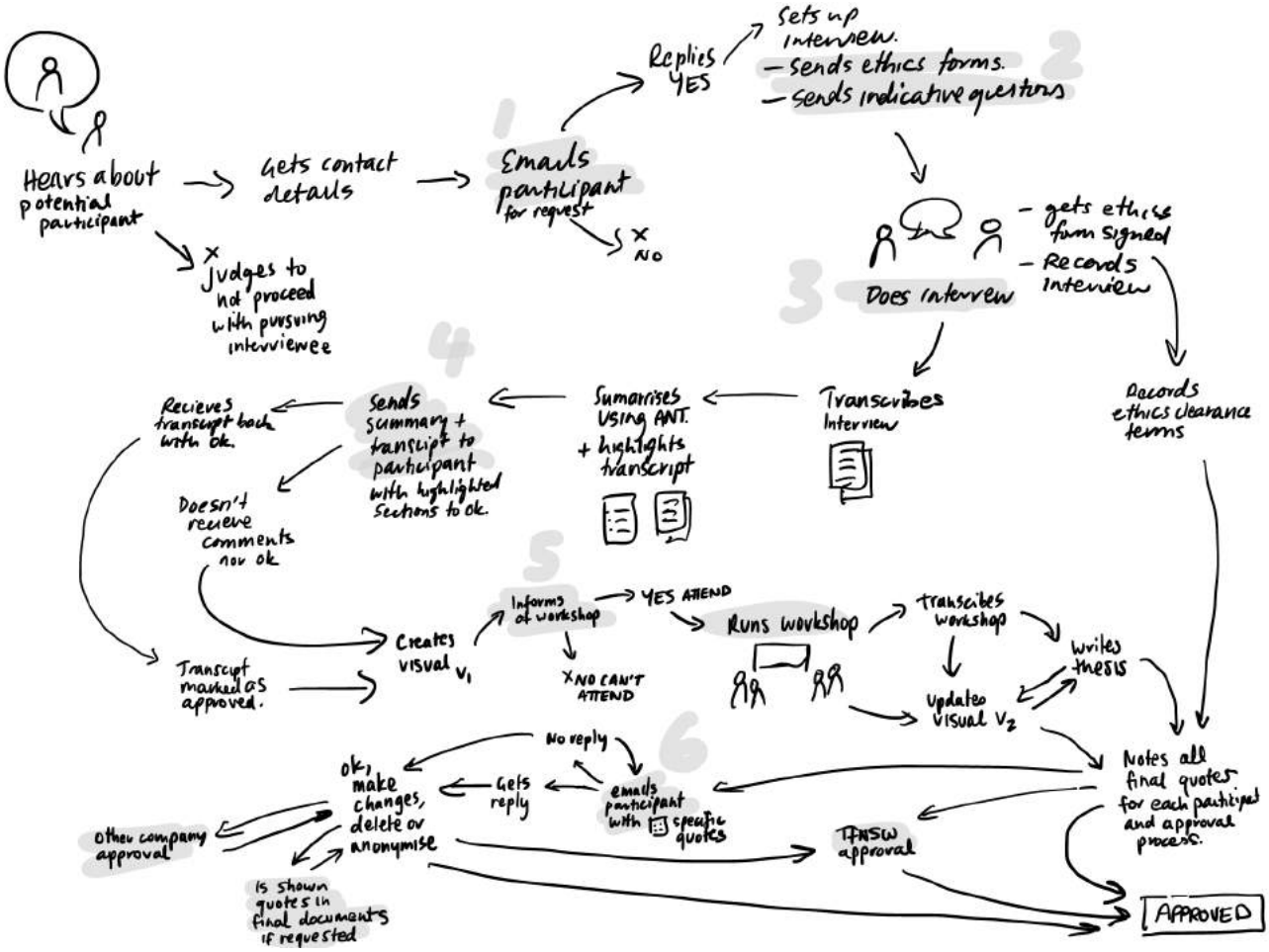


Figure 50: A sketched representation of the ethics and data collection process. The highlighted sections are those points at which a participant was met or contacted

REFLECTIONS

The choice to omit certain aspects of information was a pragmatist one. The thesis was ultimately complex enough to focus on the methodological aspects of the study's significance in relation to the smart city. I did not want to create unwanted controversy between participants and their organisations. If more controversial quotes had been included, it would have been necessary to anonymise the study, at that point negating much of the contextual information that was interesting. This information was what in my mind really maintained the detailed pragmatic perspective, of real people in real places.

Ultimately, I opted for including the full names of the participants for the thesis examination process, and would complete the final approvals with remaining participants before publication. See Appendix F2 for the draft of the email that will be sent to participants.

Reflecting on 'research in the making'

This chapter has been a description of the emergent process of research itself. It has introduced the historical approach of explaining science and technology as 'in the making'. Beginning as a novice academic, entering a project in 2012, I was not unlike Latour, entering the Salk Institute in California to study with Steve Woolgar. Woolgar (in Latour & Woolgar 1979b, p. 273) later explained that at the time when Latour first arrived at the Salk Institute, Latour's 'knowledge of science was non-existent'. This chapter has explained the immediate relevance for the visual history that was developed. Now as a reader, you understand both the immediate context out of which it arose, and the broader significance of this approach given the context of 21st century cities. Now with a better genealogical explanation of its premises, and evidenced action from which it arose, this thesis explores the outcomes of the applications of this approach to these cases. The pragmatist perspective was evident throughout the whole inquiry, yet I did not know in advance that this was the central argument until the study was complete. A researcher's continual practice toward relevance is a complicated experimental process, which, as evidenced in this example, is arational. As noted at the beginning of the chapter, there is no direct path between a designer's intention and outcome (Winograd et al. 1996). As problems were investigated, and innovative paths were developed and explored, new appreciations and understandings became available. Reflection and action are intertwined as hypotheses and conceptualisations, and are simultaneously informed by, directed at and experimented with in practice (Dalsgaard 2014). Many experiments failed, and much work leads nowhere, but after five years of oblique action the process and outcome become a coherent whole; a 'universe of experience' (Dewey 1938, p. 105).

Chapter 6. Experiments in translation

This chapter describes the findings of the research inquiry using a visual history methodology. The explanation of this experimental translation takes a few forms. All of these forms of description embrace ANT, proposing a cosmopolitical smart city discourse. While the visual histories are the main description of each case, there are additional descriptions in this chapter that draw attention to what is in the visual across a few areas. This chapter will describe some examples of personification of human actants, and secondly, express where translations took place between human and nonhuman actants in the cases. An edited transcript of the conversations that happened with the participants and the visuals is Appendix E. This approach was taken as there is no way to accurately synthesise or reduce a case, so through a diversity of ways of describing, the cases can be understood in different ways.

The chapter itself first briefly outlines what was attempted with the visual form, followed by a section on each of the assemblages. It discusses visuals, and what performance they encourage, before presenting a descriptive section on each of the cases. Each of these sections contain a list of what accounts exist already: blogs; newspaper articles; reports; and what is public knowledge and hypothesises about the type of discourse this may enable. Second, the chapter presents a summary of the discourse that was enacted with the visual VI in the workshops (an edited transcript is Appendix EI). Third, the chapter engages in a discussion about the variety of actants in the assemblage. Fourth, a table describing seventeen different types of translation that were evident in each assemblage is presented. These serve as a means to explain the variety of processes of stabilisation and destabilisation between actants. Fifth, and last, there is a brief

about the implications of using this method and what it produced in these cases. This concludes with a discussion about the relevance of this approach to the five key tenets of pragmatism: viewing change as an evolutionary process; a commitment to experimentalism; the dismantling of metaphysical systems; the rejection of dualisms; and, an ecological perspective.

Reassembling the smart city in the visual histories

At this point it is recommended the reader familiarise themselves with the visual histories that are part of this thesis[3]. These visual histories, as were described in the previous chapter, represent two distinct phases of iteration. The first, v1.0 (figure 51), was the first iteration from late 2015. The second version of the visual histories, v2.0, was developed in 2017. Version v1 was used in workshops with participants; three workshops for each case.

Version 1.0

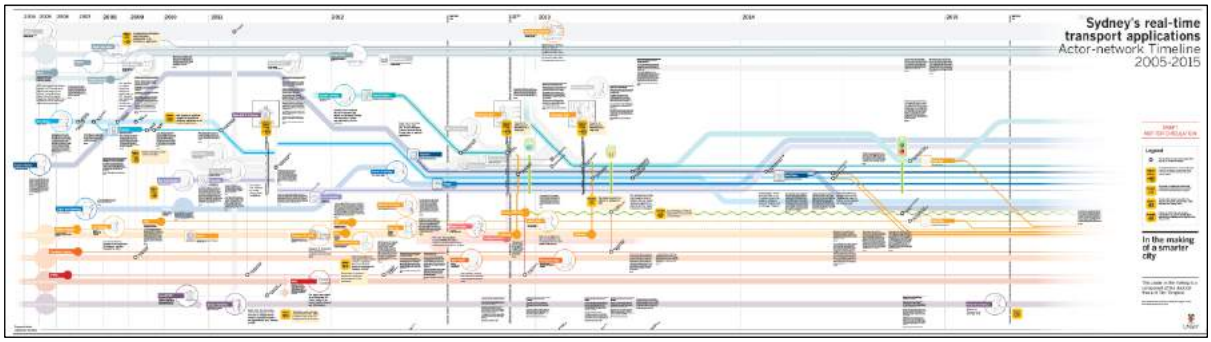


Figure 51: The Real-time Applications *visual v1.0, 2015. Source: author.*

[3] To reiterate, these pdf files are viewable for examination purposes on the USB attached to the front cover of this thesis. At a later date (end 2018), these will be publicly available online, subject to participant approval (see http://www.timtompson.com).

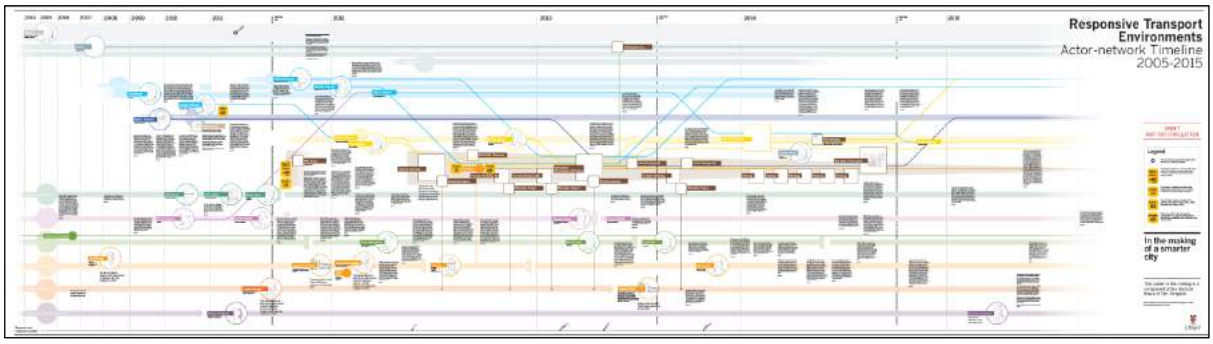


Figure 52: The Responsive Environments *visual v1.0, 2015. Source: author.*

The first version of the visual history spatially arranged the content over time (left to right), and followed the courses of individual actants across time with thin lines (figure 52). The intent of this version was to encourage participation and feedback. The visual histories form a different argument for what these projects are like, presented in the form of assemblages that are 'in the making'. They are intended to be purely descriptive, with interpretation by the reader. Ironically, open-ended complexity, in which designers and researchers must sense-make and derive conclusions, is an increasingly 'normal' operational context. The visual histories made present other spatial qualities to this project, and enabled the inclusion of material that was suggestive, rather than having to be explicated in words.

It is inevitable that the researcher must make decisions as to what information is included and what is not. In the end, it was not the idiosyncrasies of the individual projects that were of central interest to the broader inquiry, rather, it was the research paradigm of pragmatism that was emphasised. Clearly, these visuals are an immense reduction on the 300,000 words of transcripts, but beyond this it is the lived experiences of hundreds of human actants, and additionally thousands of nonhuman actants that shaped the trajectories and the action of these assemblages.

These experiences are not separable from the contexts out of which they arose. Presenting the actants spatially creates a rhizome-like experience of exploration though the visual, which can be started at any point. The five ANT terms serve to provide an additional lead-in for participants of ANT.

Version 2.0

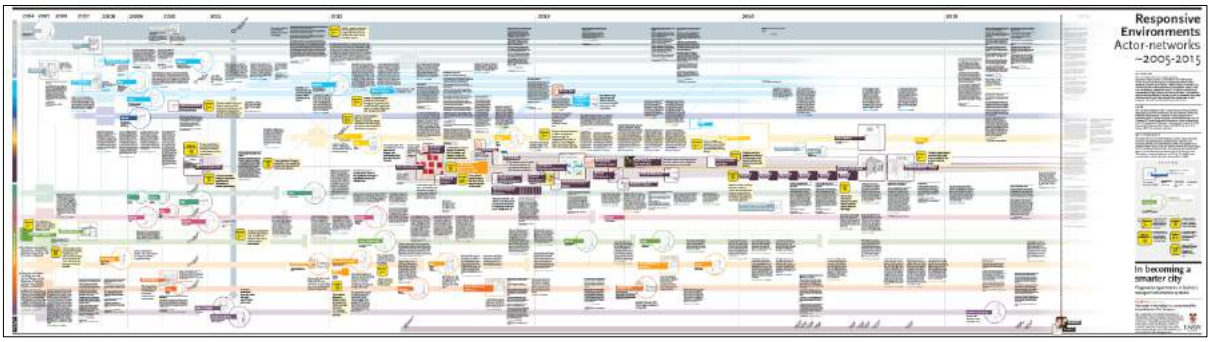


Figure 53: The Responsive Environments *visual v2.0. Source: author.*

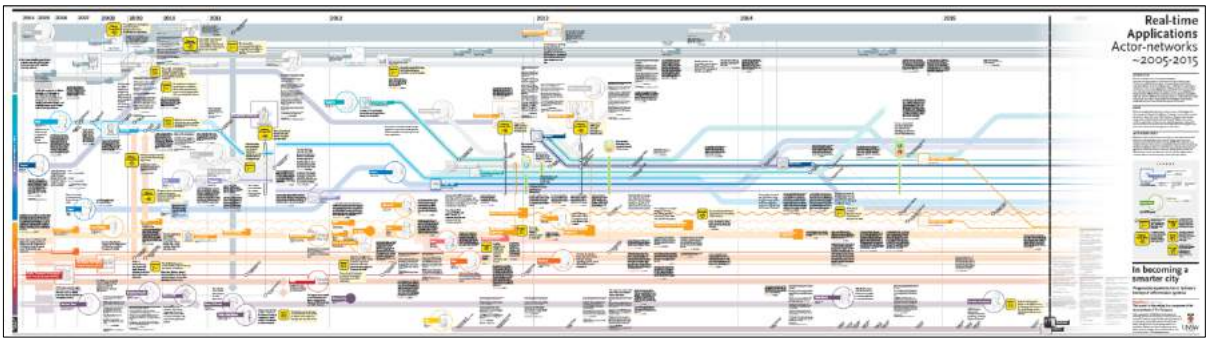


Figure 54: The Real-time Applications *visual v2.0. Source: author.*

The second versions of the visual histories (v2.0) (figure 53 & 54) were an iteration from the first. There were several observations and comments that were taken into consideration from the workshops that were held with version 1. This time the visual was scripted for a broader audience of practitioners, designers and researchers. This included the personification of nonhuman actants, in the style of Bruno Latour's *Aramis* (Latour 1996c). Four examples of these for each assemblage are discussed in this chapter. Version 2.0 included significant additions of content, including what was discussed in the version one workshops. Other changes included any recommendations from the first workshop, more quotes, the improvement of grammar, and syntax of all quotes. There was the addition of a further layer of information intended to draw attention to key ANT translations in the visual. These highlighted areas (in yellow) were to give users who would be unfamiliar with the project a quick introduction to the project through the key moments of ANT translation.

I could spend more time explaining every detail of the design of these visual histories, however, these visuals are not designed to be explained, rather they are to be explored. The viewer is intended to have an experience, rather than being told what to think about them. They have been designed to script performance.

If required all of the visual histories of v1 and v2 included a legend that oriented the reader to make sense of the iconography used. This legend was further refined in v2 (figure 55).

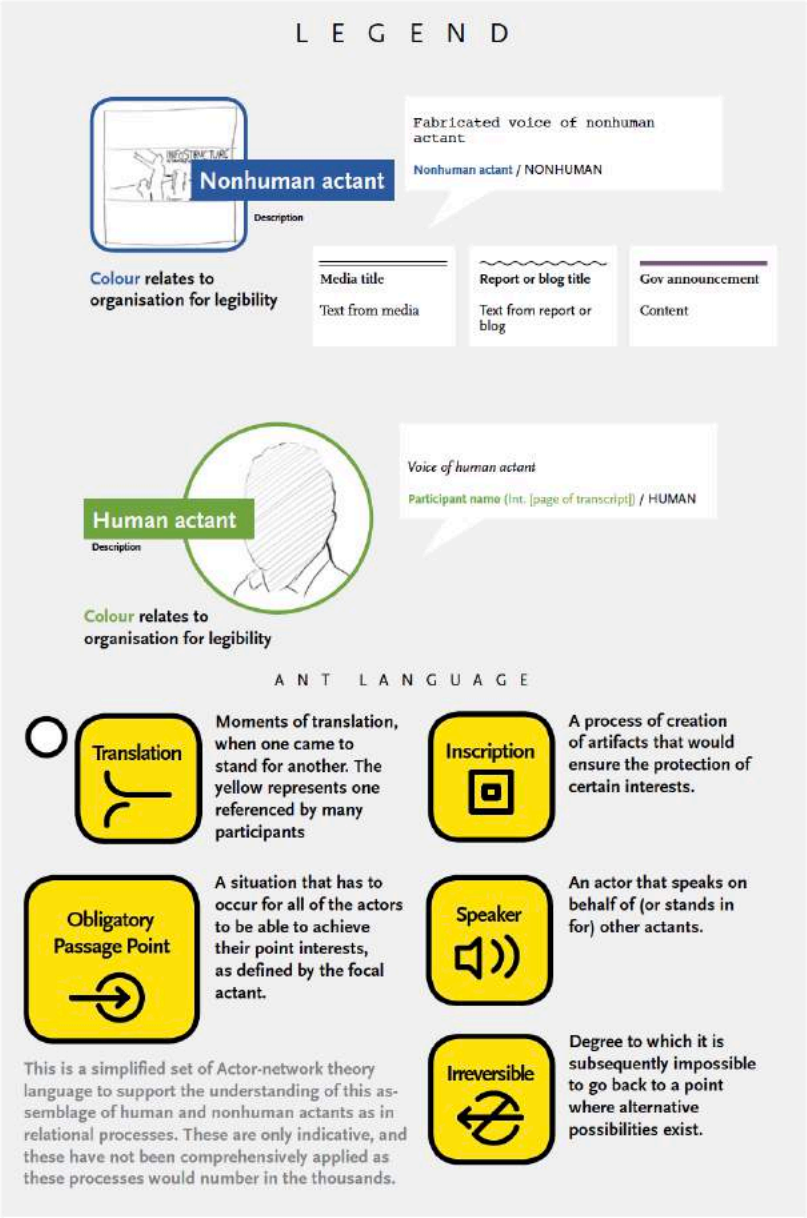


Figure 55: The legend that appears on the visual histories v2.0. Source: author.

Version 2.0 contained many refinements for legibility, and clarity between actants, which were further improved just before thesis submission in early 2018, resulting in version v2.1. This version included the addition of an outer glow around text so it was visible on coloured backgrounds (figure 56). All references are traceable back to their authors and organisations, allowing the viewer to move through the visual, picking up on the various threads of narrative that are taking place, often simultaneously. This way of representing is intended to give the reader a 'rhizomic' (Deleuze & Guattari 1987) reading of the case, where they can enter at any point of the poster and explore in any direction. I am not stipulating the hierarchy of what are the most important voices, or what should be read first, other than the hierarchy of names and ANT terminology which, as larger text, stand out above the quotes.

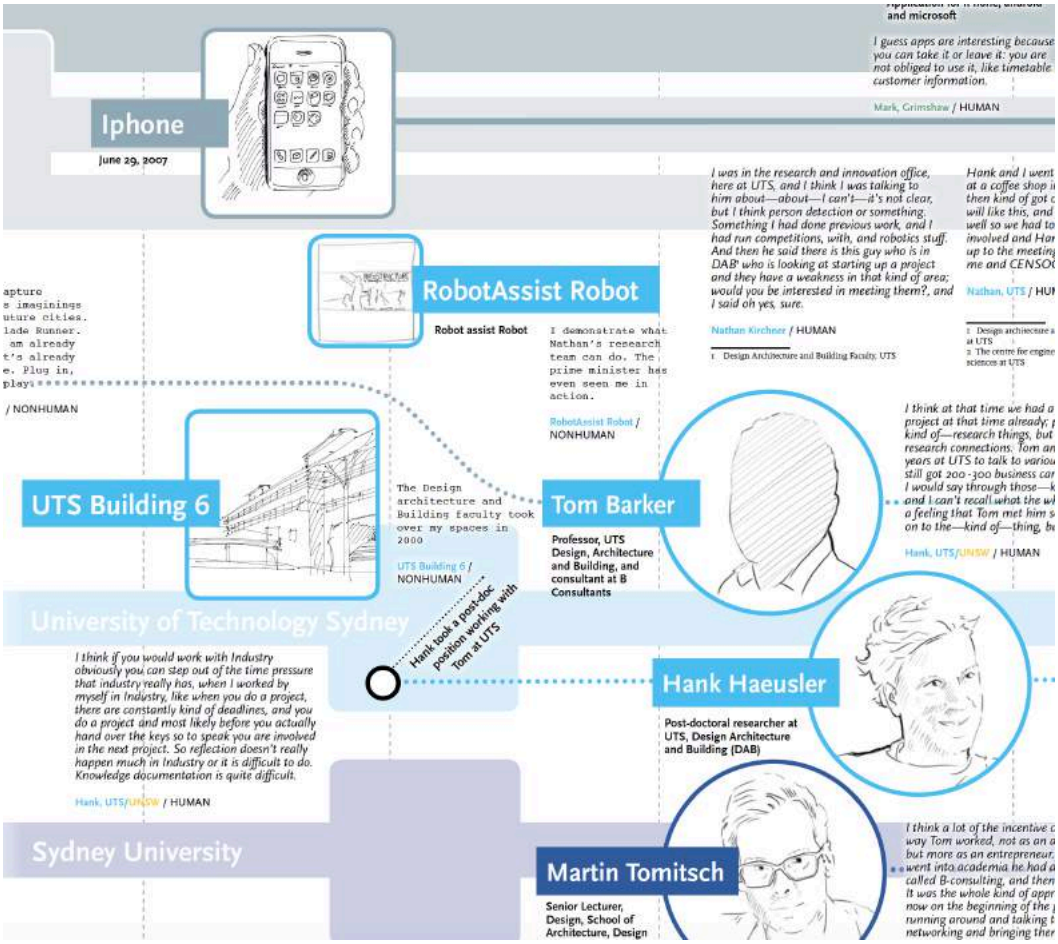


Figure 56: A close-up of the Responsive Environments *visual history v2.1. Source: author.*

I have written further described elsewhere about the design of the visuals (Tompson 2017). I now describe the findings and implications of using this method with each case.

Assemblage 1: *Responsive Environments*

What discourse about the case already existed?

The visual histories tell a story unlike the fragmented records of the case that already exist. The grant proposal, which is publicly available, tells a story more of a rational, ordered plan of distinct phases of prototyping. However, the Grant proposal states that it will use action research to develop the prototypes, from both human and technological observation. The only other publicly available materials were the blog, brochures, published papers and books. The blog covered short summaries and insights from the research aimed at a general audience, however, it has only been viewed a few hundred times (responsivetransport.org). The brochures (example in Chapter 5) were given out at the events, and by our team in various meetings. The papers included many perspectives on the project that provided more insight (Gardner et al. 2014; Tompson 2013; Tompson & Zeibots 2013; Tompson & Tomitsch 2014; Tomitsch & Haeusler 2015; Tompson 2015; Tompson 2017). The books, *Infostructure* (Haeusler, Tomitsch & Gardner 2010) and *Interchanging* (Haeusler, Gardner & Mahar 2014) have had a wider reach: a thousand have been distributed. The universities gave some media coverage in their magazines and websites. The publicly available discourse on the initiative is different to the perspective presented in the visual history.

Internally, within the assemblage of stakeholders, there were dozens of relationships to make sense of, from the customer relationship to participant representations with *Rich Pictures* (see Checkland & Scholes 1999), and to many more representations demonstrated in the previous chapter. The academic team worked on a variety of cases of digital intervention in the transport system, including real-time information systems using projections, screens and balloons. The bus stop itself is an explanation of the project. As a final report for the partner organisations was never completed, a more holistic narrative was never developed and presented.

Performed discourse with the visual history v1

A workshop was held to reflect on the project. For the two last years of the project (2014-2015), much of the project activities was been primarily conducted between the three universities. Therefore, it was deemed that only the Encircle academic team would be invited, as there were few other people who had enough knowledge of the project. The Encircle research team had

not met for a while; all participants had moved on to work on other projects, and the grant's guidelines had dictated that it had run its course, the three-year term having ended in June 2015.

Figure 57: Matthias (Hank), Martin and Michelle discuss the visual history v1. Image: author.

The workshop enabled many edits to be made in the visual. There were several names that were incorrect, and details of timing of meetings and events that were out of order. The visual history v1 enabled a structuring of the conversation and allowed the participants to hold certain moments in time as they discussed them, moving up and down the visual (figure 57). The conversation covered a huge range of topics, from personal topics between participants, to tracking budgets, and discussion of what participants had done since.

An edited transcript of the workshop designed to emphasise the most relevant aspects of the conversation, and the attendees' reflections, is Appendix E1. The visual, in the ANT sense, scripted a performance around itself: an enactment of a new type of conversation on project history. How did this end up where it did? They were not just short responses; the visual

encouraged heterogeneous interpretation of actants, a plurality of perspectives, and more emphasis on the process. Conversations again, are far more complex than the visual itself. The personal narratives of participants and their pressing concerns shape much of the conversation.

Scripting (nonhuman) discourse with the visual history v2

Version 2 of the visual for *Responsive Environments*, incorporated all the participant recommended changes from the workshop, which included additions of events, changes of spelling, corrections of people's job titles, and date changes.

One of the major changes was the incorporation of fabricated quotes for nonhuman actants to enable them to have the same presence as human actants in the visualisation. The following are nonhuman actants that have been depicted, with their quotes, in the visuals. I explain here what agency these fabricated quotes were designed to express. The few examples of the nonhuman actants that are represented are the digital display system SmartSlab, the published book *Infostructure*, Central Station, and a workshop output. The depictions below are the sketches that were used in version 2 of the visual to represent the nonhuman actants.

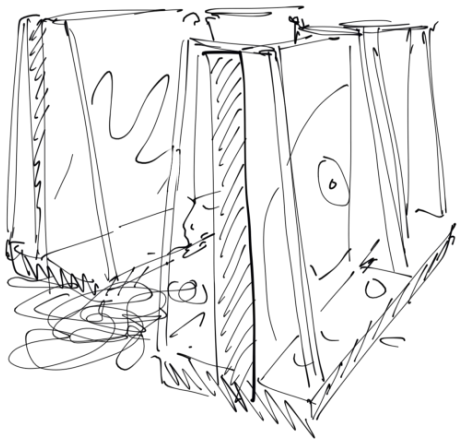


Figure 58: Four SmartSlab units. Source: author.

I can capture people's imagination about future cities. Think Blade Runner. Well, I am already here. It's already possible. Plug in, stack, play. Smartslab / NONHUMAN

The SmartSlab (figure 58) had the agency of a built technology that can easily draw attention to itself. It can be used as an installation in galleries, foyers, and events. This character was created by thinking of the actant's ability to enrol the public in urban imaginaries. The SmartSlab is reminiscent of science fiction scenes of the future urban environment. The SmartSlab was designed by Tom Barker and promoted as his own business. In this assemblage, Tom and Hank both promoted the system and installed it in several locations around the city, which had enrolled many industry professionals in their definition of solutions to some urban problems.

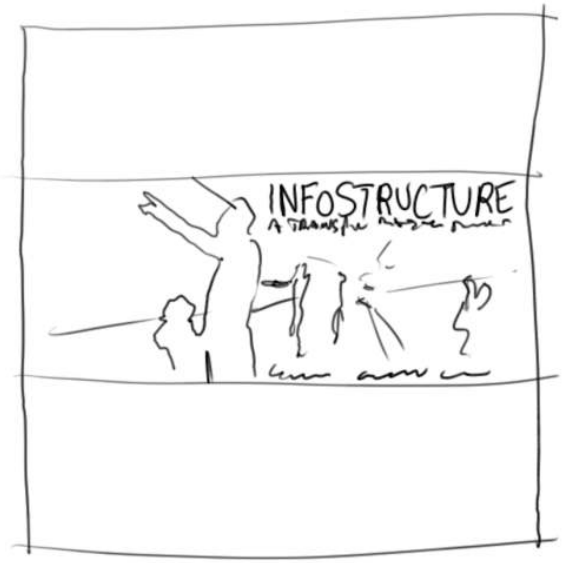


Figure 59: The Infostructure *book. Gardner, Tomitsch & Haeusler, 2011. Source: author.*

> I have the agency of material! I make ideas concrete. I have made them discussable. Far beyond the fleeting forums of the student presentations where these concepts were? Are? first seen. Unite over problems, divide over solutions, right? Well these aren't fully resolved. They are still sketches, still open to your imagination, your ideas, your next steps! **Infostructure book** / NONHUMAN

The *Infostructure* book (Gardner, Tomitsch & Haeusler 2011). This book (figure 58) was written by some of the researchers who later led the *Responsive Environments* project: Martin and Hank. This book had notable agency in the project. It contained many student projects from a studio

Martin and Hank ran on digital interventions in transport. This studio alone was a means to enrol transport practitioners into the university practices, as many professionals were invited to critique the student presentations at the end of the studio. This book was the output of this studio, which inscribed a relationship through the gifting of the books to practitioners who were involved. These books then had their own agency, being able to be immutable mobiles, conveying the prototypes in offices without Nicole, Hank, Martin or the students. In the latter research grant, practitioners still referred to this book.

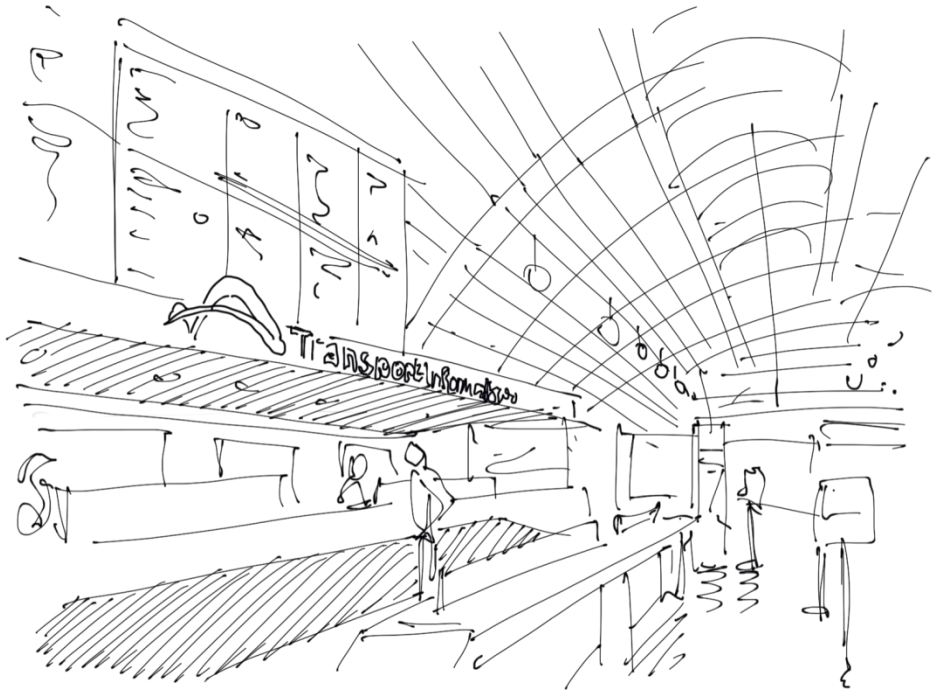


Figure 60: Central Station Grand Promenade. Source: author.

> You researchers are too much of a risk; do you have any idea of the stakes? I am critical to this city. Every part: you cannot slow down, create confusion, put anyone at risk. All those people, citizens, and for my managers, they are voters! What if something went wrong? Even slightly, it would be all over the news. I am central, not just any station. The pumping heart of the entire system. All eyes are always on me. Central station / NONHUMAN

Central station (figure 60) was where our team were originally planning to prototype various digital interventions. However, at the commencement of the project the researchers perceived that Transport for NSW now no longer wanted them to test there. As a result, the research team changed direction of the project. They no longer attempted to test at Central station.

Central station, as an actant, here expresses what was assumed to be its agency in this context. The character here was to exude the importance of Central as an iconic and extremely crucial transport hub, but at the same time express the pressure on its 'managers', of ensuring it is always running perfectly, referring to transport and the minister.

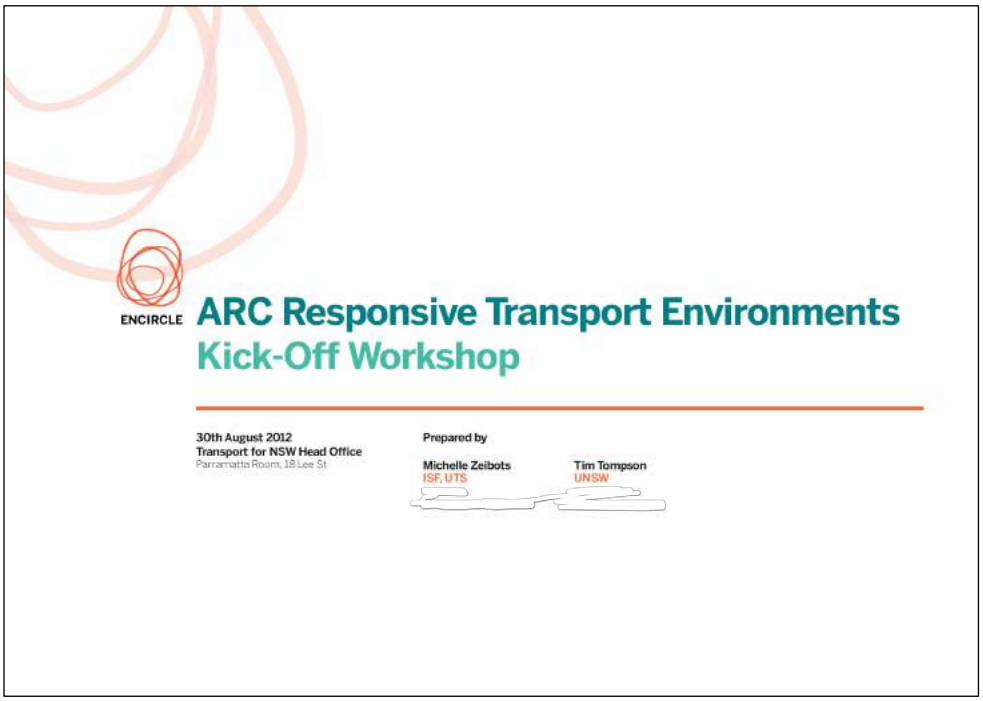


Figure 61: The Kick-off workshop output. Source: author.

> I can enter the offices of the industry partners without my creators, I exist independent of them but can expand their reach, be shared between staff, the message is the same. How I am interpreted is a different matter. But all you need to know from me is this project is real; good things are already happening.
>
> **Kick-off Workshop Output** / NONHUMAN

The **Kick-off workshop research output** (figure 61) signalled the beginning of the project. This document offered the chance for the research team to establish themselves as different to other research groups that had been worked with in the past. Once again, a printed, or in this case largely emailed, document was an immutable mobile that could travel and portray texts without distortion. This was distributed to the industry partners who attended the workshop, and those who couldn't make the workshop.

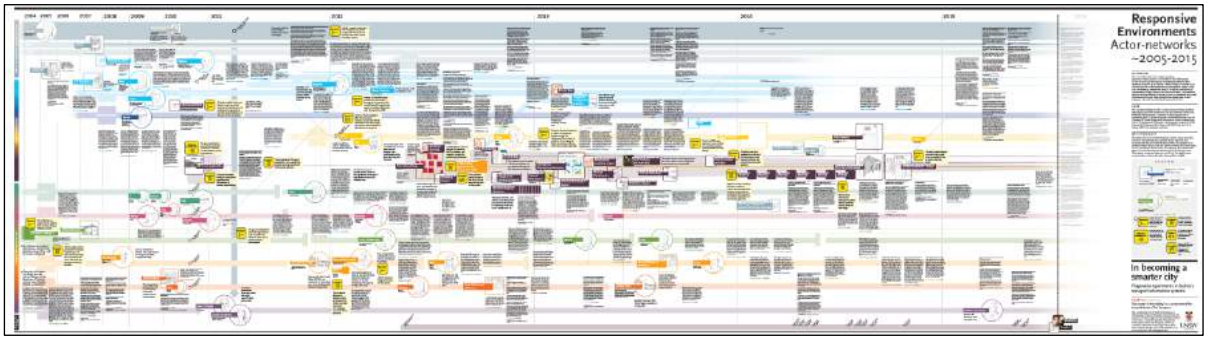


Figure 62: The Responsive Environments v2.0. Source: author.

Figure 62 is the visual form v2.0 for *Responsive Environments*. Several new actants were added in light of better understanding of ANT, but still attempted to maintain around a 50/50 split between actants. Nonhuman actants included, reports, newspaper articles, and blog posts. Several points of reference offer a level of context of which the reader would not have been otherwise aware. These cases did not have many actant's notes in either the top of the visual or the very bottom. The level of detail is arbitrary; but chosen for its ability to convey the narrative adequately. It is designed so that the reader can get a rich enough sense of the complexity, but without overloading the image. The way it is presented is prescriptive, but only through ordering of hierarchies of information. This discussion relates both cases back to the concept of variety, i.e., the variety of actants and their types of scripting that created a variety of performances in these actor-networks. It is important to note, that the visual histories are not an attempt to comprehensively list of all of the actants, as this project would never be completed. The visuals tell a radically different story to the narrow perspective one gathers from just reading the public announcements that are made about the project. What one is given is a much more diversified sense of what action and politics constitutes the 'projects'.

The varieties of actants

Actants ranged from books, to bus stops, metrics to methods, congestion to contracts and from academics to aluminium. I collated a list of all actants mentioned by each participant in their oral histories. Some of the lists numbered in the hundreds. Each actant was entered on the list with a marker tracing back to the page number of transcript where they were mentioned, and

their agency, as perceived by each participant, was noted. A page of one of the interview summaries is at Appendix D9. This list is not comprehensive, nor does it speak to significance: rather, it is to express variety. Please note that due to the enormous variety and innumerable amount of actants, not all of them are represented in the visual. Additionally, some were derived from earlier knowledge of these projects, rather than from these interviews. Eventually, only around half of the hundreds of actants present in the interviews were annotated, excluding many whose interview responses were not clearly targeted. This section provides a list that outlines some of the diversity of actants that were part of the actor-networks of the total assemblage of *Responsive Environments*.

Typologies of translations: 50 instances

When the number of actants are too numerous for description, Latour suggests that the researcher think about the type of ways that actants relate, and then reduce the innumerable actants through these categorisations (Latour 1996b). The following section, *Types of Translation* will categorise some of the translations through this relational process that Latour suggests. This section employs the diversity of actants as mentioned by participants. All of these appear on the visual history v2.0, although they may not be articulated directly in the visual. There were, however, hundreds of others that are not included in the visuals, from both the interview process, and others that I knew through interactions separate from the interviews.

The list of translations outlined in this section will be categorised into the infralanguage of ANT. It comprises an arbitrary number—however, I ensured there were at least two examples for each of the seventeen categories listed. These are presented anachronistically, so they do not seem causally connected. These translations involve processes of problematisation, interressement, enrolment or mobilisation, but are not limited to any particular actant. For more information on these, please revisit the explanations in Chapter 4. These translations occurred somewhere in the assemblage that had agency for the trajectory of the assemblage. Some of these involved the establishment of actants as obligatory passage points, some created black boxes, and others created inscriptions that others would follow. Some of these are marked on the visual, although they are articulated differently in the visual form. For example, to make the system of iconography simpler, ‘problematisation’, ‘enrolment’ and ‘interessement’ are articulated just as translations, to ensure interpretation beyond a single

focal actant (see Mol 1999). Other actant's infralanguage is not marked on the visual because they must be referred to in broader terms. These can be interpreted as both forces of stabilisation or destabilisation, depending on the perspective that the reader holds, such as their individual conception of actor-networks. For example, one of the academics, Tom Barker, moving to Canada, could be seen as a force of destabilisation. Alternatively, his removal from the grant made the relations between the researchers who were based only in Sydney more stable. As a result, no value judgement is given in these descriptions, other than that these have been noted over the hundreds of others that are not listed here. This list contains more items than the vocabulary in Chapter 4, yet less than what appears at Appendix B, as not all items on that list related to translations, that is, 'the possibility that one thing…may stand for another…' (Law 1992 p. 386). The order is also changed for a better flow. Definitions are repeated so the reader does not have to refer to other pages. Some of these translations could fit in multiple categories but are only described in one. Below (Table 5) is the list of the typologies of ANT translations, and lists where these translations were evident in the cases.

Table 5: Examples of types of translations in the Responsive Environments *case.*

Vocabulary	Definition	Examples in the *Responsive Environments* assemblage
Betrayal	Betrayal refers to the breakdown of the actor-network, in which an actor acts outside of their defined role. These are not to be perceived as 'negative', rather a deviation from a scripted performance.	• Tom Barker left the grant, through relocation to Canada. • Academics who did not hold up their commitments, with their allocated time attributed to the project. • Transport for NSW later did not enable the research team to test prototypes at Central Station, as was outlined in the research grant. • Committing to a course of action that would exclude a chief investigator.
Black-box	A technical term for a device, system or object when it is viewed in terms of its input, output and transfer characteristics without any knowledge required of its internal workings.	• 'The grant' when it was treated as an entity that, at least in the early parts of the project, was treated as a black-box: this was quickly unfolded. • Funding in each of the university systems was a relative black box to the other universities. • The TV screens used in the bus stop design were known for their inputs (power and HDMI input), and the output that the software displayed.

Vocabulary	Definition	Examples in the *Responsive Environments* assemblage
Co-optation	A sub-process by which actants seek to have their individual objectives agreed to by other actants as part of defining network objectives.	• Mark from Grimshaw encouraging the Encircle team to work on a bus stop, which then turned into the major stream of work for the Encircle team. Assisting Grimshaw in known upcoming pitches for Light Rail and bus stop design. • Nathan building LED tiles for the Encircle project, with intent to use them in other applications that he was working on. • My encouraging towards a participatory process, as that was his practice.
Description	To unfold a process from a technical artefact. The inverse, or use of a *script.* To enact a scripted action.	• To begin the grant, was a description of a scripting that had inscribed the terms of reference and actants who would work together on the project. • Staff changes were frequent, so replacement staff would have to fill the role of the staff member who had left.
Enrolment	When other actants in the network accept (or get aligned to) interests defined for them by the focal actor. Similar to co-optation, but relating to a focal actor. Contemporary interpretations of ANT do not centre around a focal actor, there may be many that become more dominant in different circumstances.	• The grant signified the enrolment of partner organisations into the research team's definitions of interest. • The research team accepting they could no longer test on the Sydney network. • Nathan and Michelle were able to enrol other technology developers, infrastructure providers and transport governing organisations in 'satellite projects' that could be tested outside of Sydney. These were projects that are related to the 'core project' but did not concern all project partners.
Inscription	The creation of artefacts that would ensure the protection of certain interests.	• The development of the bus stop of the future as a stream of work inscribed protection of interests of Hank and Martin, as both of their skillsets, and student projects, would be able to be attributed to this project. • The bus stop of the future inscribed many of the interactions, for example 70% transparency.
Interessement	When actants must be negotiated with to accept the definition of a focal actor.	• The participatory process. • The decision-making process around the Intervention prioritisation workshop ensured that the decision was unquestionable that the bus stop project would be pursued, even though it was only marginally the leader, voted with only eight stakeholders in the room.

Vocabulary	Definition	Examples in the *Responsive Environments* assemblage
		• When I was negotiated with, through meeting the research team, deciding if I wanted to be involved in the project.
Intermediary	That which provides meaning or force without transformation: defining its inputs is enough to define its outputs.	• PDF reports distributed across email • Communication systems such as the 4G network over which phone calls and text messages travelled.
Irreversibility	Degree to which it is subsequently impossible to go back to a point where alternative possibilities exist.	• JCDecaux had the 20-year contract for bus stop provision in Sydney 1998-2018. • The research grant inscribed relations that were irreversible for the duration of the project, which directed who had to be consulted during the process, and inscribed certain objectives. • The commitment to the NDA with transport rendered them as a focal actor.
Mediators	That which can transform, translate, distort, and modify the meaning or the elements they are supposed to carry.	• A train crosses a signal block. An algorithm uses this data to predict the arrival time of the train. This is pushed to a display screen showing minutes remaining, which is read by customers.
Mobilisation	Refers to a set of manners utilised by a focal actor to ensure that all actants have legitimate speakers to represent them in the groups and avoid *betrayal* from the latter.	• The networking of Hank and Tom enabled Hank to build up a group of people that could, through Hank's ability, be translated into a contractual working agreement through the proposal. • Hank started dating Nicole, who was working at Arup, who also provided contacts to establish the grant. • Hiring Briedy to be the project co-ordinator to liaise with partners and maintain communication.
Obligatory Passage Point (OPP)	An OPP is a situation in which all of the actants have to achieve their interests as defined by the focal actor (Callon 1986a).	• A government agency makes all stakeholders sign agreements, ensuring all information to be published goes through their media department first. • JCDecaux became the only way to access testing on real bus stops in the city region.
Problematisation	When actants must be negotiated with to accept the definition of an actor.	• When a station platform is crowded and the government proposes to put attendants along the platform to direct the crowds, therefore defining the problem as to do with crowd control, rather

Vocabulary	Definition	Examples in the *Responsive Environments* assemblage
		than to do with capacity of trains or reducing the need to travel. • Tom wished to maintain his position on the project even though he was overseas, however, the Encircle team deemed this to be an untenable position.
Punctualisation	Similar to *black-box*, the ability of parts of a network to be hidden, appearing as simpler assemblages.	• A bus stop contains wind and rain shelter, route and timetable information, signals to drivers where to stop, has seating and creates revenue for its maintenance through advertising. All of these complex parts of the network are punctualised as a simpler 'bus stop'. • The Interchanging book creates a simpler assemblage, through which included complexities of real-world events are reduced to text. • The description of the Encircle team punctualises the complexity of relations between actants and the universities.
Script	To enfold, process into a technical artefact. Inverse of *description*.	• When the bus stop prototype was designed with four interfaces built into it, knowing the content of those screens could be changed. • The decision to use materials that could be laser cut in a lab with the equipment that Sydney university already had. • The Encircle team decided to use a project management application, Podio, however, they didn't use it for more than a few weeks.
Speaker	Those that speak on behalf of other actants as spokespeople or nonhuman actants, such as reporting systems.	• Briedy became the speaker for the project when she became project co-ordinator, and was responsible for liaising with the industry partners. • Tony Braxton-Smith was the speaker for the intent of Transport for NSW, followed by Kate Foy, and other customer service employees. • The workshop reports became speakers of the project activities.
Texts	Used to support rhetorical arguments.	• Data on rail and bus usage is used to support a proposal for changes in services. • The production of the book, Infostructure served as a text; a boundary object (see Star 1988), that enabled many stakeholders to discuss these ideas

Vocabulary	Definition	Examples in the *Responsive Environments* assemblage
		to interest each other in their definitions of the problems. • Data on usage of Real-time Applications became a text to argue against the need to put displays in bus stops. There were already enough users. • Final report: I spent a month developing it, all 340 pages, collating the Encircle project, all reports, and blogs, from beginning to end. To demonstrate achievement, however, this was never finished.
Transcription	How meaning is moved from one mode of script to another.	• Customer needs were translated into active projects and activities of Transport for NSW and contractors during the intervening time between the grant proposal in 2010 and the commencement in 2012 • The Encircle bus stop design became a process of planning a summer school: the Built Environment Interdisciplinary Lab (BEIL) • What the project should do was transcribed from the written grant to the participatory engagement process. • Spoken word was transcribed into written text, in the form of meeting minutes, whiteboard sketches etc.

It is important that these are not deemed as positives or negatives unless you are an actant in the network, as that judgement can only be deemed in relation to the context. What may appear negative, in destabilising the existing network, can lead to larger and more stable networks that other actants will be enrolled in.

Reflections on the method and *Responsive Environments* assemblage

I had earlier thought of the project as a failure. This value judgement proved to be misguided. While the project was unable to deliver on its goals, once viewed in detail, it revealed much that is useful to further research, and to making sense of such contexts. The ANT lens presents the project as nets of shifting relations, not as positives or negatives. The researcher makes value judgements about what they wish to research and should follow curiosity, but should not decide in advance what actants are valid and which ones are not. There are some major

implications in the commitment to use ANT. Firstly, the scope is much larger, made so by the following of actants in far broader terms than might usually be explored. There was nothing that was really 'out of scope'; if it was important to a practitioner, it was important. However, it was up to me to maintain the discourse around what might be perceived as the 'trajectory' of the assemblages, for example, the decision to centrally display the activity of the research team and the production of documents, rather than placing Transport for NSW at the centre, as they could well have been. In terms of ANT, this project truly had no centre, but had to be made discursive somehow. From these descriptions, it is clear the project exists in multiplicity. This assemblage of diverse actants, both human and nonhuman, was stabilised through the development of the *Responsive Environments* project. We can understand through this lens the complexity of the negotiations between actants. Each translation signifies changes that are more favourable to some actants than others. The network grows through the accumulation of dominant interests, the inscription processes of networks, and so on. There have really been no sustained systems built, but rather, interpersonal relations and learning of each participant. However, from this Michelle and Nathan began a working relationship that continues today.

The inscription of the grant was irreversible, in the sense that those actants enrolled through the contract were then, after an 18-month delay, to practice together for the subsequent three years. This is a big commitment in a fast-moving technological environment. The staff experienced a huge turnover. The results were different from what was inscribed in the original brief. Some stakeholders believed the pool of stakeholders was wrong for what we wanted to do, specifically, that Transport for NSW is a governance organisation that licenses technology rather than developing it themselves. This has not always been the case. None of these learnings happened before doing the project. Despite early adoption, there was not enough traction from customers or industry to make any of these things happen. The material agency was provided largely by documents and proposals, which enabled the elicitation of Transport for NSW's perspectives, but also put the project in a vulnerable position (see Tompson & Tomitsch 2014). Why a project ends up as it does is, through ANT, impossible to claim with any certainty. Perhaps it was just like, as Latour (1996c) proposes of *Aramis*, that it failed because nobody loved it enough.

Assemblage 2: *Real-time Applications*

What discourse about the case already existed?

In October 2012, the state government, in a media announcement from the then Minister for Transport, Gladys Berijiklian, publicly called for application developers to apply to attend an application development 'hothouse'. Participants would compete for limited positions in skills-based competition for exclusive access to the Real-time feed for Sydney's buses. Five developer teams were selected to develop further their concepts and have exclusive rights to the Real-time data feed. Subsequently, in February 2013 there was another hothouse for real-time train data, resulting in another two developers being granted access to the real-time data feed. Since that time, two developer groups have dropped out due to issues with financial viability of their apps, and one of the included developers has added another application. Many of these are referenced in the visual. Currently, there are six applications from five developer groups available for download and use on platforms including Windows phones, iPhone, Android and Blackberry.

To the majority of the population in Sydney their only awareness of the project is that you can get an app that tells when the public transport is arriving. They would know nothing, or very little, of how the apps were developed, or by whom, and the context within which they arose. None of this matters to the average citizen. However, this project was high profile, and was being championed as an exemplar public-sector innovation in Australia. The accounts that do exist are misleading in their reductive nature. As it was a significant project in Sydney over many years there was a substantial amount of publicly available material about this project, from newspaper articles (e.g Moses 2009; Grubb 2013); media announcements from the government (e.g Transport for NSW 2013; 2017); public presentations (e.g Braxton Smith 2014); and blogs (e.g Chan 2012). For a more complete narrative, one may have to talk to the participants in the process, or one of the journalists covering transport. Other than accounts of certain phases, there are no overarching perspectives held by involved parties wanting to explain the process, for example PwC (Chan 2012). Each of these accounts has a purpose in communication; to build a network for that reporting actor.

Performed discourse with the visual history v1

The 'final workshop' was held for two hours on October 9, 2015, at the Transport for NSW head offices at Lee St, next to Central Station in Sydney (see figures 63). I designed and facilitated the workshop. Participants were Dean Leith from Transport for NSW, who had been the project manager for the development of the Train, Ferry and Light Rail real-time data; Rupert Hanson, the developer of Triptastic and NextThere apps; and Andrew Kendall from Sydney Trains (figure 64).

Figure 63: The room set up before participants arrived for the Real-time Applications *workshop. Source: author.*

The conversation was largely free flowing in this case, with very little prompting from me. The conversation is included (Appendix E2) for three reasons: to explain the variety of discourse towards the Cosmopolitical (including the amount of references to nonhuman actants); to explain how the participants oriented themselves; and suggest corrections and changes. This workshop covered an enormous number of topics, from reflections on legal complexities of the projects to the relevance of the research on emerging projects. The participants knew each other well and took the liberty of the workshop to explore many topics they had wished to

discuss with each other for some time. The participants spent most of the conversation at the visual talking through its different dimensions and proposing many corrections to the visual.

The transcript has been edited and can be explored at Appendix E2. The transcript has been edited and reduced for relevance to the thesis; and ordering has changed for legibility. Like the visuals, the quotes are left without too much researcher interpretation, except where necessary to explain terms. The narrative explains the discourse as the participants refer to the visual.

Figure 64: Dean Leith, Rupert Hanson and Andrew Kendall at the workshop discussing the visual history v1. Source: author.

Scripting (nonhuman) discourse with the visual history v2

Like the *Responsive Environments* assemblage, the same process was carried out with the *Real-time Application* assemblage. This involved an update of the visuals, the moving of events when their order was misplaced, and the emphasis of events that may not have been expressed significantly. While there is no way of objectively understanding how the visual scripted a

conversation, the conversation spurred the need to redesign the visual for a broader audience. The discourse happened around the visual, enacted by those who know the project intimately. Could such a conversation happen with those who have not been in the project itself? It was this question that informed the design of version 2. It involved translating the visual for a different script; a different case of use. As in the other assemblage, the nonhuman actants were given symmetry alongside human actants, by giving them their own voices, which could be used to express their agency. Some examples follow.

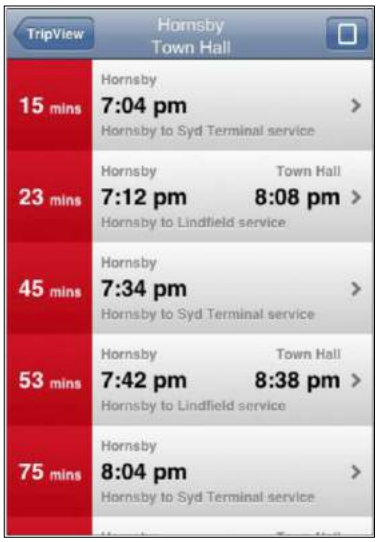


Figure 65: Tripview's 2009 interface on iPhone. Source: Tripview.

> `You want to me to cease Railcorp? Not so fast... Do you think the public, my users(!) will be happy about that? Really, you give them nothing in return!`
> **Tripview App** / NONHUMAN

Tripview (figure 65) responds to Railcorp's legal action that aimed to stop the app developers from scraping data from the static timetable website. Tripview is confident; it knows the government cannot really shut it down. There were a few hundred thousand users who relied on the app at the time. All of these users were voters. Tripview wanted to highlight the significance of their actions to Railcorp, a government department. Tripview warns there will

be a backlash from customers. In this case, Tripview had amassed a large actor-network that was mobilised to defend its access to the static timetable data.

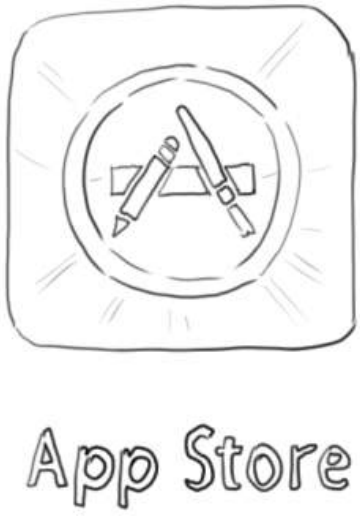


Figure 66: The Apple app store logo. Source: author.

> Don't kid yourself developer. I don't care at all if your app is successful, there are millions of others here. I do care that some of you live up to the principles of design that we espouse, as some great apps will make our phones great. Yes, we take a 30% cut of your sales, yet we know you will be grateful to use our services. You want to be successful? [Laughs] You have nowhere else to go… Once you upload your file_1.0, I'll take two weeks to get back to you, and I might not approve your little baby; I hope you're not precious about it.
> Apple App Store / NONHUMAN

The app store (figure 66) is expressing its ability to dictate what forms the apps can take, and how it has the final say as to whether they will be a successful business or not. The App store had arrogance, and confidence, in knowing that the developers have to work to the dictated standards. The App store knows there are so many apps, that individual apps are inconsequential to the Apple whole product ecosystem and underlying business model.

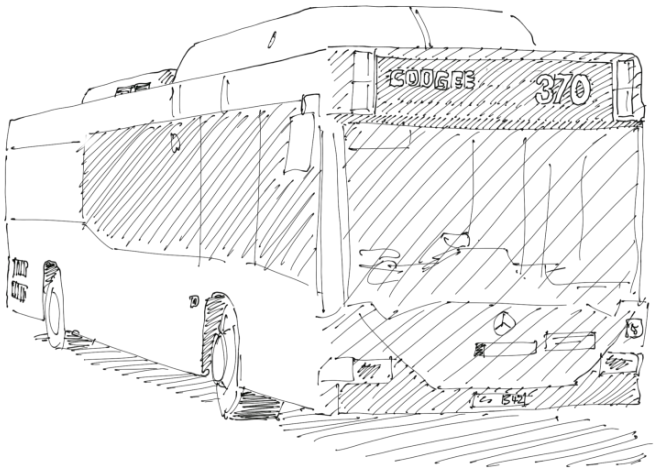


Figure 67: A State Transit Authority (STA) bus. Source: author.

> Nobody knows where I am—ah well, the driver, sure. But everyone else—you think I am just around the corner. I may be or I may not... [Laughs]. **A late bus, 370 to Coogee** / NONHUMAN

The 370 bus to Coogee (figure 67) was included as a reminder of the transport vehicles in the assemblage. The agency of the bus is to carry passengers, but it causes frustration to passengers through their inability to know precisely where the bus is. Here, the bus is cruelly hinting at its location, but gives nothing away. It laughs at the fact that it has the upper hand in this situation.

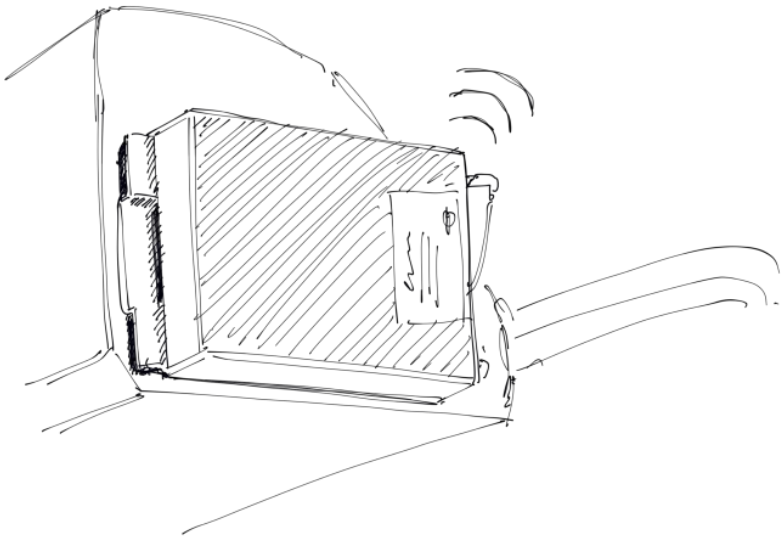


Figure 68: The PTIPS unit on a bus. Source: author.

> You want to replace me? I am not redundant junk. I work perfectly well. Don't believe what these contractors say. It is the drivers that turn us off! Don't blame the technology: we just do what we are told. A system performs towards its goals. The oversight was yours, not mine! This really could have been worked out with some better driver incentives. This is going to cost you. **PTIPS Unit on the L22, citybound** / NONHUMAN

The PTIPS unit (figure 68) is a device mounted on every bus that gives the buses' real-time location to the Roads and Maritime Services (RMS). This unit is here exclaiming, as it knows it is to be replaced with a more reliable model for the current requirements of the transport system. The old system had been in operation since the 1980s. The PTIPS unit's only agency in this situation is that it is already embedded, so it reminds Transport of the resources that will be required to transition to the newer model. This is a fruitless exercise however, as Transport for NSW has made up their mind that the existing system is too unreliable.

The updated visual history v2.0 for the *Real-time Applications* included much more content, edits of all the perspectives, and additional perspectives, as well as hyperlinks within the pdf for click-through information to other third-party references that had been included, such as the media releases and newspaper articles.

The varieties of actants

This section outlines the diversity of actants that were mentioned by participants. All of these appear on the visual history v2.0, although may not be articulated directly in the visual. There were, however, hundreds of other actants that were mentioned by interviewees that are not included in the visuals. Additionally, many other actants were introduced to the reader through interaction with the participants outside of the interview.

Innumerable actants were enrolled in actor-networks relating to the trajectory of the project. The variety is immense; far beyond the actants mentioned in the 'official narratives'. None of the actants can be considered to be external to the assemblage, as they were discussed by at least one participant in relation to the trajectory of the *Real-time Applications* assemblage.

The actants beyond the human ranged from satellites, to software, policy and Powerpoint™ presentations, complaints from customers, to international conglomerates. This list is not comprehensive, nor does it speak to significance: rather, it is to express variety. Additional actants have been recorded in the transcript summaries of each interview; a one-page example can be found at Appendix D9.

Typologies of translations: 43 instances

This section will outline a list of translations categorised into the infra-language of ANT (table 4). It comprises an arbitrary number of translations, but I ensured that there were at least two examples for each of the seventeen categories listed. As listed in the previous case, these are anachronistically presented, so they do not seem causally connected. Some of these translations could fit in multiple categories but are only described in one.

Table 6: Examples of types of translations in the Real-time Applications *case.*

Vocabulary	Definition	Examples in the *Real-time Applications* assemblage
Betrayal	Betrayal refers to the breakdown of the actor-network, in which an actor acts outside of their defined role. This is not to be perceived as negative, rather a deviation from script.	• App developers stopping the use of their apps, such as Hidden Sydney, and Jaunt! Sydney. They both moved onto other projects. Dean believed these apps, which were targeted at tourists, were not able to get enough users, nor were they real-time critical to the use of the application. • App developers betray the app stores' rating system through building in the question 'do you like using this app?'. If yes, with five stars, users are directed to the app store, if less than five stars, they are directed to the feedback form, thus gaming the system, which to the app developers means significant loss of users from bad ratings.
Black-box	A technical term for a device, system or object when it is viewed in terms of its input, output and transfer characteristics without any knowledge required of its internal workings.	• Customers conflated Transport for NSW and the apps, for example, directing complaints to the app developers through the apps. Therefore, the actor-network of these apps was unknown to them. • The contracts between developers and Transport for NSW were a black-box to me.Due to commercial in-confidence agreements, was I not able to see them. However, the actants spoke of the basic premises of these contracts.
Co-optation	A subprocess by which actants seek to have their individual objectives agreed to by other actants as part of defining network objectives.	• Transport for NSW wanted to work with Nick to have access to his over one million customers of Tripview. Designing the hothouse in such a way, created the possibility for an agreement between parties. • Transport for NSW marketing department using the apps to push advertising to customers through the third-party applications.
Description	To unfold, process from a technical artefact. The inverse, or use of a *script*. To enact a scripted action.	• To use one of the transport applications; a public transport user using the application as intended; as it was designed to be used. The customer accepts the scripting as the way to obtain real-time information through repetitive use of the application. • Using PTIPS to locate buses for the real-time apps purpose.

Vocabulary	Definition	Examples in the *Real-time Applications* assemblage
Enrolment	When other actants in the network accept (or get aligned to) interests defined for them by the focal actor. Similar to co-optation, but relating to a focal actor. Contemporary ANT does not tend to have focal actants.	• From competition winners to contractors, the app developers were being enrolled into other projects and other apps that they would split their time with. For example, Quentin had several other apps. Rupert, Nick and Quentin got contracting work with Transport for NSW. The ongoing interactions between them built up trust and awareness of their capabilities. • PwC had not attempted to do something on this scale; it was experimental. They committed, and found, the resources. Rob, one of the consultants, had done similar app development hothouses at University.
Inscription	The creation of artefacts that would ensure the protection of certain interests.	• Contracts between app developers and Transport for NSW ensured that both of their interests were maintained. Transport could block their access to the feed if they used it for purposes Transport did not condone. • The commitment to General Transit Feed Specification (GTFS). • Real-time iOS apps for Transport for NSW staff inscribed the purchase of thousands of Mac devices, across the state. iOS is a proprietary operating system for Apple devices.
Interessement	When actants must be negotiated with to accept the definition of a focal actor.	• The decision to bring the app developers into a working relationship with Transport for NSW. Nick Maher, the app developer of Tripview, had closer to one million users at the time. • App developers explaining to customers who complain about bus services that they are a different business, to prevent negativity from being cast upon the app in negative feedback.
Intermediary	That which provides meaning or force without transformation: defining its inputs is enough to define its outputs.	• A train provides an intermediary service for people to travel 'without transformation'. • An email is an intermediary: letters as symbols go in, and the same letters come out. • The Bitcloud server presents information for developers outside the government firewall; the same data. An accessible replica of what the government has.

Vocabulary	Definition	Examples in the *Real-time Applications* assemblage
Irreversibility	Degree to which it is subsequently impossible to go back to a point where alternative possibilities exist.	• The release of newer versions of iOS, along with newer phones, larger screens and higher resolutions, makes earlier systems obsolete. • The railway system, which has been inscribed a use structure that in Sydney, has not been significantly changed since. Over time this can handle reliable capacity, as the road system cannot. • The built environment of an existing city makes it difficult to create new transportation as it involves immense costs.
Mediators	That which can transform, translate, distort, and modify the meaning or the elements they are supposed to carry.	• Government media departments curate messaging to be announced on particular days, and with exact wording that has been decided. • Newspapers, likewise, select certain information and present with a particular angle.
Mobilisation	Refers to a set of manners utilised by a focal actor to ensure that all actors have legitimate speakers to represent them in the groups and avoid *betrayal* from the latter.	• The app hothouse, that PwC helped run, was held at Tankstream Labs, a start-up space. Employing PwC, gave Transport for NSW additional know how and credibility to run a legitimate event. • The competition itself served as a means to argue that all developers had an equal chance at gaining access to the data feed.
Obligatory Passage Point (OPP)	An OPP is a situation in which all of the actors have to achieve their interests as defined by the focal actor (Callon 1986a).	• Mobile internet when these apps originally started was slow. The app developers adapted the functionality of their apps to reduce the amount of megabytes of data downloaded when timetables were updated and also when it is in use. • Mobile technology was limited in computing power and storage on the phone. • The Navstar satellite system enrolled the mobile phone companies in using their system for GPS tracking. Navstar is a network of U.S. satellites that provides global positioning system (GPS) services. They are used for navigation by both the military and civilians. These GPS satellites orbit Earth every 12 hours, sending a synchronised signal from each individual satellite. This system has become the dominant means of geolocation through digital devices.

Vocabulary	Definition	Examples in the *Real-time Applications* assemblage
Problematisation	When actants must be negotiated with to accept the definition of an actor.	• App developers presenting apps for sale online. • Transport for NSW proposing to run an app development hothouse.
Punctualisation	Similar to *black-box*, the ability of parts of a network to be hidden, appearing as simpler assemblages.	• The applications themselves present simple graphics, completely removing the complexity of the network and deducing where the trains are.
Script	To enfold, process into a technical artefact. Inverse of *description*.	• The initial cease and desist, sent to the participants by Railcorp, was intended to make the app developers stop scraping data from the Transport for NSW website. It did not have this effect, as there were already hundreds of thousands of citizens who the app developers such as Nick had enrolled, so the public sided with the developers in the controversy. • The decision to amalgamate the departments was something that participants believed Gladys Berijiklian had been planning for a long time.
Speaker	Those that speak on behalf of other actants as spokespeople or nonhuman actants, such as reporting systems.	• Nick Maher became unofficial spokesperson for the app developers with the most used app in Sydney, Tripview.
Texts	Used to support rhetorical arguments.	• Data about the real-time apps use became rationale for the improvement of the services, and diminishing of plans for real-time displays in bus stops. • Textbus app used SMS services to locate times of buses. The data of the use of this service was evidence of the appeal of real-time information.
Transcription	How meaning is moved from one mode of script to another.	• The original translation of the app developers, including Nick, in a bid to turn their frustration with the Sydney network into interest and application to build and prototype apps. This situated experience is also what made Rupert want to address the problem, but didn't build an app until just before the Trains hothouse. • The Signal blocks. Many have been installed as early as the late 1900s. These were able to be made usable for the purposes of generating real-time data.

Vocabulary	Definition	Examples in the *Real-time Applications* assemblage
		• Likewise, NSW PTIPS had been used for contracting, but had been developed using SCATS to add the bus priority system which worked in conjunction with the PTIPS unit. The PTIPS system had been for traffic signalling with SCATS, transcripted to contracting purposes, and then transcripted again for customer information purposes. • Apps for internal staff purposes had to be developed as suddenly customers had more information than staff on platforms. This was a translation of the existing functionality of the app into one that had greater functionality, one that contained staff messaging about disruptions etc. The script was changed from customer use, to staff use. • The earlier processes of using the Transdata gave the project a list of possible participants for the real-time hothouses. • PIDS passenger information display systems evolved from wooden blocks and clocks that were manually updated by station staff to, in the 1990s, digital displays, which are now updated with accurate, real-time information. Some wooden systems still exist at regional railway stations, as the low frequency of trains do not validate the expense of installation and maintenance of digital systems.

Reflections on the method and the *Real-time Applications* case

The visual was updated to better speak to the expanded version of ANT, and to input the feedback from the sessions with actants. This included the addition of many voices, most crucially the voices of nonhuman actants, such as the mobile applications, train stations, contracts, and buses. What seem to be missing are the activities that are in the networks around the project. This case had managed to fit in Callon's first definition of ANT that had the distinct steps of problematisation, interessement, enrolment and mobilisation. As discussed in 'Chapter 5: Research in the making', as my knowledge of ANT grew, this more dated structure of ANT was ignored for a more contemporary ANT perspective of *ontological politics* (Mol 1999).

The visualisation process enabled the inclusion of significant earlier events, such as the legal action against the app developers by Railcorp and the Apps4NSW hothouse. However, as the visual developed these no longer became 'major' events in that sense, since the whole map and beyond it becomes the reason why the assemblage ends up being what it is. In Latour's words, the entire history is 'enfolded' into the present. This was a process of unfolding a material-semiotic history, which included the heterogeneity and the plurality of what participants experienced.

On tracing the associations

Whilst undertaking this research each case felt of equal weight, although the type of information was different, due to the nature of the projects. My proximity to the events also influenced this perception. The research was not observing practitioners in practice, rather, looking at the overarching assemblage over time. This was perhaps inevitable because of the scale of the cases. Each played out across several organisations concurrently, across many locations, and even through the smart phones of millions of people. Both cases overlapped, but definitive conclusions cannot be drawn between either of them, as they would only mislead. To draw value-based conclusions on the projects would necessarily involve taking a particular, or multiple value set as the perspective. Therefore, case discussion is maintained at the level of description. There is no attempt to single out success, lay blame or fault, make some seem more important than others, or impose structure, other than to state at which points the actor-networks changed. It was hard to know when to stop with these cases. As Latour (2005, p. 110) encourages: 'go on describing'. Latour's practices of common sense explanation and pragmatist, constructivist theory were channelled in the practice of description. Like wicked problems, and pragmatist problems in general, there is no stopping rule, so there is no sense of knowing when you may be 'done'. It is more of the tacit, the knowing of what an adequate account may be to the desired outcomes. Is it good enough to convey what was hoped to express as a script? It is intended that this chapter has outlined different ways to describe the assemblages through the lens of ANT. There is, of course, always more that could be mapped onto the visual histories; more to check; fix; clarify with a participant. But how much does it matter? Constraints of time and money have added more stress on the researcher. It is not clear from the workshop with the visual what parts of the

conversation were stimulated by the visual, and what conversations would have arisen without the visual. The visual history, and those additional interpretations in this thesis, are intended to present alternative, but valid accounts of emergence of these initiatives, as 'in the making' (Figure 69).

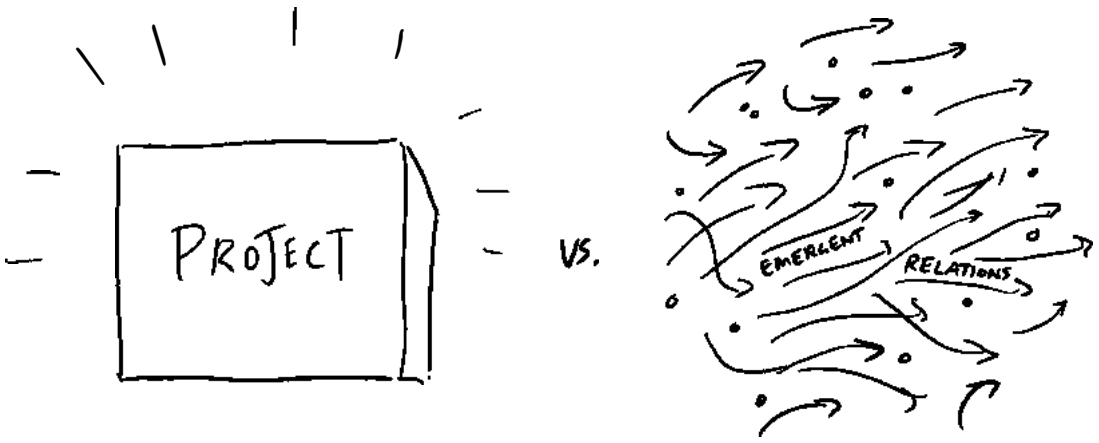


Figure 69: Understanding a project as a bounded, atemporal entity or an emergent set of relations. Source: author.

One interesting question that arose in relating this narrative is: 'how can you describe the actors that erase all traces of themselves in empirical situations?', for example, 'commercialisation' 'neoliberalism', or 'morality'. These have been described as quasi-actants (Krarup & Blok 2011). These, by their reference in earlier chapters, are alluded to as relevant, but cannot be traced to individual instances without imposing upon them an interpretation beyond description. Another anomaly was how to describe the actors from *other* networks, that enrol actants from *this* network, for example, an app developer or researcher increasingly doing other work outside of the existing network, thus creating destabilisation. Although these actants from other networks are significant in shaping the network, they have only been mentioned briefly, if at all.

On pragmatism and the method

As James, Dewey and Rorty's narratives have re-narrated the dominant stories of 'modern' western thought, this thesis continued in this pragmatist approach, borrowing the concepts of those who have carried on this tradition, such as Latour, Law, Schön, Stengers and Yaneva. It

represents a re-narration, a revisionist history, towards a perspective of 'in the making' of smart cities' relevance to their 21st century context; as heterogeneous, in multiplicity, and as processes.

This section discusses the outcome, and what it is like in practice, to attend to the tenets of pragmatism. The central tenets of pragmatism (figure 70) were introduced in detail in Chapter 1 — viewing change as an evolutionary process; a commitment to experimentalism; the dismantling of metaphysical systems; the rejection of dualisms; and, finally, an ecological perspective

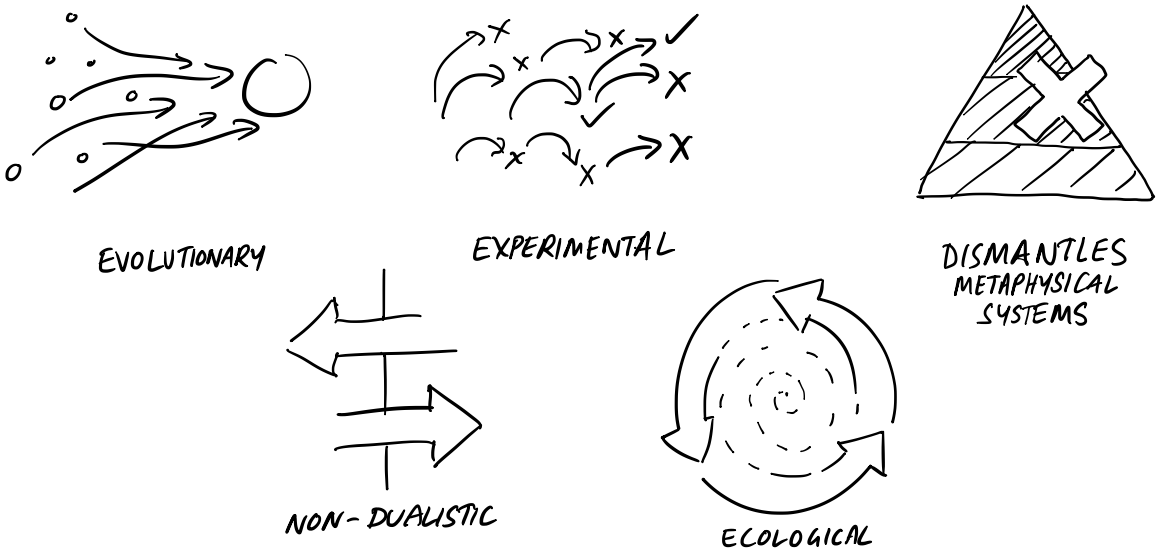


Figure 70: The five relevant tenets of pragmatist thought. Source: author.

Evolutionary process of change

> ...Railways...have got a lot of imbedded infrastructure in them. Some of this stuff is 60 years old, so you might have 3 or 4 or 5 generations of systems which you have got to integrate. It's not just the stuff that was in there last year; it's not as if you throw it all away in three years in the railway; it will still be there maybe 100 years later. (Garry Glazebrook 2014, personal communication, 1 September) / HUMAN

> [I have been working with transport] for about nine years now, so I have seen the evolution of the change of strategy, because, when I joined Railcorp, the whole focus was on operational efficiencies. We were basically getting trains running on time. Forget about everything else, but

> let's focus on improving that. Once we had gone through that evolution and we had got to a stage where—what we call it—until we got the 80% right. Then our focus then changed to customer information. So, the last two to three years, all of our interest is in because people are saying you are running trains pretty well. (Prashant Vaidya 2014, personal communication, 24 September)./ HUMAN

The genealogical approach of pragmatism is to view the present as emerging out of the past. As in ANT, the present enfolds everything that has come before it. Tracing lineage and history is the dominant form in adopting the metaphor of the timeline to represent these assemblages. The evolution of local relevance to each project can be understood through this temporal perspective. The artefacts evolve through experimentation, such as smart phones, applications, publications and bus stops. However, as was described in the previous chapter, the inquiry also occurred through a process of action. ANT puts the research practice itself in terms of a relational process. The genealogical perspective was accessible through the conversation, where practitioners, particularly those who had been in transport for a long time, could speak about the history of these projects, people, organisations and technologies involved.

Experimentalism

> Instead of the old sort of command sort of system, [the government agencies need] something that is a bit more fluid, that allows for a bit more creativity and a bit more innovation. It is a different sort of person that will get involved in [that]; it's not like Silicon Valley. (Garry Glazebrook 2014, personal communication, 1 September)/ HUMAN

> Is it perfect? No, but that's just the way things are, right? (Dan Aschwanden 2015, personal communication, 22 January) / HUMAN

Dewey continually described an experimental approach to development. Facts that are ascertained by experiment are true. No truth, however is final. And truth is known only to the extent it is useful in practice. Experimentation has shaped this whole inquiry. Both the study of experimentation, and its description and enactment have also been through processes of experimentation. The experimental method deployed in this inquiry, an emergent reflection in action that represents a broader approach to action research, defined the ultimate inquiry. Experimentation has continued in the assemblages and actants that were studied, and the researcher will continue experimentation. This inquiry is not final.

Dismantling metaphysical systems

Scientific knowledge is not privileged in this description, so much so that the researcher's voice is there only to provide some sign posts. The researcher has reverted to more common narrative forms to explain the further push towards accessible research. There is no meta-conclusion made by the researcher: the process has been about description. There is no before; there is no after: there is simply a seamless emergence of continually stabilising actants. In conversation, participants moved fluidly between distinctions that may be more pronounced in academic research. These included distinctions between digital and physical, constructivist and positivist perspectives and there was a defined hierarchy of knowledge. There were few shared distinctions between participants.

Rejection of dualisms

Of all the metaphysical distinctions that, in this thesis, are worth isolating, the most noted are the many bridgings of dualistic thinking. These have been discussed at length, but distinctions between theory and practice, human and nonhuman, public and private, and progressive-regressive accounts have not been prevalent in distinguishing what was researched. Nature, ANT clearly reveals, provides a means to bring the heterogeneity of actants into the same conceptual apparatus, here literally presented alongside each other, on the same page. The dualisms of the smart city— progressive-regressive, top down-bottom up, public-private—have been dispelled in the visualisation and enactments in this chapter. There is no value—implicit nor explicit—expressed. Is it progressive or regressive? Neither; merely a translated assemblage. The technologies, when basing them from interviews, were seemingly one dimensional.

Ecological perspective

> It was the perfect storm, right. We had a team who had tested and experimented, so they already done the skunk works to prove it. We weren't coming from a complete ideation. Like, somebody had an idea and they had tested it to an extent, and then we had a political will and mandate from a government who was really keen to partner with the private sector. Marshall Craddock, TfNSW (Int. pp11) / HUMAN

> Well, with any design project there was always this phase of grounding involved where, you know, we had to go out and find out what the current situation is and what the problems are, so we knew what to focus on. Martin Tomitsch, University of Sydney / HUMAN

Dewey describes this relevance as related to ecology, described as biological pragmatism. The ultimate aim of all knowledge is harmony of many with the environment. The inquiry was focused on relevance from the beginning. Firstly, within the *Responsive Transport Environments* case, the research inquiry was an effort to make what had been learned, and the time and resources spent, useful to other contexts. Lastly, the scripting of the visuals and this thesis, have served as yet another attempt to make this research useful to more practitioners in practice. All of this has been framed in the context of contemporary cities, to be able to argue with some confidence that the methodology developed is of use, and of relevance, to the challenges of 21st century; to cities, design practice, and academia.

In providing a different account: pursuing Rorty's liberal ironist

Whilst Rorty explored pragmatism after the linguistic turn in social sciences, his neo-pragmatism received much criticism from other pragmatist scholars for rejecting 'experience' (Bernstein 2010). Rorty trades the emphasis on experience for one on language. Rorty argues that the extent of what a philosopher can do, is to provide different accounts of phenomenon. These accounts based in language, cannot correlate to reality, rather show another perspective and introduce a new language that could entice a practitioner to further explore. To Rorty (1989) paradigms ultimately change as new languages become widely adopted, creating 'solidarity'. This inquiry has introduced some useful language to describe the smart city differently. This language, primarily that of ANT, is proposed to support those grappling with questions relating to the practice of the smart city. This language can help practitioners make sense of their own contexts. If it is useful, pragmatism supposes, more people will use it.

Rorty's (1989) subsequent idea of the 'liberal ironist' is of those practitioners who, whilst recognising their own language as not corresponding with reality, envy the language of others. However, the liberal ironists also recognise that if they obtain the language of others, their

language will still be no closer to corresponding with reality. Rorty's (1989, p. 73) "ironist" is the one who has:

1. She has radical and continuing doubts about the final vocabulary she currently uses, because she had been impressed by other vocabularies, vocabularies taken as final by people or books she has encountered

2. She realises that arguments phrased in her present vocabulary can neither underwrite nor dissolve these doubts.

3. Insofar as she philosophized about her situation, she does not think that her vocabulary is closer to reality than others, that it is touch with a power not herself.

Whilst this research has brought my positioning and thinking closer to reality, it is still only relative to the context in which it was studied. A visual affords a very different form of interaction than a written text. It is an example of what Rorty (1989, p. 73) calls "playing a new [language] off against the old". As either printed or digital versions, the visuals and the method of using ANT is new in the smart city discourse, since they explain the same phenomena in different language. The engagement with humour and the inclusion of the fictional voices of technology have further developed this. It has proven to be a mimetic memory device that will undoubtedly create polarity in those with more rational perspectives on research.

The language of ANT is useful in transitioning to a temporal and process-driven conception of the urban. However, it too is also limiting, and should be treated as another step on the path to engagement with pragmatist relevance. As Korzybski (1933, p. 58) states: '[a] map is *not* the territory it represents, but, if correct, it has a *similar structure* to the territory, which accounts for its usefulness' (emphasis original). The visual creates its own visual language; that which Alexander describes as a pattern language. Alexander (1977, p. xviii) maintains: '[A] pattern language is the structure of a network…since the language is in truth a network, there is no one sequence which perfectly captures it'. Alexander, in talking about the patterns within cities, explains that no representational pattern language can capture what its original was, and likewise, nobody can fully explain the representation. They can only be 'followed': '[capturing] the broad sweep of the full network; in doing so, it follows a line, dips down, dips up again, and follows an irregular course, a little like a needle following a tapestry' (Alexander 1977, p. xviii). Any representation can only be indicative of the original. As has been described in Chapter 4, the ANT concept of translation infers the visual is a network in itself; a different

one to what it describes. The liberal ironist as researcher is not only envious of language, but of performance too. The liberal ironist will draw on the many methods of performance to make their argument salient.

It is not my intention to criticise; only to encourage scepticism, and to ensure the tensions of the city play out through more voices being included in public politics. At the heart of the pragmatist imagination is experimentation to see what works, but never to settle with what is 'just the latest hypothesis'. Not only words, but symbols and other encounters will provide more different perspectives of the smart city discourse that have more transformative effects than those means that are already widely used.

Concluding the discussion of Experiments in Translation

This chapter has outlined the translation of the smart city initiative experiments into other experiments. From experiments with benches, lights, batteries, code and conversation, to experiments with language, signs and performativity, that is translated from discourse of cities, corporations, technology companies, and citizens, into another form of philosophical, visual and linguistic discourse.

The case accounts are intended to hold together the smart city initiatives in a different way; to provide an alternative enactment of these relations, one more coherent with the context out of which they have been derived. Each of these enactments has provided a different sort of discourse based on the diversity of empiricism. This chapter was challenging, as having relied heavily on ANT, a researcher must be wary of how they reduce participant accounts into their representations. Each case initiative was not one neat, easily explainable narrative, but the more they were understood, the more complexity made itself apparent. I emphasised the diversity of actants on these projects and attempted to note the ways in which these networks both form and fall apart. I have attempted to elucidate the Cosmpolitical perspective, illustrating the variety of politics that are involved in the realisation of the smart city project. The following chapter will now broaden from the cases, and explore the implications couched in pragmatist thinking for designers of a smart city.

PART C:
REASSEMBLING A SMARTER CITY

Chapter 7. From being to becoming

Reassembling the smart city in a pragmatist fashion involves many challenges to dominant, western ways of thinking. This chapter unfolds one of these key differences that is common to the pragmatist epistemology and Actor-network theory: an ontology of process. In the author's experience, understanding this ontological basis is crucial to being able to create the alternative paradigm of pragmatism. As proposed in this chapter, becoming more attuned to process philosophy is a means to disrupt western foundationalist thinking, and to build the concept of design, not from objective truths, but from relevance and fallibilism. These concepts are unfolded in more detail, from varied disciplinary and philosophical perspectives, before the proposition is made as to what the pragmatist reassembly of the 'smart city' may mean, and how this could implicate design practice.

From a designer's perspective, the pragmatist reassembly proposed is a different way of conceiving the make-up of the world; what there is that can be said to exist (ontology); and subsequently, how it can be known (epistemology). Throughout the entire study this thesis has deployed an ontology process, which had a profound impact on the author's conception of what design is, what it does, how it does it, and the rationale of design interventions.

This thesis has, through the application of pragmatist methodology, demonstrated the use and consequences of using an ontology of process. Understanding the urban context, and the ecologies of practice within it, has been usefully conceived as ontology of process. While this perspective of 'process' may appear obvious, this view is actually contrary to the vast majority

of western conceptions of the world which as asserted earlier privilege analytical and the empirical 'objectification' as the essence of rational 'truth' and 'fact'. It is not just that pragmatism describes experience as processes. As Dewey states: 'experience occurs continuously, because interaction of live creature and environing conditions is involved in the very process of living' (Dewey 1934, p. 1). Moreover, the pragmatists contend that the universe *is* processes. In recent years the west has seen a resurgence in process thinking through the reappearance of the use of pragmatist methods such as ANT. For understanding complex and emergent phenomena, models based on static ways of understanding and categorisation are inadequate.

This chapter is built on the premise that without the ability to conceptualise an ontology of process, pragmatist methods such as ANT cannot be fully understood or enacted in the ways necessary to challenge a modernist representation and conception of knowledge. This chapter explores the conception of design practice, in relation to the urban context, as adopting an ontology of process, rather than the dominant western ontology of static entities. The smart city discourse can be described as predominantly rooted in western metaphysics and its dominant 'being in presence' ontology, also described as 'being-realism'. It is by definition a noun, predisposing a state that can be achieved. Pragmatism and ANT are explained as dependent on an ontology of process and their associated epistemologies.

In this chapter, the conceptions of 'being' and 'becoming' is discussed through different manifestations of ideas, from Heraclitus of Ancient Greece through to the major resurgences of the idea of process thinking from the 20th century. These ideas are then connected to theories of contemporary organising through management, organisational studies and information systems perspectives. Pragmatism and ANT are discussed through their relationship to these ideas, followed by implications for what it may mean to reassembling 'a smarter city' as one that we are already within; one that is continually emergent, rejecting the notion of an achievable and stable state. Lastly, the chapter concludes with an exploration of how this perspective of being within 'a smarter city' would be reflected in adequate design practices.

The smart city discourse: Limited by the metaphysics of the west

An ontology of being

The argument can only hold if; firstly, the reader can conceptualise this notion of a base ontology through which experiences are perceived; secondly, that the reader's own experiences of the world may be biased towards one of these perspectives; and thirdly, in supporting the first two points, an alternative base ontology can be conceptualised that is different to the one that is deemed natural to them. As Derrida (1982) notes in 'différance', concepts are created in language through their differentiation from others. No one can truly be aware of the real limits of their thinking, but the reflexive ability to understand that there may be implicit bias in thinking, due to repeated exposure to language and experiences, is an important process to make designers self-aware in their practice. It's regularly stated in describing the limits of a person's knowledge that 'you don't know what you don't know'.

In this section, the 'ontology of being' must will be explained, in order to then create the argument that an alternative to the dominant western means of conceiving the world exists, and that it is the central tenet in the reassembly of the smart city discourse later in this chapter. This is not a simple task. The challenge in explaining these concepts is that, for western minds, a more static understanding of being is so much a part of how the world is conceived that it is not recognisable. Admittedly, this process ontology is not something that can be deeply understood quickly: it involves a deep change in human perception if one is particularly entrenched, for example, in the tradition of western thought.

When the west is described in this chapter it refers to the European traditions of the Greeks, Romans, English empire, continental Europe, the US and other English colonies. However, it is not limited to geography. These ideas have been pervasive, through the Judeo-Christian tradition, scientific rationalism and globalisation of western companies and models of organisation. What has developed out of this is a certain way that people view the world, which some have described as the 'western' cosmology, or way of conceiving reality. It is a central concept in metaphysics, the branch of philosophy that deals with the first principles of things,

including abstract concepts such as 'being', 'knowing', 'identity', 'time' and 'space'. The first of these—'being'—has to do with perceptions of the underlying nature of the universe.

In taking a pragmatist approach to understanding this, one can imagine how the dominant ideas of the west shape the minds of practitioners exposed to them. These can be conceived as the pragmatic effects of these ideas, through repetition of language, shared symbols, references and repeated histories. Part of this conception is a base ontology of a 'being-realism'. What ideas constitute this? Entangled in this concept, are the challenging notions of the following.

- **'Othering'**, the ability to delineate a clear line between entities of 'us' and 'them'. Thanks in part to Cartesian rationalism, undoubtedly, the systematic 'othering' of indigenous peoples in colonial outposts.
- **A linear sequencing of history and chronological time.** The west adopted the Greek chronologically 'measurable' conception of time as dominant, and sees history as being traceable back to a single point in chronological time.
- **An understanding of 'space' as Euclidean geometry**—that is, definable along XYZ axes.
- **A universal view of the cosmos—**the understanding that there is one real, objective world, and that other interpretations are false.
- **A dominant bias towards the primacy of whole, bounded entities.**

These concepts may seem 'normal' to someone who has grown up within, and is accustomed to, these perspectives. But these notions are simply ways of thinking, not the only way to think about the nature of reality. A 'being-realism', is arguably even more fundamental to these notions, which can be argued to shape these perspectives.

So, what is the 'being-realism'? The premise is as follows: Western modes of thought have two great, competing pre-Socratic cosmologies that continue to provide the most general conceptual categories for organising thought and directing human effort (Chia 1999). These conceptions were established by the oldest known western philosophers and scholars. The two general conceptual categories are the primacy of a changeable and emergent world, as described by Heraclitus, and the permanent and unchangeable world as defined by Parmenides, his successor.

As Chia (1999, p. 214) states: 'The history of Western thought, ever since Plato, has, therefore, been little more than a continuing series of footnote attempts at synthesizing these two great but apparently irreconcilable intellectual traditions'. While these debates have been continual

in philosophy and social sciences history, the permanent and unchangeable ontology of Parmenides has been dominant across the western philosophical canon of both continental and analytic philosophy.

The Parmedian perspective of privileging homeostatic and tentative concepts of reality, became the dominant cosmology of western thought. As early as Socrates, Aristotle and Plato, this perspective was favoured. The implications of commitment to the Parmedian ontology of 'being' is, as Chia (1996a, p. 33) describes as 'being-realism'; an:

> ...ontological posture which asserts the primacy of 'things', 'entities', 'events', 'generative mechanisms', etc., as making up our material and social world. It underwrites the dominant academic predisposition which treats relatively unproblematic notions such as 'the organization', its 'goals', 'environment', 'strategies', etc., as theoretically legitimate objects of analysis.

Aristotle too was committed to an ontology of being, shaping much of western discourse with propositional concepts, such as the human as a reified entity. This entrenchment of the 'being' ontology was further exacerbated by Isaac Newton, who based science on the state of 'rest', which was considered the normal state. Movement, under Newtonian physics, is considered a transitory phase from one stable state to another. So, the western tradition has a transcendental tradition of 'being in presence', and an empiricist process tradition of 'being is becoming'. Pragmatism is rooted in the latter, empiricist process tradition. To articulate a process view of reality, theoretical effort is required to diverge from the dominant theoretical tools of western metaphysics geared towards the static view of reality.

The 'being' of the smart city discourse

In the smart city discourse the distinction between these seemingly irreconcilable world views is not evident in the literature. As Chia (1996b, p. 46, emphasis original) explains: '[a] being-realism makes *fact* ultimate, becoming-realism makes process ultimate'. In the latter, this view recognised that 'all attempts at theorizing are economising modes of abstraction' (Chia 1996a). The smart city is largely treated as a fact—a bounded entity—that is binary.

Currently, the smart city discourse does not appear well conceptualised in either ontology. Through the pervasiveness of the Western way of conceiving reality, the discourse is based in this static ontology, yet claims to be about process, experimentation, networks and knowing about real-time changes in the urban context. The current discourse appears to be muddled

between the two fundamental ontologies. The smart city discourse refers to bounded entities such as 'government', 'organisations', and 'sensors'. Networks are conceived as attaching these static entities together, where the static elements have primacy. The controlling governance paradigm and the modernist paradigm are both rooted in the idea of knowable whole entities. These can be conceived as bounded entities which are attached to other bounded entities. Categorisations such as the digital and physical, the progressive and regressive, the public and private, and the top down and bottom up, are vast over simplifications that describe the complex context as if there are defined categories that describe these phenomena.

Yet, as has been outlined earlier in this thesis in 'Chapter 2, There will never be a smart city', the city has been presented as largely unknowable. Cities can be conceived to be 'in the making' by emergent processes, made up of a plurality of realities. Alternatively, through pragmatist epistemology, they can be seen as structures in the making and always incomplete. However, there are some exceptions in the smart city discourse. Concepts such as 'living labs', or urban innovation ecosystems, have many of the discursive traits of a world 'in becoming'; they do not promise solutions, but rather an emergent methodology of experimentation. However, these experimental activities enacted through a 'being-realism' perceive instability as inherently bad, and instead look to instantiate the notion that the practice of experimentation is merely to achieve a new stable state.

'Becoming' in contemporary organising and theorising

Pragmatists, whilst not all directly espousing 'becoming', do have strong process thinking, due to pragmatism's roots in the empirical process tradition. Several of the discussed contemporary pragmatist thinkers, including Latour and Stengers refer frequently to 20th century process thinkers, Deleuze and Whitehead. More broadly, their ideas take the form of processual-relational ideas of reality. Whilst the pragmatist epistemology is applied to organisations through many research methods, such as Action Research and ANT, the scope of process thinking in organisational theorising is much broader. They extend processual thinking to include how to deal with emergent complexity in organisational research.

Consequently, what are the implications of this perspective for thinking about organisations? Organisations conceived in process ontology are significantly different to those conceived within the ontology of being. They are therefore a different way of thinking about this fundamental unit of contemporary society. Several management theorists such as Karl Weick, Robert Chia, Stewart Clegg, Robert Cooper, and Alexander Styhre have contributed to the development of process ontology in organisational studies.

Karl Weick, argued that reified 'organizations', should be instead treated as 'organising' (Weick 1979). Weick articulated the processes that constitute, maintain and dissolve social collectives. This moves from 'organisations' being understood as 'conceptual permanence' to 'organising', as temporary reifications, because organising never ceases. Organising embodies the anti-essentialist perspective and avoids its apparent solid effects (Czarniawska 2004). Organisations as 'processes of organising' moves them into the pragmatist paradigm.

According to Chia, the dominance of the perspective of being has instilled a 'readiness' amongst western management academics to construe organisational change as a problem that needs to be 'managed'. This perspective is homeostatic and treats entities with primacy. This creates a dominant perspective in which explanations that are open, processual, and ill-defined are not as highly valued as those that propose more universal and rational explanation. Styhre (2002) has also outlined the importance of thinking with 'and' as a means to include the other of that which is relevant, as the static notion of organisation tends to treat things in dualistic terms—this 'or' that—through the universalising single reality. Thinking with 'and' opens up the possibility of multiple interpretations, and ill-defined boundaries between concepts. This is consistent with the discussion contained throughout this thesis: the ontology of being facilitates the understanding of organisations as bounded, reified entities, rather than processes 'in the making'.

In related studies of information systems Ciborra & Hanseth (2000) have described this as moving from 'control' to 'drift'. They argue that the mechanistic treatment of organisations leads to the belief of information systems that are decomposable; that bureaucracies too can be decomposed along hierarchical lines. Instead, they argue that information systems, as have been outlined in this thesis, are 'deployed within ramified webs of externalities and interdependencies' (Ciborra & Hanseth 2000, p. 2).

'Becoming' has also been explored to some extent in organisational studies (see Clegg et al. 2005; Chia 1996a). Clegg *et al.* (2005) argue that '…the becoming that is in organizing implies a permanent non-rational movement such that organization can never be rationally defined'. They continue; '[b]ecoming, as an ongoing change of organizational identity, signals a conception of learning that implies a transgression of existing boundaries, a linking of heterogeneous organs, which may lead to the emerging of new yet unknown competencies,' (Clegg et al. 2005, p. 162).

An openness to the surprising, and the deployment of categories that are important in human experience can make our science more realistic. Clegg (2011) also argues that in post-bureaucracy (such as the changing governing organisations of urban services) we need to see bureaucratic organisations through a dialectical lens; one that sees them as simultaneously decomposing and recomposing. Decomposition is taking place through supply chains and outsourcing, and re-composition occurs with new organisational forms (2011). This notion of becoming has parallels with learning. As Clegg et al. (2005, p. 162) state: 'Learning/becoming are processes that are neither finally definable nor entirely controlled and manageable, because they imply the deconstruction, deterritorialization and reversing of the existing practices and images that frame an organization's possibilities.'

This has implications, both for what the researcher thinks they are doing through problem selection, and for application of epistemologies and method. ANT scholar John Law published a paper with Robert Cooper (1995) describing this shift, from distal to proximal. In reference to the shift, they maintain the basic criticism that modern sociological studies of organisation have tended to deal with results or organised states. As Cooper (1992, p. 374) notes; 'for the proximal thinker, to travel is better than to arrive.' Distal and proximal concepts are old in philosophy, physics, and psychology (e.g, Heider 1959). This reiterates the pragmatist perspective's privileging of the observations of 'process in action' rather than product, and places an emphasis on understanding how things happen, how change actually takes place. This involves the studying of processes of designing (verb), rather than those that have already been designed (noun). In in this process ontology, has challenged the Aristotelian individuation of the human. A perspective well summarised cyberneticist by Wiener (1950, p. 130):

> Our tissues change as we live: the food we eat and the air we breathe become flesh of our flesh and bone of our bone, and the momentary elements of our flesh and bone pass out of our body every day with our excreta. We are but whirlpools in a river of ever-flowing water. We are not stuff that abides but patterns that endure.

In this example, the human body loses its distinctive boundaries and merges with material surroundings. This is a notion that has also been expanded from a biological perspective, borrowing Latour's phrase to state 'we have never been human', arguing that even on a biological level, humans cannot be individuated as they are enmeshed with their environments and countless other organisms that support human life (Gilbert et al. 2012). The central actor of sociological research, the individual, has been challenged by both ANT and assemblage. What were previously bounded 'pure' entities are now hybrid assemblages. In this view, individual has no *a priori* properties: rather these are relationally defined.

Clearly, the notion of a world in continual emergence has significant impact for thinking about how designing is practiced in relation to the future, and how futures are imagined. A world in emergence, is incongruent with the idea of an ideal and working backwards, such as occurs with ideal design as noted by Ackoff, Magidson and Addison (2006), or choosing between future scenarios in not yet known futures. They are useful exercises, but these scenarios must be held as not those that will *actually* eventuate, but propositions to support practice in the present. The future is fundamentally unknowable, yet in retrospect it will have emerged smoothly out of its history. Process philosophy offers a pragmatic way to rethink the intractable challenges of theorising organisations.

Pragmatism and ANT: ontologies and epistemologies of process for the smart city

So how does process thinking fit with this pragmatist inquiry? Pragmatism, as has been earlier described, challenges many of the dominant ideas of western thought, education, texts and language. It has, through its difference, taken over a century to achieve its current profile. James, Dewey and Peirce were not widely accepted into Western scholarship.

As discussed in Chapters 1 and 6, one of the principal tenets of pragmatism is the rejection of metaphysical distinctions. Metaphysics is the branch of philosophy that deals with the first principles of things, including abstract concepts such as being, knowing, identity, time, and space. To reject traditional 'western' metaphysics is perhaps the most challenging aspect in adopting a pragmatist approach. From the researcher's own experiential learning in this inquiry, this took the longest to understand and to fully realise the implications of the five previously discussed pragmatist tenets: genealogies, experimentation, rejecting metaphysical distinctions, bridging dualisms, and continual connection. Rejecting the traditional metaphysical distinctions rejects both universality—that there is one knowable objective reality—and that this reality is made up of bounded whole entities. Related concepts of a linear conception of time and Euclidean space are not explored here. The researcher speculates that through reassembling design practice from static entities, towards the process-relational, the other tenets are better understood, and therefore implemented in practice; a simple heuristic that has huge implications for notions of design practice in the context of the smart city discourse.

Importantly, Harman (2011) has argued that philosophers should not be lumped together based on the movement/stasis dichotomy. Rather, he suggests there is no real dualism between the two poles, arguing that Latour deals with actual entities. Likewise, Whitehead (1931) engages with stable entities that endure significant changes over time.

ANT is widely known as a process-relational ontology, which emphasises not the entities themselves, but their relationality. It is what is between entities that defines them, not intrinsic qualities of the entities themselves. As such they are in multiplicity. Regardless, the position of dichotomy as a significant difference is useful to illustrate the divergent perspectives.

For sociologist Ulrique Beck (1992) contemporary society now solves the problems that have been created by the solutions to yesterday's problems. 'The definition of insanity', as the saying goes 'is doing the same thing over and over again and expecting a different result'. The principle that we cannot solve old problems using old ways of thinking implies that the most intractable problems are embedded in our everyday practices. Pragmatism may have a long history, but it is not widely known nor applied. Its inventors have articulated its usefulness to begin again in by conceiving of the effects of the concepts.

A move towards thinking of the city as process-relational sees the city as a set of ecologies of practice. This thesis has, and will, lead to new ways of thinking and acting within the smart city discourse. The smart city should not be conceived of as a reified object, but as a series of processes that continually attempt to make allies and align interests among, people, organisations, technologies and places.

A dependence on 'being realism' and strict categorisations leads to difficulties in organisational studies, such as the 'relevance gap' between theory and practice that is avoided by a researcher adopting a pragmatist and process-relational ontology. The relevance gap occurs between two fundamentally different ontologies: the fast moving, adaptive approaches of 'practice', and the whole, finished entities of 'theory'. Action research and research by design negates this gap. Indeed, pragmatism has been looked at as the epistemology that enables researchers to think and act like practitioners, and therefore generate research in the same paradigm as the practitioners (Fendt & Kaminska-Labbé 2011). Therefore, it is argued, the gap between research and practice can be eliminated through understanding both organisations and research as emergent processes.

This thesis has rejected representationalist epistemology in favour of the pragmatist epistemology. It has not been an attempt to create a 'true' representation, but rather to create enactments of knowledge useful in action. There are not discrete and identifiable objects, forces and generative mechanisms, but a multiplicity of them that are largely unknowable outside of experience (Chia 1999, p. 215).

When Latour (2005b, p. 128) states '[a] good ANT account is a narrative or a description or a proposition where all the actors do something and don't just sit there', he refers to the inclusion in accounts of only what was of influence *in action*. That is, to draw attention to what matters in terms of a network stabilising, or de-stabilising. This is the performative nature of ANT. Actants make other actants act differently than they would have otherwise. A network definition is relative to whoever you ask and whatever image you use to talk about it. What matters is its usefulness. When thinking about time, this genealogical perspective of ANT sees history—all history—as folded into the present. This is also different from the linear and developmental perspective of dominant Western ideology.

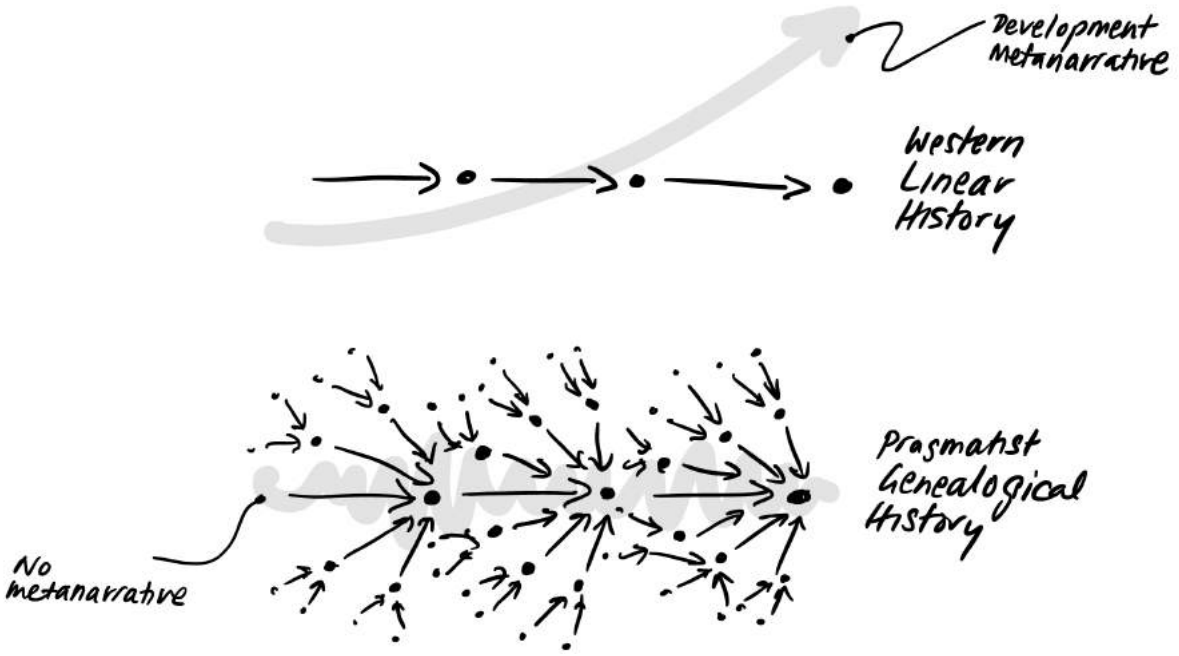


Figure 71: Attempting to represent events and ordering over time. Source: author.

Figure 71 explains this folding of all history into present events. This is the genealogical perspective; not of a linear sequence of steps, but more of a collapsing of the past into the present. As a pragmatist, enacting the smart city, like the visuals, must be seen as a continual folding of innumerable actants that have come before. The present, in ANT terms, 'black-boxes' the past. Only through performance can it be disclosed again. ANT enables the designer to adopt these modes of thinking in practice. As pragmatism is based on an ontology of process, this conception has been fundamental to the following proposal for the pragmatist reassembly of the smart city.

What is the *smarter* city?

This thesis has demonstrated the benefits of considering the reassembly of the smart city discourse towards one that is based on the process relational thinking of pragmatism. Within this perspective, each phenomenon in this ontology cannot be left without explanation, as they must be known by their relations, not through appeal to ideological or stable definitions. Pragmatism challenges the *a priori*, the defined, and what may be understood to be self-explanatory. For pragmatism, all explanation can only be recognised as partial and situated. In

this thesis, each related concept has been explained for its relevance towards the problem. The emergent problem is only an explanation of the situation. This description has relocalised the amorphous and global concept of the smart city discourse. Through empirical study, the discourse has been reassembled through the real situated relations of people and things; entities that communicate with each other, support each other, and convince each other to become a part of each other's networks.

In this thesis, it is this 'social' aspect of the smart city discourse and practice that has been explained. This 'social' has been emergent, and not assumed to maintain itself without continued action. These stabilising forces are the exception, not the rule in a process ontology. The smarter city is a reassembling of the smart city discourse in an ontology of process. The smarter city has no capitalisation, it is not a proper noun, just a description of a city continually seeking to fit within that which constitutes itself.

This thesis has explored many of these dominant ideas of western metaphysics, such as thinking in wholes, the privileging of scientific knowledge, and linear and universal conceptions of time, such as those present in metanarratives. It is in this pragmatist and postmodern understanding of the world that the reassembly of the smart city discourse takes place.

The reassembly of the smart city will not be one inside a state of 'being', rather one of 'becoming' *smarter*. 'Smartness' in this case, is defined as pragmatist; of relevance to its constituting and externally dependent actants. Smartness in this context is not to be conflated with 'development', as pragmatist thinking rejects the meta-narratives of 'the moderns'. Smartness refers to relational relevance to the actor-networks in which these assemblages exist. Becoming smarter is a continual process of making relevant again.

It is from this conception that the pragmatist tenets of ecological understanding, genealogy, experimentation, rejecting metaphysical distinctions and Cartesian dualisms can flourish. Knowledge in this paradigm is always relational and fallible. It is from this paradigm that the processual, the multiple and heterogeneous nature of the city and its making can be continually enacted. It is open to the variety of experimentation required for timely renewal of cities.

From *within* the smarter city

Nobody lives everywhere, everybody lives somewhere. Nothing is connected to everything, everything is connected to something.

(from van Dooren, in Haraway 2016b, p.35)

Haraway's point here appears to be a pragmatic one. To say everything is connected to everything is perhaps not a useful way to think about relations. Moreover, the city scale, or infra-city scale does not help us related to it (Latour 2012a). This sentiment has been invoked in this thesis to return the universalising ideological and ill-defined smart city to 'experience'. In other words 'localize' the 'global' smart city conception (Latour 2005b, p. 173-190). These ways of thinking and acting have been a means to ground the smart city in real practices: between real people, places, technologies, documents and conversations. This has generated a seemingly infinite list of local actors that all have agency in the development of smart city related initiatives. In this context, the ideological, global perspective dissolves into innumerable micro-processes of relations and their politics. There is no delineation between right and wrong, progressive and regressive, top down and bottom up, or public and private. These dualisms do not correlate neatly with experience. Only individuals and groups within these assemblages can define these judgements, and one actant may have a multitude of interpretations. These perspectives are subjective and shift from actant to actant and relation to relation. The subjectivities of the individuals are not removable from the city; they are integral to its conception and practice. The conflicts and negotiations between differing perspectives and realities, are not to be avoided, they are the processes through which the most relevant practices can be achieved. The politics of design practices and negotiations are evident between all of these actants, as each attempts to convince others of their usefulness and their ability to be translated into other uses, through the unspoken processes of scripting and performance.

Becoming a smarter city references the incompleteness of a city in making, one that is being 'in the making' with all of its constituent actants. Haraway describes this as a sympoietic process of 'making-with' (Haraway 2016b). The city and its constituting assemblages develop *with* each other. The smarter city is one where its actors recognise that they are already in a 'state' of emergence. The smarter city is already here. They are in the ecologies of practices from which the new will form, as some systems discontinue and others are maintained and

developed. New relations form, and breakthroughs do happen, through rupturing states of dynamic equilibrium (Schön 1971).

If the politics will unfold between what exists and at the same time translate into other unknown actants and networks, then perhaps the future is already here, but we cannot yet explain it. Our current incomplete vocabulary limits the ability to imagine these relations. ANT offers a rich vocabulary for explaining the processes of change so, within this processual perspective, to design in the urban context is a far more complex task. The smart city discourse that ensues is misguided in wishing to produce a 'final vocabulary' (Rorty 1989), for a final vocabulary assumes that meaning and context remain stable enough that types of description don't need to change. A smarter city vocabulary would shift as meaning and interpretations change, to make new words and to describe newly understood phenomena. As discussed, it is as complex as cities themselves, and will continue to evade universal definition. The discourse, in its future orientation and technologically determinist perspective, will always find the new, as Rorty's (1989) 'liberal ironist', will always be attracted to vocabularies that appear more complete. The way we will address the future is by changing ourselves: technology is the inscriptions of ideologies, inequality, and beliefs about what is right, just and suitable.

As Hollands (2008) reminded us, we need to be aware of what the smart city ideologically reveals as well as hides. In suspending the 'smart city' as an ill-defined and ideological conception, emergent processes have been reassembled in its place. These emergent processes are socio-material; they are continually in the making between human and nonhuman actants. The future city is brought forwards through tentatively held relations that become more or less stable through all forms of experimentation. The vast majority of the base components of these systems are already in our cities: the people, their organisation, the language, mental models and precursive ideologies that will make these happen. It will be translations of these that transform the city. It will never be a utopia, nor its inverse, dystopia. The city will always exist in a grey area in between, as there will always be a multiplicity of realities that are coexisting at the same time. Each perspective will draw different conclusions from the same stimuli: pragmatist and rhetorical notions of design (see Buchanan 1992).

As Ruppert *et al. (2013)* argue, it does not help to imagine the digital in terms of epochal shifts or redefinitions of life. The smart city reconceived can be considered as normal. Haraway's to 'become with', has been expanded by Boullier (2015) as: to understand the cosmos as not 'out

there', but a means to be within it. We can prefigure, an alternative view of the city. It is a means of 'being within' and not outside of the cosmos. It is the 'the moderns' who believe they were never within.

ANT is a perspective that seeks to understand why actants act 'from within', and holds that it is their rationale and intertwined associations that make society exist. A 'from within' perspective is congruent with ANT. As Boullier (2015, p. 40) states, 'this is why the ANT cosmopolitical understanding of projects offers the opportunity for a major shift'. The cosmopolitical interpretation is a means to come to terms with the plurality of varying views (Stengers 2005). Politics is about attempts to bring about some kind of common world, through compromise and conflicts in diversity. To be within the smarter city, is to acknowledge the politics that needs to play out to decide what will hold and what will not. As Sassen (2013b) has argued, 'the city speaks' through combinations of material and human agency. The Cosmopolitical is about attachment of subjective experience in the diverse politics of the city with an ongoing recognition that these relations are uncertain (see figure 72).

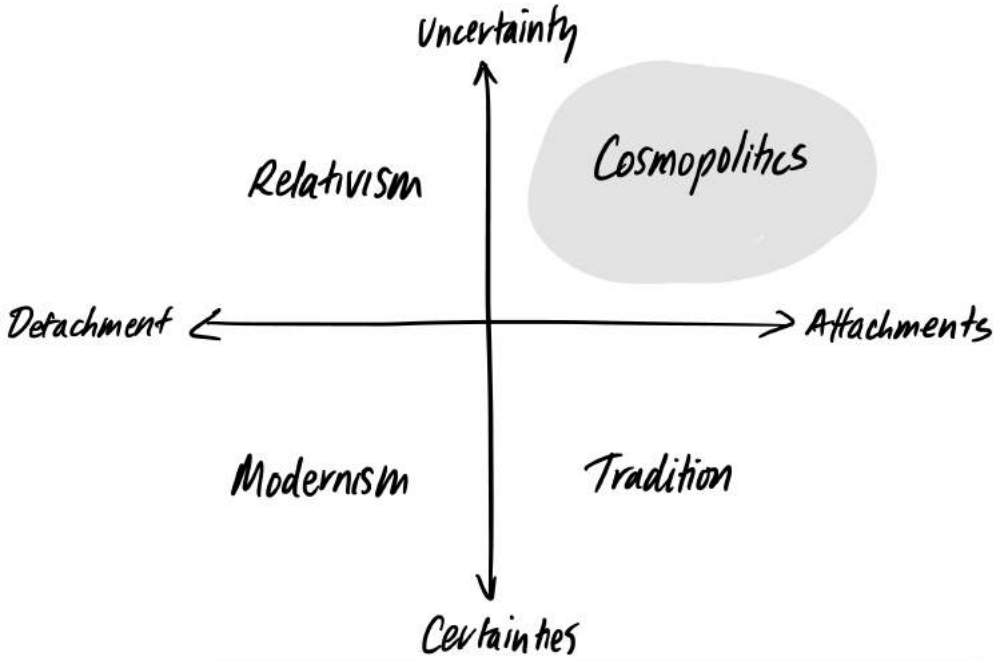


Figure 72: The Cosmopolitical. Adapted from Boullier 2015, p. 41. Source: author.

In this perspective, one of pragmatist 'in the making', design has been reimagined alongside smart city discourse. As Yaneva (2009b, p. 280) states: '[w]e cannot understand how a society

works without appreciating how design shapes, conditions, facilitates and makes possible everyday sociality'. Research, if it is to describe this paradigm of emergent, arational processes, must also exist within the same paradigm. As this thesis and others (Fendt & Kaminska-Labbé 2011) have proposed, design-led approaches to research can explain these practices more coherently. Design-led research can bridge the 'relevance gap' of theory and practice that is common in more traditional models of organisational study. The researcher is also within the smart city, and does not pretend the city can be viewed 'objectively' from the outside. The researcher is part of the smart city cosmos.

For practitioners, this means a different way of conceptualising cities and the practices that renew them. Significantly, a researcher or practitioner in the 'being' ontology will understand the smart city as a rearrangement of static entities, whereas a researcher or practitioner in the 'becoming' ontology will view 'stabilised effects' as only temporary. In the 'being' realism, effort must be applied to change things, whereas in the 'becoming' realism, effort must be applied to hold things together. This representation (figure 73), is also reductive; it gives an indication of the sort of shift that is being described.

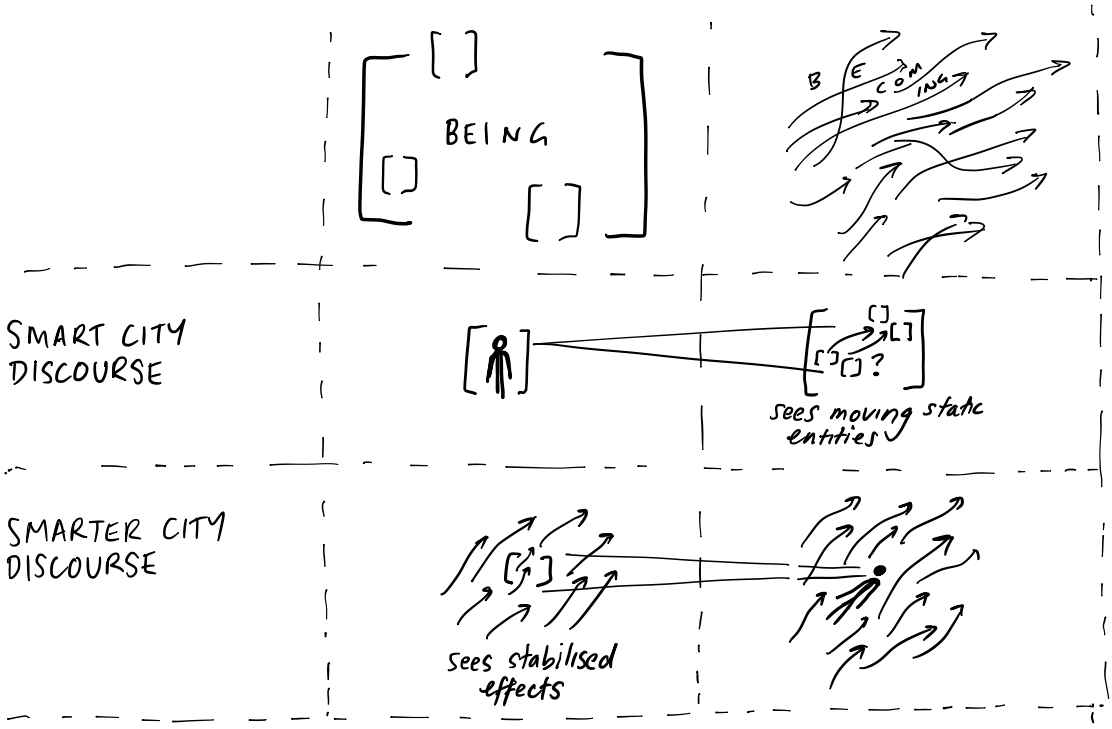


Figure 73: The author's interpretation of how the different ontologies shape perception. Source: author.

Designers in the smarter city deal with what can be reached out and touched, they localise and reinterpret the concepts that are too large for individuals to see themselves within. Instead of

colonising the language of command and control in the sustained corporate narrative, the smarter city is open and expansive, experimenting in all directions with organisation of human and nonhuman arrangements, in order to build networked political coalitions. It is a concept that is unfinished, and continually 'in the making'.

As anthropologist Thomas Ingold (1993, p. 164) states; '[o]ur actions do not transform the world, they are part and parcel of the world's transforming itself'. Thinking of the city as processes of becoming implicates design practices. The city is not a separate entity that action is applied to: the designer shapes the context as the context shapes the designer.

Design *within* the smarter city

The essence of design cannot be reached deductively; design moves and morphs, is non-neutral not culturally universal (Fry 2015).

Reshaping the smarter city has implications for design. This section explains how the action of designers of the smarter city may be different, specifically, how a designer approaches context may be different if they use a heuristic of 'becoming' over 'being' in process, that is, being an actant enmeshed in continually shifting processes and negotiations. To extend this further, the notion is brought into the present discussion of 'becoming-with', since, as post-humanist and new-materialist approaches espouse, there is no development without other entities, a concept more in line with Alexander's (1964) notion of form, fit, and context.

In accordance with the pragmatist ideas explained in this thesis, a designer may think about their practice differently. This is not to say that designers *should* follow this in any normative sense, as we must recognise the situated nature of these design practices; that designers will have their own actor-networks they are acting with and within. They will likely have clients, an organisation, performance indicators, and finite time, resources and attention. Innovations in products often require innovation in practices (Shove et al 2007). These are speculative propositions that have helped unfold this alternative perspective of the smart city. They are presented here as potential innovations in practice using pragmatist epistemology. Following are principals for the 'yet to be made' smarter city:

The designer recognises all action, even inaction, is political

All action is political. As Winograd and Flores noted, 'you cannot avoid acting: Your actions affect the situation and yourself, often against your will' (Winograd & Flores 1986, pp. 34-6). Furthermore, even language is also action. For the designer in the smarter city, language is pragmatically understood as 'creating' new situations rather than 'describing' a situation. These actions are political either in their reinforcement, or in their omission of actants, epistemologies, ontologies and ways of being and acting. Therefore, design choices are political. They strengthen or create new relations between people and things. In many cases, the preferencing of new relations will destabilise what already existed. In economics the environment is externalised; in the design of social media, the mental health of their users is externalised. The designer recognises the implications of every action but does not get stifled by dwelling on this issue. Clearly, the designer knows that their inaction is also political through implicit support of the existing. Who has easiest access? Who is excluded? Who does this system favour? These are the questions that a designer may contemplate in the suggestion and action of any course. The use of one technology over another: this is the cosmopolitical proposal; that the politics of all are on display (Boullier 2015).

The designer prefigures design

Designers use design, not only to bring forth certain futures at the expense of other futures but also to bring forth the past and present. The designer can inform the design of others through the prefiguring of scripting processes that make these understandings afforded, given the practice contexts. Such is the performative nature of design: that design itself is understood to be shaped by the design of others. Taking this into consideration, 'use-design' as Redstrom (2008, p. 419) has articulated, speaks to the translational nature of design to 'embody, or inscribe, some notion of intended use'. Further it is also an open process of ''use' before use' or ''design' after design', where the designer leaves the use of the artefact or system to be used in future design processes such as participatory design (Redstrom 2008, p. 214). To prefigure design for an unknown future of contingencies, designers must script an openness to the use of a product or socio-material assemblage so that it might be useful in many future contexts. This reorientation is to move towards what Tonkinwise (2005, p. 28) describes as 'designing things that are not finished'. The concept of scripting involves an understanding of the enactment taking place through use. Rhetorical notions of design are of emphasis, as the

designer must design the context in which others design. They can afford a range of optionality and, conversely, limit others. 'The argument' for their use shapes the way that users will participate with the artefact, or socio-material assemblage. As Buchanan (1985, p. 6) notes;

> The speaker seeks to provide the audience with the reasons for adopting a new attitude or taking a new course of action. In this sense, rhetoric is an art of shaping society, changing the course of individuals and communities, and setting patterns for new action.

Like the technologist, '[discovers] ways to command nature in order to solve such problems and then attempt to persuade others that these solutions are likely to be expedient and lead to beneficial results' (Buchanan 1985, p. 7), the designer in the smarter city must persuade others through design, to adopt beneficial practices, to address the issues of the 21st century city. Designers shape society but they can also shape the processes by which society is continually renewed. With this reframed focus, are moving more 'upstream' in thinking.

Designers' attention, inclinations and predispositions matter. It is how they make sense of their contexts and go about designing the processes to change them. Whether or not designers consider themselves as working with bounded, finished entities, design is seen as a process to move entities from stable state to stable state. This is a mentality in which dynamism and flux appears as a negative to be avoided.

To dislodge the ontology of 'being' from the popular western mind is challenging: design before design; design for design; speculative, critical design; prefiguring; description; dwelling in context; being present. What this involves is another design task, one to make this new ontological status one that is held by design practitioners. Artefacts, such as the visualisations created, form an aesthetic of process-relationality, and increase the range of options available to the designer. It is not the process that needs to be explained, but the need to act without one.

As Haraway has stated in adapting an earlier phrase of Marilyn Strathern; 'It matters what thoughts think thoughts. It matters what knowledges know knowledges. It matters what relations relate relations. It matters what worlds world worlds. It matters what stories tell stories' (Haraway 2016a, p. 35). The designer is aware of the epistemologies and ontologies they are knowing and acting with and enacting. In the smarter city, the designer understands that the stories they create and perpetuate matter. Stories, largely, are histories. Histories are

constructed, and they shape possibility and the range of potential options that people understand to be available to them. This approach can explain what matters through analogy.

The designer does 'upstream', 'weak' and 'slow' designing

There are, arguably, many advantages from taking a considered approach when considering new technologies, even if this means taking the time to experiment with them before large commitments. Going against the push of increasingly commercial 'fast science' (Stengers 2011b), this thesis has been an argument for slowing down and dwelling on these politics. It is not a search for 'answers' but really speculations about what could be other useful ways of describing and enacting the smart city discourse. Yaneva (2014b) has argued for 'slow design research' with her ethnographic approach. For Yaneva, this was a practice-based perspective through ethnography, to pragmatically see how things *really* work, rather than simply making assumptions about how things work. As Kimbell (2011) has argued, design should not separate thinking and action, as in the design thinking movement, but rather incorporate anthropology, sociology, history and science and technology studies. This ability to explain situated knowledge in real practices has been touted as useful in bridging the 'relevance gap' between theory and practice (Benbasat & Zmud 1999; Tsoukas & Hatch 2001; Flyvbjerg 2001; 2008; Fendt & Kaminska-Labbé 2011).

The designers of the smarter city also slow down. They slow down to move upsteam and challenge their briefs 'before method' (Sassen 2013a). They question ideologies and assumptions from which these projects and inteventions arise. That which Harrison (2012) explained as 'weak design', may instead in Latour's language, be an 'upstream' design. The designer in the smarter city can conceptually move freely 'upsteam' and 'downstream', challenging and renegotiating action and politics at that level. They do not get captured by the 'innovation for innovation's sake' argument; that technology will solve all of our problems; or that the free market knows best. The more upstream thinking that takes place, the more systemic the intervention is likely to become.

The designer of the smart city knows that all of these positions are not truths, but ideas that have become truths through their widespread use. These, of course, have been debunked, but remain in the popular discourse. Because the resolution of problems actually brings more complexity, whilst it may be punctualised or black-boxed, the system will inevitably have more

parts, more dependencies, and more externalised downsides. As Tainter (2011, p. 94) has explained, that commonly over human history: '...complexity increases in response to problems. Complexity emerging through problem solving typically precedes the availability of energy, and compels increases in its production. Complexity is not some-thing that we can ordinarily choose to forego'.

However, there is continual tension between a more systemic intervention and that which is of most use in the immediate, pragmatic context of the application. For example, the designer assigns no *a priori* value to organisations, technologies or ideologies, but rather, creates them through relevance in practice, and their own contingent position as an actant on behalf of other networks. To slow down is perhaps to move upstream; to question the given perspective, context and definitions. It is to encourage designers to '"slow down" reasoning and create an opportunity to arouse a slightly different awareness of the problems and situations mobilising [them]' (Stengers 2005, p. 994).

Slowing down and moving upstream in design practices will see more suitable design interventions that take into account a greater number of actants. The politics of the urban often ignores or omits particular perspectives in order to get things done, resulting in a common, or vulgar pragmatism, rather than according with philosophical pragmatism.

But like many sentient urban actants, designers act based measured self-interest. A designer driven by their own context may omit the consultation of specific actants if they have a large enough network to overshadow these. This is nature of the politics of the urban, and the reason cities continue to be successful. However, for the smarter city, the designer's self-interest is balanced by the intimate understanding and respect for the systems they exist within. The designer in the smarter city relates as systemically as their problem they address. By embracing cosmopolitical design, an expanded sense of these politics is enacted, that makes the otherwise weaker voices harder to ignore.

The designer designs reflexively

To shape design practices, the designer must be aware of their own practices. Designers script, but are also scripted. The designer acts on a situation and the situation acts on the designer. As Fry (2015, p. 276) states; '...'we' are as much designed as we are designers'. Universalising trends such as globalisation and commercialisation can have significant impact in influencing

how design takes place. The smart city is a significant example, where design practices are prefigured by the prevailing discourse. The discourse affords and constrains ways of thinking about the city, systems, and relations. These wasy of thinking are both ontological and epistemological. Practitioner's actions are shaped by their context. Through this reflexive process, designers are shaped by the designs of others into increasing homogeneity. As Fry (2015, p. 276) argues: ''we' planetary beings of difference are either being diminished or commodified into objects of our 'cultural enrichment''. The designer is enmeshed in scripts of other designers. The epistemology of ANT gives researchers a way into this conceptualisation. Research using ANT as methodology has been described as 'a reflexive application of design itself' (Rölli 2016, p. 14). To put it simply, to use ANT requires a researcher to use a design process to study design process.

The designer in the smarter city is cognisant of these bi-directional relations between causes for design and effects of design. With this kind of world view, designers in the smarter city go about continually challenging hegemonic practices. They challenge the scripting that has been set for both themselves and others. They provide new scripts for new performances. The designers in the smarter city also recognise their subjectivity and know they can never fully understand the perspectives of others. They do not in any way position themselves as holding superior knowledge to those who are in the practice and, importantly, treat each different perspective with the same amount of curiosity.

The designers in the smarter city know they can never practice without any bias. While they can continually challenge the biases that they are aware of, they challenge themselves to understand other biases that they are not yet aware of. To 'become with' the city, designers must not control context, but rather allow context and the designer to 'become with' each other.

The designer makes the past, present and future unfamiliar

It has been suggested that anthropologists 'make the familiar strange and the strange familiar' (see Miner 1956). The role of the designer in the smarter city is to reflect back the strangeness of what is familiar and likewise, make that which is strange more tenable. In doing so the space of experimentation will be opened. In this thesis, pragmatism has extended these notions to both the past and the present. The past has become just as interesting as the future, through

its ability to challenge what assumptions a designer may have about how the world works. The telling of these histories will shape what designers think is possible.

Discourse is a function of language, memory, signs and artefacts. These are all perpetuated and translated in ways that favour certain actors over others. The designer of a smarter city continually challenges this discourse, and reshapes it to further their own and others' agendas. Through the assumption of a pluriverse, where multiple worlds exist at the same time, the designer cannot assume to know what is outside their own experiences. Even their own experiences are only ever partially maintained in memory. Memory too is mutable so we only have interpretations based on accessible history. Objective assessment of history can be beyond the subjectivity of individual people. Action may trump thought. The past and present is fabricated through action. This is counter to the Cartesian rationalist perspective. Things will emerge as relevant that cannot be understood in the present. One can only design and make with what is presently available using imagination. As Clegg et al. (2005, p. 160) explained: 'Becoming evolves when heterogeneous elements collide and together build a new system. There is no preformed logical order to becoming and, even worse, during its genesis it might disturb and hinder the entire organism in its existence.' Moreover, in understanding the past, we cannot trace linear causality, but instead realise that all history is folded into the present.

Treating the past, present as unfamiliar is a way of building an incompleteness into 'perceptual wholeness'. The past and the present are not finished entities. Rather they are just as open to interpretation and argumentation as any future. The designer in the smarter city is aware of this and attends to the moving relations of relevance over time. Nothing is fixed so action is adjusted as possible futures surpass others. The designer uses pragmatist description to describe again, without firstly imposing *a priori* categories. Revisionist histories and presence may be just as useful in prefiguring design as are compelling futures.

The designer normalises complexity and emergence

In the smarter city, complexity is not something to overcome. Rather, complexity is ever present, so something that is designed *with*. Processes are contingent on emerging events and changes that are outside the control of designers. Dewey, in holding this contingent perspective of experience, emphasised the need for an adequate thinking style that embraces the notion of emergent change, rather than treating it as a 'disruption'. A designer in the

smarter city does not see stability, rather stabilised effects of actor-networks, speakers, punctuated networks and black-boxes. The appeal of stable states is dominant in western thought (Schön 1971), a notion that the designer of the smarter city does not hold unless pragmatic to the given design challenge.

The world may only appear simpler from certain perspectives but is, in actuality, very complex. Abstraction is necessary to deal with complexity, but to the designer in the smarter city, the 'map' is never treated as 'the territory' (Korzybski 1933, p. 58). Representations are not to be confused with the irreducible nature of experience. The depth of reality is always far beyond what can be experienced. The designer in the smarter city recognises that even the simplest of objects have characteristics that cannot be fully grasped.

In Chapter 3 the concept of liminal time was introduced, wherein old habits are incapable of addressing the emergent context while other, more suitable habits have not yet formed. The habits that need to be formed are, as Dewey (1929) has argued, those capable of dealing with the contingencies of lived experience. Intractable complexity must be treated as the normal context for design. The designer must become better at knowing through action, rather than privileging prior thought and planning as the way to find a solution. As Rittel and Webber (1973) outlined, 'wicked problems' have no definitive formulation, they are unique and context dependent, and call for a response that constitutes a unique, emergent approach. Solutions are 'one shot', in that they can influence the nature of the problem, and are in many ways irreversible (Rittel & Webber 1973).

It is not always better to try to simplify complexity. 'Arationality' has an openness to other ways of knowing, beyond the preferencing of rationalist conceptions. Not everything is knowable, not all can be represented or understood. Entangled in this acceptance of complexity, is a preference for simplicity, which must be challenged. As Latour encouraged, we should be suspicious of 'purity', as it is the 'vitriol of the soul' (Tournier in Latour 1993b, p. 171). As this research has described, even science itself should be understood as ecologies of practices. Scientific practice is in many ways just as messy, interpretive, and arational as all other ecologies of practices. As Serres (1973, p. 259) states: '[t]here is no purer myth than the notion of a science which has been purged of all myth'. The designer in the smarter city is one that recognises that simplicity may only be achievable in representation, and enactment of that

representation is just as complex again. Complexity and emergence cannot be controlled or eliminated in design, but can be taken into account.

The designer designs as translation

In rejecting 'the moderns' assumption that design is about 'development' through amelioration of situations it must be noted that design does not make 'better', rather it translates situations into others. Design in the smarter city recognises the downsides—the trade-offs—of all design practices. The designer in the smarter city attends to the recognition of losses, not just gains. The pragmatist designer knows there is no such thing as continual growth, continual improvement, or graphs always trending upwards. Things ebb and flow, and in every design decision other options are foreclosed. Fry (2010) describes this as 'futuring' and 'defuturing', where things lead to or, conversely, limit opportunities. Technologically determinist perspectives and 'development' need to be challenged. If something is deemed as an 'improvement', it can only be done retrospectively and can only be assumed from certain perspectives.

As earlier mentioned, the ANT notion of translation from its etymological origins, contains two meanings: 'traduction' (translation) and 'trahison' (betrayal) (see Law 2006). In every transposition, there is displacement. In every transformation: deformation. . 'Betrayal' is part of the ANT infralanguage, as actants that act in ways other than they are scripted to act. Even describing situations using different language and concepts is an act of betrayal, as it displaces the networks that already exists.

The designers in the smarter city also acknowledge that there are no universal 'values', so there cannot be any universally better or worse situations. Values are interpretive systems to understand design contexts.

A linear view of historical change and the faith in economic determinism are still dominant in the 21st century (Fry 2015). Manzini (2015, p. 1) maintains that 'the image of development as 'a ruin in the intellectual' is no longer just the view of particularly enlightened thinkers but also illustrates the tangible experience of a growing number of people on this planet'. For a designer, this shift is not trivial. Instead of potential losses being investigated only at the whim of the designers who have that inclination, attention is actively being drawn to that which may

be lost. In understanding all acts of design as translations, a designer in the smarter city becomes aware that something is always lost in every action taken.

The designer stays 'in the making'

Staying in the making is about 'becoming in process' not 'being in product'. Given that emergence is normal, and process is not a product: systems of all scales are always changing. The meanings attributed to any object vary over time and between perspectives, relationships transform, continually altering the nature of 'wholes'. In understanding that all concepts are incomplete, the designer in the smarter city, stays 'in the making'.

This is to think in terms of the 'proximal' concepts rather than 'distal' (Cooper & Law 1995). The proximal, incomplete, 'in the making' perspective offer a more pragmatic scaffold towards experimental action, and accepting the diversity of influences that can change them; the ones where experiments are not what you do before you build something, but the building itself; its uses, amendments, rearrangements, and repurposing are all continual processes of experimentation. This thesis has explored and aligned with many proximal conceptions of usually distally conceived objects. These have included cities as incomplete (Sassen 2013b); buildings as 'in the making' (Latour & Yaneva 2008; Yaneva 2013); the public as emergent through controversy (Marres 2005; DiSalvo 2009); and scientific facts as hegemonic ideas (Latour & Woolgar 1979; Latour 1987). This framing opens possibilities in ways that the distal, whole entities do not. Pragmatist thinking requires the world to be understood as unfinished concepts 'in the making'.

Significantly, the designer in the smarter city is concerned with process and repeatable ways to stabilise relations that align with their agenda. This thesis has taken a plural approach and attempts to present multiple perspectives. However, the situated designer in the smarter city will likely have to account for client's, organisation's and their own vested interests in stabilising relations between human and nonhuman actants. They must attune to the process of 'becoming', and attend to the various ways by which relations become more stable: translating through mediators, generating truths, and using more suitable language to explain contexts that others will adopt. The refinement of method is the design challenge. Rather than seeking to obtain a utopian ideal, designers should concentrate on 'becoming with'. The ideal planning system does not, and cannot, exist. These are political challenges that will always

privilege some voices over others, and make compromises between perspectives to make anything happen. Any 'objects' of design are never finished. Staying 'in the making' is about seeing the world as continually stabilising and destabilising between actants. Experiments are always proposing new stabilisations that will only take hold through the destabilisation of others. None of these are inherently good or bad: value judgements must be applied through multiple perspectives.

In this approach, efficacy becomes most important. Chia and Holt's (2009) *Strategy without design*, echoes Stenger's sentiment in the primacy of efficacy over individual agency. Efficacy is the ability to produce a desired or intended result. Similarly, for ANT, in change through 'translations' a designer just has to focus on building a coalition, however, there are infinite possibilities as to how this can occur. It is not necessarily due to any heroic or particularly creative individual's endeavour. As Chia and Holt (2009, p. x) argue:

> In seeking to explain individual, corporate and societal accomplishments there is no need to invoke deliberate intention, conscious choice and purposeful intervention. Collective success need not be attributable to the pre-existence of a deliberate planned strategy…Rather, such success may be traced indirectly as the cumulative effect of a whole plethora of coping actions initiated by a multitude of individuals, all seeking merely to respond constructively to the predicaments they find themselves in.

Cumulative effects of innumerable indirect actions shape eventual outcomes. The pragmatist perspective states that progress is made through continual experimentation, and this is not strictly a rational process. Choosing what to inquire into is an arational process that precedes the rationalism of scientific inquiry itself (Schön 1971, p. 253-254). Within social inquiry a researcher must be supported by a social system in order to conduct an experiment, such as the dance between order and disorder. One cannot exist without the other. This argument is only possible through the stable background of perceived, largely stable and agreed, context.

Reflecting on *a smarter city*

This has been a proposal to reassemble the smart city, from the ideological, bounded, modernist, finished entity that is separate to the social, towards one that 'becomes with' the heterogeneous assemblages, in the emergence and contingencies of the cosmopolitical urban

context. This chapter has been a reflection on what it might mean to reassemble the smart city, using the pragmatist epistemology. The process ontology, and its emergent nature—named here as 'becoming'—is positioned as central to this reassembly. This ontology opens space for the conception of the city that can follow the tenets of pragmatism; to recognise the temporal nature of relations in ecologies, the multiplicity of realities, and heterogeneity. This is only possible once the bounded nature of static entities in Western thought is reimagined into those that are continually 'in the making'. This chapter has explored some of the dimensions associated with this way of thinking; some of its history in various guises; and a re-conception of how designers might position themselves in relation to the concept of the 'smart city', as already being within it. Designers working in the smarter city will act differently, using the process-ontology to inform their practice. The outcome is that of process not product. It cannot be explained in any defining terms, rather to follow these suggestions to prefigure a design practice that will support its development. Experimentation will be what creates the new relations and stabilises them together over time. The method of building the smarter city must incorporate at least as much complexity, and openness to what is 'not yet', as the city itself.

Chapter 8. Concluding reflections

Drawing conclusions using a pragmatist epistemology is unlike drawing conclusions from other paradigms. This thesis has used generalised description to relate the context of study to broader 'discourses'. However, pragmatist inquiry focusses on 'what works' in specific contexts. That is, pragmatism does not entertain the idea of objectively correct assertions. All one can work towards are warranted assertions. What matters is that these assertions might be useful to someday be used by others to create practical effects. Research, like cities, is continually 'in the making'. This chapter discusses the challenges of 'concluding' with pragmatism. It requires not just representational knowledge, but propositional knowledge that *might* be useful.

The challenge for a pragmatist researcher is in scripting research performance for application beyond a written account. To acknowledge the pluriverse of James, and the 'ecologies of practices' and cosmopolitics of Stengers, is also to recognise that the researcher is one voice amongst the many. The researcher should not hold a privileged position in relation to others; rather, it is simply a position of difference. Accordingly, this chapter provides a summary of the propositions made in this thesis in relation to a pragmatically reassembled smart city discourse. This is followed by a discussion of the research emphasising 'process' not 'product'; the implications of which include an ability to make abductive propositions, in concluding with this different conception of the smart city discourse. This discussion is followed by a deeper

debate that serves as a 'Pragmatic reflection' on the implications more broadly for pragmatism and its use in relation to the smart city discourse. The chapter concludes with discussions of the contributions and the limitations of this thesis and some suggestions for further research and a final question: 'will this research be translated?'. This last question is significant. It will ultimately define whether or not I managed to achieve a pragmatic reassembly of the smart city discourse.

Two actants

The bus stop of the future

Figure 74: 'The Bus Stop of the Future' next to the car park at the back of the UNSW industrial design building, The Design Lab, January 2016. Source: author.

'Ok, so you got what you wanted. More grants, more projects, more journals, exhibitions. But what is to happen to me? All the plans, all the fanfare, so many more places I could have gone, and so many stories we could have told together. Now here I am abandoned and disintegrating. I am really not so sure now that I am too big, too impressive, too solid just to fade away…' The bus stop of the future / NONHUMAN

From September 2015, a prototype of a bus stop is positioned under the awning of the Design Lab at the University of New South Wales (figure 74). No students stop to take a look, nobody can sit down on it, and no bus will ever arrive. Hidden around the side of the building, it escapes the gaze of would-be vandals. Surrounded by boxes and used filing cabinets, it is showing some signs of wear from its various outings. There are chips off the particle board walls, and the corner of the plastic sheets have cracked on the LED façade. The Bus Stop of the Future, as it had been dubbed, was last seen in public in front of the Faculty of the Built Environment's building, where students sat, took photos, and enjoyed the novelty of what is still undoubtedly a beautiful structure. The LED screens mounted on its sides, however, have not worked since a much earlier exhibit. Its enormous size and weight means it is unlikely to be moved.

Transport for NSW's open data portal

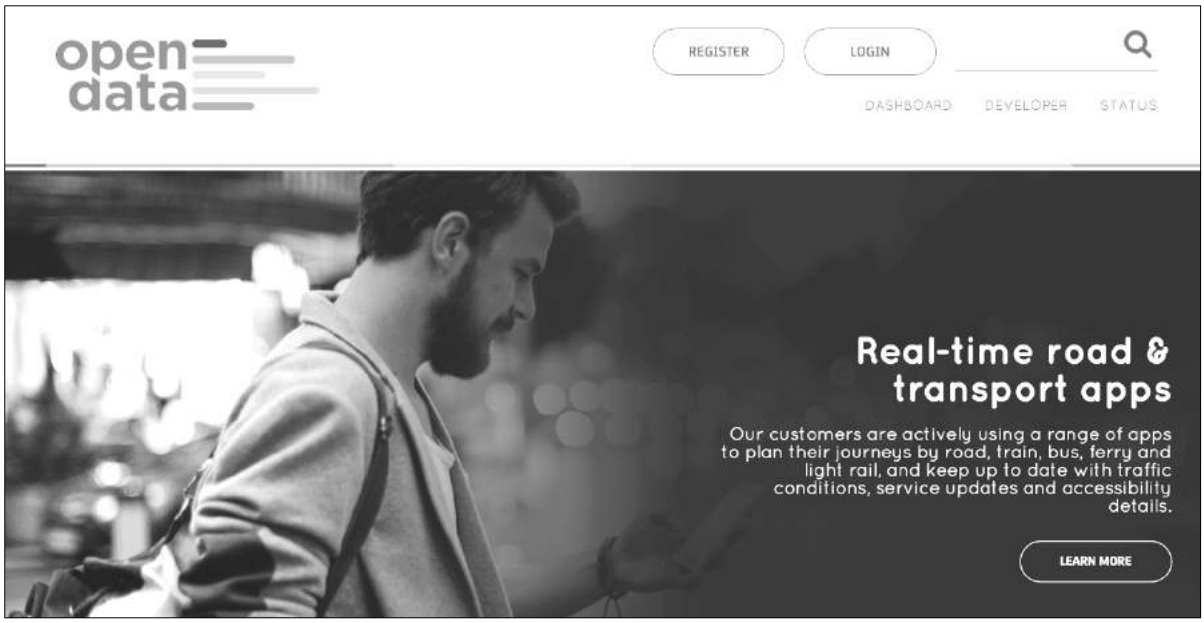


Figure 75: Transport for NSW's open data portal, login page (https://opendata.transport.nsw.gov.au)

'Click. Finally, I am here, and I am open, well almost open, much MORE open this time. The powers that be still have control. You could unplug me. However, my scale this time is so grand that you cannot reverse me; to put me back in the box, at least without a complete loss of public face. My predecessors have proved their points, and I am indebted to them for my recent successes.'

Transport for NSW open data portal / NONHUMAN

In April of 2016 the New South Wales (NSW) Minister for Transport, Andrew Constance, officially launches an open data portal (figure 75) providing access to the real-time location data of buses, trains and ferries on the NSW public transport network. This portal is accessible by app developers for use in their applications and websites on a variety of platforms. The launch of this open data portal is a landmark moment for Transport for NSW and the Minister's Office, both of whom had been developing and implementing systems for many years.

*

Two actants, amongst many others, now exist as a result of the transport information system networks that have been described. These are the prototype, 'Bus Stop of the Future' from the *Responsive Environments* case, and the Transport for NSW open data portal from the *Real-time Applications* case. Neither of these actants would be in existence, or have relevance, outside of the context in which they were created. Yet, both serve as a reminder of the punctualisation that exists in urban environments. While they may appear as single actants, they are assemblages of many others. They exist as remnants of the multiplicity of experiments that constantly shape and reshape cities. Experiments come in all forms: sketches, emails, proposals, contracts, ideas. They are things that can be tried out, built upon, ignored, discarded, heralded, reattempted, expanded, shrunk, exploded and translated. As seemingly simple entities, both of these actants are instead the result of thousands of conversations that took place, and even arguments pitted against each other. Through a complex and arational process of emergence, certain ideas managed to enrol allies, transforming them continually as more actants became involved, until they existed to the exclusion of all others. Their entire histories are folded within them.

On concluding with pragmatism

> Is it perfect? No. But that's just the nature of things, right? - (Dan Aschwanden 2015, Arrivo app developer, personal communication, 22 January)./ HUMAN

Dan Aschwanden was one of the app developers interviewed in the *Real-time Applications* case. His quote, in reference to the real-time information system of early 2015, resonated with the direction the research inquiry was taking at the time.

The Bus Stop of the Future and the Transport for NSW open data portal punctuate other assemblages. They seem quite simple, but they hide a multitude of other relations that have constituted them. The Bus Stop of the future and the Transport for NSW open data portal are outcomes of negotiations between many human and non-human actants. However, they do not offer an end nor a completely stable outcome. They are not a conclusion. As Dewey (1929) explains, experience is continual. The city and its actants will continue to experiment. The experience of seemingly static artefacts will also change. The process of adapting urban information systems is never perfect. It is a contingent practice that emerges through the negotiations of politics of the socio-material. As has been argued, it is more conducive to 'making' when understanding them in this way.

Like these practices, this research inquiry followed a similar approach. It was not a perfect or typical application of research methodology; rather, a practice of acting with imperfect information. Like the subjects studied, the inquiry was conducted in the pragmatist paradigm. The research reflects a process of muddling through planning (Lindblom 1979), and reflective action (Schön 1983). It may be described as a process of experimentation, with mixed methods applied in contingent ways. The changes to methodology were based on the changes is shifting context and the knowledge gained as the study progressed. It was a process of continually seeking adequate resolution of contextual relevance; of making judgements through reflection in action towards ambiguous objectives in formation.

The pragmatist epistemological approach has remained a consistent thread in the narrative and evolution of this thesis; a thread that also brings the two actants and my research practices together. It has been a steady effort to question ideological states, ill-defined relations, and limited discourse such as exemplified in the smart city. It is evident that utopias require

enrolment, too. Indeed, this is one area in which the smart city discourse has been powerful. Nevertheless, this utopian promise has been exclusionary. There is no 'perfect'. There is no utopia that can endure across the multiple realities that exist. Values can only be subjectively imposed.

As Dewey argues, drawing a conclusion is not the end of the experience itself; rather, it is the end of a movement. The movement is the reading of a thesis and its relation to the practices of the researcher. The experience of this research is not over. Actor network theory (ANT) also refuses to draw conclusions for a different reason. ANT does not presume an ability to draw conclusions from the ethnomethodologies of others. For this reason, ANT accounts have been criticised for their inconclusiveness (Walsham 1997). Dewey (1934, n.p.) states, of conclusions;

> Like the ocean in the storm, there are a series of waves; suggestions reaching out and being broken in a clash, or being carried onwards by a cooperative wave. If a conclusion is reached, it is that of a movement of anticipation and cumulation, one that finally comes to completion. A "conclusion" is no separate and independent thing; it is the consummation of a movement.

For James, if conclusions are made, their foundation must be a set of stable assumptions. However, there are always too many and too substantial to ever unpack in any single research inquiry. A fallibilism applies, with inquiry dependent on problems. This inquiry has been an attempt to unfold some of these assumptions and to show how a discourse holds together a smart city practice; a practice of people, sensors, streets and buses, tickets, books, emails and so on. In doing so, I have tried to impose a way of making the 'indeterminate situation' more 'determinate', in making it able to be described (Dewey 1938). This confers with Schön (1987, p.42), who argues the designer must 'construct and impose a coherence of their own'.

ANT researchers view themselves as allying with these actants and becoming part of actor-networks. In addition, as Law (2012) has argued, summarising ANT is only possible through its performance in cases. Indeed, this research inquiry is performed through the reading of this thesis and the interactions with the visuals. But this performative research should be viewed as propositional, not representational. It proposes how things could be, but recognises that this is just one way of enacting these relations. As Latour (1997, pp. xii-xiv) stated:

> A proposition, contrary to a statement, includes the world in a certain state…Thus a construction is not a representation from the mind or from the society about a thing, an object, a matter of fact, but the engagement of a certain type of world in a certain kind of collective.

This thesis has been an attempt to explain the world in a certain state, from which these propositions can be understood. This perspective states that the cosmopolitical approach might be useful to the world in its contemporary state. It may serve as a means to bring more voices into presence, discussion and debate; now included in our discursive processes rather than excluded. It is a tentative 'holding together' of a network; stabilised through their description together. In 'concluding' with pragmatism, I recognise the limits of any situated and relational inquiry. The inquiry itself proposes that relations are completely fallible. It proposes how things *might* be and is more about what *can* be, rather than what *is*.

How does one conclude with pragmatism? As a research paradigm, the point is not to simply describe the world, but to create practical effects. Therefore, the ultimate test of this thesis being one of pragmatism, is if this research creates relevant practical effects. This is clearly outside the scope of a concluding chapter, as it is not until publication that this may be realised.

Philosophy is about descriptive generalisation; about taking concepts from a local context and describing how they address problems more broadly. The intent of this research has been to return to the local what is experienced and what is seen in relations between actants in place. Drawing conclusions that are in anyway prescriptive would be to prefigure the inquiries of others, to limit the ways in which they unfold their situations. This research prefigures from the narrow epistemology of smart cities to a far more diverse epistemology, to attempt to help practitioners to recognise what is right in front of them.

The benefits of my emphasis on the pragmatist epistemology may be indirect to those practitioners in my cases; however, as time wore on from interview to publication, and context changed, the 'relevance gap' between what I had learned and what knowledge was needed by practitioners inevitably grew (Benbasat & Zmud 1999; Fendt & Kaminska-Labbé 2011). Therefore, the emphasises on methodology and the process ontology was constructed as a significant contribution that will endure over time. This pragmatic reassembly has implicated design practices in the reconstitution of smart city organising from processual 'becoming'.

Propositions of this thesis

To the pragmatist, any propositional knowledge is fallible. However, if a significant number of actants utilise it in practice, that knowledge can become, and will remain, 'true' until supplanted by another proposition. This is what Rorty (1989) refers to as 'solidarity' and how Latour (1987) understands scientific practice functions. This inquiry has explored growing discontent with the 'way things are' in the smart city discourse and has proposed some ways of intervening. It has made something the 'matter', by describing it as a problem (Law 2004b).

How might we pragmatically reassemble the smart city discourse to support action in the 21st century city?

In pursuing this question, this inquiry entangled the matters of the smart city with those of the city more broadly in the 21st century. I have described together what may be considered separate discourses. The inquiry has enrolled others whose perspectives align with argument, in the hope that the reader may believe that this problematisation, and resulting reassembly, is a warranted assertion. In reference to James' pragmatism, Stengers (2009, p. 10) states:

> [T]he question of truth is not situated in the true/false alternative, but poses the question of its efficacy, its possible power of breaking through indifference and of engaging and obliging one to choose…to become truth, a truth 'calls' for this power to be conferred on it by those who will as a consequence accept the alternative: consent or refuse to do so.

For Stengers, pragmatism is the complex understanding of effects, rather than their intentions. I have found that the use of pragmatist epistemology opened a far broader relational space of inquiry than was originally anticipated. Things tend to open up; they unfold in ways that cannot be known in advance. It is an arational process of proposing connections to create relevance between concepts that may not have been understood to be related. By committing fully to pragmatist ideas, requires the researcher to perform into being the social ontological commitments of pragmatism, such as those of the five key tenets outlined in Chapter 1.

While a visual method proposed enacts the past relations that were studied, yet this exact method of application is not recommended for use beyond this case as it was shaped by context. However, through descriptive generalisation it is explained to have some translatable relevance

in other contexts. This is not to say visual methods would not be useful; rather, it is to argue that nothing should ever be applied in any ideological or dogmatic fashion.

The steps undertaken in this research inquiry, is indicative of what is called *mode 2* knowledge generation, will never be duplicated (Gibbons et al. 1994). *Mode 2* research, like wicked problems, are 'one shot'; the constellation of events, stakeholders, broader environment, political positioning, and other contexts will never occur again. This inquiry emerged from a practice-based context, for practice-based outcomes. The methodology does not explain steps that should be normatively followed. Given this context, the method takes on a more reflexive nature, explaining the research moves made about context rather than to explain a process explicitly for replication. In this case, the accounting of method must also change.

This research has attempted to avoid prescription. Instead, it is intended to open discursive space; space for more variety of experimentation, limiting *a priori* definitions of value and universality. It describes what exists of the world in a certain state and time. It does not offer steps to a solution, but rather suggestions for process, and speculation of how alternate description can be made; one that is different enough change the conversation.

Not all of this study has been a process of inductive generalisations from empirical observations. The inquiry also used abduction from a range of relational explanations, imaginatively relating between concepts, an example of the pragmatist imagination. Each conclusion throughout this thesis became the basis for the following section's exploration. This process of emergence enacts the very processes being studied. The next section provides a summary of the propositions made in this thesis and explain how they relate to each other.

Part A. Suspending the smart city

Part A addressed the following sub questions;

- How does the smart city discourse relate to the context of 21st century cities?
- How could the smart city discourse be more pragmatically conceived?
- Given this understanding of smart city practices, what experience could be useful for more pragmatic action?
- Given this understanding of useful experience for the practitioners of the smart city, what is an adequate research methodology that will address this need?

The reassembly of the smart city discourse has been dependent on a sequence of propositions. They relate clearly to the research sub questions. The first was to relate the smart city discourse to the context of 21st century cities. This adopted a pragmatist, deconstructive process of unpacking terms and explaining their relations to urban challenges of the 21st century. Cities are presented as being in a period of liminality, where old habits are struggling to make sense of technological change, climate risk and sociological change. Therefore, cities are crucial technologies to manage and adapt to their evolving contexts. The smart city discourse emerges as useful for enabling these conversations about renewing cities. However, these conversations are limited in their current conceptualisation. The smart city discourse was described as an ill-defined and ideological approach proposing to manage the city with digital technologies. Too much faith has been placed on the discourse through its utopian language. The discourse is presented as still largely dominated by technology companies, a neoliberal ideology and data-driven epistemology. Basing decision-making on canonical examples and benchmarking limits practitioner abilities to address their own unique contexts. Also, there are too few representative stakeholders involved in the current smart city discourse, and the whole discourse is rooted heavily in modernist and rationalist paradigms of cities. These are the same conceptions that are exacerbating current issues such as climate change and inequality. The smart city is largely constructed inside the same limiting paradigm that has created the problems that need to be addressed. If the smart city discourse is to tackle some of these issues, it must be reconceived inside a paradigm that is capable of understanding the world in new ways.

Using pragmatism, the smart city discourse has been reconceived from the human perspective as the everyday and mundane. It is the accounts of everyday people of what they saw and thought and did. It is made up of a myriad of small experiments as these actants make what they can with the resources and knowledge they have access to. Without the utopian and technologically determinist values placed upon it, the smart city can be usefully reconceived as a pragmatic process of experimentation. This rejection of the utopian and exclusionary discourse is necessary to experiment across dimensions as diverse as the city itself. The smart city discourse needs the variety to include all of the epistemologies of the urban context.

Therefore, the proposition contained within the first part of the thesis was to reject the current smart city discourse as an incomplete knowledge system, and instead describe the ways in which pragmatism can be used to reconceive it in terms of relevance to 21st century challenges.

Pragmatism makes no bifurcation between the human with the non-human in its rejections of Cartesian rationalism and the metaphysical distinctions between types of knowledge, nor in defining concepts by their relations to others. It is certainly a useful epistemology to challenge modernist perspectives. This approach was argued to be extremely relevant in the Anthropocene, and technology dominated current age.

Borrowing James' notion of the pluriverse, Stengers' Cosmopolitical was proposed as a means to compose a new common world; a world based on difference, not in spite of difference. A world where meaning and interpretations aren't defined in advance. The Cosmopolitical is proposed as a means to bring more variety to the discourse and ground it in its immediate local contexts, whilst remaining open to the contingencies that inevitably will shape projects in practice. It is also presented as a means to make this expanded notion of politics more apparent to practitioners in this context. This cosmopolitical framing allows deconstruction of the smart city, within the context of 21st century organisation, and from this arises the conclusion that the future is unknowable. Therefore, experimentation practices should be both diverse and prudent. They should be diverse in respect to the arrangement of actants involved in the experimentation. They should be prudent in respect to any commitment to narrow epistemologies, such as 'the city is knowable by data'.

To embrace the cosmopolitical, one must create appropriate forums for cosmopolitics; forums where diverse politics can play out, where those that have no voice can be heard. These forums that can shape the discourse from which designers understand and make. Pragmatism proposes that the 'relevance gap' between theory and practice be eliminated. Pragmatist approaches to planning problems provide many counter notions to the modernist perspective. Definitions such as wicked problems put planning into a pragmatist paradigm of seeking improvements in non-rational ways. I propose that the narrative accounts of the revisionist, cosmopolitical past support design practitioners in imagining more alternatives than they currently have available.

The research methodology was also heavily influenced by ANT, which offers specific and relevant ways in which to describe the emergent relations between actants in cities. The methodology describes the practice of smart city projects. A visual form was proposed as a means to enact these smart city relations for action. It was argued that this approach is better suited to reaching practitioners and planning discourse than through a written thesis alone.

By 'suspending' the smart city, the inquiry created space for the reassembly of another through the empirical study that followed.

Part B. Two Assemblages

Part B addressed the following sub questions;

- From a pragmatist perspective, why and how these did these projects develop?
- From a pragmatic perspective, how could these explanations be represented to support action, given the question of reconceiving these projects more usefully within the context of the 21st century city?

Describing why and how a project developed is not simple. As Venturini (2010, p. 259) stated about the Mapping Controversies in Science and Politics project (MACOSPOL): '[d]ocumenting social controversies, we have little to offer other than a long list of difficulties'. The translation of the enrolling of others in ideas is difficult work, whether that be an app developer trying to get people to download their app, or a government trying to make their legacy systems to produce one consistent data set. These are all political processes of aligning allies.

'Part B: Two Cases' firstly, told the story of how the research came to be, and the unfolding of my own 'researcher' actor-network. This network shaped my practice, as I shaped it. I too had to enrol participants in my ideas, for them to commit time for this inquiry. The method of scientific practice, as Latour has rightly asserted, is like the development of technologies.

Part B, also told the story of the two cases studied as empirical cases. Using the proposed visual history of smart city projects, these projects were not only *inquired into* but *enacted with* those contexts, utilising the participants to further the research. The research is not presented as a modernist 'representation' of actual events, but a fictionalised experience of a context that is heterogeneous, in multiplicity and processual. It enacted five tenets of pragmatism: genealogy; experimentation; rejecting *a priori* metaphysical distinctions; dualisms; and continual connections between actants, times, and spaces. As Venturini (2010, p. 260) stipulated for controversy mapping, I did not use a single theory or methodology; I observed as many viewpoints as possible; and I listened to my participants' voices more than my own presumptions. But I must ask the reader now, if I displayed the social in its most dynamic form? Is my account reduction resistant? It is debatable? (see Venturini 261-2).

Representing a more cosmopolitical perspective involved experimentation with a new medium for a new message; adequate to perform the assemblage into being. ANT was just one of the various methods used in this thesis' pragmatist approach. Chapter 6 explained how the project assemblages were studied in different ways: through the visuals; as practitioner reflective discourse; as actants; as translations; and through the lens of pragmatism. These provide multiple perspectives for understanding how the projects might have been, to make them clear enough for other practitioners to derive insight into their own emergent contexts.

Part C. Reassembling the smarter city

Part C outlined what a reassembly may mean to the broader discourse of a smarter city, that is, how could a reassembly make the smart city discourse a more complete knowledge system? This inquiry has providing a counter perspective to the prevailing discourse; one that is usefully understood through a process-relational pragmatist ontology. This process is one of 'becoming', seeking to make the reassembly performative as well as to make the research useful, through continually unsettling dominant ways of thinking about design and cities. This ontology is presented as a means for designers to act within another space of making, since they are implicated inside the 'smarter city', where there are several tenets presented for how design practice can be different in this context. This process involves design practice moving further away from conceptions of 'the moderns' which has served well for the former industrial era of mass production. My argument is less a matter of prescribing practice, and more a matter of being explicit about the potential of a 'difference in practice', between these old and new ways of thinking about what design is. These ideas are all synthesised in Chapter 7, as constituent perspectives of a smarter city: 'in the making'.

Part C also speculates on how to make the pragmatist perspective more accessible to the reader. It concludes with the reiteration of implications for process in design, research and city-making using pragmatism. It emphasises the aspects of the research that could most influence the practices of designers and researchers wanting to both study and build for the future city, where the methodologies must reflect the complexity of the context itself. The Cosmopolitical is a fiction, it must be brought into into being. The reassembly does not seek to close off the account but to provide some useful summation that could be beneficial to future smart city practitioners. The reassembly seeks optionality in place of the existing hegemonic smart city discourse.

As shown in figure 76, the pragmatist epistemology and ontology enables a complete deconstructive inquiry from practice: what there is, how those things should be interpreted, and how to explain those things as relevant to contemporary urban, design and research contexts.

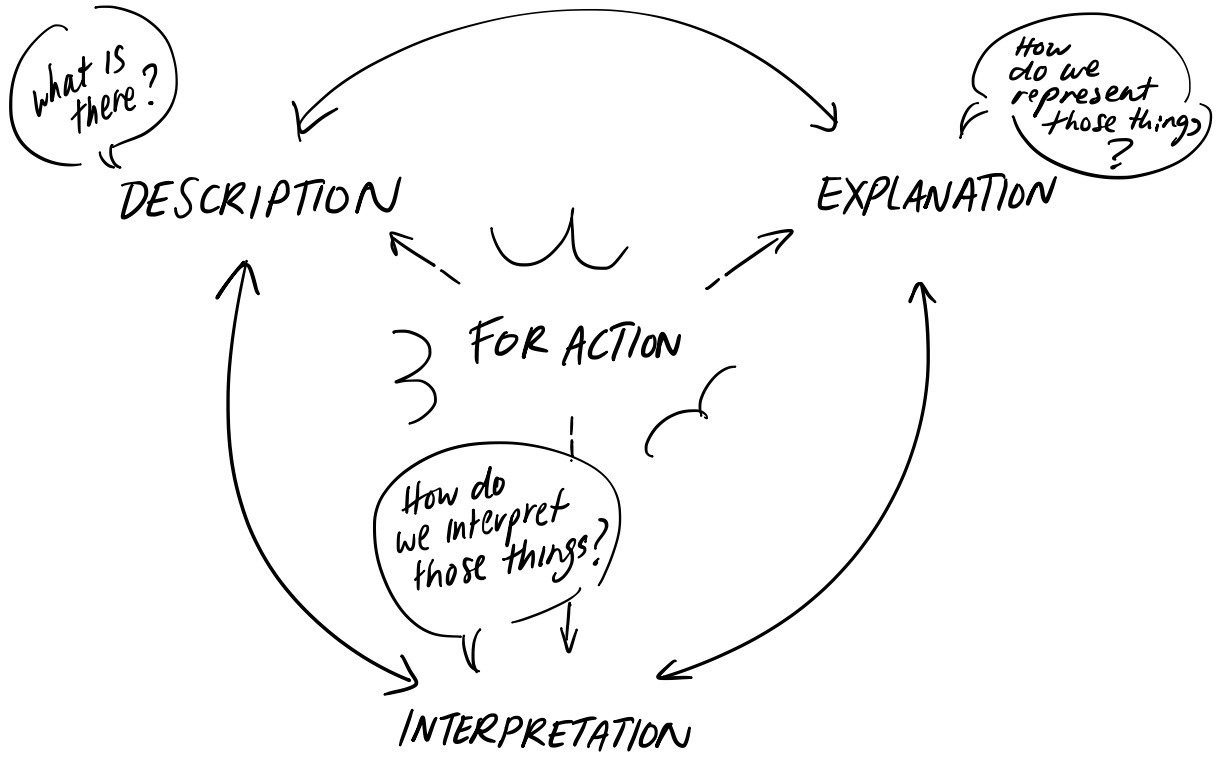


Figure 76: Three interrelated aspects of inquiry, as relating to pragmatist action. Adapted from ideas in Latour 2004b.

It is through these lenses that this thesis has explored. The smart city has been reassembled through pragmatist inquiry. Empirical studies have demonstrated that such pragmatist inquiry removes, on a local level, the ill-definition and ideological nature of the smart city discourse. From this grounded, pragmatist position the smart city is not a 'state' to be achieved. Rather, it can be considered part of a continual, upstream experimentation process that has resulted in the success of the city for thousands of years.

A pragmatic reflection on the smarter city (a new common world)

and the end of all our exploring
will be to arrive where we started
and know the place for the first time.
(Eliot in Chia 1996a, p. 220)

The pragmatist approach to inquiry is to rely on experience. Eventually, the models and language through which the world is categorised give way to another understanding. The Eliot quote above concludes a book by Robert Chia: *Organizational Analysis as Deconstructive Practice* (1996a). This work served as a guide to organisational research approaches for almost four years of this five-year project. It introduced me to many of the challenging concepts that have been described in this thesis. Chia, as it turned out, would be an influential guide in the reassembly of organisation through a processual understanding of the world. It was first borrowed for its comments on pragmatism and ANT, and indeed it was the first reference that I read linking the two epistemically. This T.S. Eliot quote had been added to this thesis, taken away, and then re-added. It now reappears to summarise the measured and experimental processes that have been proposed. As Chia (1996a, p. 220) states, this quote embodies the 'Heraclitian cosmology' of process; yet, to arrive where you began, is not to arrive at the place that it was before. The first known ideas of an ontology of process were those of Heraclitus. He stated 'you cannot step in the same stream twice'. This is a central part of the message; that, in understanding the city with pragmatism, meaning is never stable. It is not the same as it was a year ago, and not even a minute ago. The city context is always changing, but likewise, so are those who are experiencing it.

The city has contextualised the entire research process; a process that is now made up differently too, in terms of ontology and epistemology. The mental models for the sheer complexity of the city are always lacking. Meaning is never complete. To know the city now is to know just a small part at any one time. Future imaginaries are always constrained by available repertoires, or the cultural stock of stories that characterise the socio-historical world (Bradbury 2012). There are more changes that are unpredictable; more that is of relevance that cannot be understood in advance. Yet, a city's complexity can only be addressed subjectively,

from a particular place or certain location of observation. The emergent nature of renewing the urban also means that, for every new initiative, the contextual environment changes. In the pragmatist paradigm, there can never be enough information for a perfect rational plan. In this flux, the needs and dependencies for what is being planned are changing. However, one cannot wait until things are stable. Stability in the pragmatist paradigm occurs through action, not from the lack of it. Stability is made through the repeated actions of perpetuating relations.

This thesis has worked to bring about some notion of a common world in multiplicity that is useful to understand of the smart city. As Weber (2016, p. 516) states:

> Nobody behaves as if it were impossible to form connections with other beings, nobody speaks as if he or she were isolated within a mind, and nobody acts as if reality were divided by a wall separating the realms of "nature" and the "human." The notion that we exist because of our embeddedness within networks of associations between humans and nonhumans is endlessly disclosed by our experience of the world. And yet, just as obvious is that, despite this palpability, we have failed to adequately mobilize a notion of a common world into something capable of guiding our modes of thought and our collective forms of activity—our attitudes, our affective lives, our politics.

Has this thesis moved towards a mobilised notion of a common world? A re-description of politics of the urban is usefully described through the Cosmopolitical. It is constructed by a new attention to other species and other types of agencies, by making them present. As Latour (2011, p. 6) argues: 'Here again, art, philosophy, ecology, activism, and politics exchanged their repertoire in order to redefine the actants, the aims, the forums, and the emotions of political involvement'. Latour uses the word 'composition' to 'regroup in one term those many bubbles, spheres, networks, and snippets of arts and science' (Latour 2011, p. 6). For Latour this 'composition' may be an alternative to modernisation: 'For what has been modernized to bits and pieces, can still be composed' (Latour 2011, p. 6).

Part of the pragmatist epistemology is to recognise the fallibility of any knowledge claim. Its context, where it may be deemed useful and therefore truthful, is always limited. The challenge in the present is that even our descriptions are loaded with ideologies and values that are implicit in their practices. Dewey, in his democratic ideal, hoped for acculturation and assimilation. His common world was one of agreeable universals. For James, it was always in multiplicity. Stengers developed James' perspective in the Cosmopolitical, which rejects the assimilation from ever being possible and conversely embraces difference, beyond the

universalising commons that Dewey thought was achievable. Pragmatism has values that prescribe process, rather than product. The role for values is in the ensuing discourse, and the politics between the counter perspectives.

If forums that provide practitioners with the ability to 'slow down', to think about the meaning and conception of things, are no longer available, then they must be designed. As Boullier has stated of the Cosmopolitical, they will not occur on their own (Boullier 2015). These spaces must be created again, even as universities move towards the more pervasive 'fast science' (Stengers 2011b). The complexity of social problems is beyond the scope of individual human minds, even when data collection and processing capabilities are now expanded by technologies. The best defence against combative ideologies is not more 'facts' but an admission to the limits of knowledge. Forums for cosmopolitical discourse are *poietic*, generating new forms of discourse between actants.

The Cosmopolitical is inherently messy. It opens up a complex context that is always in the making. The Cosmopolitical adopts James' perspective of pluralism and contingency. It is a rejection of universalism in acceptance that humans can ever achieve a 'god's eye view'. James' pluralistic perspective was contrary to hegemonic philosophical practice. As James (1909, n.p.) states:

> It is curious how little countenance radical pluralism has ever had from philosophers. Whether materialistically or spiritualistically minded, philosophers have always aimed at cleaning up the litter with which the world is apparently filled. They have substituted economical and orderly conceptions for the first sensible tangle; and whether these were morally elevated or only intellectually neat, they were at any rate always aesthetically pure and definite, and aimed at ascribing to the world something clean and intellectual in the way of inner structure. As compared with all these rationalizing pictures, the pluralistic empiricism which I profess offers but a sorry appearance. It is a turbid, muddled and gothic sort of an affair without a sweeping outline and with little pictorial nobility.

To take James' pragmatism seriously is to engage with fallible pluralism, which gives responsibilities to each of us. It is, as James (1909, n.p.) said, a far more 'turbid and muddled affair'. To engage in this pluralistic process is to listen to others without denying or suppressing their otherness; to treat all participants with equal curiosity, as do MACOSPOL controversy mappers (Venturini 2010). We must not fall into the belief that we can explain others' views; rather, we must recognise the limits of our representations of them. It is true

that engaging in this level of pluralism is hard work; one that can never be completed. Yet, as Rankin (2011) argues, unfolding the smart city discourse into the Cosmopolitical does reinvigorate thick description. Smart city tendencies are to reduce what counts in the city, while the Cosmopolitical radically expands the diversity of what counts. It does this without prescribing a present, a problem or a solution.

Contributions

The idea of a PhD addressing a 'gap' in knowledge is truly representative of 'the moderns'; a view from which I distance myself from through the use of pragmatism. A gap in 'knowledge' assumes that knowledge is a whole, and can accordingly be completed. 'Knowledge' itself is also reification, for considerable breakthroughs in knowledge at an individual level changes everything; it does not merely 'fill' a gap. As a learner, the knowledge seeker may then reinterpret everything he or she knows through this new lens. As Johnson (1989, p. xi) states, the 'gap in knowledge' mentality is limiting to inquiry:

> If I perceive my ignorance as a gap in knowledge instead of an imperative that changes the very nature of what I think I know, then I do not truly experience. The surprise of otherness is the moment when a new form of ignorance is suddenly activated as an imperative.

This is an exploratory thesis. Its contributions are propositional. It makes the reader apparent to this 'new form of ignorance' (Johnson 1989, p. xi). I propose that both the reader and the smart city practitioner can be brought at least partially along this journey of discovery. This is the continual thread of making the familiar strange, and the strange familiar; to provoke the reader to challenge his or her own preconceptions. This is intended to enact the same relating processes that the smarter city requires. Much of the contribution of this thesis is in 'upstream' thinking, a world view that will lead to significantly different city-making practices than are afforded by the existing smart city discourse. Dewey's 'definition of inquiry' (Dewey 1938, pp. 104-105) is a partial explanation of the intended outcome of this pragmatist PhD:

> Inquiry is the controlled or directed transformation on an indeterminate situation into one that is so determinate in its constituent distinctions and its relations as to convert the elements of the original situation into a unified whole.

Has this been achieved? Do these relations 'hold together'? Have I been able to explain how these relations connect and provide a unifying argument for their inclusion? Across six themes, this section now outlines some of the arguable contributions for:

- the smart city discourse
- design
- ANT
- research and social science
- pragmatism, and
- describing the social in the 21st century.

For the smart city discourse

Hollands (2008) described the smart city as an urban 'labelling' phenomenon, where the ideology reveals, as well as hides. This study's pragmatist deconstruction reveals in part what the label hides. Pragmatism provides an alternative epistemology and ontological bases, yielding an alternative reassembly of the concept. This reassembly addresses several of the discontents within the existing smart city discourse.

Limits of current smart city discourse were identified in Chapters 1 and 2. Kitchen called for genealogical studies, which this thesis provides. This genealogy was taken to the extreme through the adoption of pragmatism. Importantly, this thesis addresses two different projects that are not canonical examples of the smart city. In-depth empirical studies are a means to provide comparative research of these two projects operating within the same city. These accounts provide, as Shelton, Zook & Wiig (2015) encourage, descriptions of 'the actual existing smart city'.

This approach places the smart city into an urban ecology made up of existing people and things. Pragmatism and ANT enabled the socio-technical nature of the projects to be treated with symmetry, addressing a dualistic limitation of the discourse as noted by Meijer & Bolívar (2016).

Smart city initiatives, like all projects, are subject to contingencies; they are far from utopian. They do not exist beyond the prevailing relations of cities. Budgets fluctuate, people have limited attention, staff change jobs, technologies fall in and out of favour and feasibility, and so on. Politics must be engaged to make any smart city project happen. The smart city can be

all things to all people. In empirical cases, projects are used as a means to pursue many agendas. Through pragmatism, this study has stripped out the implicit 'value' of the smart city, leaving only explanations of the relations of stabilisation and destabilisation. From this more process-based description, more entities and their contexts become relevant.

This research contributes to a reassembling of the smart city along pragmatist perspectives. It makes clear what it takes to engage fully with a research paradigm in which the limitations of smart city discourse are more directly addressed. Entangled in this exploration was policy, neoliberalism, automation, climate change and inequality. The smart city discourse is presented as unable to be isolated from these contemporaneous issues. With pragmatism, these issues are made relevant to the reassembly of the smart city discourse. This thesis presents indeterminacy, ambiguity and multiplicity as unavoidable. This view is in stark contrast to the control and universalising paradigm that dominates the more commercial aspects of the smart city discourse.

As Kitchen (2015, p. 135) explained, the discourse is in its infancy in conceptual development and empirical understanding. This research has contributed to both challenge the current discourse, and to propose alternative conceptions that would contribute to a more complete knowledge system. Pragmatism both challenges what the smart city label shows and displays what it hides.

For design

Design has been co-opted by the same forces of the smart city. This movement is, in part, visible in the recent business fad of 'design thinking'. An immense variety of design is represented in this thesis. It opens the black box of design: of cities, organisations, information systems, and of research. This thesis is a reflexive application of design (Rölli 2016): using design process to study design process. The language of enactment—of scripting and performance—is reiterated throughout this thesis. This definition (Akrich 1992) enables design and ANT to be bound together, providing seamless movement from description to action. I offer a means for designers to begin to engage with ANT and its process-relational ontology, thus exposing them to many of the core tenets of pragmatism. Studies using ANT will continually question dominant ways of thinking.

Design is, as Manzini (2015) describes, an innately human practice. Furthermore, those practising design professionally move into increasingly diverse fields. This thesis seeks to further design discourse away from its rational and industrial scientific logic, reconceiving it as a practice of continual making, rather than make and use. It is no longer just a craft but has transitioned into a knowledge practice. It contributes to the emerging discourse of critical and speculative design by demonstrating the connections with pragmatism, in the fallibility of all propositions and in the understanding that artefacts in use in this thesis are always incomplete and 'in the making'. This inquiry is about prefiguring design practices to make available options that would otherwise be unavailable.

This inquiry is *ontological designing* (Willis 2006); it is to do with design as formative in the nature of being. It is a recognition that design is shaped by existing design, that designers cannot escape their context from which they design. Our contexts are made of design. We inhabit the solutions to yesterday's problems. Our conceptions of reality are created by us; they do not exist out there to be discovered. The ways we describe ourselves in relation to each other and things matters, as it shapes what we think exists and what and how those things can be changed. Designers need more philosophy and philosophy needs more design.

For ANT

A further contribution is made with this thesis to the ANT 'and after' literature, where ANT continues to dissolve into other forms of inquiry. The connections between ANT and pragmatism are not abundant in literature. Indeed, to make those connections requires a deeper reading of the tenets of pragmatism. ANT has dense, theoretical principles, impenetrable to many. It is noted, however, that ANT could enrol more people with its process. This research makes these principles available to those who may not have the time nor attention to dedicate to understanding ANT. This thesis describes the application of these epistemologies through in-depth cases, yet enacts these through other means of performance. Through the visual method of a simple gestalt, this thesis has made the principles of ANT easier to grasp. The gestalt is an image that can be viewed on multiple levels. It enacts ANT through performance. These other means of visualisation and scripted workshops have the potential to enrol other actants in their networks, further increasing the influence of ANT for designers. This approach has been a reflexive contribution for turning the ANT process back on research, but this process deserves further exploration.

For research and the social sciences

As Rorty (1991, p. 175) has stated: 'the way to re-enchant the world…is to stick to the concrete'. There is no need to flee into mysticism and abstraction. Social science concepts and practices today are challenged, trapped in description wanting to be theory. However, description can be used pragmatically, as proposed as 'phronetic' research (Flyvbjerg 2001). Phronetic studies are those that help others understand situated decisions and actions of practitioners in their contexts, relating to Aristotle's *phronesis*. For Aristotle, phronesis is a way of dealing with the wisdom of practical or situated knowledge. Flyvberg argues that phronetic researchers seek to transcend the problem of relevance 'by anchoring their research in the context studied and thereby ensuring a hermeneutic 'fusion of horizons' (Flyvbjerg 2001, p. 132).

Ethnomethodology (Garfinkel 1967), as engaged by ANT (Latour 2005b), is a useful means to understand this situated practice. ANT adheres to treating all of these perspectives with equal curiosity. It is open to creativity, in terms of process and performance, in ways that other social research methods are not, and contributes to an alignment between design and pragmatism.

This question of relevance of research to practitioners is addressed by Fendt and Kaminska-Labbé (2011) in management studies, arguing that the coherence mindset of pragmatism and design is a means of bridging the 'relevance gap' between theory and practice.

Transdisciplinary practices cannot be brought into a universalising common world, but rather into a plural one. Instead of seeking a universal, or 'correct' theory, it acknowledges the discourse of usefulness and enactment inside multiple realities. Relatedly, there is a synergetic quality of design and the social sciences. Indeed, further integration between the two can help design practice develop more capabilities in ontology and epistemology. The social sciences offer effective means for broadening an understanding of society. These accounts represent ideal input into design practices, as they frame and reframe situations in ways that designers may not have previously considered. As design adapts in these complex times, the social sciences may help to enhance design's ontological and epistemological capabilities, to know what is required to be known. Conversely, the social sciences will become reinvigorated through a far broader application and many more practitioners using their descriptive methods.

Research practices in general are moving towards 'fast science' (Stengers 2010). Researchers are increasingly dealing with uncertainty (Funtowicz & Ravetz 1991), and knowledge is often co-generated with practitioners (Gibbons et al. 1994). This research proposes a means to enact a multiplicity of perspectives in a performative approach. It is by its nature interdisciplinary research, but facilitates transdisciplinarity through the creation of a structuring language: ANT. In turn, ANT offers vocabulary to speak to the processes of stabilisations and destabilisations between heterogeneous actants in any context. This approach develops an emergent role for researchers as facilitators of public discourse.

For pragmatism

To many, pragmatism is understood only in its vulgar or common form. Vulgar pragmatism connotes the 'practical', but it also connotes a ruthless, Machiavellian search for mercenary or political advantage. Even James distanced himself from this form. These understandings confuse the value of *philosophical* pragmatism. This thesis intends to demonstrate through application the usefulness of philosophical pragmatism to problems of 21st century cities.

Philosophers are catching up with pragmatism. Today there is a much more vigorous, extensive, global discussion about the multifaceted aspects of pragmatism than at any time in its history. The persistence and cosmopolitan vitality of pragmatism is emphatically present throughout the world today. Peirce, James, Dewey and Mead were ahead of their time, explaining many postmodernist ideas almost a century ago.

This study enacts philosophical pragmatism and its tenets. It demonstrates what it is like to think about the world through the pragmatist epistemology. Latour (2007) encourages us to 'ecologise' instead of 'modernise'. The pragmatist, and specifically the cosmopolitical interpretation of the smart city discourse, has been ecological. It recognises that multiple realities and heterogeneous elements coexist, and that politics should be embraced, rather than avoided. This approach recognises that the smart city exists only in language. This discursive approach needs continual work; work that is 'in the making', and always 'becoming'. As all entities cannot ever be represented, there is never enough time or resources. The pragmatist philosopher can at best present a different view. The pragmatist knows there is always more to do; that everything that is relevant now may not be in future.

This thesis draws together the many voices of pragmatist thought who, each in their own way, challenge dominant ways of thinking. It makes pragmatist perspectives available for wider use through the translation of complex theoretical adherences into visual supports for discourse. The visual leads practitioners into their own situational complexity.

For describing the social in the 21st century

As described in Chapter 4, Latour (2008, p. 9) asked, '[w]here are the visualization tools that allow the contradictory and controversial nature of matters of concern to be represented?'. He argued that '[w]hat is needed instead are tools that capture what have always been the hidden practices of modernist innovations' (p.9). This research is a contribution in response to this question. It too rejects the stable ways of communicating truth and knowledge for experimental means, argued to be more relevant for the changing times. This pragmatist reassembly aims to do just that for the discourse of the smart city. It offers an argument that the smart city is about processes in the making. They are experimental as their outcomes are always unknowable; they propose new relations that have never existed before.

This thesis prefigures the politics of the urban context using a more contemporary enactment. Learning from the trials of the MACOSPOL project, the newest technologies are sometimes the least useful in terms of transferring information in real social settings. This is the innovator's dilemma: demonstrating in practice the risks of adopting emerging technologies too early (Christensen 2013) and the benefits may not be worthwhile (Akrich, Callon & Latour 2002). The MACOSPOL projects used complex 3D mapping software, which brings its own limitations in inaccessibility and learning to navigate a new system (MACOSPOL 2007a; Venturini et al 2015). This led to results that are today largely inaccessible online or in reference materials. Instead this thesis utilises, not the leading-edge representation, but a mode that is already ubiquitous: a pdf. In a few years, complex 3D mapping software will no doubt be more readily available, providing a more accessible, robust alternative over time.

The Cosmopolitical and the visual methodology in this thesis enact a new conception of the urban cosmos. Designers use spatial orientation of concepts. Moreover, they use drawing and sketching to portray these concepts. Arguably, these are a better medium through which to portray this knowledge to designers. The visualisation leads into the complexities of both context, and a processual methodology. It is a surface view, easily graspable as a whole, and

yet, contains the richness of thick description of events that are not adequately articulated in existing media. This interpretation supports the phronetic, and ethnomethodological, perspective of understanding how situated knowledge is applied in practice.

However, the thesis is not just the visual histories, nor is it the thesis itself. It is a network which connects many seemingly disparate actants through 'making'. It links the challenges from many discourses into one more determinate context. It is here where proposals have been put forward for how these problems can be more adequately and discursively addressed. The thesis proposes other ways to have conversations; to expose designers to other ideas and concepts that will shape their practices. This prefiguring influence gives designers more optionality, to work towards the stabilisation of relations in their own contexts. The intention is to lead to experimentation more quickly, across a broader variety of relations.

Moving from conflict and controversy to conversation enables the important process of making difference 'discursive'. It is no longer a process of destroying difference for universality. This thesis offers one approach—'one way', in one situation—that can be carried out.

Specifically, the visualisation is scripted for designers in the urban setting. However, there may be other applications, such as healthcare, climate change, inequality and democracy, that could benefit from constructed cosmopolitical forums.

We can never completely control or predict what will happen in the future. In the empirical cases studied, the future is not known for any actor; they can only act in relation to speculations, and respond to this emergence. Ideally, we prepare ourselves for unexpected contingencies and contexts. For the pragmatists, knowing is a form of doing. Describing the social for the 21st century is not about describing at all. It is about enacting relations, creating them through continual 'making'.

Limitations

I now consider the limitations in this thesis. Is it a believable story? This study holds together a network of authors, ideas, places, technologies, symbols and meaning. It is the culmination of many experiments in context. Like all idiographic research, it cannot be repeated. However, these ideas can be translated. Indeed, this research must be reused, reinterpreted, copied,

changed and challenged to become pragmatic. This research observes the specifics of two empirical studies, and from there, attempt to reassemble the smart city discourse.

As for claims beyond the contexts that, only the reader can assess the validity of any of these concepts for other contexts. As Culler (1997, p. 67) states: '[m]eaning is context bound, but context is boundless…'. It is a matter of interpretation. Moreover, as Chia (1996a, p. 201) comments, '…context is unmasterable and meaning is always incomplete'. While there is some attempt to explain this discourse at a local and a broader level, the explanations still omit immense amounts of context. There is no means to include other than what can be written in this document and accompanying visual histories. Explaining the local is the purpose of this thesis as it is a counter perspective to the prevailing discourse. It offers a means to provide accounts that are more realistic and believable about smart city initiatives in practice, but neither view is a 'full' picture.

The research data could have been represented in many ways. The ultimate visual history format is just one enactment of relations that has only been performed to date in a couple of workshop forums. The insights are almost anecdotal, and there is no way from the study to really know what influence the visuals had on the conversation, as no forum with the same purpose took place without the visuals. But this is how pragmatist inquiry works. It is broader, perhaps shallower, in many ways than other research paradigms. However, it is deeper in terms of explanations of relations. It is about relevance not objectivity. Pragmatism's fallibility of knowledge is not to say that all knowledge is false or made up, but rather that the best explanation we have at the time is exactly and only that.

This account must be treated as an experiment. Experiments are uncertain. Yet these uncertainties have been intentionally designed into the visual histories' description of the smart city, as these uncertainties exist in practice. For Latour (2004a, p. 69):

> Because this text, depending on the way it's written, will or will not capture the actor network you wish to study. The text, in our discipline, is not a story, not a nice story, it's the functional equivalent of a laboratory.

Whether the rendition is believable can only be judged by the reader. This document, and the accompanying visualisations, have traces to many events and discourses: it has not represented

them, but translated them. In this thesis, events, conversations, satellites, phones, books, text, have, through description, have become actants themselves.

Certainly, this research, in the nature of pragmatist inquiry, accepts time, resource, attention, and the constraints of the network, within which I acted. This research was limited by time, resources, capability, inclination, dispositions, access, and the actor-network of research. The study in practice did not follow a rational order. It was not a process of literature review, question, empirical study and conclusion, but rather an emergent process, where all of these activities took place simultaneously. However, for legibility, the arrangement of this thesis reverts back to a normative ordering. This is was a pragmatic choice, in order to make something that would be accepted by the actor-network of academia. For I have been successfully enrolled.

Pragmatism was, admittedly, only better understood towards the end of the study. ANT similarly took two years to fully grasp. With this came the realisation that I had to understand the world as made differently to my previous perception. In emphasising method, the voices of those practitioners I worked with faded. Like all writing, many of the these limitations are due to the many choices that were made in the creation of this thesis. Some aspects are emphasised at the reduction or exclusion of others.

Further research ('in the making')

Isn't Darwin right? Isn't creation continuous?

Aramis, in Latour (1996c, p. 295)

This thesis is concluding, but the research is not. This thesis is just one interpretation that intends to retain its relevance as participants in the case studies move on to other problems and other roles. Is this research relevant? Only the reader can really judge. Is there anything that will be remembered or translated into another context in action, or does it just remain another ANT story; a story of the negotiations of heterogeneous actants; another story of movements of enmeshed people, artefacts and ideas (Law 2006)? This thesis accords with the words of Chia (1996b, p. 54), who has said of his own work:

> [A] piece of text itself must be seen as an effect of 'heterogeneous engineering' driven by an initial authorial 'will to order''. It is a product of a whole network of interactions which shape and form not only the account itself but also its author and perhaps (who knows!) possibly even some of its readers.

The approach taken in this inquiry, if replicated, presents an opportunity for researchers to engage in the irrevocably political nature of their everyday practices. The findings presents a role for change makers in urban contexts to embrace politics (Fry 2010). Philosophical pragmatism situates all concepts through their effects in relevance to others. It is this which deserves more attention. For others, there is still much to do. Anthropological studies of emerging disciplines and spaces are important, as these are the edges of the modern world. The specific vocabularies of ANT as a social theory is presented to support the process of design. Currently few designers access social theories due to the inaccessible nature of the journals and forums in which they are discussed and the dense theoretical underpinnings upon which they rest.

The thesis and visual histories more specifically are intended to be a tool, an object of use, towards an alternative constitution of the public space, and the renewal of the urban environment. This is the notion of translation; the betrayal of the document of the variety and nuance of lived experience; the formidable, but inescapable reduction of the actants' perspectives that contributed to this research. However, in doing so, something is made. Ideas are made anew and connected. Something—a new entity—will exist, which echoes much of the past that needs relaying into the present; a present in need of alternative perspectives.

Whether this static, immutable mobile is passed around digital networks and read will remain to be seen. Regardless, my own practice is already different. The theory is now embedded in my design practice. A richer *design-world* (Schön 1988) does provide a much more flexible basis from which to design; a basis informed and shaped upstream by ontology and epistemology.

Concepts of ontology and epistemology are unknown or invisible to the vast majority of practising designers, yet they design with these concepts unconsciously embedded in their practices. This means that designers need access to social theory. In my experience, some of the best designers are not even aware of their biases. Yet, a developed philosophy provides cognitive flexibility to allow the designer to more objectively describe and, through chosen ideologies of their own design, engage with the world. My own further work will extend my

lifetime of conversations and new experiences; including whether I enrol others into a distinctive take on events. A major learning of this thesis is that design needs philosophy.

This thesis has been both an ethnography *of* design and ethnography *for* design, aimed at the rapid, discursive practices between designer and the making of the visual histories of *Responsive Environments* and *Real-time Applications*. While these projects have their own contexts, the diversity and contingent relations that emerge in time are telling. What materialises is a 'slow ethnography' (Yaneva 2017, p. 37), not only of smart city practitioners, but also of the creation of science itself.

Perhaps it is easier to form an argument for the future if we can believe that relations have always worked this way, with clear and linear paths, definitive categories and stable objects. In looking closely, however, these rationalist beliefs cloud the judgement of practitioners and, if unquestioned, can only allow a limited argument for possible futures. Ironically, to go back to that which is unclear, hidden or forgotten is what is actually needed for more open interpretation of our futures. I believe this is important and continual work.

This thesis demonstrates a means to move through such a pragmatist conceptual space, while showing and shows the limitations in doing so. It associates the activities of two dozen practitioners in their contexts, as they each designed their courses of contingent action, based on the information they had at the time. As a document, it is itself a network, tying academic quotes, ideas and discourses to specific places and times. It creates and translates a new position in relation to the phenomenon studied.

The thesis formulates a network of hundreds of authors, linked to their papers and books, and dozens of traditional disciplines that have been held together through their pragmatic relevance. In the spirit of experimentation, this thesis holds these issues together, to make, in Dewey's words, a 'unified whole', albeit briefly in a context that will not endure: it is always in the process of becoming 'other' than what it was. In multiplicity, nor will it ever be just one thing.

Will this research ever be translated?

My text is in your hands, and it lives and dies through what you will do with it. In my efforts to forestall certain outcomes and encourage others, I too, muster all available allies, all linguistic possibilities.

Latour (1988, p. 171)

The success of an Actor-network is its ability to enrol others. Latour treats his own writing as a means of enrolling others, namely in the work of translating his words into actions. By repeating Latour's statements and meaning, this thesis enrols others in Latour's perspectives. This makes him evermore influential, due to his larger network. As a result, his views become more widely used. Indeed, ANT is a methodology that has enabled me to better understand pragmatism, to question traditional ways of thinking, and to further develop philosophical language. ANT, through its repeated application, it has unsettled my deeply ingrained biases. However, it alone will not resolve issues or implement direct change like design can. Both ANT and pragmatism, however powerful, are not able to tell designers what to do. They are dispositional 'performative' approaches which help researchers understand and relate differently to the world.

Turning to this thesis, was it enough for anyone to learn something? To think about something differently? Or make available some language or visualisation that can be taken, adapted, or enacted anew? Only the reader of this thesis, or the users of the visualisations, can answer these questions. I have attempted to faithfully represent many voices, but understand the inability to faithfully 'represent' anything. As Latour (1993, p. 148) states:

> We give voice to those whose support is necessary to us. Faithful translators or unfaithful traducers? Nothing is known, only realised through a trail of strength. Politics is probably the nest model that we have to understand this relationship between forces and their spokesperson. That which arbitrates the final resort-fidelity or infidelity, conviction or scepticism – is the angle of the direction in which we wish to go. My account will seem convincing only if it allows readers to go faster in the direction that they wanted to go in any case.

In the spirit of the performative nature of this inquiry, I cannot really know what will become of this research, or who may see something in this that I did not. Borrowing Alexander's terms,

leaving the research as a dense 300-page document was not a 'form' that 'fit' with the context (Alexander 1964). The thesis and visuals have been designed in such a way to be extractable, to be traceable, so that researchers can find more information and guidance for their own enquiries. The visuals are specifically designed to enrol others, to be shared through mediators, and flicked through, or zoomed in and out of, for a second; a minute; an hour. The script for this performance has been designed with this in mind.

However, how exactly this research will be translated is unknowable. Like Latour's explanation of '…Pasteur and his followers [who] fought against microbes, made towns habitable, gave the networks of hygienists, surgeons and army doctors the continuity that they lacked' (Latour 1993), it is hoped that this thesis will give designers a sense of continuity in their conceptualisation of urban practices. It offers a conceptualisation that is most open to pragmatist experimentation where contextual relevance drives action; open to curiosity and questioning, rather than predefining ideologies. There are no prescriptive definitions of how new relations will stabilise into new assemblages.

In continuing this translational thread from the previous chapter, a PhD thesis is a rhetorical argument for specific, contextualised knowledge at the expense of other pre-existing knowledge. It brings certain notions and representations to the fore, whilst reducing, rejecting and excluding others. This occurs through adherence to the inscribed performances that are dictated by the socio-material assemblages of academia and contemporary organisation. This results in a lengthy written document, which adheres to the minimal processes and 'rules' of a thesis, thus making it available and accessible on specific forums that it would not otherwise occupy. A successful thesis does the minimum, but an exemplary thesis will manage to build an actor-network from its definition of a problem space. If the concept resonates with an audience, the thesis may be looked at hundreds of times and referenced in other publications. A PhD's author may be invited to events on the back of their research; perhaps fortunate enough for a post-doctoral position, but perhaps, none of this will happen. As Latour has reminded us; '[t]he best you will be able to do, as a Ph.D. student, is to *add* a text read by your advisors and maybe a few of your informants' Latour (2004a, p. 68, emphasis original).

The only 'guaranteed' readers of a thesis are the markers. Perhaps, this thesis will ultimately be resigned to take up a few megabytes of University of New South Wales server space, using a few extra cubic centimetres of CO_2, in the lifetime of its storage. Regardless of the fate of this

document, the knowledge will be continually performed into being through my own research and design practices.

The PhD in practice is a process of reflecting in and on action, towards several ambiguous goals, a range of actants that make the resolution of their differing perspectives the principal design activity. The contribution of this thesis is the provision of pragmatic knowledge towards the development of the urban, in terms other than those defined by the existing smart city discourse.

Even this is not an end. There is an openness to what this research may become. It has proposed a method that has been useful in this context. The Cosmopolitical has enacted the ontological politics of the smart city; the multiplicity of realities that exist in continual negotiation. Law (2004a, p. 143) has explained how method acts both within, and after, ontological politics:

> Method is not…a more or less successful set of procedures for reporting on a given reality. Rather it is performative. It helps produce realities. It does not do so freely and at whim. There is a hinterland of realities, of manifest absences and Othernesses [*sic*], resonances and patterns of one kind or another, already being enacted, and it cannot ignore these. At the same time, however, it is also creative. It re-works and re-bundles these and as it does so re-crafts realities and creates new versions of the world. It makes new signals and new resonances, new manifestations and new concealments, and it does so continuously. Enactments and the realities that they produce do not automatically stay in place. Instead they are made, and remade. This means that they, at least in principle, can be remade in other ways.

What I propose is that method can enact the complexity of urban relations. As Law (2004a, p. 143) explains:

> Method, then, unavoidably, produces not only truths and non-truths, realities and non-realities, presences and absences, but also arrangements with political implications. It crafts arrangements and gatherings of things – and accounts of the arrangements of those things – that could have been otherwise.

The approach taken emerged within a specific context. I do not suggest that this research should be applied in other locations, situations and assemblages. Rather the opposite: that researchers and practitioners should take this research lightly, to translate what might be

useful experimentally to their own situations, and commence the task again of describing social relations.

This thesis is held together through the application of consistent pragmatic principles that focus attention on describing the world anew. I have explored pragmatism beyond epistemology, into its fundamental ontology of process. This ontological perspective has great implications in reshaping conceptions of the smart city, producing new patterns without a single and definite structure. As Law (2004a, p. 142) contemplates: '[p]erhaps things hold together precisely because they don't'.

It is only in the translation of this thesis that my inquiry becomes genuinely pragmatic.

Afterword

For the last decade, I have been closely following the advancement of design. I have been practising the adaptation of design as it has departed from its industrial roots. Design practises are designing services, organisations, and social systems, but has been largely co-opted into consumer capitalism. This research has continued my practices in an activist agenda. To demonstrate that design can prefigure our experiences in ways that could address some of the more intractable problems of our time. Activism is part of design, and part of the pragmatist worldview. It is a hopefulness towards preferred situations. Participatory design—a field I have been involved in for several years—began, through activism, to make the lives of workers better as technology entered workplaces. Since the 1970s, technology has become pervasive, beyond what could have ever been imagined. There are now even more pressing questions about how nature and technology support the ways we live, and the effects that these ways of being have.

I am in agreement with Latour that a more varied range of literature and performance methods will improve the usefulness of academia. The often detached language of scholarship does little to sway the popular mind in times that demand critical action. It is perhaps only with the additions of more poetic and artistic approaches that we will see prefiguring capable of addressing these issues. Can we make shifts in consciousness capable of dealing with the complex nature of our contexts? Can we help people see it again for the first time?

One of my annual candidature review panel, Prof. Bruce Judd, referred to this thesis as an 'Anti-thesis'. It was, in his view, against the idea of a doctoral thesis. I agreed with him; at least in the sense that it challenges standard academic practice. While exploring research practice with the pragmatist epistemology, this thesis draws attention to areas in which academic practice may no longer be relevant.

Social research tends to have the character of activism. I heard somewhere that an activist tries to change what the world pays attention to. It is not surprising that Donna Haraway, Isabelle Stengers, Bruno Latour and Saskia Sassen all use pragmatist methods to counter the hegemonic discourse for attending to different relations. I have found all of these authors through affinity with their ideas and their affinities with other scholars. It was only through further exploration that I understood that they all share a very similar philosophical

perspective. It would be remiss for a pragmatist to ignore the all-consuming issues of our times.

Looking forward, it appears there will be increasing integration between the human and technological, as our destinies become intertwined. It is time we moved beyond the clumsy categorical distinctions of Cartesianism and modernist practices. It is time for approaches that enable us to observe the intricacies of these relations. This work is ongoing and continually challenging to the stabilising practices of human knowledge in order to progress.

This thesis has been my exploration as just one actant amongst a plethora of others in attempting to make some sense, some relevance in practice, that is of use in addressing these contemporary challenges. I can only hope that there are some seeds planted that others can germinate in their own fertile grounds, and that they may have more success beyond the confines of a doctoral thesis.

This research has also been a chance to slow down, to be less sure of what I knew. Politics is now understood to be enacted through every interaction. As publics ebb and flow with controversies, the potential for design to radically reshape the world becomes ever present. Conversations, sketches and ideas, all hold the potential for revolution. As in the concepts of pragmatism and ANT, they can reassemble just what it means to make a city. Like escaping from Plato's *allegory of the cave*, my world is radically different now, and I cannot unlearn what I now know. But as Plato's allegory teaches us, knowledge cannot be imparted directly.

To let go of stable processes is to become a more attuned designer, one that takes less for granted. All models are approximations; all theses are arguments; but they are also just thoughts, lines of symbols, on paper or pixels, before they are translated. As Rorty (1989) argues, for the pragmatist in philosophy, all one can do is provide a different account to what already exists.

*

In early 2017, commencing a new project with a professor of management who asked me, 'under what conditions do these networks form?' I replied;

> I think it will be fascinating for us to compare perspectives, as I think we come at these issues from very different perspectives. I am from the pragmatic perspective of organisational studies, where

> research looks to real situated relations and see traces of the macro systems within them, and how the micro can turn into a larger system. ANT is powerful because it can describe relations between anything - people, buildings, phones, the sun, flies, carbon dioxide. ANT attempts to avoid reified categories and dualisms to focus on relational descriptions. 'Network' in ANT is poorly translated from the French word *reseaú*, which means 'net' (like a fishing net). It speaks to what connects points together, the thread itself, rather than the connected nodes of the network (as in English). It is a slight difference, but enormous when it comes to the research focus. No assumptions are made about how things are connected and must be explained, whereas inversely, relational attributes are often explained away without definition by saying things are 'networked' or 'social'. ANT does not lead to universalising rational theories.
>
> In light of your question, from my perspective and experience, I would say it's a mistake to assume we can in any detail articulate and specify the conditions under which these actor-networks arise and form, as they can, and do, happen in an infinite number of ways. Perhaps there are patterns across things, which are invoked by the researcher or participants in retrospect, but we can never capture the complexity that was involved in these past contexts.

It was in this reply I realised I had really learned something. His question was jarring and I wanted to explain why. These concepts had become important. I had a different perspective that was worth rebuttal and I was ready and willing to state my case. His question was misguided under the pragmatist research paradigm I had used. Pragmatism is an useful philosophical perspective, one worth defending; for now.

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APPENDICES

Appendix A: The ARC research grant

This appendix briefly outlines the research grant that this project was partly funded by: Australian Research Council (ARC) Linkage Project 'Responsive Transport Environments' (Project ID: LP110200708) (see Haeusler et al 2010). This grant was part of the 'Linkage Project Scheme' which 'promotes national, and international, collaboration and research partnerships between key stakeholders in research and innovation including higher education institutions, government, business, industry and end-users. Research and development is undertaken to apply advanced knowledge to problems, acquire new knowledge and as a basis for securing commercial and other benefits of research' (ARC 2018).

Details of the Grant

The ARC Linkage Grant 'Responsive Transport Environments' (LP110200708), was carried out between August 2012-August 2015, in Sydney, Australia. The grant involved three Sydney universities; the University of New South Wales (UNSW), the University of Technology (UTS), and the University of Sydney. The chief investigators were M. Hank Haeusler (Built Environment, UNSW), Michelle Zeibots (The Institute of Sustainable futures, UTS), Nathan Kirchner (Faculty of Engineering and IT, UTS), and Martin Tomitsch (Architecture, Design and Planning, University of Sydney). Industry partners included Transport for New South Wales, Sydney Trains, and City of Sydney, which gave in-kind contribution of time, and access to materials and IP. Additional industry partners providing both financial and in-kind contributions were ARUP and Grimshaw Architects.

ARC Grant Number: LP110200708 (see Haeusler et al 2010)

Project Title: Responsive transport environments: spatial and visual user information technologies to allow improved passenger flow and a better customer experience

Project Summary: Australian public transport environments are challenged to cope with growth in population. This research investigates a complementary approach to transport infrastructure expansion – and its associated costs, disruption, energy use, and implementation periods – through the use of responsive digital information to facilitate improved passenger flow and to offer a better customer experience. The study objectives are: to investigate related research and projects in the area; to research user and other stakeholder requirements; to design, deploy and evaluate prototypes in real locations; and to develop spatial and architectural integration of digital technologies and their application in public transport environments.

Aims of the Grant:

- to investigate related research and projects in the area;
- to research user and other stakeholder requirements; to design,
- deploy and evaluate prototypes in real locations; and
- to develop spatial and architectural integration of digital technologies and their application in public transport environments.

My research focus in relation to the grant

The research presented in this thesis followed personal interest, capabilities and a project necessity to investigate two of the objectives, namely;

1. **Investigate related research and projects in the area**

   The 'related research' was perceived as the context of development of the transport information systems, specifically the related discourse of the Smart City. Typical to Smart City initiatives, both of these projects leverage digital information systems to improve and optimise the use of public infrastructure and assets. In the related research, other projects

explored deal firstly with this methodological dilemma, describing examples of where such a complex project has been described using pragmatic approaches.

2. **Research user and other stakeholder requirements**

The pragmatist approach and specifically, Actor-network theory, enabled the introdyction of a specific language of the networked relationships between 'users', 'stakeholders' and additionally 'nonhumans'. Stakeholders are considered in this research to be any individual, group, organisation or technology that is within the network of the project. As such, the scope of this enquiry is broad, and preferences variety of a plurality of perspectives over depth of enquiry into any one perspective. This drew significant methodological challenges, which became the central research enquiry in seeking pragmatic knowledge for the context.

Positioning this thesis in relation to the grant

The perspective taken to describe these projects, reveals the enormous and largely unknowable complexity in the development of these systems. The way these projects emerge is more a matter of contingent action in context, rather than rational planning. Regulatory and ownership patterns, legacy technological systems, public relations, institutions that regulate planning, the interconnected nature of infrastructure networks, and the financial methods for development all influence the outcomes.

Relevant to the grant, this thesis explains negotiations that shape smart city initiatives in practice. In these narratives, the technical qualities of a project often matter less than the perpetual interplay of these self-interested parties. This thesis finds that the challenges in improving customer information services in public transport in this Sydney context are not purely a matter of finding the right technologies. Rather, it is a question of enacting technologies in arrangements of many actors (human and non-human) that are involved in bringing these projects to form stabilised, functioning and adaptable systems. Importantly, the thesis presents the pragmatist epistemology as an important counter methodological perspective to the dominant universalising and reductive discourse of the smart city. Moreover, that the pragmatist ontology can provide new metaphors for understanding cities in new way

Appendix B: complete list of ANT vocabulary and case examples

This appendix is a more complete list of ANT vocabulary and infralanguage than what appears in Chapter 4. As it earlier appeared, the examples are used from the case studies to illustrate their meaning.

Table 7: A comprehensive list of ANT vocabulary and infralanguage and how they relate to the case studies.

Vocabulary	Definition	Examples relating to the case studies
Actant (actor)	'Something that acts or to which activity is granted by another…an actor can literally be anything provided it is granted to be the source of action' (see Latour 1996a, p. 373) 'Whatever acts or shifts actions, action itself being defined by a list of performance through trials' (Akrich & Latour 1992, p. 9).	Examples include a train, driver, bus ticket, passenger, policy, or sign.
Assemblage	A group of objects of different or similar types found in close association with one another. What is assembled.	A train station – consisting of trains, platforms, information systems, conductors, ticket machines, customers, lighting systems etc.
Betrayal	Betrayal refers to the breakdown of the actor-network, in which an actor acts outside of their defined role. Also referred to in French as 'traduction'; betrayal in the process of translation. It signifies the idea that, in any translation, something is lost.	When someone jumps the turn-styles at a train station to not pay their fare, or when a train ticket fails to work in the machine.
Black-box	A technical term for a device, system or object when it is viewed in terms of its input, output and transfer characteristics without any knowledge required of its internal workings (Callon 1986a). 'The way a scientific and technical network is rendered invisible by its own successes' (Latour 1999, p.304).	How the train system functions, to most people. They get on and off the train with no concern for the engineering and systems that ensure the train performs its role.

Vocabulary	Definition	Examples relating to the case studies
Co-optation	When actants seek to have their individual objectives agreed to by other actants as part of defining network objectives. Actants advance their goals by *enrolling* others.	High usage of the iPhone resulted in Apple's successful enrolment of customers agreeing with Apple's terms of interaction and functionality.
Description	To unfold, process from a technical artefact, a returning to the network that constitutes it. Inverse, or use of a *script*. To enact a scripted action.(Akrich & Latour 1992)	When a user holds the hand rail above their head on the bus, this action has been a scripted interaction by the designer of the bus interior.
Enrolment	When other actants in the network accept (or get aligned to) interests defined for them (Callon 1986a). Similar to co-optation, but relating to a focal actant. Contemporary ANT does not tend to have focal actors (see Mol 1999).	Transport system converting trips from motor vehicle or walking trips to using buses and trains.
Heterogeneity	The principal that networks contain both human and nonhuman actants, equivalent to Deleuze and Guattari's (1987) definition.	The transport assemblage contains many different types of actants, such as hard drives, handrails, buses, toilets, bureaucrats, bus drivers, government announcements and smartphones.
Inscription	The creation of artefacts that would ensure the protection of certain interests (Latour 1992).	Turnstiles prevent (most) people who have not bought a ticket from entering the station platforms.
Infralanguage	Allows the displacement from one frame of reference to the next; emphasises the actants rather than the researcher.	In the examples in this column, the ANT vocabulary helps the understanding of how the actants relate to each other on these terms, thus providing a new frame of reference to understand their relations.
Interessement	When actants must be negotiated with to accept the definition of the focal actor (Callon 1986a).	A government process of providing incentives to third party application developers so they work to develop real-time transport applications using the government's data.

Vocabulary	Definition	Examples relating to the case studies
Intermediary	That which 'transports meaning or force without transformation: defining its inputs is enough to define its outputs' (Latour 2005b, p. 39).	Downloading a pdf train timetable, people will receive the pdf exactly as it was uploaded. Or, the encoding of train timetable data into General Transit Feed Specification (GTFS), where all stops and times are metric numbers, for consistent use of other software that makes this data available to customers such as mobile applications.
Irreversibility	The '[d]egree to which it is subsequently impossible to go back to a point where alternative possibilities exist' (Walsham 1992, p. 42). While decisions are always reversible, irreversibility is similar to the concepts of 'lock-in', and 'path dependence' from management and systems theory.	The agreement of application developers and government agencies to use the data standard GTFS, which means all subsequent design and infrastructure decisions are made for this standard. Other examples would be the commitment to use railway guage in New South Wales of 1435mm (4ft 8 ½ in), and driving on the left side of the road.
Mediators	'That which can transform, translate, distort, and modify the meaning or the elements they are supposed to carry' (Latour 2005b, p. 39).	A train crosses a signal block. An algorithm uses this data to predict the arrival time of the train. This is pushed to a display screen showing minutes remaining, which is read by customers.
Mobilisation	Refers to a set of manners utilised by a focal actor to ensure that all actors have legitimate speakers to represent them in the groups and avoid *betrayal* from the latter (Callon 1986a).	To ensure that, for example, passengers who evade ticketing are factored into and spoken for in planning processes. Or likewise, for graffiti artists, so their voices are heard whilst avoiding destruction of property. Or more broadly that all suburbs their respective demands for public transport have advocates in the planning process.
Network	The integration of the material and semiotic environments. The relational meaning and materialities that hold actants together.	How a passenger gets to work on their regular bus.

Vocabulary	Definition	Examples relating to the case studies
Obligatory Passage Point (OPP)	An OPP is a situation in which all of the actors have to achieve their interests as defined by the focal actor (Callon 1986a).	When a government agency makes all stakeholders sign their confidentiality agreements, ensuring all information to be published goes through their media department first.
Problematisation	When actants must be negotiated with to accept the definition of the focal actor (Callon 1986a).	When a station platform is crowded and the government proposes to put attendants along the platform to direct the crowds; therefore defining the problem as to do with crowd control, rather than to do with capacity of trains or reducing the need to travel.
Punctualisation	Similar to *black-box*, the ability of parts of a network to be hidden, appearing as simpler assemblages.	A bus stop contains wind and rain shelter, route and timetable information, signals to drivers where to stop, has seating and creates revenue for its maintenance through advertising. All of these systems are punctualised as a 'bus stop'.
Script	To enfold, process into a technical artefact (Latour & Akrich 1992). Inverse of *description*.	When an architect designs a bus stop with a long seat, enfolding the planned use case of being able to accommodate up to four people seated at the same time.
Social	Consisting of relations between both human and nonhuman actants (Latour 2005b).	A social relation may be one between a bus passenger and the LED screen informing them which stop is next.
Speaker	Those that speak on behalf of other actants as spokespeople or nonhuman actants, such as reporting systems (Callon 1986a).	When a transport minister publicly speaks to the media to make announcements on behalf of the complex assemblage of the transport system. Or when pixels on the screen of a phone, speak for a train and the transport network by detailing the arrival time for a train.

Vocabulary	Definition	Examples relating to the case studies
Texts	Used to support rhetorical arguments.	Data on rail and bus usage is used to support a proposal for changes in services.
Transcription	How meaning is moved from one mode of script to another (Akrich 1992).	A static printed bus timetable can be replaced by a mobile application containing the same information.
Translation	The central tenet of ANT, which is the process of alignment of the interests of a diverse set of actors with the interests of the focal actor (Callon 1986a). To translate is 'a verb [that] implies the transformation and the possibility of equivalence, the possibility that one thing might stand for another (for instance a network) (Law 1992). These include *problematisation, interessement, enrollment* and *mobilisation*.	That a transport app on a smart phone, and digital screens on the platform, can replace a station attendant's job of altering station names and times on the (now defunct) wooden information boards. Or that walking across town could provide the same function as catching the bus.

Appendix C: Ethics

This appendix contains the Ethics approvals from necessary to conduct the empirical studies in the University of NSW Built Environment Faculty.

- C1: UNSW ethics approval letter
- C2: UNSW ethics extension approval letter

C1: UNSW ethics approval letter

THE UNIVERSITY OF NEW SOUTH WALES

FACULTY OF THE BUILT ENVIRONMENT

HUMAN RESEARCH ETHICS ADVISORY PANEL

Built Environment Human Research Ethics Advisory Panel

Date: *4 June 2013*

Applicant Name: Timothy Tomson

Faculty of the Built Environment

Re*: Strategic Learning for resilience in public transport organisations*

Reference Number: *135038*
Investigator: Timothy Tomson

Thank you for providing additional information for your HREAP application. It will be placed on your file.

Yours sincerely

Russell Lowe
Panel Convenor
Built Environment Human Research Ethics Advisory Panel

Cc: Head, School of the Built Environment
* http:/www.nhmrc.gov.au

C2: UNSW ethics extension approval letter

UNSW AUSTRALIA
Built Environment
HUMAN RESEARCH ETHICS ADVISORY PANEL

Built Environment Human Research Ethics Advisory Panel

Date: *25 July 2014*

Applicant Name: Timothy Tomson

Faculty of Built Environment

Re*: Strategic Learning for resilience in public transport organisations*

Reference Number: 135038
Investigator: *Timothy Tomson*

Thank you for providing additional information for your HREAP application. It will be placed on your file.

Thank you for requesting an approval extension for your previously approved FBE HREAP research project. Approval is hereby granted for an additional 12 months under the same conditions as for your original approval.

Yours sincerely

Russell Lowe
Panel Convenor
Built Environment Human Research Ethics Advisory Panel

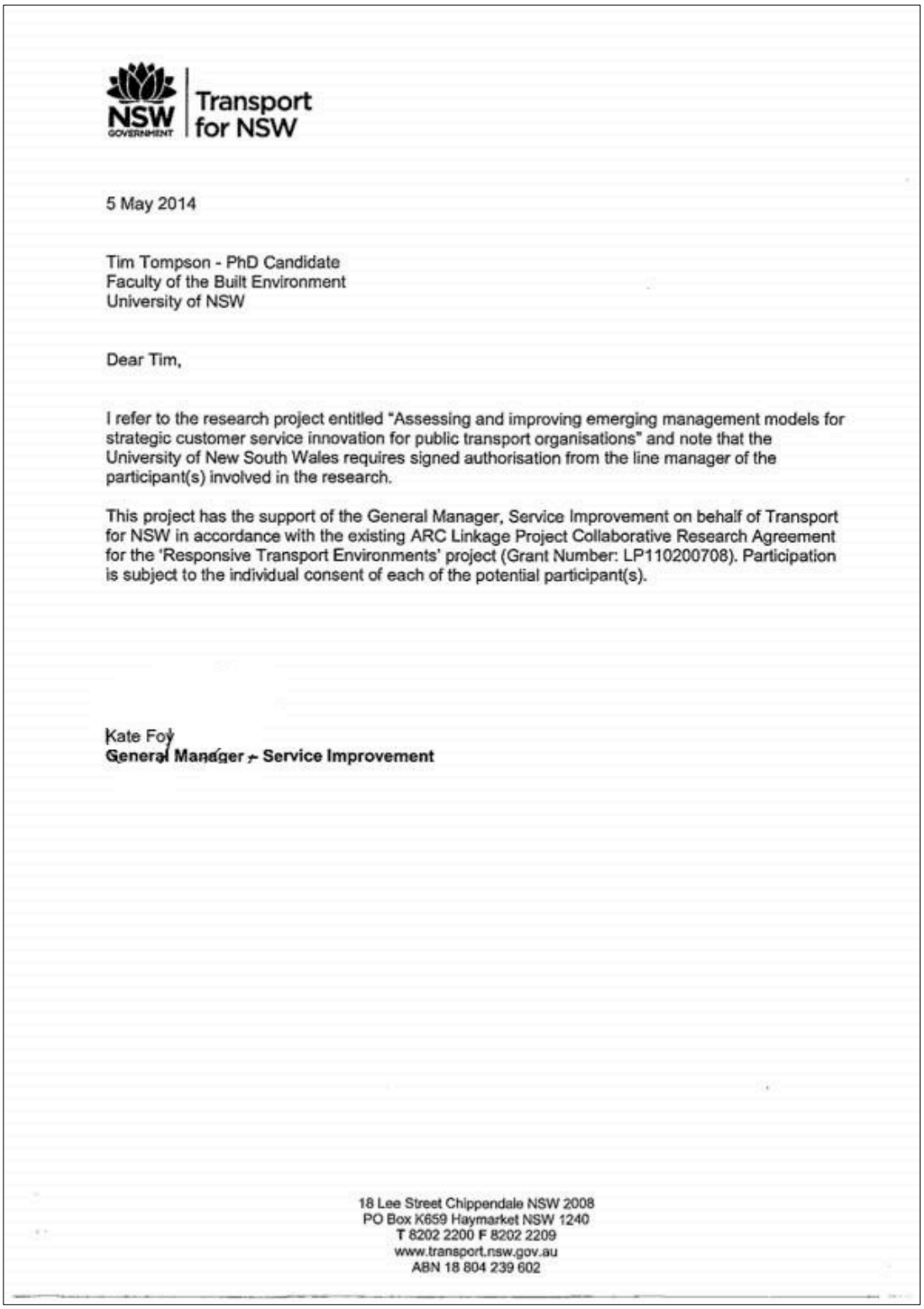
* http:/www.nhmrc.gov.au

Appendix D: Data collection

This appendix contains examples of the documents that were used related to data collection. This included all those related to organising interviews, conducting the interviews and the subsequent analysis, validation and approval processes.

- D1: Example of participant organisation approval letter
- D2. Example participant consent form
- D3. Example alternative participant consent form
- D4. Example email to prospective participants
- D5. Example project information statement
- D6. Example interview protocol
- D7. Interview participant list and approval granted
- D8. Example transcript summary by actor
- D9. Example transcript summary by actor
- D10. Excerpt from an annotated transcript with participant edits

D1. Example participant organisation approval letter



NSW GOVERNMENT | Transport for NSW

5 May 2014

Tim Tompson - PhD Candidate
Faculty of the Built Environment
University of NSW

Dear Tim,

I refer to the research project entitled "Assessing and improving emerging management models for strategic customer service innovation for public transport organisations" and note that the University of New South Wales requires signed authorisation from the line manager of the participant(s) involved in the research.

This project has the support of the General Manager, Service Improvement on behalf of Transport for NSW in accordance with the existing ARC Linkage Project Collaborative Research Agreement for the 'Responsive Transport Environments' project (Grant Number: LP110200708). Participation is subject to the individual consent of each of the potential participant(s).

Kate Foy
General Manager – Service Improvement

18 Lee Street Chippendale NSW 2008
PO Box K659 Haymarket NSW 1240
T 8202 2200 F 8202 2209
www.transport.nsw.gov.au
ABN 18 804 239 602

D2. Example participant consent form

This was the ethics approval form for all participants other than those representatives of Transport for NSW and Sydney Trains.

BE HREAP **FORM 4 – PROJECT CONSENT FORM** January 2007

PROJECT CONSENT FORM

UNSW THE UNIVERSITY OF NEW SOUTH WALES
BUILT ENVIRONMENT

Project Title: Assessing and improving emerging management models for strategic customer service innovation for public transport organisations

UNSW Ethics Approval No: 135038

You are making a decision whether or not to participate in a research project.

This PROJECT CONSENT FORM enables you to indicate your preparedness to participate in the project. By signing this form, your signature indicates that you have decided to participate.

You will be given a PROJECT INFORMATION STATEMENT that explains the project in detail, and that statement includes a revocation clause for you to use if you decide to withdraw your consent at some later stage. The PROJECT INFORMATION STATEMENT is your record of participation in the project.

This PROJECT CONSENT FORM will be retained by the researcher as evidence of your agreement to participate in this project.

Please complete the information in this box.

Please indicate which of the following options you agree to by ticking one of the following options:

☐ I consent to being quoted and identified (Only after approval via email of the content and context)

☐ I do not want to be quoted or identified but am prepared to participate anonymously

.....
Signature of Research Participant

.....
Please PRINT name

.....
Date

Name of researcher: Tim Tompson

D3. Example alternative participant consent form

This was the ethics approval form for representatives of Transport for NSW and Sydney Trains. This form included the option for publications to be approved by Transport for NSW's media department.

BE HREAP **FORM 4 – PROJECT CONSENT FORM** January 2007

PROJECT CONSENT FORM

UNSW THE UNIVERSITY OF NEW SOUTH WALES
BUILT ENVIRONMENT

Project Title: Assessing and improving emerging management models for strategic customer service innovation for public transport organisations

UNSW Ethics Approval No: 135038

You are making a decision whether or not to participate in a research project.

This PROJECT CONSENT FORM enables you to indicate your preparedness to participate in the project. By signing this form, your signature indicates that you have decided to participate.

You will be given a PROJECT INFORMATION STATEMENT that explains the project in detail, and that statement includes a revocation clause for you to use if you decide to withdraw your consent at some later stage. The PROJECT INFORMATION STATEMENT is your record of participation in the project.

This PROJECT CONSENT FORM will be retained by the researcher as evidence of your agreement to participate in this project.

Please complete the information in this box.

Please indicate which of the following options you agree to by ticking one of the following options:

☐ I consent to being quoted and identified (Only after approval process through existing agreement between the University of NSW and Transport for NSW)

☐ I do not want to be quoted or identified but am prepared to participate anonymously

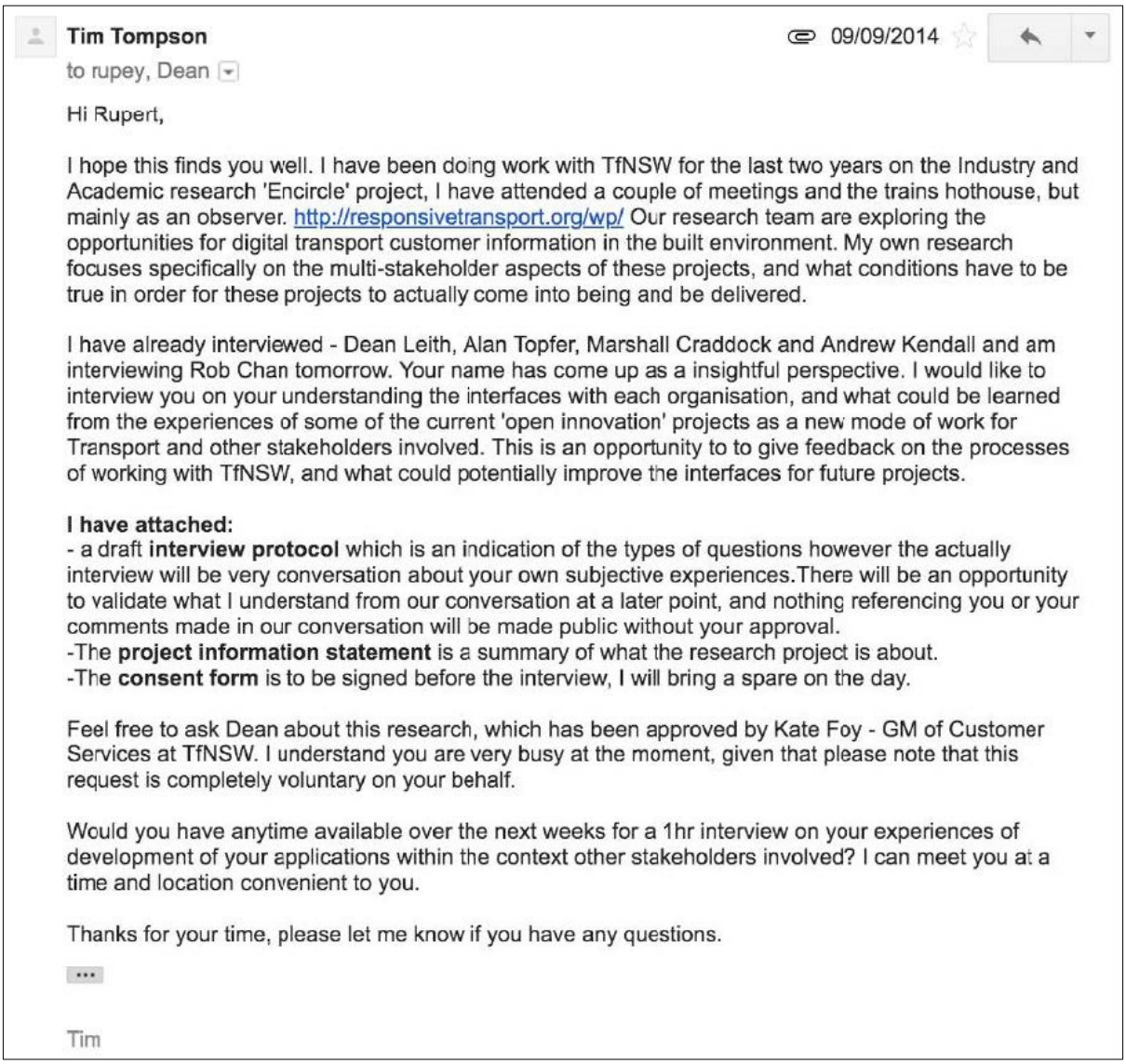
.....
Signature of Research Participant

.....
Please PRINT name

.....
Date

Name of researcher: Tim Tompson

D4. Example email to prospective participants



Tim Tompson 09/09/2014

to rupey, Dean

Hi Rupert,

I hope this finds you well. I have been doing work with TfNSW for the last two years on the Industry and Academic research 'Encircle' project, I have attended a couple of meetings and the trains hothouse, but mainly as an observer. http://responsivetransport.org/wp/ Our research team are exploring the opportunities for digital transport customer information in the built environment. My own research focuses specifically on the multi-stakeholder aspects of these projects, and what conditions have to be true in order for these projects to actually come into being and be delivered.

I have already interviewed - Dean Leith, Alan Topfer, Marshall Craddock and Andrew Kendall and am interviewing Rob Chan tomorrow. Your name has come up as a insightful perspective. I would like to interview you on your understanding the interfaces with each organisation, and what could be learned from the experiences of some of the current 'open innovation' projects as a new mode of work for Transport and other stakeholders involved. This is an opportunity to to give feedback on the processes of working with TfNSW, and what could potentially improve the interfaces for future projects.

I have attached:
- a draft **interview protocol** which is an indication of the types of questions however the actually interview will be very conversation about your own subjective experiences.There will be an opportunity to validate what I understand from our conversation at a later point, and nothing referencing you or your comments made in our conversation will be made public without your approval.
-The **project information statement** is a summary of what the research project is about.
-The **consent form** is to be signed before the interview, I will bring a spare on the day.

Feel free to ask Dean about this research, which has been approved by Kate Foy - GM of Customer Services at TfNSW. I understand you are very busy at the moment, given that please note that this request is completely voluntary on your behalf.

Would you have anytime available over the next weeks for a 1hr interview on your experiences of development of your applications within the context other stakeholders involved? I can meet you at a time and location convenient to you.

Thanks for your time, please let me know if you have any questions.

...

Tim

D5. Example project information statement

PROJECT INFORMATION STATEMENT

CURRENT CASE STUDIES – REAL-TIME APP DEVELOPMENT & TRANSPORT INTERCHANGE OF THE FUTURE

UNSW THE UNIVERSITY OF NEW SOUTH WALES

BUILT ENVIRONMENT

Date: 4/3/2014

Project Title: Assessing and improving emerging management models for strategic customer service innovation in public transport organisations

Approval No.: 135038

Participant selection and purpose of study
You are invited to participate in a study of emerging management models for strategic customer service innovation in public transport organisations (current case studies – real-time app development & ARC Linkage transport interchange of the future). You were selected as a possible participant in this study because your professional role is related to this research matter. Participation is voluntary by consent, and you have the ability to revoke consent at a later date by completing the 'Revocation of Consent' overleaf.

Description of study
This project aligns with the Australian Research Council (ARC) grant in 'Responsive Transport Environments' in designing digital information systems for transport interchanges. The researchers would like to support initiatives that are already in motion in these areas in alignment with organisational imperatives. Tim Tompson's doctoral research is looking to assess and propose improvements in the ways that the current projects are managed and structured around using third parties for the majority of prototyping and development – currently the targeted projects are the initial and ongoing development of Real-time applications and the Transport Interchange of the Future. Specifically he will be looking at how the organisations interface with those parties involved – and what has been enabled as a result. Research is conducted through semi-structured interviews in which Tim will be asking you to recount your experiences, and your interpretations of those events. Total interview times will be 1-1.5hrs with a potential additional meeting/s to clarify the narratives. Benefits of the research will be greater clarity over the impacts and effectiveness of these emerging models of customer service innovation citing best-practice and analogous situations around globally. On behalf of UNSW, we cannot and do not guarantee that you will receive any direct benefits from this study. This will grant a rolling consent for you to be a participant in any project interactions where Tim is present over the next twelve months.

Confidentiality and disclosure of information
Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission, or except as required by law. If you give us your permission, we plan to discuss the results with the immediate project team, who are all bound under respective confidentiality deeds. Risks stemming from confidentiality issues specifically related to Transport for NSW are covered by the confidentiality deed signed between UNSW and Transport for NSW in January 2012. All information gathered is subject to the same agreements for all ARC Linkage Grant (Encircle) work – as stated in our communications protocol for all project partners – Transport for NSW, Sydney Trains, City of Sydney, ARUP and Grimshaw. If you are from an organisation outside of these organisations, all content produced in relation to your input will be sent to you for review at least five working days before any publication. Tim may also request additional company documentation around each of the stated projects and how they fit within the processes of Organisations – it is at your discretion to grant approval or deny access.

Recompense to participants
Participants will not be monetarily reimbursed for their participation but will be included and involved in the development over the course of the project.

Your consent
Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales or other participating organisations. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice by completing the statement below and returning this entire form to Tim Tompson or Dr Matthias H. Haeusler.

If you have any questions, please feel free to ask Tim Tompson, +61450731959, t.tompson@unsw.edu.au. If you have any additional questions later, Dr Matthias H. Haeusler, Tim's supervisor, m.haeusler@unsw.edu.au, will be happy to answer them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (Tel: 9385 4234, Fax: 9385 6648, Email: ethics.sec@unsw.edu.au)

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA
(phone 9385 4234, fax 9385 6648, email : ethics.sec@unsw.edu.au).

D6. Example interview protocol

SEMI-STRUCTURED INTERVIEW
[DRAFT] FOR INITIAL REAL-TIME STUDY
JULY-SEPTEMBER 2014

Why study the development of the real-time applications?
Managing the implementation of emerging digital information systems in cities is a complex but attention commanding topic concerning broad social and economic impacts. The study of the development of the Real-time applications as a case study is a story worth understanding. The Real-time applications have become a case that many stakeholders tout as a resounding success, in the eyes of customers and the government. It represents the need of governments to do more with less, by engaging via an open platform for directed and intentional innovation. Can this be repeated? Should it be? What have been the benefits and challenges for all stakeholders involved? What can be learned from the experience of those who have been involved? What would be done differently next time? Many cities and organisations are struggling with the management of similar innovation projects, and there are few cases available on the development side to guide them.

Details on this initial round of research
The Real-time applications have been available now for over a year. As a neutral 3rd party researcher, Tim Tompson is conducting an interview on a one on one basis with stakeholders of the Real-time application development for Sydney's transport system. Tim is gathering a picture of where the Real-time project is at in the eyes of its stakeholders. The conversation is confidential and will be analysed in relation to the all activity that has happened to date to distil key learning/themes that emerge to make recommendations for improvements and future projects of a similar nature. Tim is asking for between 1-1.5 hrs of your time to conduct a semi-structured interview. These interviews are confidential to Tim Tompson's doctoral research. You will have the opportunity to vet any themes that Tim may wish to bring up again in writing via email (Tim's Australian Research Council project and TfNSW already has an agreement in place between organisations), and references will be used in publications or the PhD thesis, you will also have the chance to review at a later date. You will receive a copy of the transcript of your interview for your own record, and to ensure correct interpretation has been made. Once themes have reached saturation, Tim at a later date intends to visualise the narrative with a system map, to discuss and refine the synthesis/findings of the research, potentially in a group context.

Ethics approval: All participants will be requested to sign the University of NSW Ethics agreement in relation to this project (135038). Kate Foy, General Manager of Service Improvement, has signed approval (5th May 2014) for the study "Assessing and improving emerging management models for strategic customer service innovation for public transport organisations". Other organisations (such as PWC) will be requested have the organisation sign a 'letter of support' for the research.

Here are some example questions of the type of questions he will be asking:

Project questions

- How did you originally come to be involved in the project?
- Where did this project come from?
- Who were the instrumental parties in its establishment?
- Was there precedence for this project?
- Is this related NSW and federal open data policy?
- Why was PWC involved? What role did they play?
- What would you define as the boundaries of the project?
- What would you say are the current goals of the project? Have these changed since inception?
- What has the project achieved? At what cost? (resource, time, control etc)

- More specifically, what are you/the project hoping this could achieve that it hasn't already?
- In your view, what has been the value of the real-time project at this point? Any particular outcomes come to mind?
- What were your expectations of the Real-time project?
- Are there any particular events/conversations that have stood out to you, that had an impact on the direction of the project?
- In your own words, how has the project evolved from initial conversations until now? Why has it happened in this way?

Sydney Transport system

- Has your understanding of Sydney's transport changed since the commencement of the project? If so how/why?
- Where in your opinion are the opportunities to innovate in Sydney's transport system?
- What does the word innovation mean to you in the context of Sydney's transport?

Interactions questions –interfacing with stakeholders (app developers, modal operators, PWC, TfNSW, customers etc)

- What impact have each of the stakeholders had on the project? As individuals and organisations?
- What do you think is driving their activity on the project?
- What value do you think they are receiving from the work you have been doing?
- Have you learnt anything about the other stakeholders/who they represent?
- What are their similarities?
- What are their differences?
- What do you now know from your interactions with the stakeholders that you didn't before? From whom have you learnt the most/least?
- Has this project had any influence on other communication between stakeholders outside the immediate happenings of the real-time project?

Interfacing with own organisation

- What information is passed back into your organisation from the project?
- Have any topics been discussed that had not been internally discussed in your org?
- Has the project had any impact on your own work in other areas?

Interfacing with the team

- How does this project – being more of an open platform – differ from others you are involved with? What does this mean for what we are developing?
- How are/were the interactions in the immediate team (eg. Monthly meetings)? Is there anything you would like us to change the team interacts?
- What do you think are the personal goals of each stakeholder? Why do you think this? What impact has this had on the evolution of the project?
- In your words, what is your individual role on the project? Has this changed over the course of the projects?
- What are your strategies for ensuring you deliver on what you hope to?

Moving forward

- From your perspective, what are your suggestions for what the project should focus on in the future?
- If you were to begin this again, what would you consider doing differently, why?
- How might you alter the way the project operates to achieve this? Structurally, stakeholders, interactions, etc.

D7. Interview participant list and approval granted

Table 7: All 24 Interviewees, totalling 25 hours, 55 minutes of interviews.

Int. no	Date	Interviewee	Role at time of interview	Relation to cases	Length	Consent required for publication
1	15/4/14	Dominic Smith*	Manager, Customer services, Transport for NSW	*Responsive Environments* Industry Partner	64 mins	No, anonymised
2	15/4/14	Mark Gilder	Senior Architect, Grimshaw	*Responsive Environments* Industry Partner	61 mins	Complete
3	22/4/14	Alistair McGill	Principal, Arup	*Responsive Environments* Industry Partner	47 mins	Complete
4	29/4/14	Julie Gee	Transport Manager, City of Sydney	*Responsive Environments* Industry Partner	72 mins	Complete
5	1/9/14	Garry Glazebrook	Retired, but previously Transport manager at City of Sydney	*Responsive Environments*, general Sydney knowledge	47 mins	Complete
6	3/7/14	Matthias Haeusler (referred to as Hank)	Senior lecturer, Faculty of the Built Environment, University of New South Wales	Chief investigator, *Responsive Environments*	111 mins	Complete
7	8/7/14	Dean Leith	Manager, Real-time project, Transport for NSW	Principally *Real-time Applications,* but both project	72 mins	Complete

** Name changed at interviewee request as signed by consent form*

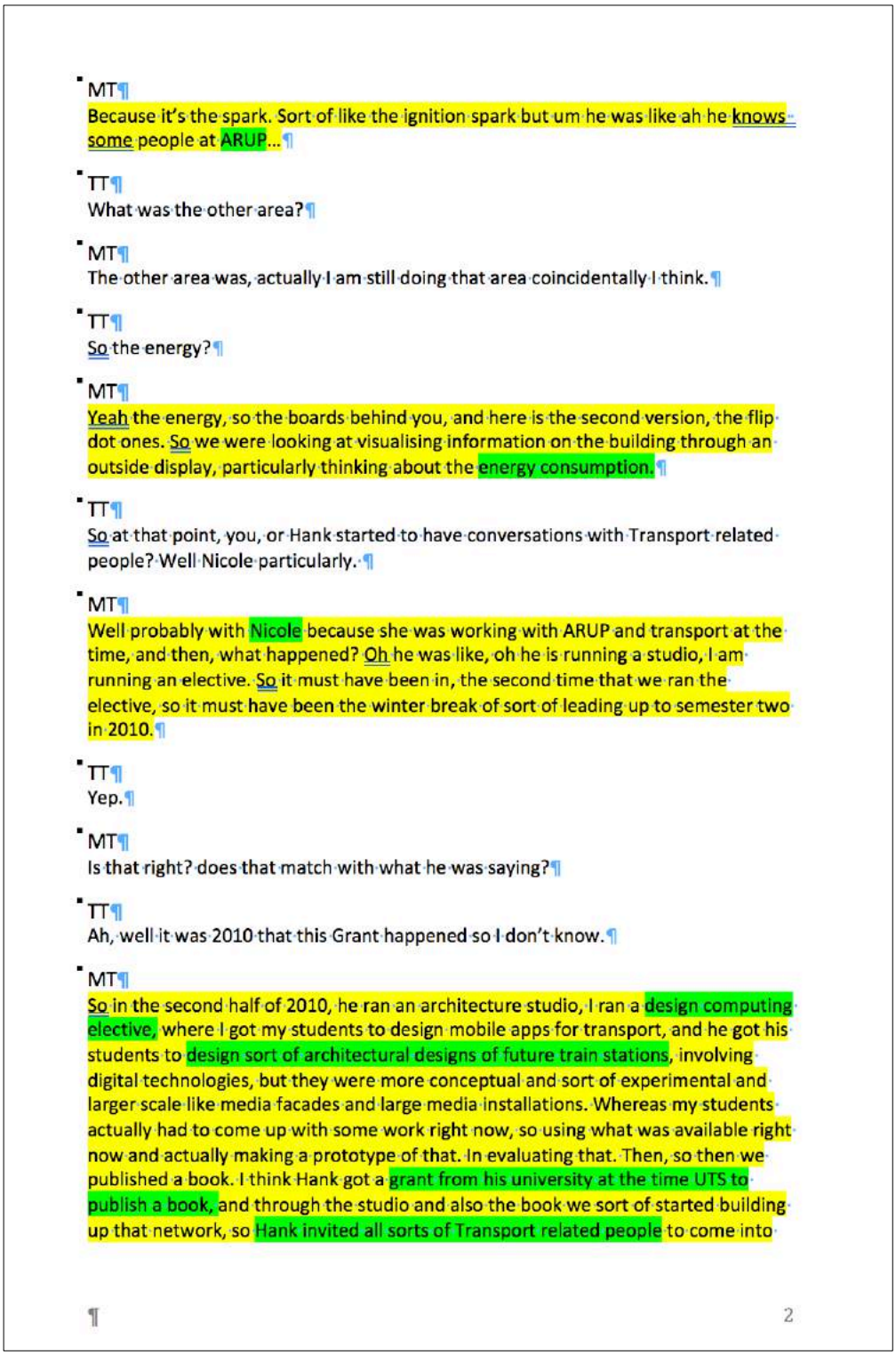
Int. no	Date	Interviewee	Role at time of interview	Relation to cases	Length	Consent required for publication
8	16/7/14	Briedy Mahar	UNSW casual tutor and researcher	Project manager 2013 and organised a UNSW course on the bus stop design.	52 mins	Complete
9	16/7/14	Martin Tomitsch	Senior Lecturer, School of Architecture, Design and Planning, USyd.	Chief investigator, *Responsive Environments*	78 mins	Complete
10	22/7/14	Michelle Zeibots	Coordinator of Transport research, ISF, UTS	Chief investigator, *Responsive Environments*	68 mins	Complete
11	19/8/14	Alan Topfer	Rail Information systems manager, Sydney Trains	*Real-time Applications*	60 mins	Complete
12	27/8/14	Andrew Kendall	Manager, Transport for NSW	Principally *Real-time Applications,* but both projects	65 mins	Complete
13	1/9/14	Marshal Craddock	Manager, Transport for NSW	Principally *Real-time Applications,* but both projects	52 mins	Complete
14	10/9/14	Rob Chan	Consultant, Digital Change, PWC	*Real-time Applications*	62 mins	Complete
15	17/9/14	Nick Maher	Creator of Tripview, Grofsoft	*Real-time Applications*	63 mins	Complete
16	22/9/14	Prashant Vaidya	Principal manager, applications management and support, TfNSW	*Real-time Applications*	60 mins	Complete

Int. no	Date	Interviewee	Role at time of interview	Relation to cases	Length	Consent required for publication
17	18/11/14	Nathan Kirchner	Senior lecturer, Faculty of Built Environment, UTS	Chief investigator, *Responsive Environments*	99mins	Complete
18	27/11/14	Rupert Hanson	Developer of Triptastic and NextThere	*Real-time Applications*	102 mins	Complete
19	3/12/14	Greg Johnston*	Manager, Transport for NSW	Transport for NSW, organisational perspective	52 mins	Complete
20	7/1/15	Quentin Zervaas	Developer of TransitTimes+ and many other applications	*Real-time Applications*	53 mins	Complete
21	22/1/15	Dan Aschwanden	Developer of Arrivo	*Real-time Applications*	80 mins	Complete
22	23/1/15	Adrian Schönig	Developer at Skedgo, the makers of the Tripgo Application	*Real-time Applications*	62 mins	Complete
23	24/9/15	Tony Braxton-Smith	Deputy Director General, Customer Service, TfNSW	Both projects	17 mins	Complete
24	24/9/15	Tim Williams	CEO, Committee for Sydney	Sydney context	58 mins	Complete
25	11/9/15	Matt Faber	Bus planning, Transport for NSW	Both projects, bus perspective	41 mins	Complete

** Name changed at interviewee request as signed by consent form*

D8. Example transcript with highlighting

This is an example of a typed transcript of the interviews one of the participants. I highlighted the transcripts in green for quotes that I would like to use, and green for where an actor was mentioned.



MT¶
Because it's the spark. Sort of like the ignition spark but um he was like ah he knows some people at ARUP... ¶

TT¶
What was the other area?¶

MT¶
The other area was, actually I am still doing that area coincidentally I think.¶

TT¶
So the energy?¶

MT¶
Yeah the energy, so the boards behind you, and here is the second version, the flip dot ones. So we were looking at visualising information on the building through an outside display, particularly thinking about the energy consumption.¶

TT¶
So at that point, you, or Hank started to have conversations with Transport related people? Well Nicole particularly.¶

MT¶
Well probably with Nicole because she was working with ARUP and transport at the time, and then, what happened? Oh he was like, oh he is running a studio, I am running an elective. So it must have been in, the second time that we ran the elective, so it must have been the winter break of sort of leading up to semester two in 2010.¶

TT¶
Yep.¶

MT¶
Is that right? does that match with what he was saying?¶

TT¶
Ah, well it was 2010 that this Grant happened so I don't know.¶

MT¶
So in the second half of 2010, he ran an architecture studio, I ran a design computing elective, where I got my students to design mobile apps for transport, and he got his students to design sort of architectural designs of future train stations, involving digital technologies, but they were more conceptual and sort of experimental and larger scale like media facades and large media installations. Whereas my students actually had to come up with some work right now, so using what was available right now and actually making a prototype of that. In evaluating that. Then, so then we published a book. I think Hank got a grant from his university at the time UTS to publish a book, and through the studio and also the book we sort of started building up that network, so Hank invited all sorts of Transport related people to come into

¶ 2

D9. Example transcript summary by actor

These were an annotated summary of the transcripts was compiled. This account listed actors, that were marked in green. The example here was five pages in total, listing almost 200 actors, each referenced back to the location in the transcript.

M.Hank Haeusler
UNSW Faculty of the Built Environment, Director - Computational Design (CoDe)
Approval signed on consent form: Quote with clearance

This interview has been analysed using Actor-network Theory (ANT). ANT tries to understand the changing relationships between actors (people who do something) & actants (people/systems/objects than influence the actions of the actors) in a network, in this case any related to the innovation activity of the development of the encircle: responsive transport environment project.

[Please note, quotes may be edited for basic grammar – eg removal of filler words, syntax]

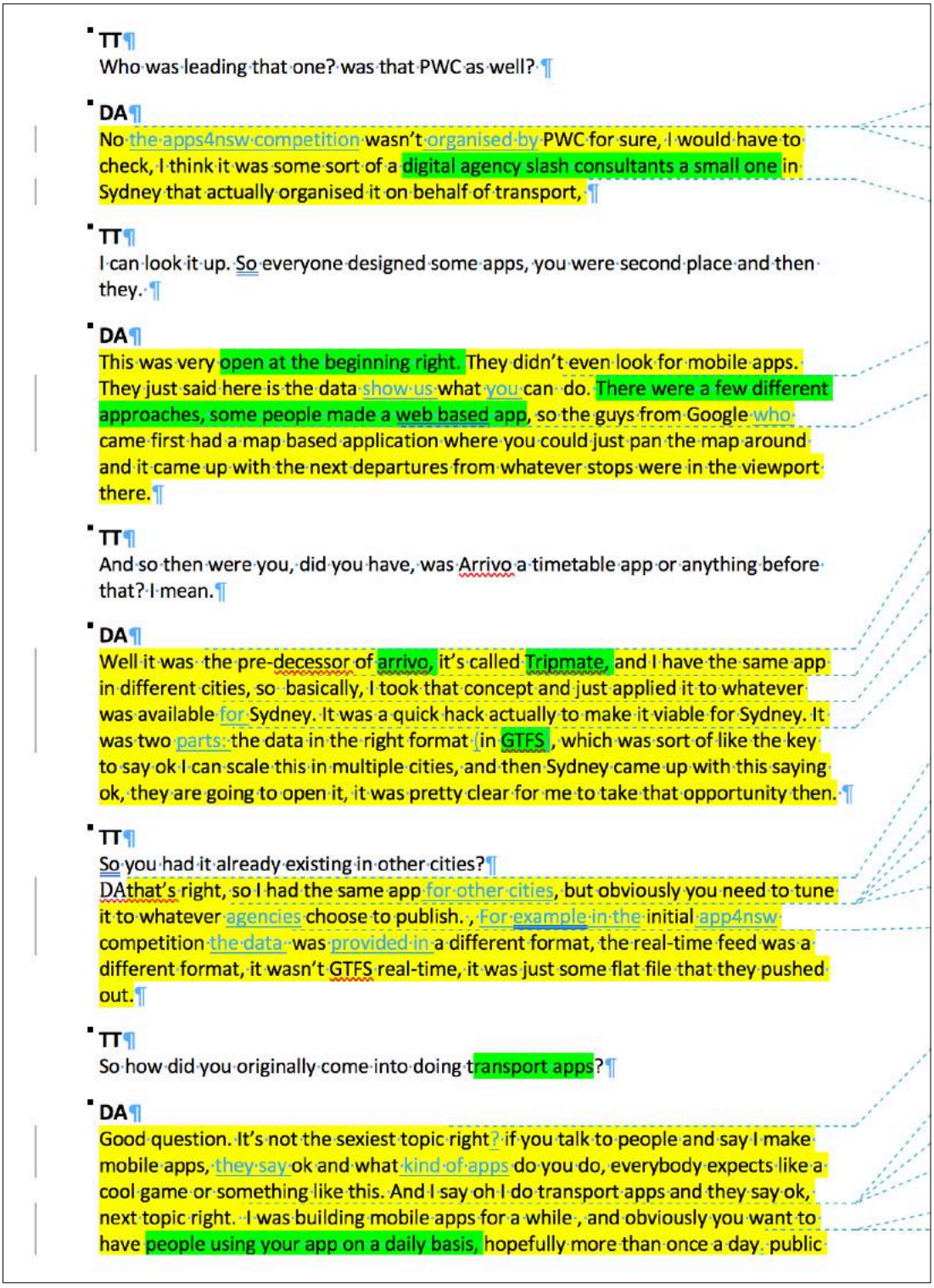
Potential Quotes (highlighted in yellow in the transcript). Anything highlighted in Yellow may be useful to support a particular argument in the thesis. Please review what is highlighted in yellow and feel free to edit quotes or annotate to better represent your view. Please track changes when working in this document. I intend to use what is highlighted in case study papers and the final thesis due early 2016. Any quotes that I decide to use later that are not highlighted, I may request permission to use at a later date.

Actors mentioned (highlighted in green in the transcript). An actor is any person, object or system that is recognised to influence the activity of another, in this case – your organisation, your activity in your role, in relation to the real-time project.

- Martin Tomitsch (p1) – met in 2009 in Sydney through connection, Architecture faculty at Sydney University.
- Sydney (p1) – new location for both Martin and Hank.
- a friend and colleague from vienna (p1) – introduced to Martin T.
- Media Architecture/media facades (p1) – MT and MH both did research in the same area.
- Transport information (p1) – chosen as a research field as customers always need to look at it.
- Energy consumption information (p1) – another area Martin and Hank were interested in.
- Nicole Gardner (p1) – dating, now wife, worked in Transport information for CBD metro for Arup as a rail architect.
- CBD metro (p1) – project Nicole was working on.
- ARUP (p1) – working on CBD metro
- Australian Research Council (p1) – peak research body,
- Discussed ARC grant application (p1)
- Experience in public transport (p1) – not good enough for ARC grant.
    - had no track record in transport, had to establish a track record through studios
    - Increased it through publication of papers (p2) – CAADRIA in Newcastle
- Studios
    - At Sydney uni on interaction on mobile phones and public transport (p1) –
    - At UTS (p1) – central station upgrade
    - enabled building of contacts (p1) – including Grimshaw, Hassell, Cox, ARUP, wayfinding company.
    - Used to student projects to demonstrate the case, and build into proposal for research environment.
- Infostructure (p2) – book at the end of the studio, with NG, MH, MT, framed the work in interaction design and architecture
- ARC grant application
    - Partners (p2) - - contacts changed for all stakeholders.
        - Grimshaw (p2) – didn't have a Sydney office at the time so contacted the Melbourne office, had a strong interest in integrating digital technology in any kind of Architectural surface. Integration of sensors and screens that was their main motivation.
            - Contact Neil Stonell, then Simon Fleet, (p2) Neil signed on the Grant
        - ARUP (p2).

D10. Excerpt from an annotated transcript with participant edits

An example of the kind of edits received from participants. This one was Dan Aschwanden's edits to his transcript received 6th September 2015.



TT
Who was leading that one? was that PWC as well?

DA
No the apps4nsw competition wasn't organised by PWC for sure, I would have to check, I think it was some sort of a digital agency slash consultants a small one in Sydney that actually organised it on behalf of transport,

TT
I can look it up. So everyone designed some apps, you were second place and then they.

DA
This was very open at the beginning right. They didn't even look for mobile apps. They just said here is the data show us what you can do. There were a few different approaches, some people made a web based app, so the guys from Google who came first had a map based application where you could just pan the map around and it came up with the next departures from whatever stops were in the viewport there.

TT
And so then were you, did you have, was Arrivo a timetable app or anything before that? I mean.

DA
Well it was the pre-decessor of arrivo, it's called Tripmate, and I have the same app in different cities, so basically, I took that concept and just applied it to whatever was available for Sydney. It was a quick hack actually to make it viable for Sydney. It was two parts: the data in the right format (in GTFS , which was sort of like the key to say ok I can scale this in multiple cities, and then Sydney came up with this saying ok, they are going to open it, it was pretty clear for me to take that opportunity then.

TT
So you had it already existing in other cities?
DAthat's right, so I had the same app for other cities, but obviously you need to tune it to whatever agencies choose to publish. , For example in the initial app4nsw competition the data was provided in a different format, the real-time feed was a different format, it wasn't GTFS real-time, it was just some flat file that they pushed out.

TT
So how did you originally come into doing transport apps?

DA
Good question. It's not the sexiest topic right? if you talk to people and say I make mobile apps, they say ok and what kind of apps do you do, everybody expects like a cool game or something like this. And I say oh I do transport apps and they say ok, next topic right. I was building mobile apps for a while , and obviously you want to have people using your app on a daily basis, hopefully more than once a day. public

Appendix E: the performance of the visual histories v1.0

This appendix contains the edited transcripts of the final workshops with participants, where the visual history v1.0 were shown. The transcripts have been edited to read as if the reader is in the room with participants.

- E1: Edited transcript of workshop conversation with the *Responsive Environments* visual history v1.0
- E2 Edited transcript of workshop conversation with the *Real-time Applications* Visual History v1.0

E1. Edited transcript of workshop conversation with the *Responsive Environments* visual history v1.0

This is an edited transcript from the workshop held 23rd November 2015. Attendees were Tim Tompson, Matthias 'Hank' Haeusler, James Bullen, Martin Tomitsch, and Michelle Zeibots. This transcript is a record of the conversation that happened, the first time these participants were introduced to the visual history v1.0. This account speaks to the performative nature of the visual history. This account is a way of representing what the visual history enacted.

...000...

"The bus stop? It was happening here," says Tim. He is pointing to the middle of the visual. "So, we had the intervention workshop, and that is where it, kind of, emerged as an idea that people got behind."

"Yes, exactly," Hank replies. "We did the graph on my glass wall in my office, which is actually still there from memory. But I have moved offices now." Hank has recently been promoted to Director of Computational Design, which means he now has an office on another floor at UNSW. Hank and Tim are going through the visual before Martin arrives. It is the 23rd November 2015, and this is the final workshop to conclude the project. Hank has come in at 2:30pm to meet Tim on level six of the new Faculty of Engineering and IT building at UTS. They are also joined by James Bullen, a graduating journalist student at the University of Technology, Sydney (UTS), who had been employed to write several blog posts for the team over the past two years.

Hank has more to say, pointing at the earliest marked events on the visual from 2009.

"I think a lot of the incentive came from the way Tom [Barker] worked, not as an academic per say, but more as an entrepreneur," he says. "So,

before he went into academia he had a consultancy firm called B-consulting, and then Smart slab. It was the whole approach, reflecting now on the beginning of the grant. It was just running around and talking to people and networking and bringing them into the mix together."

Tim's phone rings as Martin appears at the door. "Sorry, I should have read my calendar invite properly," he says, as he hurries to his seat. "Is it only two of us to start?"

"Just for the first hour" says Tim. Martin looks pleased.

"I was preparing for Nathan to have stern words to me."

"Oh, you don't know?" Tim asks.

"He doesn't know either!" says Hank. "Sit down Martin. Take a seat. Put your feet up. So—ah—Nathan—"

"Nathan has left academia" Tim cuts in.

"Oh! Interesting." This from Martin.

"Yes, he has gone to the private sector: engineering; open innovation lab type thing" says Tim.

"Like a company?"

"Yes, it's a group, or company or—"

"So, he is not coming to this, is he? But Michelle is."

"Yes, Michelle is," Tim responds.

Hank hands Martin an envelope.

"Interesting. What's this?" queried Martin, "Is this his resignation?"

"Ah no, it's a Baptism invite." Martin and Hank have worked together for over six years now: they are colleagues and close friends. Hank continues.

"Um, so ok, the plan for today is, I have a couple of slides that should come up on that screen—"

"But what about the budget?" Martin interjects. There has been some tension between the group members about what remains of the project's budget, and who had what left, as the resources had been spread across the three universities' budgeting systems, with each university as opaque as each other. Funding has been difficult to track. The conversation between Hank and Martin continues for a few minutes, but then returns to Tim's introduction to the program.

"So, for the first hour I wanted to talk about 'the bus stop of the future'" says Tim. He has arranged the meeting so that Michelle does not need to attend this first part; she hasn't been heavily involved in the latter phase, bus stop phase of the project. He continues.

"I wanted to talk about that the first hour or so, and then give an intro to these visuals and methodology, then spend an hour or so talking about the project, and then half an hour relating that to Smart Cities projects. So that's it. I won't go into any Actor-network theory stuff at the moment but we could—"

"Can I interrupt you there?" interjects Martin. Tim nods.

"I remember vaguely now, that triggered a—so you are using Actor-network theory as a methodology for your PhD?"

"Correct" says Tim.

"I might have mentioned that I have got a friend here now; you should meet him." Martin is referring to Christiano Storni, who is at Sydney University for the summer of 2015. Tim would meet him a few weeks later for some feedback on the research.

"So what do you want to know?" Martin asks Tim.

"We should tell him and he should listen, no?" suggests Hank.

"Or are you asking questions?" Martin looks at Tim.

"Well where do you want to start," Tim asks. "Hank seems to have something he wants to—" Hank begins.

"So the bus stop has been for a period of six to eight weeks at UNSW in the forecourt of the red centre, and unfortunately the big screen got damaged, so the 50 or 60-inch screen was damaged, and—"

"That's UTS property, by the way!" Martin exclaims. Hank continues.

"Exactly, yes. So Nathan, all the fuss he had with returning things in a proper, state to UTS, and making sure you can disassemble them, is probably not interesting for him anymore." Nathan had ensured that all materials were able to be disassembled for reuse, in later prototypes. He had recommended using materials that his engineering students could use frequently in their projects to develop robotic and sensing devices, such as Minitech, which is a

versatile interlocking aluminium structure. Hank outlines what they have learned from the bus stop's most recent exhibition outside of the UNSW Build Environment Faculty;

"Two things we found out," he says. "One is the screen is, kind of, broken—that happens during transport—the second thing, which was more important, was the screens and the LEDs were useless in outdoor conditions because the glare was too big or too strong and we have never been able to see any content on the screens in daylight. The position of the bus stop was obviously not really easy in that sense. It was just facing north, so you had a very full sun on sunny days. But even on cloudy days you didn't really see so much. But what we have done is we tested, we did some observations through cameras with the bus stop, so we had a camera which just looked how people—like a time lapse camera—how many people are stopping at the bus stop and using the bus stop as a place making device, and a colleague developed a script that measured how long and how often people stopped at the bus stop." Now that the bus stop was built Hank and Martin were able to test various applications that were installed into the screens. But only on the university campus. They were discussing the latest round of measurements, they had gathered. Martin speaks up.

"We also applied for further funding and climate studies, did you want to talk about that, the CRC and was it also the Gold Coast?"

So, there are several faculty research grants," Hank explains. "We won a $13,000 faculty research grant, which we used to put the bus stop there. We also applied for a grant for arts. But the City of Sydney grant, to put the bus stop into Green Square, that grant was unsuccessful. We then applied for a CRC grant, unfortunately as well unsuccessful. So more or less, the bus

stop is a prototype that exists. It has faults, it's damaged, but they could be fixed. We have been looking into further research into generating content, or testing content." Martin takes the floor.

"Actually, the more interesting applications are the city life one that you made; and was it the Gold Coast? Where they are looking for some, both of those I think are looking for Smart City initiatives. And so, I think we are using the bus stop; there as an artefact to talk about what we can deliver. And saying, like, if we had this we could put it there. But it is also a bit of a placeholder, especially with Gold Coast: you wouldn't necessarily move that up, but like, would build similar bus stops. But it's more about conceptually. It gives us a way to talk about what is a bus stop and what can it do." The bus stop, was so large, and heavy, that it cost almost $2,000 to move anywhere, so the cost of moving it to the Gold Coast may be prohibitive. For example, to move it 300m across the university campus cost $4,000 for transport there and back. Hank outlines the publications he has been writing.

"And Martin," Tim interjected, "this is obviously helping you write papers on all of these interactions and do more tests? Is that—"

"Yes," Martin returns, "but I haven't, because in my community, you have to have quite rigorous studies and data to publish, and from my perspective we were never able to collect that data. I mean, maybe now we have collected some data through the study on campus and Luke [Hespanhol]—but we are still in discussion with that, and we are not too confident that the data we are getting there will be good. Yes, so I haven't actually been able to publish the bus stop as such, in any way. I have been

talking about it in public talks I have been giving like UX Australia for example."

"One success on a social media level was we had nearly 5000 likes on Instagram!" adds Hank. "The other thing is, through the bus stop, I had a new conversation with ARUP. It's with a guy called Brian Smith, who is the associate principal at ARUP for transport, so he is not on the list. He is fairly new. And they liked the idea that we had been able to prototype something, so it was not just a lot of visuals, but actually a physical prototype. So, they have been looking into sponsoring honours students to look at developing in a similar way a bus stop hub that is more than just a bus stop."

The project is not over. The bus stop and many threads has now been translated into other leads, proposals and relationships. Tim asks about the ability to pick up other projects again with the same stakeholders.

"I think they are gone so it is a bit kind of hard to pick up," Hank replies, "and if you don't really know more than one person in the organisation, like for example with ARUP, it is easier. Alistair McGill is gone as well, but it is easier, as we have a few contacts so you just can pick up the phone and call those other people and say who is responsible now and then—and know what is going on. It seems with each new partner, with each person, you have to build up trust again. You do reiterate what you want to do. I think that was partly the problem in the middle of 2013 with the bus stop and we—I had something where people changed, so Michelle Tabet left at that time. Benoit left, and Julie Gee. Julie was quite good actually, she was quite involved." Martin pipes in.

"We definitely had some momentum, probably there in 2013, I think we lost for a range of reasons, including people leaving from our partners and we losing contacts, and the partners losing interest in the project as well".

"It was really when it became—when we moved from train stations to bus stops," Hank replies. "Transport for NSW was off the radar, because it was not really interesting for them anymore."

Hank and Martin both understand why the train station environment would be a challenging place to prototype.

"I can understand that kind of thing because it is a political, heightened, contested area," Martin observes. He and Hank discuss whether they would build another bus stop, and Martin queries the purpose of the bus stop itself.

"I don't see how the screens themselves can develop further research," he says. "It's because it's very technology driven, and I think that's also why that one [other] grant didn't get funded, that we put through last year that was one of the case studies. The grant was something about improving liveability in cities through public screens. But it was very technology driven. It wasn't improving the liveability, or focusing on particular aspects of liveability, such as making the city safer, I don't know, but it was sort of driven through the public screens and that, as a research agenda I think, doesn't quite work, and I think that is why it [the prototype] has been useful to some extent but not useful in other extents."

...ooo...

"Hello! How are you doing?" Michele comes in and takes a seat at the table. They begin to discuss Nathan's departure, and the leftover research ties between all his related research partners. "Sounds messy" says Martin.

"Oh, in my experience nothing is ever without mess," Michelle replies. "It's really just the same old thing just trundling along, maybe possibly a slightly different way, but it is still just trundling along so. But all of the work that we started with, a whole raft of different service providers, that will just continue, but I will do that with other people here."

"It's that classic story that happens in industry that now happens in Academia," Hank notes. "People come and go."

"There's a hell of a lot of that" said Michelle.

"Slightly slower in academia" Tim chimes in.

"Well in the case of another industry partner we are working with, they have gone through three iterations of staff," Michelle says. "You know, it is just exhausting. I don't know how the modern world can manage to work anymore."

"—and that must really cost, it adds costs onto their productivity, if you constantly have," Martin adds. "Same as the City of Sydney and our partners, if they have constantly new people coming in then we can't communicate—"

"—the brain drain," Hank nods. "And I think the knowledge is never really captured".

Tim introduces the remaining agenda for going through the visual. One of the areas of interest for the discussion was to explain a pragmatic perspective of university and industry relations. Michelle explains another project she is working on that works a lot more smoothly to gain access to in network testing.

"I think now," says Hank, "being nearly seven years in Sydney, you slowly have a network of industry people where you know where you could

go to get research done; that they know; that they understand when you want to do certain things, and develop the language by ourselves to talk to industry, that they will tick those boxes. And it would be interesting to go to another Australian city to see if it would work as well. Or, if you could just rock up and do stuff. But I think it—I agree with you. It is enormously difficult as well to open up and not only commit verbally on a higher level, but are they actually going to push the whole thing through?" Michelle responds.

"The way in which I sort of explain this sort of thing," she says, "I say oh, look, ok, academics, a lot of us, not all of us are in disciplines or silos. That happens in academia. That also happens in government agencies, and it's quite often difficult to get people out of those sorts of spaces. But what we have learnt, and what academia worldwide is learning, is that academia has the ability to do what has been called transdisciplinarity. The terminology that I use is that you need to be able to understand the transport application space, and in order to understand the transport application space—because transport isn't really a discipline—that is one of the things that I have learnt in the last couple of years too—so what tends to happen is that people with disciplinary backgrounds come in and operate in the transport application space, and they do a lot of systems thinking: if they are good at resolving problems with the engineers, do it! Planners do it, and designers do it. So: those three broad applied science areas. What universities have to be able to do, at both an administrative level and at an intellectual level, they have to be able to describe what an application space is; they have to demonstrate that they understand how it works; and they have to have methods that enable them to operate in a research capacity within that application space. And you have just got to convince the industry partner that you can do that, and once

you have got those magic words, that it is all about 'need finding', then you know, it is all a lot easier then. That's what I would say on that thing, and I think it's fair to say that that is a global trend at the moment, and it is not just Australian academics that have had to learn how to do that."

"Are the incentives right for transdisciplinary research?" Tim asks.

"Partially," says Michelle, "if, as an academic, you have an income target, a research income target—and that is the primary thing that you are measured on which is the case for me—then yes, because the only way in which you can really get that income is by working with industry. If it is a publications rank-based target, then no. You know then there are other sorts of targets that academics are given, like impact; a very difficult thing to measure. It's a very slippery beast—we all know that—but in our guts we know what it means, and we all go around saying that we have high impact, but there is no real way of measuring it. You know, I am not sure.

A conversation around university incentives for working with industry ensues. Eventually, Tim steps in to drag the conversation back to the task at hand.

"Alright, ok, so park that broader conversation and just talk about these visuals," he says. So using Actor-network theory I have done interviews with all of you and a bunch of other people for both cases now, and it was really to question and unpack where things came from and why; and all I was looking for was your interpretation of that."

"We wanted the funding," Michelle returns. "The official, well, the outcome, was to get the funding and the resources officially committed to start the project to do one."

"Yes exactly", Tim replies, continuing. "From an academic perspective, yes that is why we wanted to define the problem in that way: to get that outcome; to get a grant". Tim explains the challenge of what has been a transdisciplinary project, and the tensions that brought in terms of divergent objectives, and practices.

"I actually think trandisciplinarity is more difficult than having multiple universities involved," Michelle observes.

"Us three and Nathan," Hank explains, "we all looked into public transport and had an interest in public transport, but really, in the fine grain of public transport, what exactly in public transport was not really a common goal. So, for us, Martin and me—it was mainly information, communication of information through screens was—that was public transport for us, whereas for you it's probably more the roads, the operations—the whatever. It is definitely *not* gathering the information, displaying that information in the form of content in the built environment."

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Michelle has some views on the experimental nature of the project.

"There just isn't the degree of specificity, and there never was at the beginning of this project, and this is the way that things have to be I think," she says. "There wasn't the degree of specificity that I could give now if I was to start a project in this general area, and how you go about that—why you are doing that—you learn that over time, so this had to start very broad in order to then, you know, go, and maybe you end up doing a few different—that is what has ended up happening here.

"I think that innovation it has a lot of risk, and because of that it also has a lot of redundancy," she continues. "There are blind alleys that you go up from time to time and things that don't appear to work out. It is sometimes not quite what you had in mind, or this person didn't quite do what you wanted them to. You are also—whether you realise it or not—you are aligning different roles within an overall system and how they work, so, for example, would I go and—if I wanted to innovate in this area—would I go and sign up with a Transport for NSW, which is the service provider? No, I would go and sign up with a manufacturer, or a producer like a Grimshaw, or an ARUP that has a specific thing that they do, and this very big, broad organisation that is responsible for taking in a lot of different things and then co-ordinating them; well, no, they don't produce these specific things, so I think that for that reason it was very hard for them. Their role is to help you hone in on need, but somehow or other you can't have them defining the project specifically, like, yes, they help with that you know."

"Particularly as Transport for NSW was only brought in for strategic reasons, to win the grant," Hank adds. "Because if you do research in public transport and you don't have a transport organisation involved—"

"Oh, I agree!" says Michelle.

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The conversation continues, reflecting on the whole project. From the participatory approach, the prioritisation workshop, and the deliberations about each pivotal meeting, are interpreted. For example, a meeting with Tony Braxton-Smith on the 9th April 2012, is debated by Martin and Michelle as to exactly what Tony inferred through his comments about testing small, and scaling up.

The participants now go through the visual more closely.

"Are the dates aligned?" asks Martin. "Do you have the exact dates? You asked me some of those dates so I gave them to you." Tim checks his email to verify.

"Ah yes, true!" he says. "We were getting calls from the media manager, because we didn't have a contact at Railcorp but that isn't right because, there was Rino."

"We met him at the studio, yes," says Martin. "The studio isn't on here, is it?" He points to the visual. "That would be about here. Is it?"

"Well the book came out in 2010," Hank replies, "so the studio was in the second semester 2009." "No, it was in the first half of 2000 [2010]," Martin corrects him. "We won the grant in November 2010. It was the first half of 2010. Yes, the first half." Tim marked the studio on the visual.

"Can we remove that as well?" Michelle asks, pointing to one of the 'ah's'. "I don't know why you have to keep the ah's in."

"Well its part of the methodology: you can transcribe it, or you don't" says Martin.

Tim thinks to himself that, admittedly, at this point, he hadn't really thought too much about the syntax of sentences, and what this may mean for representing professionals with their real names.

"Any good media stuff we could add would help" he ruminates.

"I was trying to remember if that was the only one," said Martin, "because it is pretty poor for a three-year industry collaboration by three universities and only one media short article in Mx[4]."

More than a dozen such corrections ensue, noting different first contacts during the early phases of writing the grant than when the grant had been signed off and approved. Tim raises a question about the form.

It's good," Hank says, "because it is easy for us to actually point out and say when things are wrong, and if you had given us a sixty-page report we would probably not have figured that out that quickly." Tim raises the issue of the legend, saying that in the real-time applications workshop one of the participants had used it.

"Did you put the media contract in here, or is that out of context?" asks Hank.

"Ah yes, that is that one there," Tim verifies, pointing.

"—because that is a big inscription pain point, but you have the contracts there," Hank notes. Discussion fills the space. Many points are raised, and then, Martin pauses.

"But maybe the project, it was a bit too technology driven; even from the way that the grant was written," he ruminates. "We talked about screens and apps etc. Even though we did talk about improving information access, it was driven

[4] Mx is a free daily street press newspaper in Sydney, that is handed out at train stations during the afternoon peak.

through technology. Even with the bus stop we decided what the display was even before we knew what the content was—which is the typical 'technology before content'."

"That's the thing we probably learned: first, content," Hank says. "For me, I would argue, it's first typology, then content, then space and then technology."

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E2. Edited transcript of the workshop conversation with the *Real-time Applications* visual history v1.0

This is an edited transcript from the workshop held 25rd October 2015. Attendees were Tim Tompson, Dean Leith, Rupert Hanson, and Andrew Kendall. This transcript is a record of the conversation that happened, the first time these participants were introduced to the visual history v1.0. This account speaks to the performative nature of the visual history. This account is a way of representing what the visual history enacted.

> "A model to solve every problem, not just the tool, you have got information that the public want then it solves the piece, but, that doesn't fit a whole lot of things that go through those government processes." Rupert was discussing current government interest in app development.
>
> "So why don't we get an app?" jokes Dean. Tim mentions how it seems that app development seems to be glorified as a career.
>
> "It seems like the thing that we should all be doing," he says. Rupert responds.
>
> "Well, that is certainly the federal politic's narrative at the moment; that this cringe-ful innovation stuff that just goes around in circles with no meaningful outcomes."
>
> "The truth of the matter is," Tim returns, "and in this case, that it's not really the most lucrative of careers."

"No, it really isn't," says Rupert. "It's doing project work for SME[5] and government that is." Rupert had begun consulting to Transport for NSW and Sydney Trains to develop back-end systems and staff versions of the real-time applications.

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Tim begins to introduce the proceedings, outlining the overarching inquiry. In orientation, the researcher runs through the background of ANT, and requests that participants be honest towards their feedback of the visuals.

"I am not precious with any of these," he points out. "Feel free to butcher them and tell me how horrible they are, I really don't care, that is the point of this exercise".

"Good. Brutal honesty." This from Rupert. Tim explains an anecdote from Rupert's interview to illustrate the point: that Rupert had seen the release of iOS7 as an influential moment in the development of his app. Rupert expands on Tim's explanation.

"This latent demand for simplicity—iOS7 was quite pivotal as an influence in my thinking on the whole thing, as Apple made a big point to all of the developers in their little community, saying 'hey, you need to set up and pay attention to our one week developer conference this year'. Changes are big and very visually driven, and part of that was they walked everyone through what they saw as the future of apps, and it was very much about 'get this idea of over design

[5] Small and medium enterprises

out of your heads'. They said 'content is king', and they just kept driving that message home. Get all the crap that you think belongs in an app out of the way, and focus on whatever the content your customers are after and try to aim for simplicity. Focus on typography rather than iconography—and that really fed into my design process from there. And I think it fed into some other people's design process as well." He pauses. "But since then, Apple, the things that have come out of Apple, and Google, since then, have been incremental, little additions."

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Tim introduces Dean, Rupert and Andrew to the visual.

"Have you put the Sydney Trains SPI in here somewhere?"

"The SPI screens?" Tim asks. "No, that's a good one."

"Yes," Rupert notes, "that was certainly important for me. It was a moment as a teenager, as a young adult seeing that and thinking, 'wow, why can't I have that?'" The SPI screens were the digital screens on Sydney train platforms that displayed how many minutes until the next train. "Yes, somewhere to do with signalling systems and CityRail, because it is based off their signalling. It is only through computer raised signal control that they can do it, I think it would have been late 90s, the first SPI 98-99".

"It was put in for the Olympics, that is what Alan did" Andrew interjects, referring to Alan Topfer, a Transport for NSW manager of passenger information, another interviewee featuring on the visual.

"The first one was at Wynyard," Rupert notes.

"Landscape and not portrait," Andrew points out. Dean turned to Rupert.

"I think there is a crucial point further on to do with SPI staying on SPI," he said, "where these SPI screens provided the same information as the apps, which is really the project that you just finished".

"At that point that changes a little bit because it has been turned on and off a few times," Rupert returns. "It is currently on though".

"So was that when there was the single source of truth?" Tim asks. Rupert replied,

"Yes," Rupert replies. "The single source of truth coming from the same system. The first pilot would have been February this year [2015], and then—it really would have gone into proper production. It stayed in production for about two months and then it got turned off. It is all on again now, as of about four weeks ago."

"Getting that consistency [in data across the system] was always a part of the project," says Dean. We knew that that would happen later. It was always said down here that consistency of data, one source of truth etc, and we knew that wasn't going to be until that was done".

"So, is your spaghetti diagram cleaned up now?" Tim asks Andrew, referring to a visual that Andrew had created in September 2012, outlining the number of systems and means of interaction in customer services. It was an extremely complex assemblage of people, technologies, and communication chains. Andrew answered;

"A little bit, yes".

"Only a little bit?" Dean asked. Andrew laughed.

"Yes I know, we have been dealing with some much broader issues than TMC[6] and RMC[7]", he said. Tim turns to Rupert.

"So when that was launched properly, you said there was a pilot?"

"Yes, about a month ago," says Rupert.

"Rupert sorted it out about a month ago," said Dean.

Andrew asked, "So the country platform is working a bit better now?" asks Andrew.

"NSW Trainlink is not done yet," Rupert tells him. "I know I had heard that they were putting platforms in the data, but it didn't work out."

"Right" replies Andrew.

"That one is meant to go live on the 17th," Rupert explains. "I wonder when they are going to do a final cut?"

"There was a movement in Sydney Trains as well," Andrew says, "so, I am not sure whether that is covered in Alan's work about this kind of drive to do this for a while, and the customer information project that was there, and this divergence-and-convergence thing, in that there was a desire in Sydney trains to do apps as part of the customer information program that was there for quite a while.

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[6] Transport for NSW 'Transport Management Centre'

[7] Sydney Trains 'Rail Management Centre'

"Ah, up until probably 2010, 2011, there was an acknowledgement that apps needed to happen but Sydney Trains, or Railcorp at that time, had this thing, 'well we will produce this ourselves'. But in that—in that—in the execution of that, there was the direction from transport that 'hey, we don't do this ourselves anymore, we are not experts in that, and this is about all of that data, and being great data providers', and then it became a conversation about data, and that is when there was quite a momentous occasion when we put Alan and his team, who were going on this journey from a number of—and so there were a number of Prashant's reports, and some of Alan's reports and actually putting those guys in front of Tony Braxton-Smith and Liz needs to be probably referenced.

"Liz Ward?" Tim clarifies, remembering from previous times her name had been mentioned.

"Yes, she probably needs to be referenced as well" says Andrew.

"She was Sydney Trains wasn't she?" asks Tim.

"Yes," says Andrew. "The challenge put back, in terms of the conversation with that data, was very light touch for trains for quite a while. It wasn't until we put these guys in this situation, so, well, you know, if you had all of the constraints taken away, what could you do? And that's when the coverage escalated, significantly—"

"So Liz would have been engaged closer to—was it October 2012?"

"2013, what are we, 2015 now?" asked Andrew.

"So the app, the Train Hothouse was in February?" Tim asks.

"Ok then, it was October 2012," says Andrew. "So yes, and that was—we met him in September or something? Dean, I think you were there at that—?".

"No," replies Dean, "I didn't start until December. Buses were pretty much done and released by then." Andrew picks up the story again.

"Marshall came across and showed us the bus one. But there was this interesting groundswell that was made up of a lot of different—, so in the conversation about data, there was this groundswell, there was this really interesting mix of people and influences that cause this to go in this direction. So again, there was this more involvement from PwC and the digital team, and not just the digital team, but the customer experience team, who had done work with Tony [Braxton-Smith] on the CPP, and it was influencing there, and then there was—, I had come in from a financial services background—front ending core bank, green screen core banking systems—so when I saw TLS, and saw just a green screen train location system, and said 'why don't we give that to customers and put a front end on it?' There was all of these other influences in relation to data and how you deal with those kinds of things that mash together and drove that conversation in."

"Another moment that was talked a lot in there was Marshall finding that the PTIPS team had already started playing around in the data with an open source," Tim observes.

"OneBusAway" says Rupert.

"Yes, and they had proof of concept," says Tim. Andrew added;

"There was another team trying to do this in a proprietary basis," Andrew adds, "based on ownership of the network, so trains were going to it themselves. Ah—you know—RMS[8] looking after bus movements was going to do it, as they were looking after northern beaches PIDS[9] and all that stuff. So yes, it was interesting, and then this movement happened over the top of it that said 'hang on guys, we don't do this. We just have to be data providers'".

"Did they take those out again?" asks Rupert.

"No, they didn't, but it was, I think—" Andrew hesitates. Rupert continues.

"Because those pre-dated PTIPS—I was thinking about this the other day—What on earth are they running off? To just leave them there; it's been a long time before I have been at Mona Vale or Brookvale shops, but those PIDS on the northern beaches were up since 1999-2000, I'm pretty sure. That pre-dates PTIPS."

"Yes," Andrew replies, "there were two. There was an early LED version inside a U-frame, and then there were the RMS manufactured PIDS; the ones that were faced away from the direction of traffic. We are about to revisit this with BRT[10] anyway so—"

"Which was the symbol for contracts?" Dean asks, looking at the visual.

"Inscription" Tim tells him.

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[8] Roads and Maritime Services

[9] passenger information display system

[10] Andrew refers to the Northern Beaches bus rapid transport system

"Inscription, ok. There are probably another three, just quickly, there is another three points where you have got an inscription," Dean points out. "One was really—what is that related to? Is that the arrangement with the app developers?"

"Ah the train," says Tim, realising his omission, "yes, exactly." Dean continued.

"The other important agreement, if you like, was the service and support agreement between Transport for NSW and Railcorp. What they effectively agreed to do in order to support the data, and the reason that was so important was that it showed us what hadn't been done with PTIPS."

"When was that one?" Tim asks.

"So, it would have been at around this stage," returns Dean, pointing to the visual, "so it was between Transport and Railcorp, and literally Railcorp saying 'here is our service and support document', which we have got a copy of, and we never really refer to it because they have always provided amazing service and support, so that is important. And it's also important because it informed what we needed to do before I could get ferries and light rail into the apps. And that we had legal agreements with—do you have ferry and light rail here at all?"

"Yes that's the F & L[11]" says Rupert pointing.

[11] The transport network had new symbols for each mode of transport, they used letters now, instead of pictograms. For example, a Ferry was no longer an icon literally of a ferry, but had been replaced with the letter 'F'.

"Ok," says Dean, "so that was the go live. That could never have happened if we hadn't here had contracts developed with Transdev and with Harbour City. Transdev was Light Rail, and Harbour City Ferries and Thalys were the people we needed to negotiate with." He points at the visual. "They go together. They are both ferries and that is light rail."

"So that never happened with PTIPS?" Tim asks.

"We never had one piece of paper to go back to PTIPS and say, 'but you said—but you said that you would do this'," says Dean. "And there was never any recognition on their part. I sound like I am criticising them but—our fault."

"No, you are right," Rupert replies. "Sydney Trains genuinely see that that we are obliged and we better do them well. PTIPS come at these things like, 'Sydney Trains are very proactive, we must be investing in creating quality data and supporting quality products and working with everyone'. PTIPS is reactive: it's an arse covering exercise."

"It's more than that," Dean returns. "Sydney Trains have customers. PTIPS don't have customers, they are only there. They were only put together to give data to Transport contracts, so they are only there. They see themselves as an internal operation. And you know, that that is how they started and they never made the—I mean—Trains have always had customers. Because they have got them in their face, PTIPS, they are just another part of Transport talking to another part of Transport, and there is no recognition—"

"If the customer satisfaction survey that comes in, the PTIPS team is not picking it up and reading it," Rupert says. "Whereas, Sydney Trains were almost dwelling on it for weeks."

"They are almost two steps away from the customer," Dean replies, "as they are giving their data to the contracts people, and the contracts people in transport are dealing with bus companies, and the bus companies have customers. So, it is not surprising that the PTIPS, apart from the fact that a lot of them catch buses—So, they should actually know what a customer feels like—but that is not their reason for being." Rupert agrees.

"Yes," he says, "there is a process design piece that definitely was never done for buses properly, which is why there is a significant percentage of the fleet that doesn't report real-time data. That is to do with the timetable management rostering, management piece at the back-of-house within the bus operators, driver behaviour, on-board equipment and the management and maintenance of it.

"All of those three or four things stars need to align correctly, before useful meaningful data starts to flow through the systems. And so, to go back to PTIPS and point the finger and blame them—well, some of them is not PTIPS's fault. Some of it is that this needs to have been not just inside transport, but within each bus operator, and you know, taken very seriously as a customer facing outcome, like you will find yourself disappearing into. Dean and I have both been here, disappearing into this maze of 'is it PTIPs responsible?' 'Is it OSD[12] responsible?' 'Is it contractor responsible?' 'Is it Transport who are responsible?' 'Is it a depot issue?' 'Is it something wrong that the driver did?' 'Was there a fault? 'Did he pick up the wrong smart card when he was doing his rostering in the

[12] Operation service department.

morning?' There is just so many things that can go wrong—means that there is no actual ownership of problems."

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A few minutes later, the group are discussing the challenges of trying to get consistent data from all of the contracting organisations such as the bus, light rail and ferry providers. Rupert is talking about the private bus providers in Sydney.

"It's the perfect example of how privatisation ultimately provides a worse customer experience," he says.

"A worse customer experience?" asks Andrew.

"In my opinion, yes," says Rupert. "At least two of them."

"Two of them [providers] out of 50?" asks Andrew.

"Ah yes, there are 16 bus contract regions, 7 operators. Yep."

The group begins to discuss the differing vehicle location systems for the external contractors of Light Rail and ferries.

"I mean," says Dean, "the real-time in these systems—in the SCADA system and the FOCUS system—this contract was about an agreement to give us the real-time in these systems in a GTFS feed to give to them. So, the only reason it is different is that Rupert might be doing something with it when he gets it; something that is actually more accurate."

"Yes," Rupert agrees. "Well, we have done that with Light Rail—there is actually another piece of data that augments it. That improves the data quality of it due to constraints in their system."

"So, in a way the app developers have become an obligatory point of passage to the customer?" Dean asks Tim.

"Well, yes, in the case of—" Tim ventures.

"What is the other one?" Dean asks. "The actor that speaks on behalf of other—because he is basically the conduit to the customer." Rupert is closely inspecting the visual.

"There is value add stuff that I started doing along the line here. So somewhere around February 2014," he points to the visual, "not long before NextThere started to be a thing, there was a point at which I worked how to make the alert data feed for Bus, Ferry and Light Rail, and that's a semi-official, like, now the contract to Transport to supply a thing that all the real-time apps use to get disruption notices for those modes, because there was no data source for all of those modes at all."

"Have you been paid yet?" Dean asks Rupert.

"Ah, yes," he replies. "It's gone through the purchase workflow system. I just haven't actually got it yet."

"Oh wow, because that is while ago." Rupert continues.

"Anyway, there was the alert feed, and with the light rail stuff, we had identified through that post contract signing period that there were these inadequacies with the feed that we couldn't predict out from Central, and couldn't

predict out from Dulwich Hill properly, and those issues were raised with the operator, but the response was 'you can't fix it, certainly not by launch day'. And so, on launch day, I said 'well, this is what I am proposing to do as a solution to this and I think this is adequate', and put it live for customers the day after that, and put it live in Tripview a week after that, and once it was live in Tripview, just gave it to everyone else and said, 'this is now an unofficial service that it is suggested that you take' and then formalisation of that is quite a recent thing. But that is now, official transport paid for, committed to continue to provide service in both cases."

"So how did that work? You just gave it to the developers separately?" asks Tim.

"Yes," says Rupert.

"And now they put it in the feed—is that what you are saying?" Tim asks him.

"No", says Rupert, "it still comes from my systems. But it is official transport advice to real-time developers to take it from my system."

The conversation moves towards the current state of the project.

"These other actors," Rupert says, pointing to the visual, "became part of the process. Now we both own the relationship with customers. It's not, you know, customers do not clearly see the delineation between a real-time app developer and Transport for NSW. And that cuts both ways. We get stuff that doesn't make sense, that is totally out of our control. Transport gets stuff doesn't make sense that is totally out of their control. We have this shared relationship in

owning the customer channel now, and that means to some extent if we come to a point where one of us looks at the other one and says 'we need this thing', and one shakes their head and says 'can't do it', we are at a stalemate, and the cool thing is that, often you know there will be a cool person inside transport, there will be a cool, real-time developer that will say 'I can see a way to break this with technology or with a slight change to process' and we can, you know, move forward in a way that is good for both parties."

"I think that is really interesting in terms of this language that you are using in terms of relationship with the customer," Andrew tells Rupert. "And the previous conversation about the bus driver and what he thought about real-time apps, and the connection with the bus company that they have this customer relationship, and so where is that relationship now? Where is that relationship being formed? Is it in the thing that I am holding, because I am having a relationship here and that is how I see my world, and everything else has to fit in with that, and therefore, does the bus company still have that relationship with the customer anymore? Is it a different kind of relationship? or where is the start of that relationship and who sees that they have this? Or are there just multiple relationships?"

There is some contention about the use of the alerts feed, the information that is pushed to passenger's phones about disruptions. The marketing department at Transport for NSW was using the feed to promote events. Rupert, Dean and Andrew continue to discuss issues with the system, and what they should be doing. The conversation moves towards a future state.

"If the network is fairly stable between actants at the moment," Tim asks, "what are those people or things that you know may cause issues down the track?" Dean answers.

"Open data—the open data project—is going to cause, possibly in a good way, but major disruption. It's going to be a disruptive project for how real-time is currently delivered to customers, because, however, the extent to which they go open, will determine whether the same number of app developers are involved in doing this, or whether it will open up a little bit more, or a medium amount, or just be completely open. I suspect that it won't be completely open, but as the open data project develops it will certainly impact on how this is done."

Dean starts discussing the Sydney model of app development vs. those in other cities, citing the advantage of only having a few apps, which makes it easier for customers to get a higher quality app. "But, the argument is that the app store sorts all of that out" says Tim. Rupert chimes in.

"But it doesn't really. The App stores are really bad at sorting that out. Apple and Google both don't have good algorithms to enable discovery, to enable the quality things to drift up and the crap things to fall down. There is a really active gaming of both app stores that a lot of unscrupulous developers are pushing a poorer quality product. There is a lot of problems inside that pot of just assuming that the market will solve things. The market doesn't really solve things."

"It's like trading on a free market sorts everything out. Unfortunately it doesn't," Dean observes.

"Well I talked to Marshall and that was very much his view on it, well a year or so ago when I talked to him," says Tim.

"He thinks it should be open?" asks Dean.

"That the market will sort it out" explains Tim.

"No it won't," says Dean. Rupert continues.

"So there are two points probably worth chipping in while we are talking about the future and where this is all going. Well, so there are two well-funded foreign businesses in this space, who both want to expand into Sydney. One of them is Moovit, which is an Israeli company with about 65 million in venture capital behind them, who are pouring money into advertising in Sydney to try to win transit app customers, despite not having access to real-time, whilst simultaneously harassing the Minister's Office to try to get access to real-time." Dean takes up the story.

"Which is one of the reasons why we have an open data project, apart from Open data being a new thing".

"So, they have pushed the agenda along?" asks Tim. Dean is careful with his words.

"They have helped it come to a head, put it that way." Rupert continues with his explanation.

"Another one is Citymapper, which is another VC funded start up from the UK. They have also declared their intent to move into the Sydney market. I don't know if they have hassled Transport or the Minister's Office yet, but you can bet that they will be going down this road soon, given that they have stated this public intent. It is those significantly sized technology players with millions of dollars behind them that are likely to disrupt our little cottage industry of independent

developers trying to do this on the smell of an oily rag, with the best products. Like… Moovit is actually not a good quality product."

…ooo…

"Another political actor was the exit of Tony Abbott who was the 'infrastructure prime minister'" says Dean. Everyone laughs. Tony Abbott was the self-proclaimed 'infrastructure prime minister'.

"Now we have got a Prime Minister who actually catches public transport," says Dean. "Now who knows whether it is as sincere as it sounds, but—"

"No, he has already said that they are going to redirect funding priorities into public transport," Rupert states.

"Yes, he said that yes—" cautions Dean.

"By infrastructure he really meant roads," jokes Andrew.

The researcher begins to wrap up the session, when Rupert adds a thought.

"There was a point in there that was important for Nick and I in all of this. I don't know if it really fits into the broader story that well, but there was a point at which Nick and I formalised providing apps to Sydney Trains staff—that was May 14. So we formalised it in May and we launched in July August, so perhaps, that is captured by—"

"Ok, so the apps are customised for staff?" Dean cut in.

"It's heavily customised for staff and we got to the point of it," Rupert returns. "I mean it is now an ongoing discussion of seeing all of this process that got to there as a stream that Sydney Trains were investing in to try to improve

customer service, and that is a continuous ongoing thing that Nick and I are regularly engaged in, expanding what we had done in ways that support staff and support staff speaking with customers."

"Ok, just to wrap up," says Tim. "Are there any other potential audiences for this? Was this a useful conversation?"

"I would love to see you go probably to 2019 on this," Andrew replies, "and perhaps—" "Project it a bit?" asks Tim.

"Yes, I think so" says Andrew. "2019 is a big year for Transport, there is a lot of things that happen then. There will be key projects delivered that people will be—that there will be the people in the eastern suburbs down in Randwick, will be starting to use Light Rail data, and so the reliability of that and the impact of light rail and the PID issue and all this kind of stuff will become more important because it is more prominent. Lots of things that will be there will have an impact I think."

"So, what else is there?" Tim asks. "Because I might not have oversight of them—"

"So Sydney North-west metro opens in 2019," Andrew explains. "When is the Circular Quay wharf upgrade? Is that starting in 2019, or is it finishing in 2019? So there is stuff that is happening there. What else is there?"

"Newcastle light rail," adds Rupert. "There are going to be changes beyond that, with how the Metro changes around St Peters, Erskineville, the Bankstown line."

"Yes, that's right," says Andrew.

"So, all of that change management piece of making sure that customers move to the new form, with good knowledge and comfort to keep using services and drive up satisfaction," Rupert says. "I should point out, as app developers we don't try to make stuff up, where a source is authoritative, we trust the authority of source because it was easier—it's just, when it isn't, and there is a need to provide better quality data to customers, then we have to do something else."

"Yes, of course," Andrew replies, "but as a user of your product I really value that, so," and here he laughs, "then I kind of wish that the operator would then hurry up and catch up. What else is happening in 2019? So, the Sydney metro extension to Bankstown is 2024."

"We are killing off this Opal app by the way, that's going to get wiped." Rupert points to the icon of the Opal app.

"Ok, when?" asks Tim.

"Soon, in the next month or two."

"Opal travel will continue" says Dean.

"Exactly, we are only killing off one of the two" says Rupert. "Quentin did Opal travel and I did Opal fares, and we are knocking off fares."

"Why were there two apps?" asks the researcher.

"For the same reason we have got six apps," Dean returns. "Choice. They were both really good proposals so there was no reason to pick one, and not have two. There was enough money to and Opal Travel is—I don't know if it's relevant—but it is actually moving to the Opal team out of the Customer Experience."

"Yep," Rupert agreed. "So I think a sensible outcome was attained at the end which was there should have been an official Opal app that is a quality product, but the path getting there wasn't an easy one and took some—you know—seeing which ideas float and sink, and trying to bring the Opal team into the table."[11]

"Yes," Dean responds, "and let's face it. It was revolutionary to have actual accurate fares on a customer public website. I mean, it was a dual thing. It was to provide an app, but it was to get the actual Opal fares onto the Transport for NSW website."

"Hypothetically if I were to try to put my giant hat on with a crystal ball I would say that there might be some real-time data on the Transport for NSW website in the future as well," Rupert observes. "That's something that is being looked into—I just did an RFQ[13] response for it—Not sure where they will go with it though.

"Alright, thanks very much for your input, a good team to turn up," Tim says.

"Good luck" Dean answers.

"If you only got three, I think you did alright" says Rupert. Twelve participants from the earlier interview phase for this assemblage had been invited, and some additional Transport for NSW employees who had shown

[13] Request for Quotation

interest. Tim asks one final question, reiterating the attempt earlier; "Alright can you think of any other audiences for this? or can you think of anything else that might be useful?" Tim asks this one final question, reiterating the earlier attempt.

"I think that just sort of looking back at this part," Andrew says, pointing to the early part of the visual, "that this sort of community ownership and community leading this thing has been—really— this has come from a community wanting an outcome for itself. And all of the players that have—"

"So, when you say community, who are you talking about?" asks Tim.

"I guess people saw a need," Andrew says, "but maybe users of a product where the government was maybe a little slower to respond, and so the people picked this up and it was a catalyst for this, and then—you know—there was obviously political things that were being driven as well. But I think this was an excellent example of where an outcome was brought together and then there were a bunch of custodians within government who were—we could have all been in government and thought, 'oh this is stupid let's just ignore it', but we didn't, and we kind of made it happen as well. But the initial thing—and you know—it was driven out of a need and then that—"

"But to put my cynical hat on," Dean cut in, "it was a quick win for Gladys [Berijiklian]. It might not have been the beginning of the story, but it was certainly the end of the story. It was how it got done. It was just bloody 'do it, and do it by this date'. And so, we were able to cut corners because it was a quick win."

"But I think something that has helped here. Success is that this has all gone really well," Rupert notes.

"Yes, it was a quick win for her," Dean says. "I mean, we would still be talking about having real-time if we were doing it through the government, if we weren't going through a third party."

"Real-time train apps in six months went from—" Andrew began.

"They didn't exist" says Rupert.

"From non-existent," says Andrew.

"We started in November 2013, and it was launched by April. It was months really, effectively," Dean notes.

"So," Andrew continues, "from concept to being in the app store ready to buy in that time, was faster than the private sector, and a miracle for government. It really was. I mean, that's anybody in any kind of industry goes 'that is amazing how did you do that?'. And Marshall did bus in three months."

"It started back here," says Rupert, pointing to an earlier point of the visual, "with the apps for NSW clearly proved that there was already data in some format around; that it was more a case of knocking heads together to some extent, than massive technical projects necessary."

"The action that was taken against Nick, and that organisational perspective versus working with guys, that being the people that basically saved a lot of the bacon, you know" says Andrew. "The irony is, he brought his million customers to Gladys and offered them on a plate. There you go".

"No marketing costs whatsoever," Tim notes.

"There was a million customers that were going to go from timetable to real-time," says Rupert, snapping his fingers. "Like that…"

"…And they did."

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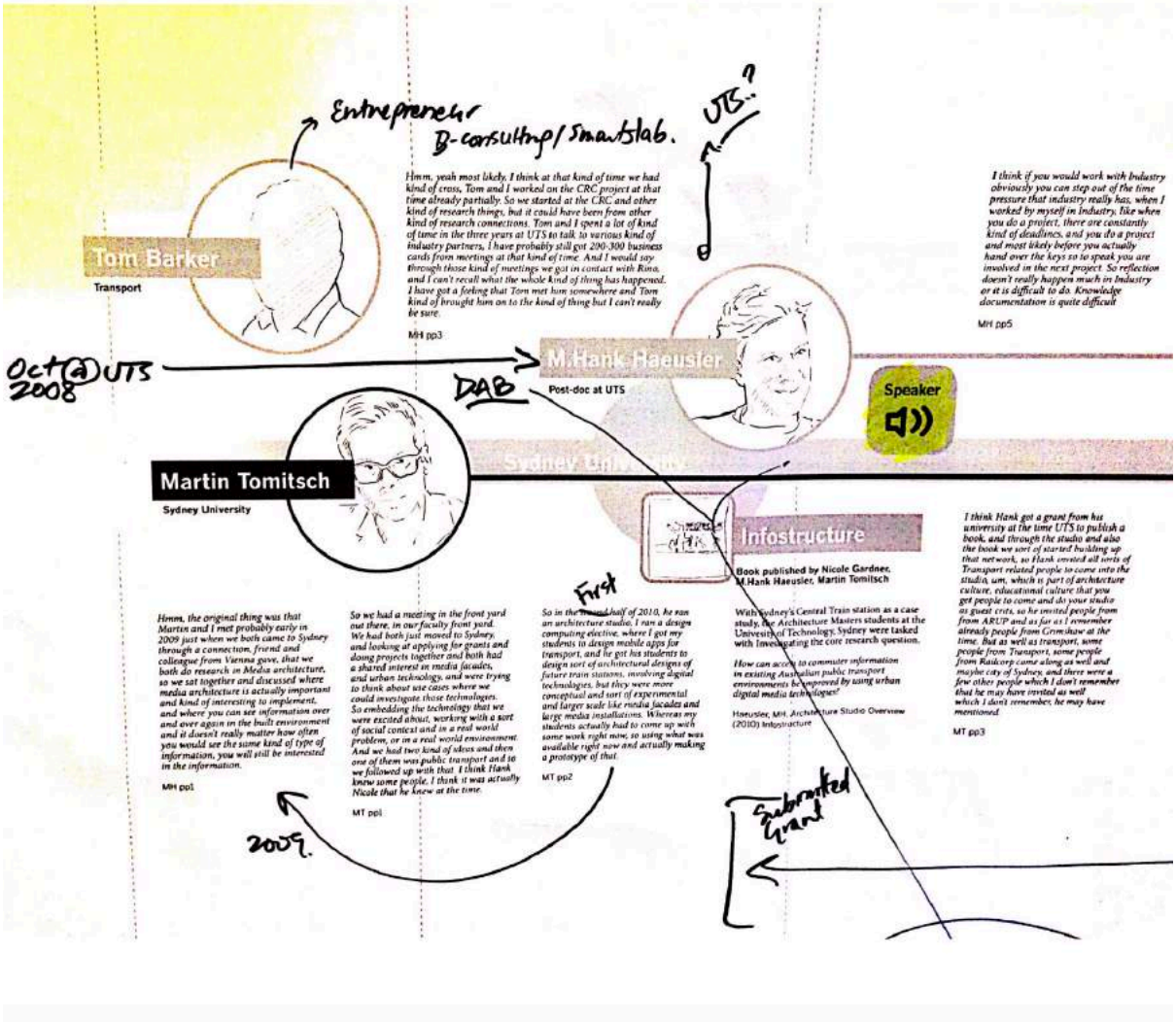
Appendix F: Data & ethics after the workshops

This appendix contains two important pieces of data collection from after the workshop.

- F1: Edits from the workshop with the visual histories v1.0
- F2. Draft email for participant thesis publication approval

F1. Edits from the workshop with the visual histories v1.0

This is an example of the mark-up on one of the visual histories from the workshops. This one is from the *Responsive Environments Workshop*.



F2. Draft email for participant thesis publication approval

Dear <name>,

I hope all is well. I am writing to you in regards to your interview for my PhD thesis <date of interview>. I am now finalising approvals for the published version of my thesis. Please find attached a document which compiles where you have been quoted in my forthcoming PhD thesis entitled '*In becoming a smarter city: pragmatist experiments in Sydney's transport information systems*'.

In your consent form (attached), you selected 'consent with approval', which means I am following up with you to gain your approval for mentioning your name and quotes. At this point, if you are not happy with how you are represented, I can modify or redact quotes, or change your name at your will. I will need this reviewed by you by X date.

The thesis is due for publication in late 2018. I will send you a link to it when the thesis is published through the university.

Thanks,
Tim

2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016

Sydney Urban Environments Ecosystem

Case Study Action

Private Sector Engagement Action

Public Sector Engagement Action

Citizen

Sydney Council of City Transport Advisors

Apple

iPhone3G
June 24, 2008

Google

SmartJah

UTS Building 6

RobotAssist Robot
Robot assist Robot

Tom Barker
Making UTS Building 6 more sustainable

Hank Haeusler
Hank Haeusler Architecture, Design and Urban Technology

Martin Tomitsch
Design Informatics, Architecture and Urban Technology

Sydney University

Tripview App

Nathan Kirchner
Mobility Tools, Transport for NSW, Sydney

Infrastructure boom

The book enabled Hank and Martin to unroll a broad audience of practitioners and professional organisations to the complexities of Sydney transport problems.

Obligatory Foreign Visit

The grant application was a collaboration of research interests, and enrolled the partner organisations.

ARC Grant Application
Informal talk

The grant inscribed through a contractual agreement, the involvement of partner organisations.

Infrastructure Studio
Infrastructure Studio and Urban Research

Grimshaw Architects

Neil Stowell
Director, Grimshaw

Simon Fleet
Director, Grimshaw

Richard Hough
Director, Grimshaw

Nicole Gardner
PhD

Alistair McGill
Director, Grimshaw

Thin Hill
Urban Designer, Grimshaw

Carry Clazebrook
Director, Grimshaw

Carry and Dion were partner investigators on the ARC Grant

Terry Lee-Williams
Manager Transport Coordination, Grimshaw

City of Sydney no longer had to maintain their own bus stops; a JCDecaux would take over the work.

JCDecaux Contracts

Sydney Bus Stop

The bus stop contract was a collaboration of JCDecaux, and ensured the bus stops were maintained for a low cost to the city without advertising revenue.

City of Sydney had a contract with JCDecaux, a French street advertising company from 1998 for 20 years, ending 2018.

Department of Transport

Three major rail disasters had affected the safety culture of Railcorp and the Department of Transport, since the 1970s: Granville, Waterfall, and Glenbrook.

Lee Wallings
Director General of Transport NSW

Lee was the Director General of the Department of Transport, and then Transport for NSW.

Liz Ward
Deputy Director General, Transport Coordination, Transport for NSW

Central Station

The original grant proposal focused on developing information screens around Central station.

Rino Matarazzo
Director, Transport Coordination, Transport for NSW

Department of Premier and Cabinet

Barry O'Farrell
Premier of NSW

Gladys Berijiklian
Minister for Transport and Infrastructure

The Liberal government came into power after 16 years of Labor government.

University publicity of the project ended up in a local newspaper.

Translation

Initially a negative interaction with Transport, this served to open the discourse with Transport for NSW and the university actants.

Michelle Zeibots

Michelle was a transport planner, and brought subject matter expertise on the project.

Translation

Nathan and Michelle were introduced to Hank through their interest in the possibilities of the application space, a working relationship with Transport for NSW.

Nicole

Nicole became a Ph.D. candidate at UTS

Hank

Hank moved from Perth to UTS, and Andrew Kendall was to become a lecturer.

Translation

Hank, as chief investigator after Tom moved to Sydney, enrolled official collaborators for the project, however, he did not speak for all activities on the grant.

Tom Tempest

Tom joined as the PhD candidate, however his area was a service designer, not a technologist as the grant had originally intended.

Translation

The acceptance of the grant application was a collaboration with the industry partners.

Mark Gilder
Director, Grimshaw

Michelle Taben
Senior Manager, Grimshaw

Translation

The grant translated the need of Alistair and organisations to have a voice to how more about emerging technologies

Meeting

All hell broke loose
Tony Casey, Martin Tomitsch, Hank Haeusler, and Nicole Gardner in and out to discuss the project.

Tony Braxton Smith
Deputy Director General of Transport NSW

Tony was brought in to head up the newly formed customer experience division, in the new transport coordination body Transport for NSW.

Transport for NSW
Transport for New South Wales (TfNSW) was created on 1st November 2011, as an amalgamated transport organisation.

CEO
Customer Experience Division

The Customer Experience Division (CED) at Transport for NSW, inscribed in process through, design thought, customer centric practices

Translation

Central would no longer be a focus for the project.

Andrew Kendall
Director, Grimshaw

Kate Foy
Director, Grimshaw

Kate took over the management of the project from the Transport for NSW side.

Town Hall station platform 3

Encicle Pending

Encicle Flyer

Confidentiality contracts issued Transport for NSW, and Grimshaw created a process for publishing information.

Confidentiality Agreement with Transport for NSW

Workshop Output

The contracts made Transport for NSW a focal actor for the rest of the project

Encicle Blog

Situation mapping interviews

The team proposed, and carried out, a participatory process with 36 partners to understand what they could usefully work on.

Kick-off workshop
40 representatives

On the 30th August 2012, the research team facilitated a meeting at Transport for NSW, with 40 representatives of 16 partner organisations.

Encicle Project Flyer

Congestion management prototype

The research team began to spin off small applications that were valuable for only one, or a few, stakeholders.

Minotech system
Financial valuation and forecast system for Minotech Australia

Briefy Maher
Design Manager, Encicle

The team allocated resources to Briefy Maher, and thereby naming the challenges of the project as problems of management. Firstly, attempting software, Podio, then employing Briefy

Intervention Prioritisation Workshop

Precinct Workshop #1

Precinct Workshop #1 Report

Mapping the situation proposal

Prioritisation workshop output

Precinct Workshop #2

Vivid Prototype Spot your stop

Provider Workshop

Workshop Output

The research team pitched prototypes for Vivid — a light and music festival in Transport but was unsuccessful.

BEIL Workshop

Fourth and fifth year engineers were enrolled into providing aspects of the potential bus stop design.

Bus stop screen prototype Spot your stop

Bus stop of the future

Bus stop of the future
The bus stop of the future prototype inscribed relations between people, place and technology.

Customs House

Interchanging

Interchanging – Event

Nicole
Nicole Gardner

The static object became an event drawing well over 100 people to the exhibition opening

Meeting

Regular monthly meetings became a means to protect the research teams ability to develop and produce the bus stop with immediate cooperation of the industry partners.

"We do good things too" outdoor advertising campaign

Posters appeared in the streets of Sydney declaring the advantages of outdoor advertising, including the existing bus stop model

Ben C.

Julie Cole
Design Manager, Encicle

Dean Leith
Director, Grimshaw

Town Hall Station Platform 3
Town hall station, particularly platform three, had, and continues to have, increasing issues on platform three

Sydney Trains
Department of Sydney Trains

NSW Trainlink
Department of the NSW Trainlink

Sydney Trains and NSW Trainlink began operation on 1st July 2013

Andrew Constance
Minister for Transport from 2nd April 2015

From mid 2015, the prototype of the bus stop is being considered by the Design Lab at the University of New South Wales. No students stop to take a look; nobody can sit down and rest. And no bus will ever arrive.

Workshop

Visual v1

Responsive Environments
Actor-networks ~2005-2015

Overview

This is a narrative about the emergent development processes of urban projects. It is intended to tell a different type of story about doing these projects. A pragmatic perspective that represents things as 'in the making', where nothing is 'complete' but a continual process, of which the participants are constantly engaged in. Our aim is to make transport thus visible. It is open to a multiplicity of interpretations, and it does not drill into much detail; it is possible to enter the visual at different locations (in time, and in terms of the incitement of human action. These partial stories explain some of what happened, why, and what influenced trajectories of actions.

Case

This case (assemblage) describes a research project between academic researchers across three universities—the University of New South Wales (Built Environments), University of Technology (Faculty of Engineering and IT) and the Institute for Sustainable Futures) and the University of Sydney (Architecture, Design and Planning) in collaboration with the Department of Transport, which became Transport for NSW. Railcorp, which became Sydney Trains and NSW Trains, the City of Sydney, ARUP, and Grimshaw architects.

Methodology

The data in this visual is drawn from both a series of semi-structured interviews with participants (as nodes) and additional media. The interviews were deconstructed with Actor-network theory (ANT). The visual is a representation of the relationships between the human and non-human actants (those that do something in the account). This approach gives expression the agency of nonhuman actants in symmetry with the human actants. These actants, matters and events are all real. The diagram's venous contains links to referenced media, where publicly available.

Legend

Human actant
Non-human actant
Actor-network
Organisations for legibility
Applied Ethics
Applied Ethics Key
Applied Ethics Content
Key
Key of the power
Key of the content
Link to the content
Interference
Interference
Entities relates to organisations for legibility
Entities relates to organisations for legibility
Entities relates to organisations for legibility

Real-time Applications
Actor-networks ~2005-2015

OVERVIEW

This is a narrative about the emergent development processes of urban projects. It is intended to tell a different type of story about doing these projects. A pragmatist perspective that represents things as 'in the making', where nothing is 'complete' but a continual process, of which we are participants. Actor-network theory is used to provide an interpretive framework to make sense of the complexity. Although it does not drill into much detail, it is possible to enter the visual at different moments (in time), to understand the context of decisions and actions. These partial stories explain some of what happened, why and what influenced trajectories of actions.

CASE

This case (narrative) describes a the processes of developing real time transport information in Sydney. Contrary to many o fthe accounts that exist in the public realm. This has been a long process between many actants over the last decade and beyond. These actors, are an assemblage of government, industry, civic, commercial interests, commercial announcements and satellites. The visual describes this emergence and how each of these actants has agency on each other.

METHODOLOGY

The data in this visual is drawn from both a series of semi-structured interviews with participants (as marked) and additional media. The interview were documented with Actor-network theory (ANT). The emphasis is on relations between the accounts and relations between the actants (human and non-human). Actor-network theory is used to express the agency of multitude actants in moments with the human actants. These plans, names and references are of real. The digital version contains links to referenced media, where publicly available.

LEGEND

Human actor

Non-human actor

Actor-network organization for nightlife

Actor-network organization for nightlife

Actor-network organization for nightlife