From Street Corner to Smartphone

Assessing the Prospects for Socio-Technical Transitions in Cape Town's Transport Sector

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Abstract

Workers, employers, shoppers, students, businesses, institutions, and governments share a problem in Cape Town: how to get around. Individuals bear this problem, but its consequences reverberate at a broader level, affecting economic security, social stability, and environmental sustainability. The city's spatial composition, an institutional legacy of socio-economic and racial exclusion, an over-reliance on private automobiles, and underinvestment in public transport are all commonly-cited culprits. Stakeholders are less unified in identifying solutions. Infrastructure- and technology-led approaches, such as new Bus Rapid Transit and technology-enabled on-demand services, are making their entry into the transport arena, but it is unclear how they will interact with established systems, such as the minibus taxi paratransit service. Furthermore, these approaches suggest a perpetuation of modernist tendencies towards techno-determinism.

This research focused on the transport travails of one location in Cape Town in order to better understand how new technologies and innovations might impact access and mobility there. The location, a new University of Cape Town ("UCT") satellite facility at a place known as Philippi Village, provided a practical vantage point from which to learn more about the dynamics at play in Cape Town's transportation ecosystem. Applying a sociotechnical approach known as Actor-Network Theory ("ANT"), I describe the various actors and relationships that enable access to this location. These descriptions reveal six insights: the central role of the road and private automobile actor-networks in conceptualising how the site should be accessed; the high influence of crime on how access is viewed and resolved; the varied transport needs of users; the benefits of passenger agency; the poor integration of public transport modes; and the divergence between existing and new transport actor-networks in actors enrolled and mobilised. From these insights I describe a range of proposals that Philippi Village users, UCT actors, and others might pursue in order to address their transportation issues. Beyond these direct proposals, I discuss ANT's usefulness as a tool for city planning, and highlight some of the larger lessons regarding Cape Town's orientation around car-centric development.

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Abbreviations

“ANT”: Actor-Network Theory.

“BRT”: Bus Rapid Transit.

“CBD”: Cape Town Central Business District.

“GABS”: Golden Arrow Bus Service.

“GIS”: Geographic Information System.

“GPS”: Global Positioning System.

“ICT”: Information and Communications Technologies.

“GSB”: University of Cape Town Graduate School of Business.

“MBT”: Minibus taxi (service)

“P2P”: Peer-to-peer.

“PHA”: Philippi Horticultural Area.

“PRASA”: Passenger Rail Agency of South Africa.

“ST”: Sociotechnical (studies).

“STS”: Science and Technology Studies.

“TNC”: Transportation Networking Company.

“TOC”: Taxi Operating Company.

“UCT”: University of Cape Town.

“VOC”: Vehicle Operating Company.

“VPUU”: Violence Prevention through Urban Upgrading.

Terms of Reference

General Terms of Reference

"Amaphela" means paratransit service by sedan or small utility vehicle (generally a Toyota Avanza) that is offered in parts of Cape Town. "Amaphela" means "cockroach" in isiKhosa (see Sustainable Livelihoods Foundation, 2013; TaxiMap, 2017).

"Avanza" means Amaphela service for the purposes of this dissertation.

"Charter service" means a service where passengers (or their representatives) hire an operator to provide them service ahead of time at a particular time and date and between a particular origin and destination (see TDA Cape Town, 2014). Although charter service is technically distinguishable from services that are organised by employers, schools, or businesses, I have grouped these types of services together for the purposes of this dissertation.

"City of Cape Town" or **"City"** means the City of Cape Town municipal government. The term "city" refers to the Cape Town metropolitan area.

"Frontage Road" means the frontage road connecting the Philippi Village property to New Eisleben and Govan Mbeki Roads. This road is technically named Mpumelelo Road and Cwangco Cres.

"Gaatjies" means fare collectors that ride in minibus taxis along with the driver.

"Main Entrance" means the primary vehicle and pedestrian access gate at Philippi Village.

"Minibus taxi" means paratransit service by minibus (often a Toyota Quantum) that is common to South Africa and Cape Town.

"New generation services" means "a set of public transport services that are beginning to emerge globally largely because of the new opportunities offered by the mobile phone" (TDA, 2017:19). This is the term for TNC-like services that the City uses.

"Paratransit" is a broad term referring to a mode of transport that lies somewhere between public transport and private vehicle ownership. Paratransit "represent[s] a systems design that theoretically is able to dynamically match supply of a service with the demand required, unlike conventional models of public transport" (Enoch and Potter, 2016:17).

"Philippi Village" means the Philippi Village Business Park, located at 1 Cwangco Crescent, Philippi, Cape Town, 7781, South Africa.

"Second Entrance" means the second vehicle and pedestrian access gate at Philippi Village, located next to the AfriCAN Café.

"Solution Space" means the programme initiated by the UCT Graduate School of Business in 2014 (see http://www.gsb.uct.ac.za/solutionspace). The Solution Space is primarily housed in two physical locations: in the library of the GSB's main Waterfront campus, and at Philippi Village.

"Solution Space Philippi" refers to the physical and metaphysical components of the GSB's Solution Space programme that are associated with its location at Philippi Village.

"Sociotechnical" means the combinations of social and technical elements that constitute human reality.

"Techno-determinism" means the concept that (1) "the nature of technology and the direction of change are unproblematic or pre-determined," and (2) "that technology has necessary and determinate 'impacts' upon [society] (Adsal, Brenna, and Mosder, 2007:20).

"Transportation Network Company" means companies who "provide prearranged and on-demand transportation services for compensation, which connect drivers of personal vehicles with passengers. Smartphone applications are used for booking, ratings (for both drivers and passengers), and electronic payment" (Shaheen et al., 2015:22). These services are also sometimes known as e-hailing or ride-hailing services (Shaheen et al., 2015).

Actor-Network Theory Terms of Reference

The field of Actor-Network Theory has developed a fairly complicated and nuanced lexicon of its own that is important to understanding this approach. Accordingly, I have compiled a list of important terms and phrases that I use in this dissertation. These terms are also defined as they come up in the dissertation, primarily in chapter 3.

"Actor" and "Actant" refers to anything, human or non-human, that acts/interacts within a sociotechnical assemblage. ANT literature often uses the term "actant" to distinguish anything that acts from "actor", which is the source of an action to help avoid the pitfalls of traditional sociology and colloquial use of the term actor (see Latour, 2005:53-54; Latour, 1992:164-66 (discussing morphisms)). For the purpose of this dissertation, the term actor will be used to refer to both.

"Actor-network" means any stabilised, identifiable sociotechnical relationship. An example would be "University of Cape Town", which is composed of many different interactions between actors who (more or less) agree upon its meaning and perpetuate it through their actions. Actor-networks are stabilised through the process of translation. See also "assemblage".

"Assemblage" means a successfully constructed sociotechnical relationship. See also "actor-network".

"Black box" is an actor-network that obtains a high degree of stabilisation resulting in its perception as an impermeable, unified element resistant to interrogation of the individual interactions that compose it (see Cordella and Shaikh, 2006; Rydin, 2012).

"Enrolment" is a designation "of interrelated roles [] defined and attributed to actors who accept them" (Callon, 1986). It is the third of Callon's (1986) four "moments" of translation. At times throughout this dissertation I use the words "enlist" or "align" to mean the same thing as "enrol". I also use the term "re-enrol", by which I mean to suggest that an actor is adapting the problematisation of another actor to better fit its own needs.

"Free association" refers to the need for a researcher to observe the "social" and the "natural" in the same way.

"Generalised agnosticism" refers to the neutrality with respect to characterisation of decisions of actors and suspension of judgment regarding those decisions.

"Generalised symmetry" refers to the use of the same vocabulary or "repertoire" in describing all actors.

"Interessement" is "the group of actions by which an entity . . . attempts to impose and stabilize the identity of the other actors it defines through its problematization" (Callon, 1986). It is the second of Callon's (1986) four "moments" of translation. Throughout this dissertation I use the noun "interessement", but I use the English verb "to interest" to refer to the same concept. See Chapter 3 for more discussion.

"Intermediary" is an actor or actor-network whose reactions (or outputs) are relatively predictable based on how they are acted upon by other actors or actor-networks (see Latour, 2005:39).

"Mediator" is a relatively unpredictable actor whose actions "transform, translate, distort, and modify the meaning or the elements they are supposed to carry" (Latour, 2005:39).

"Mobilisation" is broader acceptance among certain actors of the roles assigned in a particular problematisation and the alignment and enrolment of a diverse range of actors who accept and deploy it (Callon, 1986). It is the fourth of Callon's (1986) four "moments" of translation.

"Problematisation" the articulation of a worldview through identification of a series of actors and their roles (Callon, 1986). It is the first of Callon's (1986) four "moments" of translation. At times, to be more readable, I have used other verbs such as "frame" or "conceptualise" as stand-ins for "problematize".

"Translation" is the successful displacement of other perspectives of reality (Callon, 1986). Translation occurs as a result of Callon's (1986) four "moments" of problematisation, interessement, enrolment, and mobilisation.

1. Introduction

Workers, employers, shoppers, students, businesses, institutions, and governments share a problem in Cape Town, South Africa: how to get around. Individuals bear this problem, but its consequences reverberate at a broader level, affecting economic security, social stability, and environmental sustainability. The city's spatial composition, an institutional legacy of socio-economic and racial exclusion, an over-reliance on private automobiles, and underinvestment in public transport are all commonly-cited culprits. Stakeholders are less unified in identifying solutions.

New transport developments, including the City's Bus Rapid Transit ("BRT") plan, known as "MyCiTi", and its more recent proposal to incorporate new on-demand technologies used by Transportation Network Companies ("TNCs") such as Uber and Taxify, are shifting the transport environment in Cape Town. These new types of service depart organisationally and technologically from existing modes, which are dominated by private automobiles, an aging passenger rail system, commuter bus system, and a robust minibus taxi paratransit system. Whether and how these changes will transform transport in Cape Town for the better is the subject of much debate. While the new technologies and models upon which these innovations rely hold promise for improving the transportation options for Capetonians, the discourse surrounding them also carries some of the deterministic language reflecting modernist frameworks that have dominated planning and transport studies for the past century, with significant detrimental effects on the environment and society. The resulting approaches to transport and city planning beg the question: can we rely on new infrastructure and technology to address our transportation crisis?

In order to better anticipate and plan for Cape Town's transport future, it is beneficial to engage in a detailed understanding of both the social and technical dynamics at play in providing transport. Such an understanding can enable planners to focus on strategic points of change, which can become sites for policies and actions that anticipate and guide transitions in order to obtain better urban outcomes and address context-specific problems. This thinking broadly frames the subject of my research: what are some of the issues that Cape Town's travellers face in moving around Cape Town, and what are the prospects for leveraging socio-technical changes to improve access and opportunities for them?

To tackle this broad question, I investigated a particular set of transport challenges presented by the University of Cape Town's ("UCT") establishment of a new satellite campus, known as the MTN Solution Space Philippi ("Solution Space Philippi"), located in the township area of Philippi in Cape Town. The managers of the Solution Space Philippi want to improve access through public transport in a manner that is consistent with the

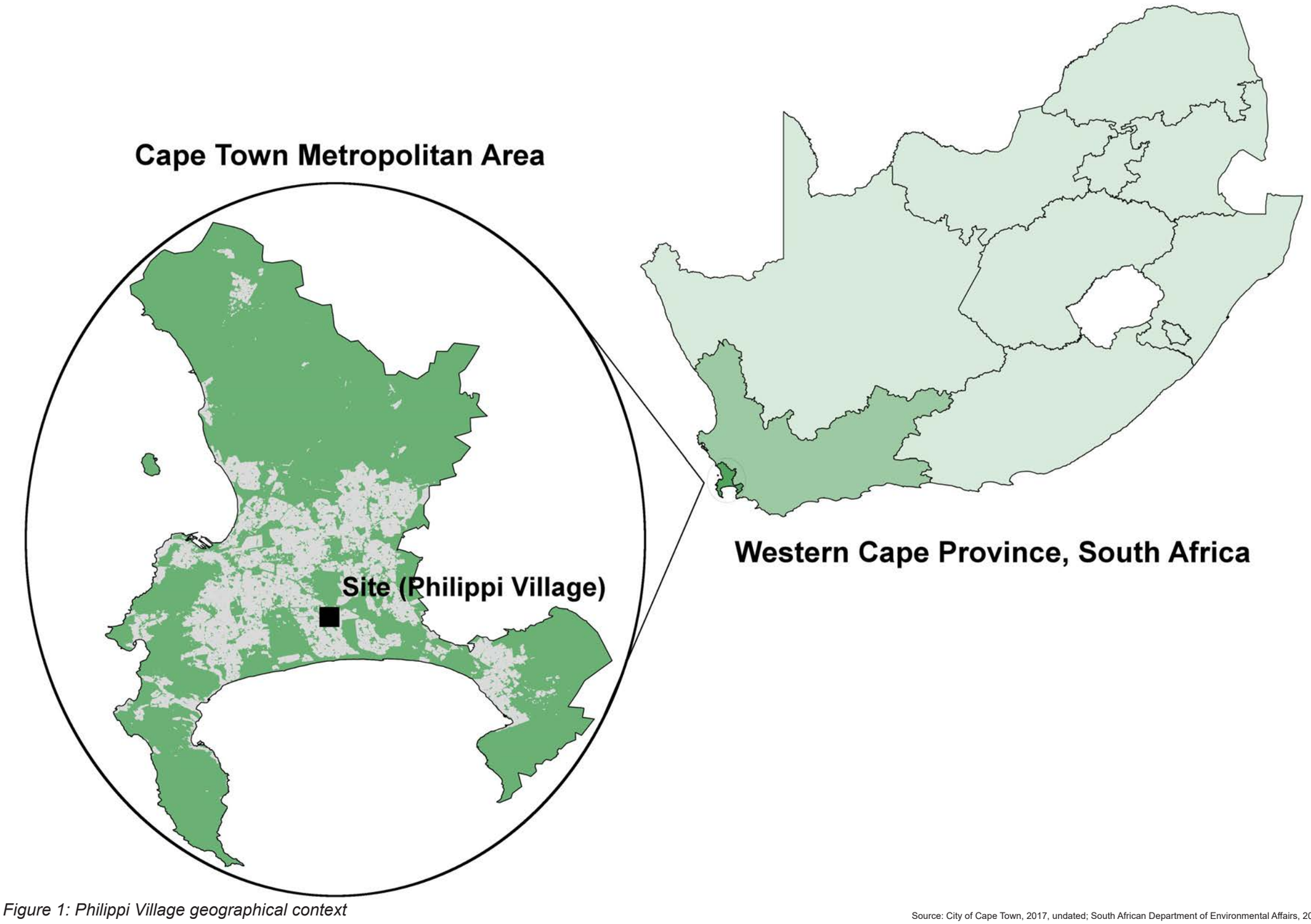


Figure 1: Philippi Village geographical context

Source: City of Cape Town, 2017, undated; South African Department of Environmental Affairs, 2017.

broader goals in its mandate, which is to promote socially-responsible innovation. This challenge, and specific access to Solution Space Philippi users' experiences, helped frame transport issues I addressed. My affiliation with UCT and connections through my supervisors, as well as my own interest in the goals and efforts of the Solution Space, provided further impetus for using it as a case study.

UCT's challenge in making the Solution Space more accessible by public transport reflects the broader transportation issues facing Cape Town and provides a specific real-world context for investigating how society and technology interact to facilitate access and mobility in the city. In order to explore this "socio-technical" perspective within this case study, I chose to utilise Actor-Network Theory ("ANT"), a descriptive methodological approach or "heuristic device" (Bender, 2010:317) to better understand and describe how access and transport work at Philippi Village. ANT requires a rather radical conceptualisation of society as a practically infinite number of physical interactions between discrete entities. In the language of ANT, it is through the regularisation, or "translation" of the patterns of these interactions, known as "actor-networks", which agency is allocated between both human and non-human actors. ANT's presumption of "radical relationality" among actor-network constituents (Farias, 2010) is particularly useful in investigating the dynamics of complex systems (Sengers and Raven, 2014), and has been used for some time to analyse the social elements of technological innovation (Bender, 2010).

In keeping with certain ANT practices, I framed my description of the various actor-networks implicated in transport access at Philippi Village in terms of four "moments" of translation—problematisation, interessement, enrolment, and mobilisation—identified in the ANT literature (see Callon, 1986:59). Through these steps, I traced both the underlying spatial context revolving around access and mobility at Philippi Village and the Solution Space Philippi, as well as various modal actor-networks, including the road network and private automobiles, paratransit and charter service, commuter bus service, and rail service. In addition, I outlined the prospects for two new actor-networks, the City's MyCiTi BRT service, and TNC service, in order to juxtapose these new services with existing services.

These descriptions resulted in six insights that I identified regarding how transport and access are established at Philippi Village. These include: the central role of the road and private automobile actor-networks in conceptualising how the site should be accessed; the high influence of crime on how access is viewed and resolved; the varying transport needs of Solution Space Philippi users; the benefits of passenger agency; the poor integration of public transport modes; and the divergence between existing and new transport actor-networks in actors enrolled and mobilised.

Based on these insights, I discuss potential options to enact change and assess whether in some cases change is more or less likely to result in enrolment and mobilisation for the benefit of Solution Space users. Several common themes appear in these proposals, including the viability of creating new alliances between existing mobilised actor-networks, as well as the potentially underestimated effort required to integrate new sets of actors into actor-networks and to alter the mediators involved in each network. These conclusions imply that the introduction of new services, like the MyCiTi and TNC services, may fail to mobilise necessary actors, or may necessarily exclude certain actors who should be benefiting from public transport services.

Accordingly, this dissertation's first purpose is to assess public transport access to Philippi Village and suggest courses that Solution Space management, Philippi Village management, and others might undertake or advocate in order to improve access to the Solution Space Philippi. Its second purpose is to demonstrate the capacity of ANT to help tackle difficult planning problems. ANT's ability to reveal hidden actors, causes, and relationships that humans take for granted or overlook in our everyday perception of reality make it a particularly helpful tool for planners. ANT also equips researchers with the tools to make the positionality of characters more transparent, thereby addressing the inherently political nature, or "wickedness" (Rittel and Webber, 1973), of planning problems.

I begin this dissertation by reviewing how modernist concepts regarding the universality of technological innovation have influenced the evolution of science, technology, and planning, and how over the past several decades scholars have criticised this dominant paradigm. I note how questioning "techno-determinism" has opened the door for a re-assessment of various transportation modes, including paratransit, but also how new technologies, particularly "on-demand" and mobile technologies, have ushered in a potential re-birth of techno-determinism. In my methodology chapter I introduce and explain Actor-Network Theory, and discuss how I utilised an ANT approach through a case study method using various established research and analytical techniques. In Chapter 4 I lay out my findings through an ANT-styled empirical description of the various key actors and actor-networks that are involved in providing access to the Solution Space Philippi. I also preface the potential arrival of two new modes of transportation serving this new campus, MyCiTi and TNCs. Based on this empirical description, in Chapter 5 I discuss key insights that result from the analysis of these actor-networks, and make various proposals based on these insights. I conclude in Chapter 6 by reflecting on my own involvement in these actor-networks, as well as the prospects for using ANT as an analytical tool for facilitating city planning.

2. Transportation and Technology: A Post-Modernist Critique

New technological innovation promises to remake and improve everything around us, including transport. This promise, which sums up technological determinism, or "techno-determinism", has shaped modernist planning and transport studies for over a century, resulting in various types of infrastructure-led development strategies (see Asdal, Brenna, and Moser, 2007). Despite significant academic literature critiquing this position, it continues to dominate policy discourse. The latest iteration of technological innovation, spawned by "on-demand" capabilities seeks to improve a historically marginalized mode of public transport, paratransit. What is lacking from the discourse, however, is a strong understanding of the relationship between the social and the technical, and how this relationship affects existing and future systems.

2.1 Modernism in Science, Technology, and Planning

In 1973, Rittel and Webber characterised the problems that planners face as "wicked problems". This term encompassed "nearly all public policy issues—whether the question concerns the location of a freeway, the adjustment of a tax rate, the modification of school curricula, or the confrontation of crime" (Rittel and Webber, 1973:160). By this they meant that planners faced issues that are inherently political—i.e. issues that cannot be solved through science or engineering.

Rittel's and Webber's statement reflected a broader realisation regarding the positivist and reductionist character of science, technology, and society under modernism. Western European Enlightenment thinking, which spawned the industrial revolution and modern society, was founded on scientific deduction, objective reason, and universalist perspective (Talvitie, 2009). Concurrent with industrialisation and modernisation, modernists conceived of the development and application of science and technology as an exercise in praising a "natural" progression of human ingenuity. As Simon (1996:13) puts it, "[t]echnology has generally been—and is still widely—perceived as being neutral in itself, and technical innovation therefore as an unqualified benefit and symbol of development" (see also Asdal, Brenna, and Moser, 2007:10-11). Within this frame, "the introduction of new technologies produce[] direct and unalterable social changes" that are seen as having little connection to social and political forces (Johnson and Wetmore, 2009:93). Asdal, Brenna, and Moser (2007:20) describe the resulting technological determinism as the concept that (1) "the nature of technology and the direction of change are unproblematic or pre-determined," and (2) "that technology has necessary and determinate 'impacts' upon [society] (Adsal, Brenna, and Mosder, 2007).

Planning has been as much affected by this modernist and techno-determinist view as other professions (Cox, 2010). For much of the twentieth century, planners have viewed themselves as "primarily technical, professional and apolitical" experts (Kiernan, 1983 cited in Yiftachel, 1989:33) seeking to systematically solve linear planning problems through a closed rational process of assessment (see Simon, 1996; Cox, 2010:96). For example, Rostow (1960) in his "stages of development" theorised that economic development consisted of four successive stages through which Global North countries had already passed, and through which Global South countries were in the process of, or still needed to, undergo (see Simon, 1996:37-38). John Friedmann (1987, first published in 1966) adopted this linear teleological position to support his core-periphery stage model of spatial urban growth, as did Wilfred Owen (1987) in explaining his "stages of mobility" (Simon, 1996:2, 38-39).[1] These approaches, which unquestioningly applied a universalist and determinist viewpoint in addressing social and developmental needs, failed to critically interrogate the bias towards technological innovation (Simon, 1996:2, 38-39). Not coincidentally, they also contained (thinly) veiled Global Northern biases that made their application either unsuitable for or actually exploitative of Global Southern societies (see Simon, 1996).

2.2 Modernism's Impact on Transport Planning

There are arguably few other realms of planning that have been more greatly affected by modernist planning than transport planning. Both physically and psychologically, many planning professionals and advocates have often unquestioningly associated new technologies in transport with progressively better access and opportunity. As Kenyon (2006:104) puts it, "cultural change, allied with the changes in the structure of the built environment, have acted to increase the importance of mobility for accessibility, increasing the mobility dependence in society, such that those without adequate mobility can find it difficult to access the activities necessary for participation in the society in which they live." Longstanding practices within engineering, planning, and transport studies of equating technological advancement with accessibility has led in many cases to costly forms of high mobility that nevertheless fail to improve accessibility equitably (see Simon, 1996). These in turn hamper socio-economic development and equity (see Simon, 1996) and negatively impact the environment (see Cox, 2010).

In fact, access, mobility, and transport are related but distinct ideas whose nuances under closer examination undermine modernist techno-determinism in the realm of transport. While the term *access* can have many meanings, within planning and transport studies it is often defined as the ease or ability of "reaching goods, services, activities and destinations" (Litman, 2015:5. See also Cox, 2010:5; Preston and Rajé, 2007:154). A broader but consistent interpretation of this definition is that accessibility constitutes both the potential for, and the activity of, interaction and exchange (Litman, 2015:5). Thus, accessibility does not need to be actualised to be present; the opportunity for accessing something in itself may constitute accessibility (see Litman, 2015).

Cervero (2005:1) describes accessibility as a "product of *mobility* and *proximity*, enhanced by either increasing the speed of getting between point A and point B (mobility), or by bringing points A and B closer together (proximity), or some combination thereof." Under this formulation, *mobility* constitutes "the desired means by which goods, services and activities can be reached—i.e. the physical act of travel" (Cox, 2010:5). Access may be achieved through mobility—i.e. physical movement—or by its substitution (Cox, 2010). The demands of mobility will be driven by the geographic distribution of goods, services and amenities that people seek to access (Cox, 2010). However, mobility itself does not necessarily guarantee access, and may even be unrelated to such goals, as in mobility for recreational purposes (see Litman, 2015).

Within this framework *transport* or *transportation* can be considered as the elements that affect mobility, for instance, the modes (e.g. road, rail, water, air) and forms of mobility (e.g. car, bus, bicycle) (see Simon, 1996). It can also stand more broadly for "the associated infrastructure and institutional frameworks, arrangements and policies, issues of access to and use of transport by different groups, and causes and implications of such considerations" (Simon, 1996:7). Clearly, based on these definitions, transportation impacts mobility and accessibility, albeit not in uniform or completely linear ways.

Because of the close links between transport, mobility, and access, these terms can often become confused, or stand in for one another. For example, since mobility is commonly considered the primary means of promoting accessibility, measures to increase mobility often stand in as metrics for accessibility (see Preston and Rajé, 2007:154). Similarly, transport is often aimed at promoting mobility for the purpose of facilitating access, and is therefore defined in terms of accessibility (see Litman, 2015).

Much of planning and transport studies has historically obscured the relationships between transportation, mobility, and access (see Simon, 1996). In the Global North, professional planning has conventionally biased itself

towards accommodating supply-side mobility through transportation infrastructure and technology (see Cox, 2010). One result of this is the significant contribution of transportation networks in the Global North (and increasingly the Global South) to the pollution in the form of greenhouse gas emissions associated with modern developed societies (see Cox, 2010). Promoting transportation technologies that reflect and project socio-cultural values further reinforces the consequences of Global North infrastructure-led development. Over the past century, the trend in mobility, particularly from a public and private investment standpoint, has been towards personal mobility enabled through the private automobile. This is not merely a technological phenomenon; the private automobile has become a marker of status and means, as well as "both symbol and tool of the freedom of the modern world" (Cox, 2010:1).

The rise of cars as the solution to physical mobility, when raised to the scale and penetration it has enjoyed in much of the world, brings with it drastic environmental and social consequences. "The current dominance of automobility as the default mode of transport cannot be sustained in either environmental or social terms" for many reasons (Cox, 2010:1). As Cox (2010:1) puts it, "[c]limate change, the destabilising effects of global geopolitics skewed by the demands of oil extraction, localised air pollution, congestion, noise, the severance of communities, and anti-sociality inherent in automobility are simply fragments of the complex and systematic problems of overreliance on the private car."

Meanwhile, the Northern bias towards personal mobility through advanced transportation infrastructure has had a profound impact on development in the Global South, where Northern planning concepts have been adopted through colonial and imperial frameworks (see Simon, 1996). The unfortunate result, as seen in the North but exacerbated by more significant poverty and inequality in the South, is an even more extreme disjuncture between development goals and the real impacts of modernisation on transport, mobility and access. This leads to the conundrum of modern transportation frameworks that may actually lead to less mobility for communities (see, e.g., Simon, 1996:60-61, discussing traditionally nomadic rural populations). In some cases, this irony has been a by-product of modernist transport planning, while in other cases, such as in colonial and apartheid South Africa, the goal of reducing accessibility for certain populations through modern transportation infrastructure was, in fact, a major goal and intended effect (Moosajee, 2014). The results of this trajectory led us to our present situation, in which revolutionary technological advances in mobility have also caused considerable issues regarding access, opportunity, equity, and health.

2.3 Critique of Modernism and Techno-Determinism

Starting largely in the 1960s, social scientists, historians, and philosophers in the Global North began to question the modernist predilection towards technological determinism (see Bijker, Hughes, and Pinch., 2012; Mumford, 1967, 1970). The new potential for globally-catastrophic harm, such as nuclear warfare and the pollution of the environment, produced by technology, spawned much of this re-evaluation (Asdal, Brenna, and Moser, 2007). At the same time, thinkers from the Global South, particularly the colonies and former colonies, began to critique the ways in which science and technology were manipulated to allow colonial powers to subjugate colonial subjects (see Fanon, 1963; Curto, 2016).

Sociological critiques and the obvious gaps in the efficacy of modernism that precipitated them revealed questions of agency and power regarding technology broadly, and modern transport in particular. For instance, in the 1970's Ivan Illich criticised the sociological impact of the technological shift towards private automobiles (Illich, 1973). Illich highlighted the "way in which dependence on private cars has the effect of restructuring economic, geographic and social relations" (Cox, 2010:24). In particular, he noted the transition "from an initial situation in which motorised vehicles serve human needs, to one of 'virtual enslavement' where human activities have to be themselves reoriented in order to purchase and maintain private motor vehicles, and where life without them becomes increasingly impossible" (Cox, 2010:24). Along a similar vein, Wolfgang Sachs (1992:92) noted: "[t]echnology does not simply fall from the sky; rather the aspirations of a society (or a class) combine with technical possibility". He argued that the modern obsession with private automobile usage in the Global North (now increasingly seen in the Global South) reflected an element of "technological narcissism" (Sachs, 1983:353).

Sociologists and historians began exploring how science and technology are entangled with society, rather than objective or separate (Pinch and Bijker, 2012). The implication of this conclusion was important because it revealed a new plane of ethics within technological development. Their research indicated that "the determinist argument is not just wrong, but inherently dangerous because it pushes out of sight the social forces at work in directing the development of technology and conceals the infinite array of alternative possibilities" (Johnson and Wetmore, 2009:94). In sociologising technology, this view negated "that a given future is inescapable" and undermined human abdication of "responsibility for controlling the direction of technology" (Johnson and Wetmore, 2009:94).

For their part, post-colonial critiques regarding transport and, more generally, technology in the context of cities highlighted inclusion versus exclusion in the context of colonial and neo-colonial structures, where the benefits of technological progress extended only as far as the colonial concept of urban "citizen", resulting in the purposeful exclusion of colonized peoples who were barred from urban citizenry (see Graham and Marvin, 2001; Graham, 2002). Here, scholars have sought to reveal how technology was used in the colonial context to assert colonial dominance (see Balbo, 1993, cited in Odendaal, 2011), as well as to facilitate exploitation of natural resources (Graham and Marvin, 2001). Indeed, patterns of rail and road infrastructure across much of Africa reflect these motivations (Graham and Marvin, 2001). These insights have been guided by political and economic critiques of modernism, including political economics (see Simon, 1996) as well as post-modernist and post-development perspectives (see Cox, 2010).

These critiques implied that the planning profession needed to move away from envisioning the planner as the technical, professional, apolitical expert (Kiernan, 1983 cited in Yiftachel, 1989), toward a more relational approach that acknowledges the "inherently political and ethical nature of planning practice, and the organisational, social and psychological realities of planning practice" (Klosterman 1985:10). Since then, academics have intensely debated the successor to positivism as a "theory" for planning (see Lord, 2014).

2.4 Tools of Critique: The Sociology of Science and Technology

Revealing the political nature—i.e. the "wickedness" identified by Rittel and Webber (1973)—in the application of science and technology to society necessitated a need for new tools with which to understand and study these dynamics. The scholarship stemming from radically re-evaluating the relationship between technology and society has since taken many paths under a range of disciplines and sub-disciplines (see Asdal, Brenna, and Moser, 2007; Johnson and Wetmore, 2009). Among these is a broad interdisciplinary field, sometimes labelled Science and Technology Studies ("STS") (see Pinch and Bijker, 2012; Asdal, Brenna, and Moser, 2007) or Sociotechnical ("ST") studies (see Johnson and Wetmore, 2009; Marletto, 2014), looking specifically at the social nature of technology.[2]

Much of the new sociology of technology and science has been guided by a few underlying concepts. First is that the sociology of scientific knowledge, including the use, design, and even content of technology, are open to sociological analysis (see Pinch and Bijker, 2012). Second is that technology operates through systems, i.e. "interlocking elements of physical artifacts, institutions, and their environment and thereby offer[] an integration

of technical, social, economic, and political aspects" (see Pinch and Bijker, 2012). The result is technology defined as a "cluster of material objects, social practices, social relationships, and social organization" (see Johnson and Wetmore, 2009:94). In this way, the term "socio-technical" is an apt descriptor of the integration between material objects and the "purpose, value, and implications" (Johnson and Wetmore, 2009:94-95) with which humans imbue them.

Some STS scholarship links its research, expressly or implicitly, with various social and political theoretical frameworks and normative ideologies, such as Marxism, feminism, and environmentalism (see Asdal, Brenna, and Moser, 2007). Other strains have sought to bridge the intellectual divide between social and scientific inquiry by maintaining a relativist stance, essentially rejecting socio-determinism as well as techno-determinism (Cordella and Shaikh, 2006; Latour, 2005). This move is often achieved by applying conceptual and methodological tools that seek to break down the complex socio-technical interactions in order to "level" out the significance of various inputs into the system (see Bender, 2010) to achieve epistemological or "methodological relativism" (Bijker and Pinch, 2012:xxv). While some criticise this move as a-political, the methodological relativists argue that systematically critiquing "entanglement of humans and nonhumans" is itself a political move and can inform normative and ethical action (see Bijker and Pinch, 2012:xxi).

More recently, scholarship on urban planning and transportation has begun to adopt some of the intellectual tools presented by STS scholarship. In particular, scholars have picked up on social embeddedness of technology and the symmetry of agency among human and non-human actors. As Farias and Bender (2010:2) write, "[t]he notion of urban assemblages in the plural form offers a powerful foundation to grasp the city anew, as an object which is relentlessly being assembled at concrete sites of urban practice, or, to put it differently, as a multiplicity of processes of becoming, affixing socio-technical networks, hybrid collectives and alternative topologies." This approach moves away from both singular and binary conceptions of the "city", instead providing instead "an alternative ontology for the city, an alternative understanding of this messy and elusive object" (Farias and Bender, 2010:9). Departing from both techno-deterministic and socio-deterministic approaches, cities can be better understood as "enacted into being in networks of bodies, materialities, technologies, objects, natures and humans" that avoid dissolving into opaque systems or institutions (Farias and Bender, 2010:13; see also Bender, 2010:304).

2.5 Allowing Space for Alternative Visions: Paratransit

Questioning modernism and techno-determinism through a socio-technical lens allows for departure from the universalist or reductionist conceptualisation of transport modes and technologies. In this context, "backward" or low-tech transport options, such as walking, cycling, and modes characterised as "informal transport" (Jennings et al., 2016) may be reassessed in new light according to how they are used, rather than judged through their theoretical technological capability (see Simon, 1996; Cox, 2010). In doing so, this new paradigm permits planners and scholars to discover and leverage new connections and associations. Among these neglected modes, paratransit reigns as one of the most important in the Global South due to its success and pervasiveness. Paratransit is therefore one of the best opportunities to change the narrative of transport from a socio-technical perspective.

In its broadest sense, paratransit covers many services that lie somewhere between formal public transport and private vehicle ownership (see Cox, 2010:8; Behrens, McCormick, and Mfinanga, 2016).[3] A fundamental characteristic of paratransit is its dynamic and demand-responsive nature: "paratransit modes represent a systems design that theoretically is able to dynamically match supply of a service with the demand required, unlike conventional models of public transport" (Enoch and Potter, 2016:17). Most commonly, this flexibility is derived from either unscheduled routing, scheduling, or a combination thereof (Cox, 2010:8-9; Cervero, 1997).

Beyond this basic definition, there is an enormous amount of diversity, but also overriding similarities. Paratransit most often involves using smaller vehicles (Enoch and Potter, 2016; Westerlund, 2016; Cervero, 1997). Paratransit is generally open to the public, or to a certain subset of the public (Cox, 2010:9). Some forms of paratransit are formally established parts of a larger public transport system, but most have been established outside formal governmental systems, and may continue to operate in a legal grey area or clearly outside the bounds of the law. Many systems are self-regulated through unions, taxi or route associations, or other mechanism (Behrens, Ferro, and Golub, 2016). Fares are often set through these self-regulatory mechanisms (Bruun et al., 2016) and are also dynamic depending on demand and competition (see Klopp and Mitullah, 2016).

Although seemingly chaotic to the uninitiated or uninformed due in part to its flexibility and competitive atmosphere, paratransit in fact constitutes "complex system[s]" that may, for instance, involve "politicians, police, bureaucrats, diverse vehicle owners, insurance companies, umbrella and route associations, drivers, touts, route managers, mechanics and, of course, the users" (Klopp and Mitullah, 2016). This "apparent complexity . . . emerges out of the way in which key actors within the system relate, capture and jockey for benefits, as well as navigate—and undermine—the formal institutional environment set up (often poorly) to regulate the public transport system" (Kloop and Mitullah, 2016:79).

The variation in forms covered by the label paratransit means that categorisation and classification are helpful, even necessary, although categorisation of this fluid and varied industry is a difficult task. Several scholars have endeavoured to classify the wide panoply of paratransit activities (see Cervero, 1997; Behrens, McCormick, and Mfinanga, 2016). In addition to formally descriptive or academic definitions, many specific types of paratransit go by their local or colloquial names, such as jitneys, jeepneys, matatus, dolla-dollas, minibus-taxis, black taxis, gypsy cabs, and hacks (see Appendix A for a categorisation of various types of paratransit services and operations). In South Africa, the colloquial name for paratransit service is minibus taxi, which in fact covers an assortment of paratransit operations (Schalekamp and McLaghlan, 2016). In addition to minibus taxis, there are also other types of paratransit service in South Africa, most notably the so-called "Amaphela" ("cockroach" in isiKhosa) service that provides local feeder service in four- or five-seater vehicles (Sustainable Livelihoods Foundation, 2013; TaxiMap, 2017).

Some scholars have used the term "informal transport" to describe paratransit that is weakly regulated or illegal (see Behrens, McCormick, and Mfinanga, 2016). Writers often use this term in the context of the Global South (Behrens, McCormick, and Mfinanga, 2016). Godard (2008) coined the term "transport artisanal" to describe African francophone paratransit services (Behrens, McCormick, and Mfinanga, 2016, citing Godard, 1987, 2008). Behrens, McCormick, and Mfinanga (2016) argue that this term actually may be more appropriate in describing paratransit in the Global South because it eschews the blurry distinction between formal and informal systems (Behrens, McCormick, and Mfinanga, 2016). Cervero (1997) opts for the term "commercial paratransit" to distinguish between paratransit that is purely commercial and open to the general public, versus services that may be sponsored by employees or developers, which offer services as a package only for a segmented portion of the population. Behrens, McCormick, and Mfinanga (2016) distinguish "public transport" paratransit from other forms of paratransit that do not serve public transport purposes. New technologies, discussed further below, have also begun to blur definitions and boundaries of paratransit.

In many places in the Global South, paratransit constitutes a far larger and more integral part of the public transport system than in the Global North, where it conventionally refers to an official service provided to popu-

lation subsets with special needs (Cervero, 1997; Behrens, McCormick, and Mfinanga, 2016).[4] Indeed, Klopp and Mutallah (2016:80) note that "[p]aratransit forms the core of public transport in most cities in Sub-Saharan Africa", nearly always as a consequence of "poor funding and management of municipal transport systems, rapid urbanization . . . and a poor regulatory and institutional environment."

Nevertheless, in line with a modernist bias towards other modes of transport, paratransit operations are often neglected, marginalised, or manipulated by public authorities. As Venter (2011) writes, "informal public transport has historically been regarded as a 'problem to be solved' by the government, official attitudes towards informal operators ranging from passive toleration to outright hostility" (as quoted in Jennings et al., 2016:302 n.2).

Studies of paratransit have generally not taken a socio-technical approach, often lying on one end or the other on the spectrum of sociological and technological inquiry. Behrens, McCormick, and Mfinanga (2016) note that "[s]cholarly publications on paratransit operations and regulation . . . are limited," particularly regarding Sub-Saharan Africa (see also Behrens, Ferro, and Golub, 2016). Much of the global scholarship has historically taken up the free-market ideas imbued in most paratransit systems (e.g., Cervero, 1997; Klein, Moore, and Reja, 1997. See also Behrens, McCormick, and Mfinanga, 2016, discussing earlier scholarship). Early scholarship during the 1970s to 1990s focused primarily on the Global North, specifically the United States, where observers argued that paratransit offered a free-enterprise solution to public transport (see Cervero, 1997; Behrens, McCormick, and Mfinanga, 2016). These scholars lamented the marginalisation of paratransit in the United States during the early part of the twentieth century when upstart "jitney" services were regulated out of existence at the behest of powerful existing trolley and public rail operators (see Behrens, McCormick, and Mfinanga, 2016, 2016; Cervero, 1997).

In the 1980s and 1990s paratransit studies extended to Global South cities, particularly in Southeast Asia (see Behrens, McCormick, and Mfinanga, 2016, citing Rimmer 1984; Roth 1987; Cervero 1992, 2000). Some of the most prominent scholarship, often conducted by Global North scholars, focused on better understanding the commercial success of such systems and the potential for using them as a template for public transport provision in Northern cities (Behrens, McCormick, and Mfinanga, 2016). This generally sympathetic literature also offered suggestions for better organisation, regulation, and funding of Southern paratransit systems (see Behrens, McCormick, and Mfinanga, 2016). For example, Cervero (2000) argued that among a range of policy responses available to informal transport, from 'acceptance', to 'recognition', 'regulation' and 'prohibition', governments should adopt 'recognition' policies, "in which rules and minimum standards focused largely on safety and insurance are enforced without public sector mediation of levels of supply", as well as 'regulation' policies, "in which market entry and exit is publically controlled" (Behrens, Ferro, and Golub, 2016, citing Cervero, 2000).

During the 2000s, much of the paratransit literature regarding the Global South diversified and shifted more towards the operational attributes and innovations available (Behrens, Ferro, and Golub, 2016). This is in part due to the emergence of policies based on the Latin American context, where governments have sought to reform paratransit operations through implementing BRT projects (see Behrens, Ferro, and Golub, 2016). The consensus from BRT experimentation has been that they are unlikely to replace paratransit systems anytime soon, and that governments must therefore instead seek to recognise, include and integrate paratransit operations into the overall public transport system (see Behrens, Ferro, and Golub, 2016). These studies have expressly advised caution against technology-driven reform: "there are no directly transferable 'magic bullets', and . . . the unquestioned adoption of technologies developed elsewhere is inherently dangerous" (Behrens, McCormick, and Mfinanga, 2016:14). Similarly, Schalekamp, Golub, and Behrens (2016:122) criticise "an overemphasis on infrastructure and technology transfer in the planning and design process" of Sub-Saharan African paratransit reform projects "and an underemphasis on existing system and incumbent operator capacities and constraints." In tackling the physical and tangible elements of public transport systems, Sub-Saharan African cities "have failed to address head-on what is fundamentally an institutional issue" (Schalekamp, Golub, and Behrens., 2016:122. See also Barrett, Finn and Godard, 2015:244). Ultimately, "government may . . . have to accept that this agenda [i.e. paratransit reform] does not revolve around the introduction of a new public transport mode, but rather around unlocking the human capital -- including the operational experience and local knowledge -- that is embodied in the multitude of paratransit businesses around the country" (Schalekamp and McLachlan, 2016:194).

More broadly, recent scholarship on paratransit in Sub-Saharan Africa argues for a more pragmatic and realistic engagement with the industry that acknowledges the realities and experiences of previous policies (see, e.g., Schalekamp, Golub, and Behrens, 2016). These strategies pay more careful attention to the economic incentives that various regulatory structures create, as well as the (limited) capacities of many Sub-Saharan (and Global South more broadly) governments (Schalekamp, Golub, and Behrens, 2016; Schalekamp and McLachlan, 2016). Jennings et al. (2016:301) warn that "[a]ny strategy will need to take governance and regulatory frameworks, reform proposals and enforcement practices, the relationship between operators and authorities, and the political and financial climate, into account." Taking a step in this direction, research by McCormick et al. (2016:126) investigated the perception of paratransit operations in Nairobi as "black boxes", and reveal their diversity "in size, organisation, management and strategy." Their research reveals a varied ecosystem of business models and operational strategies, from sophisticated and well-financed to rudimentary and subsistence level, which interact with the city's larger economic, organisational and regulatory environments (McCormick et al., 2016).

The literature on paratransit, particularly more recent studies, highlights how social and political factors, as much as or more than technical ones, have contributed to the persistence and success of paratransit. However, only a few studies have taken an expressly socio-technical approach to this subject. Accordingly, socio-technical scholarship is largely missing from the discussion.

2.6 Techno-Determinism's New Face?

Recently, technological innovations in a number of fields have raised the prospect for improving transportation options and thus, potentially, access and mobility in the urban context (Teal, 2016). Already, private and public entities are implementing these technologies across the world in specific ways to provide "on-demand" mobility. Given these technologies' potential to facilitate and coordinate complex interactions, some have proposed them as solutions to some of the issues facing paratransit services, particularly in the Global South where these services are heavily utilised (see Enoch and Potter, 2016; Teal, 2016). The reception and discourse among various policymakers, planning professionals, and scholars, indicate the continued dominance of modernist perceptions, and the need for a better socio-technical understanding of the paratransit industry.

While the range of new technology-enabled mobility services is diverse, development of services has been driven to a great extent by a number of for-profit companies based in the United States and Europe providing "on-demand" private transportation services. Among the most popular are smartphone-based, on-demand mobility systems run by private TNCs.[5] These systems utilise online platforms to make use of shared vehicles for on-demand service (see Greenblatt and Shaheen, 2015).

This new wave of technological innovation in transport has also arrived in African cities. Hotbeds for innova-

tion in Africa include Nigeria, Egypt, and South Africa (see Onwuanumba, 2016; Mutiso, 2016; Oreva, 2016). According to one source, there were 56 “e-ridesharing” services in Africa as of 2016, the vast majority of these being local companies offering services in only one city or one country (Oreva, 2016). While there were a relatively high number of local “home-grown” services, the overall market is dominated by the TNC Uber (Oreva, 2016). Local TNCs have adapted their services to local contexts, including allowing payment by cash (Oreva, 2016), as well as by experimenting with application in the paratransit industry (see Tsele, 2017).

In Cape Town and South Africa more broadly, there have been a number of both domestic and foreign companies entering the on-demand transport market, although the industry’s short history shows that gaining traction and maintaining financial viability have been a struggle, particularly for locally-based start-ups (see Studener, 2013; Georg and Rose, 2016). While the current market for on-demand mobility services in Cape Town is for the moment dominated by e-hailing services offered by two TNCs, Uber and Taxify, both of which are based in the Global North (United States and Estonia, respectively).

Observers presume that TNC business models and on-demand technologies could soon infiltrate the paratransit sector in Cape Town and many other African and Global South cities. Tech corporations, start-ups, and consultants alike are looking at opportunities to harness new technologies aligned with on-demand service to paratransit (see, e.g.,Taxi Map, 2017; WhereIsMyTransport, 2017; iAfrikan, 2017; Mutiso, 2016). Likewise, some transport academic and business case studies have sought to assess the prospects for on-demand and TNC-like technologies in paratransit (see Schmidt, 2014; GoMetro, 2017). Governments are getting on board as well, with the City of Cape Town’s latest business plan regarding its integrated public transport plan advocating for local minibus taxi industry to adopt TNC-like business models (referred to as “new generation” services) (TDA Cape Town, 2017).

Much of the scholarship is hopeful of the prospects for technology to increase paratransit efficiency, and thus accessibility through mobility (see Enoch and Potter, 2016). Leiren and Skollerud (2016:290), for instance, praise “demand-responsive” transport for approaching the mobility provided by the private automobile, noting that “[a]n increasing literature focusing on [Demand-Responsive Transport] suggests that, given communication technologies, such transport services are more responsive to user needs and therefore more attractive to citizens.”

Social dynamics in places like Cape Town, however, suggest the prospects for applying these technologies is more complex and nuanced. In Cape Town, metered taxi associations have resorted to violence and intimidation tactics to prevent what they consider to be an incursion on their market (see, e.g., Chabalala, 2016). Uber, which is particularly known for its aggressive and confrontational style, has induced strong reactions from metred taxi drivers in particular (see Harvey, 2016). Governments around the world, including the City of Cape Town, have also viewed TNCs with scepticism at times (see van Zyl, 2016; Scott, 2016; Georg and Rose, 2016; Transport for Cape Town, 2015), indicating that these companies will continue to face regulatory and political hurdles.

2.7 Summary

Despite new analytical capacities developed to counter the modernist tendencies towards techno-determinism, it remains a “virtually unchallenged orthodoxy within Transport Studies” (Simon, 1996:13-14). The technology-based promises of new ICT and mobile technologies, embodied in entities such as TNC business models and driverless cars (see Araujo, Mason, and Spring, 2014), reveals the continuing risk of perpetuating modernist techno-determinism, and the assumptions these carry regarding progress and societal benefit, particularly in the Global South. Paratransit, which official and dominant narratives have consistently sought to relegate as anachronistic to modern public transport, is now seen as the site of high-tech application and innovation. While the reversal of perceptions could benefit an industry that serves some of the most vulnerable communities, the discourse regarding this shift indicates that technology might once again be used to pursue universalist goals that marginalize those same vulnerable populations.

Moving away from the inertia of techno-determinism and infrastructure-led development in a manner that balances technological evaluation with the sociological critique necessary to address “wicked problems” suggests that a socio-technical approach is the right tool through which to evaluate and assess the prospects of technological application. In order to do this, I chose to rely on ANT, one of the most intriguing relational theories to come out of the socio-technical discourse in the past forty years. The next chapter outlines ANT and how I used it.

3. Theory and Methodology

ANT formed the theoretical and methodological basis for my research on the socio-technical relationships guiding the existing and potential transport systems serving the Solution Space at Philippi Village. ANT is a descriptive methodological approach or "heuristic device" (Bender, 2010:317) used to better understand and describe social relationships through a close empirical investigation of physical interactions. This approach requires a rather radical conceptualisation of society as a practically infinite number of physical interactions, the patterning of which creates "actor-networks." The ANT approach assumes that agency is allocated between both human and non-human actors, an assumption that disrupts the conventional understanding of cause and effect and allows for an arguably more robust and objective analysis of the particular social interactions under investigation. In this chapter I will describe ANT's conceptual and methodological background and how I implemented ANT through the use of a number of complementary research methods and techniques. Along the way, I will also touch upon some of the inherent limitations in ANT generally and this research in particular.

3.1 An Introduction to ANT

ANT spawned from the rebuke of technological determinism that emerged during the second half of the twentieth century and the re-evaluation of the relationship between technology and society. Like other strains of STS, ANT presumes an inherent sociological component of scientific and technological development. However, in contrast with other forms of STS scholarship that rely on normative ideologies such as Marxism, feminism, and environmentalism (see Asdal, Brenna, and Moser, 2007), ANT and similar STS approaches seek to "bracket epistemological claims" (Bijker and Pinch, 2012:xxv). They do this in order to obtain the objectivity required to more accurately assess scientific and technological claims about truth and progress. What sets ANT apart is its extreme commitment to empirically investigating the physical phenomena that establish social meaning.

"Materials solidify social relations" (Murdoch, 1998:360). This sentence could sum up the essential insight of ANT. ANT theorises that the "social" rests entirely on the myriad of interactions between the physical characters, or actors, that make up all human interaction.[6] It is the collection of these discrete interactions, rather than ephemeral concepts such as class, ethnicity, or race, that explain the "social". ANT is a means of studying "the way in which actors attempt to impose worlds upon one another," rather than "trying to impose another strong conception of the nature of social reality" (Callon et al., 1986).

Actually, the above sentence could be modified to state: "materials solidify social relations", *and vice versa*, because the visible physical and technical artefacts that our societies produce are supported and perpetuated by innumerable invisible interactions that extend well beyond the physical symbols of these actors' work (see Latour and Hermant, 1998). We often view the physical (and metaphysical) manifestations of certain assemblages as discrete, impermeable symbols—e.g., a mobile phone or a transit route—thereby obfuscating the malleable nature of these assemblages. However, innumerable interactions between discrete actors—microprocessors, satellites, technicians, or pavement, engineers, maps, etc.—uphold the material manifestations of actor-networks. This truth becomes apparent once these relationships begin to break down for any reason.

The work carried out in order to establish social relationships is performed by *intermediaries* and *mediators* (Callon, 1991:134; Latour, 2005:39; Rydin, 2012:26). Intermediaries are actors or actor-networks whose reactions (or outputs) are relatively predictable based on how they are acted upon (i.e. the inputs) (Latour, 2005:39). Intermediaries help define relationships between actors by actions that pass through them (Callon, 1991:134), or put differently they "transport meaning . . . without transformation" (Latour, 2005:39). Money, computer software, scientific articles, legal documents and "disciplined human bodies" are all good examples of intermediaries (Callon, 1991:134). Mediators, on the other hand, are relatively unpredictable actors who "transform, translate, distort, and modify the meaning or the elements they are supposed to carry" (Latour, 2005:39). The intermediary/mediator distinction is empirical, relative, and subject to change, as Latour (2005:39) demonstrates in comparing his normally functioning computer (intermediary) to a malfunctioning one (mediator).

The maintenance of society requires the work of all actors involved, human and non-human, to continually "buy in" to the assembled social structures (see Latour, 2005). This work, particularly the work of non-human actors, often goes unnoticed and unaccounted for in our conceptualisation of society. Where interactions are consistently maintained, they may become stabilised assemblages, assumed to be fixed in composition. Assemblages are themselves the embodiment of power, and stabilised assemblages reinforce power dynamics amongst actors (Latour, 2005). Actor-networks that achieve a high level of stabilisation may become a "black-box", perceived as an impermeable unified element resistant to interrogation of its constituent interactions (Cordella and Shaikh, 2006; Rydin, 2012). However, actor-networks are constantly subject to mutation or dissolution if at least one actor breaks the chain of interactions (Callon, 1986). As Odendaal (2014:33) notes, "[m]aintaining the integrity of [a] network . . . depends on how well it responds to a change in any of its components." The concept of black boxing and the differentiation between intermediaries and mediators provide two mechanisms for tracing the flux of agency among actors.

3.2 A Radical (and Controversial) Methodological Theory

In order to better understand how the social is constructed, ANT argues that observers must dissect the web of actions and reactions that construct social reality in a highly objective and empirical manner. The radical way in which ANT approaches this task is to expressly attribute and track action and agency between non-human as well as human actors. Under ANT, agency is not the limited purview of humans but rather imbued in everything with which we interact. In asserting as much, ANT allows us to uncover how our material surroundings are involved in the "dance" that we call society (Rydin, 2012).

Callon (1986) and other ANT researchers assert three requirements to applying ANT: (1) generalised agnosticism, (2) generalised symmetry, and (3) free association. Generalised agnosticism refers to the neutrality with respect to the characterisation of actors' decisions and suspended judgment regarding those decisions. Generalised symmetry calls for the use of the same vocabulary or "repertoire" in describing all actors. Free association requires that the researcher observe the "social" and the "natural" in the same way. The effect of these requirements is that the action, agency, or morality of a non-human character cannot be redistributed to human actors, thereby muddling the connections and interactions between all social actors, human and non-human (see Odendaal, 2014, citing Law, 1991). These requirements allow for objectivity by detaching from preconceived notions of relationships in favour of finding meaning from the existence and character of the relationships themselves.

ANT's presumption of "radical relationality" among actor-network constituents (Farias, 2010) is particularly useful in investigating the dynamics of complex systems (Sengers and Raven, 2014), and has been used for some time to analyse the social elements of technological innovation (Bender, 2010). More recently, scholars have recognised ANT's applicability to urban issues (see Murdoch, 1998; Marletto, 2014; Bender, 2010; Rydin, 2012; Odendaal, 2011), and have begun applying ANT to the fields of urban studies, planning and architecture (*see*, *e.g.*, Marletto, 2014; Hommels, Farias, and Bender, 2009; Latour and Yaneva, 2008). A few studies drawing on ANT have focused on the development of public transport (Pineda, 2009) and informal transport systems

(Sengers and Raven, 2014).

Praise for ANT is far from universal, and it has faced a range of criticism from a diverse body of scholars (see Latour, 2005; Jackson, 2015). A commonly perceived shortcoming of ANT is that it appears to negate responsibility among actors since it is the relationships, not the actors themselves, which are responsible for creating actor-networks (Bender, 2010:305). Similarly, because ANT seeks to "level" human and non-human actors to the same level of agency, some argue that this device has the effect of negating politics and absolving human actors in a manner akin to techno-determinism (see Adsal et al., 2007). Some scholars argue that ANT assumes the stories of the powerful and discounts the stories of the weak (Star, 1991). Another prominent criticism of ANT is the apparently prerequisite act of purporting to speak for others, particularly non-human actors (Jackson, 2015). Critics of ANT argue that the supposedly objective nature of the field actually misattributed intentions and perspectives, replacing their actual voices with the researcher's own (Jackson, 2015, citing Collings and Yearly, 1992, and Michael, 1996).

ANT scholars respond largely by stating that their mechanisms are misunderstood. The integral nature of actor-networks does not mean that actors cannot be held accountable for their role, as is demonstrated when that actor is removed (see Bender, 2010:306). In this case, the actor-network would necessarily change, responding to the actor's decision to opt-out, albeit with potentially unpredictable results (see Bender, 2010:306). With respect to politics and power, ANT scholars and socio-technical scholars more generally argue that the work of uncovering the socio-technical dimensions of actor-networks is itself political and that the description constitutes critique (see Bijker and Pinch, 2012). ANT scholars also note that research broadly speaking is the practice of attributing voices to others, and that ANT is particularly well suited to deal with this since ANT's analytical tools should also be pointed at the research herself to identify biases (see Latour, 2005). Finally, even where there may be misgivings about ANT, proponents argue that it can nevertheless provide a powerful tool for exploring complex socio-technical systems (Farias, 2010).

3.3 Following the Process of Actor-Network Construction

How to turn ANT into a practical means of studying socio-technical relationships? ANT scholars say "follow the actors" (Callon, 1986:59; Latour, 2005:12). While various researchers have implemented this directive in different manners, I have assumed a theoretical framework described and implemented by one of the earliest and best-known ANT researchers, Michel Callon. Callon (1986:59) identifies four "moments" in the process of establishing an assemblage: problematisation, interessement, enrolment, and mobilisation.

Problematistion represents the articulation of a worldview through identifying a series of actors and their roles. During this step mediators seek to establish "obligatory passage point[s] in the network of relationships" that require other actors in the network to align conduct and interact with one another in a manner dictated by a particular framing of the socio-technical relationship (Callon, 1986:59). Problematisation does not only identify a goal but also articulates a framework for understanding the relationships necessary to achieve that goal. Rydin (2012:26) writes that "in obligatory passage points, actants are required to come together around the dominant framing and then engage in specific negotiations within the context of such framing." It is according to this framing that each actor's role is defined (Rydin, 2012). To be a little less cumbersome, in some cases I use the word "conceptualise" or "frame" interchangeably with "problematize".

Interessement is "the group of actions by which an entity . . . attempts to impose and stabilize the identity of the other actors it defines through its problematization" (Callon, 1986:62). Callon (1986:63) explains interessement as the process of "cutting or weakening" links between an actor and other actors that would define that actor according to a different worldview. He notes that the "range of possible strategies and mechanisms" used to interest other actors is "unlimited" and can include strategies such as force, seduction, transaction, through mechanisms such as technologies, texts, and conversations (Callon, 1986:63). The point is to disrupt or weaken relationships with other actors in favour of stronger relationships with other actors according to the logic of the problematisation (Callon, 1986). Callon chooses the word "interessement", related to the English verb "to interest" and derived from the Old French "interesse"[7], based on its etymology: "[t]o be interested is to be in between (*inter-esse*), to be interposed" (Callon, 1986:62). Throughout this dissertation I use the noun "interessement", but I use the English verb "to interest" to refer to the same concept.

Enrolment is a designation "of interrelated roles . . . defined and attributed to actors who accept them" (Callon, 1986:65). It involves the successful negotiation between specific actors who interesse and are interested, and who ultimately come to an agreement regarding their roles in relation to each other. Enrolment is achieved when interessement is successful (Callon, 1986).

Mobilisation refers to the broader acceptance of the roles assigned in a particular problematisation and the alignment and enrolment of a diverse range of actors who accept and deploy it. Mobilisation is the "render[ing of] entities mobile which were not so beforehand" (Callon, 1986:71). The earlier steps of interessement and enrolment generally only include a few "representatives" or spokespeople of a larger population of similar actors, who are silent with respect to the initialisation of an actor-network (see Callon, 1986). In order to construct a successful assemblage, "actors are first displaced then reassembled at a certain place at a particular time" in the physical world (Callon, 1986). "Mobilised actor-networks are those that a diverse range of end-users accept and deploy unquestioningly", thereby stabilising the relationships (Rydin, 2012:39). An actor-network that is mobilised is stable; the actions of a few actors initially involved in enrolment are representative of a larger body of actors and are made generalisable (see Callon, 1986). Representatives thus speak for many.

These four steps constitute the "translation" of a successful assemblage representing a social construction into reality (Rydin, 2012). Translation is the process of displacing other perspectives of reality with your own: "to translate is . . . to express in one's own language what others say and want, why they act in the way they do and how they associate with each other" (Callon, 1986). The success or failure of the process of translation is expressed by whether at the end of it "only voices speaking in unison" are heard (Callon, 1986:75). In speaking as one, the process necessarily silences, or displaces, other potential actor-networks. However, as Callon (1986:72) notes, "this consensus and the alliances which it implies can be contested at any moment."

3.4 Framing the Research Scope and Process

Callon's (1986) four-step process provides a roadmap for studying the process of translation at the heart of establishing actor-networks. But where to start the process, which actors should be studied, and where should the act of tracing the actor-network relationships end? Where to start among the "swarming bee's nest" of actor interactions (Latour, 2005:121) and likewise where to "cut the network" are common problems faced in ANT scholarship (see Jackson, 2015:40). In addressing these issues, I used several principles discussed and employed by other ANT scholars.

ANT's radically relativistic quality infers that the point of departure for any study derives from the goals of the researcher herself and the intended social relationships that she seeks to describe, rather than from some overarching theory concerning the source of social dynamics (e.g. class or racial constructions) (Latour, 2005. See also Jackson, 2015). Accordingly, my research was framed by my interest in better understanding the role that new technologies can play in facilitating public trans-

port generally, and paratransit in particular, to address passenger's needs in Cape Town with respect to access and mobility. This interest narrowed down the scope of my investigation, but did not presuppose anything about the relationship between technology and public transport or paratransit.

My affiliation with the UCT further framed my research, as did my engagement with UCT and Graduate School of Business ("GSB") representatives, who suggested that my research could assist the Solution Space in addressing a perceived problem with access to Philippi Village. Accordingly, I sought to better understand the role of public transport and paratransit in serving the Solution Space at Philippi Village. This framing also provided a justification for looking at the paratransit industry, since minibus taxis are the primary mode of public transport to Philippi Village. Furthermore, the Solution Space's mission of social entrepreneurism fit well with my interest in technology innovation and paratransit, which is viewed as a highly entrepreneurial industry. Finally, over the course of my research, the desire to describe the needs of Solution Space users and the relative ease of access to information regarding the interactions of these actors further framed my investigation on users of private and public transport, including paratransit. This framing helped clarify which actors to begin to study and follow, but again did not establish a social theory to apply to understand these interactions.

The first principle of ANT research is to start by looking at social phenomena at the site where the physical interactions that embody those phenomena occur (Latour, 2005). Accordingly, I focused my investigation on the interactions involved in passengers' trips to and from the Solution Space at Philippi Village. Following the causal chains linked to these interactions, along with my study framing, provided a means of further defining the scope of my study.

Another principle Latour (2005) suggests is to focus on unpacking the roles of black boxes and intermediaries and mediators in the chain of interactions constructing the social. This involves a move from a story in which only one or a few causes are identified as causal agents to a story in which "the relative proportion of mediators to intermediaries is increased" (Latour, 2005:133). Accordingly, I focused on the ways in which actor-networks were black-boxed within the context of the mobility as well as the role of particular actors as either mediators or intermediaries and how these roles might or do shift.

However, at the same time, I had to place limits on the extent of the investigation in order to avoid an impracticable methodology (see Latour, 2005). This is where Latour (2005) suggests that ANT studies are necessarily humble affairs, focused on accurately representing small actor-network chains rather than theorising high-order social relationships. The narrow focus on user access to the Solution Space Philippi via the provision of mobility by various services, particularly paratransit and public transport, lent itself to a discrete scope of the investigation. Investigating a particular problem or controversy, i.e. user access to the Solution Space, also fit well within a piecemeal ANT approach (see Rydin, 2012, focusing on construction of a building).

Similarly, a study "cannot just mirror the complexity of controversies: they have to make such complexity legible" (Rydin, 2012:28, quoting Venturini, 2010). Accordingly, a researcher must to some extent select between actors who are most important and relevant to the question being asked, while foregrounding these decisions as much as possible. The time available for research and access to information and actors necessarily limited the scope of my research, but I also self-selected particular actors to follow and represent. These decisions reflect my review and analysis of the interactions studied and observed through my data collection, using the tools provided by ANT. Latour (2005) notes that one measure for explaining such boundaries is by carefully recording and documenting the research process itself. I have attempted to provide a sample of my recording and documentation process in the appendices to this dissertation.

3.5 Operationalising ANT: Method and Techniques Utilised

To collect data for this research, I drew on the traditional case study approach, utilising various established data gathering and analysis techniques, including primary and secondary research, interviews, and field observations. As part of the data collection process during interviews I also engaged participants in a form of "cognitive mapping" inspired by Kevin Lynch's ground-breaking 1960 study on socio-spatial recognition of urban space. In order to represent and analyse my results, I used several different techniques, including geospatial mapping and photography. The latter technique was inspired from Latour and Hermant's (1998) ANT study of Paris. Borrowing from Rydin (2012) and the Mapping Controversies projects led by Latour and others (see Yaneva, 2012). I also utilised network visualisation tools to visualise various actor networks. These methods and techniques are discussed in more detail below.

3.5.1. Method – Case Study

In line with an ANT approach (see Rydin, 2012; Callon, 1986), I utilised a case study method for this research. The case study method consists of an "intensive analysis of an individual unit . . . stressing developmental factors in relation to environment" which allows for in-depth analysis of context-specific topics (Flyvbjerg, 2011:301; Yin, 2004). Case studies are particularly suitable for empirically-based exploratory research, where constructs and theories explaining events are still in development, and for studying complex, temporal processes (Bhattacherjee, 2012). The highly localised and empirically-oriented nature of the case study method makes it a favourite among ANT scholars (see, e.g., Callon, 1986; Rydin, 2012; Odendaal, 2011; Yaneva, 2012).

The strengths of the case study method are that it can be used to study complex, unique, multi-factor situations. Interpretive case study research also benefits from its ability to collect and analyse data simultaneously and iteratively, allowing for flexibility in framing the research (Bhattacherjee, 2012). The limitations of the case study method include the lack of generalisability and the tendency towards verification. (Flyvbjerg, 2011; Bhattacherjee, 2012; Yin, 2004). These shortcomings, while important to note, are mitigated by the localised goals of the research.

The nature and strengths of the case study method lent themselves to the research subject. Furthermore, pursuing a case study method was consistent with an exploratory study, where the factors contributing to the study's object are not well established or theorised, and where different theories may be formulated to explain the observed phenomena. I addressed the bias towards verification through the various research techniques, discussed below.

3.5.2. Data Collection Techniques

3.5.2.1. Secondary Data and Resource Research

I reviewed secondary data and resources regarding the minibus taxi industry and public transport and public demographics more generally in order to determine the characteristics and state of the minibus taxi industry as a whole, as well as the potentially disruptive technologies that are appearing in Cape Town's transportation sector. The secondary data and resources I reviewed included governmental demographical data and statistics, previous academic and scientific research on the minibus taxi and transportation innovations in Cape Town, official and unofficial planning and policy documents, laws and regulations, financial documents, articles, websites, and other sources (see Bhattacherjee, 2012). The advantages of this type of research are that it did not require additional empirical collection and often involved data readily available through academic and governmental websites. A primary limitation regarding this type of research is that the data available often is not tailored towards the research question or topic, and may need additional interpretation. I mitigated these limitations through preliminary review of available resources and

cross-evaluation with other sources of information, e.g. interview and observational data, to confirm relevance and consistency.

3.5.2.2. **Structured and Semi-Structured Interviews**

Semi-structured interviews were another primary technique I used for this research (see Appendix B1, B2). Interviews are one of the most common techniques utilised within case study research (Bhattacherjee, 2012) because they allow researchers to attain deep insight into particular subjects and allow for the opportunity to have subjects to speak for themselves. They also allow researchers to collect and analyse data simultaneously, which provides for opportunities to respond to new insights and adjust the research process (see Anderson and Jack, 2006). Along with these benefits, however, interviews also contain limitations. First, interviews are time-consuming. Additionally, the close interaction between researcher and subject can allow the researcher to influence outcomes, consciously or subconsciously, through leading questions. Finally, there may also be issues of trustworthiness of interview subjects (Roulston, deMarrais, and Lewis, 2003; Yin, 2004).

I sought to address these limitations through the research design. First, in order to overcome issues of trustworthiness, I sought interviews with different stakeholder representatives, including staff from and users of the Solution Space, representatives from TNCs, government officials, and representatives of the minibus taxi industry. This allowed me to triangulate responses from differing perspectives to confirm veracity. Interview questions were somewhat standardised in order to help avoid research bias towards verification. I reviewed interview methods before the interview phase began in order to follow the appropriate procedures and etiquette (see Roulston, deMarrais, and Lewis, 2003; Anderson and Jack, 2003:170). Finally, I tried as early in the process as possible to identify interview subjects and schedule interviews in order to allow for sufficient time.

In order to ensure the safety and well-being of interviewees, and to comply with ethics requirements, I conducted interviews on a volunteer basis and only with prior informed written consent. I did not interview any minors, and I limited interview questions and topics for GSB staff and university students, and Solution Space users, to experiences with access to the Solution Space and commuting issues. Interview questions and topics with industry and government officials focused on the workings of public transport in Cape Town and potential applications of upcoming technologies, particularly telematics. I only made use of audio recording of interviews upon open prior informed consent, freely given. In other cases, I took notes with prior informed consent. I gathered interviewees' personal identifying information, such as names, telephone numbers, and emails, only as necessary to contact and distinguish each interviewee, and have been kept strictly confidential. The data collected from interviews will be anonymised before being utilised in the research results, and all notes, recordings, and other un-anonymised data will be destroyed upon completion of the dissertation process. For instance, in my findings below I refer to individual interviewees according to anonymised labels (see Appendix B3 for label key) order to protect their privacy.

The effort to limit collecting personally identifiable information resulted in some limitations in the research. For example, I purposefully did not ask Solution Space users for their home addresses, instead of asking which general area they lived in in order to track their daily commutes. As a result, in my findings, I have represented only an approximation of where Solution Space users live. While sacrificing some degree of accuracy, I felt it an acceptable concession that did not risk the overall outcome of the research. The extent I could, I also sought to verify my routes with participants, although I was only able to follow up with two out of the six Solution Space users before submitting my research.

3.5.2.3. **Field Observation**

I also utilised field observation as a research technique (see Appendix B4). The benefits of observation as a research technique are the ability to gain information and insight in unplanned and unexpected ways. A primary limitation of observation is the difficulty in simultaneously observing and recording data.

The original research proposal envisioned fairly extensive observation as a minibus taxi passenger along routes servicing the Solution Space. However, while I did engage in limited observation as a minibus taxi passenger to the site, during the research I revised my use of this technique to rely instead primarily on observing interactions with transport at the Philippi Village itself. I made this decision based on my experience during the course of research, which indicated that some of the most important issues involving accessibility of the Philippi Village site and the mobility of users occurred at and near the site, Furthermore, my initial research revealed that the routes and means of access to the Philippi Village site were far more diverse and heterogeneous than I first assumed, indicating that observation of one or even several particular routes would be of less utility. In addition, many participants and other parties with whom I engaged during the research period cautioned me about the danger and risk in travelling by public transport within the Philippi area. As is discussed in my results, the high threat of violent crime is a reality within Philippi and the surrounding areas, which are known as among the most dangerous in South Africa (see South African Cities Network, 2017). I made use of TNC services (both Uber and Taxify) for nearly all of my trips to Philippi Village, which also formed part of my understanding regarding how these services work specifically with respect to access to the Solution Space Philippi.

In order to supplement my observations at Philippi, I also made observations at the Cape Town Station minibus taxi rank and at the GSB's Waterfront campus. While limited in their usefulness for describing the particulars of access at Philippi Village, these observations were nevertheless useful for better understanding public transport options in general, and the transport routes between the Waterfront and the Solution Space Philippi in particular.

3.5.2.4. **Cognitive Mapping**

Another technique I used was a form of "cognitive mapping", drawing on information gained for this purpose during the interview process, in secondary research, and during field research (see Appendix B5). This element was inspired by Kevin Lynch's (1960) studies in cognitive mapping presented in his book *The Image of the City*, and Bruno Latour's and Emilie Hermant's (1998) sociological study of Paris, *Paris: ville invisible*, as well as Bender's (2010:317) description and analysis of both works within the framework of ANT. I used this technique in combination with secondary research and field observation to formulate an "imagined whole" of the actor-network, providing a "metaphorical glue, ordering or grasping the cumulation of assemblages" (Bender, 2010:319). This technique is necessarily a personal and somewhat subjective process, and can potentially lead to the danger of reification, "mask[ing] contlicts, differences, and disjunctures as it unifies, thus misleading our understanding of lived experience" (Bender, 2010:319). To counteract these limitations and mitigate falsehoods, I followed up with some participants and users with interpretations in order to allow for additional input and critique. I have also attempted to make clear through my labelling of illustrative maps and depictions that these are representative, rather than perfectly accurate.

3.5.3. **Data Collection Process**

Using the above techniques and Callon's (1986) four-step process as a framework (see Appendix B6), I began my research in June 2017 to identify relevant actors involved in the activity of accessing Philippi Village and the Solution Space (see Appendix B7). Using an iterative process, I started my investigation through observation, interviews and secondary research of those actors that were most immediately apparent and connected to the physical act of access, mobility, and transport. During this process, spanning over June and October 2017, I also spent time conducting desk research and inter-

views, to uncover additional actors directly involved in the activities of interest.

I identified the initial group of actors primarily through interviews, field observations, and experiencing the transportation-related activities involved in accessing Philippi Village and the Solution Space. These seemingly obvious actors played a role in all or nearly all possible means of transportation to the Philippi Village. Describing the Solution Space and Philippi Village necessitated introducing another set of actors.

Beyond these initial groups of actors, I identified subcategories of actors either directly or indirectly involved with the physical provision of transport to Philippi Village via different mechanisms. I identified these subcategories through observation and interviews, as well as through desk research reviewing texts regarding transport options to Philippi. The first category of actors was those involved in providing transportation access directly into Philippi Village.

The interactions between the actors outlined above, together with texts, interviews, and other representations from particular actors, present causal chains from which I worked out the competing identifications, frameworks and obligatory passage points that particular actors sought to establish as part of problematising transport to Philippi Village. I often relied on texts produced by actors to describe different actor-networks as a means of helping elicit overarching conceptualisations. Next, I identified which actors should be considered mediators driving these conceptualisations and the obligatory passage points around which these actors sought to interest or align other actors. Because enrolled actors and highly mobilised actor-networks provided the most obvious examples of problematisations and interessement in action, I often used this as a starting point for considering these questions. One useful technique in doing this was to seek out which actors appeared to exert the most effort constituting other actors. Another useful technique for determining these actors included tracing the cause and effect of activities, being careful to stop where physical interaction stopped and not read into or search for deeper hidden causes. A third technique was the use of counterfactuals and hypotheticals, which allowed me to compare actually achieved actor-networks against alternative conceptualisations and obligatory passage points.

Once I identified primary mediators, problematisations, and obligatory passage points, I investigated the details of interessement and enrolment. I often conducted these steps hand-in-hand, since enrolment is the result of successful interessement. In some sense, this step could be seen as the first, since it involved witnessing what activities actually occurred. Interestingly, returning to observing actual enrolment taking place after identifying and considering primary mediators, problematisations, obligatory passage points and strategies of interessement helped me focus on what interactions I was actually observing, rather than what I thought or assumed I was observing. The exercises in identifying the earlier steps in Callon's (1986) four-step process provided an opportunity to break from assumptions about how things worked. The description of enrolment provided a further opportunity to explain the "negotiation" between actors.

Finally, based on the current patterns of access to Philippi Village and the Solution Space I assessed which enrolled actor-networks appeared to be mobilised. I took the continuation or increase in consistent patterns of activity as indicating mobilising actor-networks. Because the human actors represented in the Solution Space actor-network at Philippi Village are so small in number, it is hard to say that any large mobilisation has taken place. On the other hand, individual human actors have settled into their particular patterns of access, which I believe based on my reading of ANT speaks to some extent of mobilisation.

Using these same techniques, namely interviews and secondary research, I similarly applied Callon's (1986) four-step process to identify and describe two new actor-networks yet to be mobilised at Philippi Village—the City's MyCiTi bus service and TNCs such as Uber and Taxify. These unestablished actor-networks provided a useful basis for analysing the prospects for socio-technical change in the minibus taxi industry.

3.5.4. Representation and Analytical Techniques

3.5.4.1. Geospatial Mapping

In the discussion of spatial location, relationships, travel, and routing, mapping constituted an important representational and analytical technique. I used ArcGIS and QGIS computer programs, as well as Google Maps, to review, depict, and analyse spatial data from the City of Cape Town. To this I added data gathered from my own research, including from the cognitive mapping exercises conducted during interviews (data available on request).

Maps and other images are important in that they "allow us to 'see' or understand our data in new ways" (McKinnon, 2011). There are, however, a number of limitations that I considered. First, mapping used to visualise results may reveal data regarding research subjects that the subjects may not want to be revealed (see McKinnon, 2011). In my mapping I have omitted seeking highly personalised information, such as home addresses, providing instead trips made to general areas of the city. In addition, I only mapped trips that participants have voluntarily described to me, and have sought verification and consent by participants regarding the maps I have created representing their routes.

Maps may also misrepresent information, based on selective inclusion or exclusion of data, use of particular mapping conventions, such as particular lines and colours, or other factors (see McKinnon, 2011). I have sought to avoid such misrepresentations by paying careful attention to representation through symbol and colour selection and the development of legends. I have also, where possible, sought input from participants in my research in order to verify that the maps I have created reflect their understanding of what I have mapped.

Another primary limitation regarding mapping is the tendency to attribute objectivity to a subjective process (McKinnon, 2011). One solution offered to this issue is the use of artistic practices to "subvert" official representations (see McKinnon, 2011, citing Kwan, 2007). In my own representations, I have sought to achieve a level of visual abstraction to subvert the objective nature of the maps.

3.5.4.2. Photography

In presenting my results I took and used photographs depicting various actors and actor-network relationships. I have used both photographs taken by myself and by others, but in all cases I have employed a selective technique in which I have actively chosen the subjects, perspectives, and timing. These depictions are also subject to my access and availability of photographic documentation during the research process. Accordingly, these photographs, like photography generally, are the product of a subjective process and should not be seen as objective (see McKinnon, 2011). Because the photographs are used primarily for illustrative rather than analytical purposes, this selection bias is less problematic and is mitigated by clearly communicating these visuals' illustrative purpose (see Pauwels, 2011).

Another important consideration in using photography is the protection of subject's rights, particularly the right to anonymity and consent (see Pauwels, 2011). In order to ensure the preservation of these rights, I limited my photographs to subjects that either (1) provided informed consent to be photographed (or allowed property under their responsibility to be photographed); or (2) were not easily identifiable and were photographed in a public setting.

Other ANT scholars have used photographs to depict both the actors and actor-networks. In their ANT description of Paris, Latour and Hermant (1998) incorporated "photographic exploration" to "wander through the city, in texts and images" to assemble a "sociological opera." (Latour and Hermant, 1998). Latour also uses photographic depictions to represent specific actor-network interactions more subtly in his book *Reassembling the*

Social (2005:224-25) (See also Rydin, 2012, for similar uses).

3.5.4.3. **Network Visualisation Rendering**

In order to depict both the relationships between actors, as well as the malleable and shifting nature of various stabilised actor-networks, I used the computer network visualisation software SocNetV and Gephi to generate force-directed graph drawings (data available upon request). While these programs have far-ranging uses using theories such as social network analysis, I have followed Rydin (2012:28) in using the resulting depictions as a means of illustrating actor-networks. Accordingly, these depictions should be interpreted as primarily illustrative, although they also assisted in conceptualising relationships. Other actor-network research has similarly utilised network visualisation representations (see Yaneva, 2012).

3.6 Self-Reflexivity, Ethical Considerations and Personal Bias

This final subsection highlights moral and ethical considerations involved in my research. I note how ANT affected my approach to acknowledging my own role in the research process. I also discuss my compliance with UCT ethical guidelines as well as my own ethical considerations.

3.6.1. Inserting Myself Into the Actor-Network

The radically relativistic quality of ANT extends, unsurprisingly, to the researcher herself. ANT scholars must recognise the "artificiality" of the research project, i.e. the way in which researchers engage in the process of socio-technical relationships (see Latour, 2005). The process of writing texts that seek to describe the world is itself a process of translation, a process to seek enrolment for how the researcher sees and understands the focus of research. Latour (2005) argues that researchers cannot avoid this artificiality, but can assume objectivity through transparency in the process. This transparency is accomplished by carefully recording of the process of conducting the research itself (Latour, 2005). I have addressed this by including various details regarding my background and personal views on the research, as well as the manner in which I became engaged and conducted my research, both within the body of this dissertation as well as through appendices to it. In my conclusion, I use my own participation within the Philippi Village access actor-network to discuss the implications of ANT practices on the process of urban planning.

3.6.2. Ethical Research Considerations

In addition to the rigours of ANT procedures, this research followed UCT's Faculty of Engineering and the Built Environment EBE Ethics in Research Handbook and all applicable policies, as well as generally accepted ethical standards in ethical research. The central tenet underlying these considerations is to "ensur[e] that participants' well-being is considered and safeguarded" (UCT School of Engineering and the Build Environment, 2017).

Because the research involved collecting data from human participants, I took measures to protect their safety and wellbeing. Some widely accepted ethical principles in the social sciences include: voluntary participation and harmlessness of participation; anonymity or confidentiality; disclosure of a study's intent; and neutrality in reporting results (Bhattacherjee, 2012). In order to address these ethical considerations, all participation in the proposed research was voluntary, and I informed all interviewees of their participation and asked for their consent to participate. Interviewees and other participants will remain confidential. I have also taken steps to anonymise the data that I present here. I have kept personally identifying information confidential and will erase this data within a reasonable time following the evaluation and grading of this research. I have also made efforts to share my results with participants in order to confirm that they have been accurately represented.

3.6.3. Socio-cultural and Normative Biases

In addition to these specific procedural ethical considerations, I must also acknowledge ethical considerations regarding my own contextualisation within the Global South, and the colonial history of Cape Town (see Miraftab, 2012). Notwithstanding my sincere attempts at objectivity, my own identity and identification as a North American, a male, a light-skinned person, and other conscious or unconscious biases also undoubtedly influenced data collection and results. For instance, with respect to data collection, my profile limited my ability to gather information, as my native language, background, race, gender, and profile all differed from many or most of the participants in the study. In addition, I lacked the connections or familiarity with minibus taxis or the area surrounding Philippi Village, elements that would have significantly improved research collection in that area. To the extent possible, I have endeavoured to address these shortcomings by retaining an awareness regarding my background and bias in engaging in research in Cape Town. As noted throughout this dissertation, and discussed in particular in the conclusion, I have also sought to highlight my biases and objectives.

4. Findings: Unmasking the Actor-Networks at Philippi Village

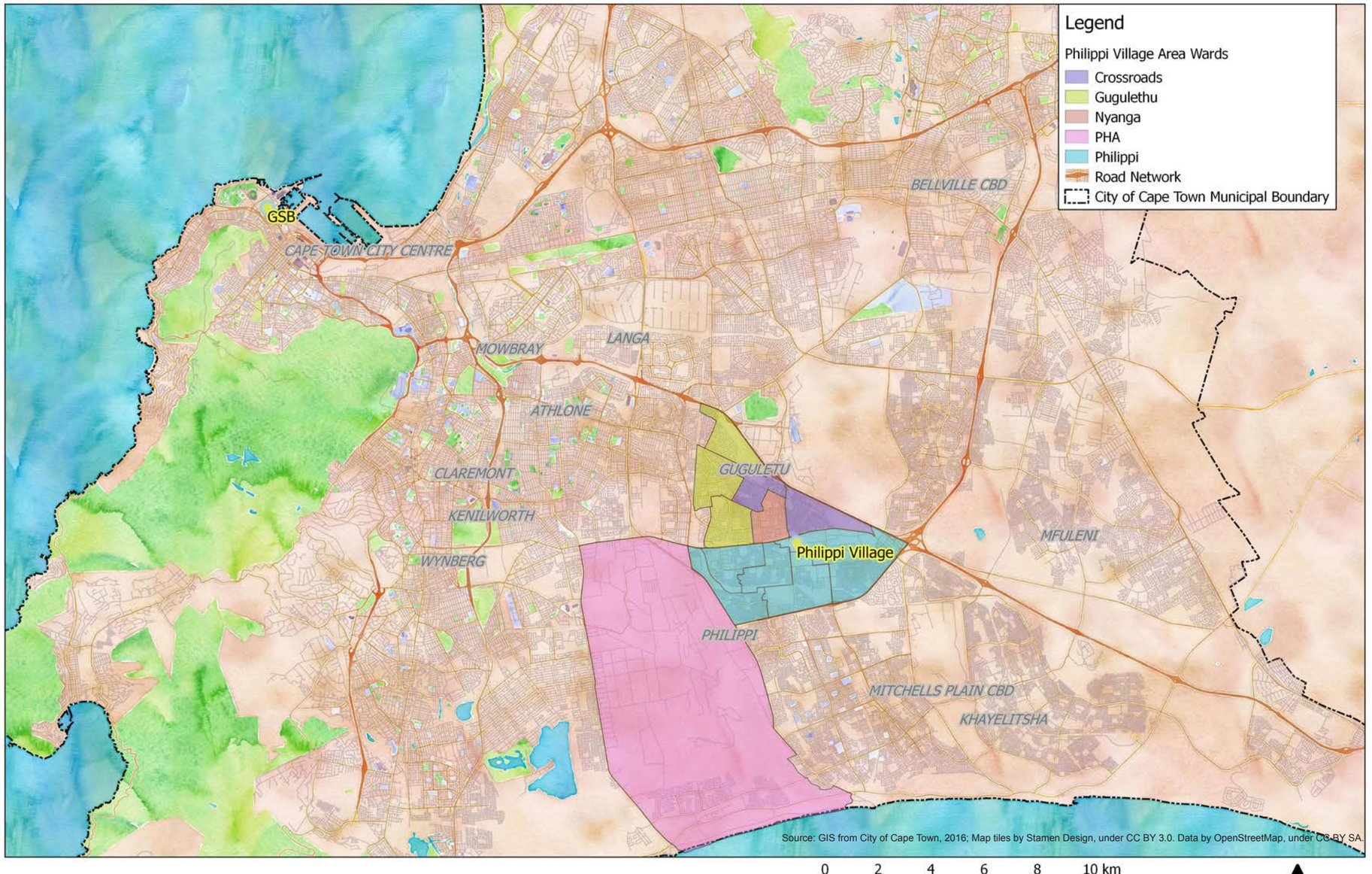
This chapter unmasks the actor-networks at Philippi Village in four steps. First, I provide the context behind the creation of Philippi Village and the Solution Space Philippi. Next, I describes the actor-networks that compose access to the Solution Space at Philippi Village. Following this, I describe the various actor-networks that constitute the various modes serving Philippi Village and the Solution Space Philippi. Finally, I discuss the potential for newer services to establish themselves at Philippi Village.

4.1 The Context: Locating Philippi, Philippi Village, and the Solution Space Philippi

Philippi is the name of a large area used for a diverse range of purposes located in the Cape Flats region within the City of Cape Town's metropolitan boundaries. This includes the Philippi Horticultural Area ("PHA"), consisting of nearly 3000 hectares of primarily agricultural land that produces much of Cape Town's fresh produce, as well as a somewhat smaller area directly to the east, filled with a mix of township communities, industrial facilities, commercial areas, and open space (Adlard, 2014). The eastern portion of Philippi lies primarily north of Mitchell's Plain and the R300 Freeway, and south of Govan Mbeki Road (formerly Lansdowne Road), is comprised of a number of identifiable neighbourhoods, including Brown's Farm, Weltevreden Valley, Philippi East, Philippi Industria, and most recently the Marikana informal settlement. To the north, situated directly across Govan Mbeki Road, are the communities of Nyanga, Gugulethu, and Crossroads. Philippi and these neighbouring areas have been the site of intense urbanisation through informal settlement starting in the 1970s (Adlard, 2014). Generally speaking, when I discuss the "Philippi area" in this dissertation, I am referring to the eastern portions of Philippi and the neighbouring communities of Crossroads and Nyanga that surround Philippi Village (see *Figure 2: Philippi Village in the metropolitan context*).

The population housed in the Philippi area is primarily black and largely poor. The Philippi area and its surrounding communities were the site of intense political contestation revolving around racial discrimination, land rights, and access to urban opportunities during the later stages of the apartheid regime in South Africa (Adlard, 2014). Today these areas have the unfortunate reputation as one of the most dangerous areas in South Africa (see South African Cities Network, 2017).

In addition to walking, the most common forms of transport in the Philippi area are paratransit (e.g. minibus taxi) and Golden Arrow commuter bus services. In addition to minibus taxis, the Philippi area is also one of the few areas in Cape Town with an established "Amaphela" or "Avanza" service, which is a paratransit service distinguished from minibus taxis by the use of smaller vehicles and route-less service within a bounded geography.[8] The area is also served by several rail stations along Metrorail's Southern Line that runs along Philippi's southern



Philippi Village and Surrounding Wards in Cape Town

Figure 2: Philippi Village and Surrounding Wards in Cape Town

boundary. To the north of Philippi, the N2 freeway provides a significant link to the larger region.

Developed within the last ten years, the Philippi Village Business Park sits just off the intersection of New Eisleben and Govan Mbeki Roads (formerly Mahobe Drive and Lansdowne Road, respectively), within the Philippi Industria next to the communities of Crossroads and Nyanga to the north. It is housed within one of the most iconic buildings in Philippi: a former cement factory used in constructing Cape Town's townships during the last century (see Adlard, 2014). The old derelict factory has been partially retrofitted and redeveloped to house A-grade commercial office space within the main building, as well as smaller retail and commercial space for businesses in retrofitted shipping containers, known as the "container walk" (see eProperty News, 2015).

As discussed in further detail below, direct motorised transport to Philippi Village is provided primarily via minibus taxi, Golden Arrow commuter bus, or by private vehicle transport. Philippi Village is strategically located next to the intersection of Govan Mbeki Road and New Eisleben Road. These roads connect the major township areas to the southeast, in particular Khayelitsha and Mitchell's Plain, to the economic hubs of the city located in Cape Town's Central Business District ("CBD"), Southern Suburbs, and Bellville to the north and west.

In 2014, the GSB initiated the MTN Solution Space, a new socially-oriented business incubator to "build African solutions and innovations across the continent" (UCT Graduate School of Business, 2017). Unlike most of UCT's other schools, which are located in Rondebosch, the GSB is located at the Waterfront area of Cape Town, next to the CBD, the historical and economic centre of the city. In addition to housing one Solution Space site at the Waterfront campus, the GSB chose a second site at Philippi Village.

Extending the GSB's permanent physical presence in Philippi, far removed from the Waterfront and Rondebosch campuses, has prompted new issues regarding accessibility, mobility, and transport for users of the GSB's Solution Space. The managers of the Solution Space Philippi have been seeking means of improving access through public transport in a manner that is consistent with its broader goals of socially-responsible innovation. While there have been no formal discussions between GSB or Solution Space Philippi officials and public transport providers regarding this topic, the Solution Space Philippi has already been used as a site for skills training for minibus taxi owner-operators. The academic staff member facilitating this training, Professor Herrie Schalekamp, introduced me to this topic as a case study for studying public transport and paratransit in Cape Town.

It is within this context that I ground my attempt to unmask the actor-networks providing access and transport to the Solution Space Philippi. What follows is my description of these actor-networks.

4.2 Translating the Philippi Village and Solution Space in Terms of Access

The actor-networks vying to transport users to the Solution Space at Philippi Village are complex, overlapping, and fluid. In order to systematically understand how these actor-networks function, I begin by describing the Philippi Village and Solution Space actor-networks themselves and how their composition influence issues of access, mobility, and transport. Starting here reveals how the initial framings ground and guide transport serving the Solution Space at Philippi Village. I will reconstruct these actor-networks using Callon's (1986) four-step methodology before moving on to the processes of translating particular transport actor-networks serving Philippi Village and the Solution Space in the next chapter.

4.2.1. Problematisation

4.2.1.1. Identified Actors

Starting with the focal point of my study, I identified key actors implicated in constituting the Solution Space actor-network at Philippi Village (see *Table 1: Key Solution Space and Philippi Village Actors*

Table 1: Key Solution Space and Philippi Village Actors

List 1: Key Solution Space Philippi Actors

- Solution Space offices at Philippi Village
- Solution Space on-site staff at Philippi Village
- GSB and other students using the Solution Space office at Philippi Village
- Social entrepreneurs and start-up employees
- Visitors and occasional guests
- GSB coordinating staff, managers, and professors
- The location of the GSB's and Solution Space's offices at the Cape Town Waterfront
- The locations of other UCT facilities in Cape Town
- Virtual and print texts describing, discussing, and explaining the Solution Space

List 2: Key Philippi Village Actors

- Philippi Village land and building structures
- Philippi Village security apparatus (guards, fences, booms, gates, turnstyles, electric access doors, etc.)
- Main Entrance and Secondary Entrance to Philippi Village property
- Philippi Village users
- Walls, fences, and other barriers
- Managers and staff members
- Tenants (including the Solution Space)

List 3: Philippi Area Actors

- Philippi Shoprite and associated formal and informal businesses
- Small business area adjacent to Philippi Village
- Govan Mbeki Road and New Eisleben Road intersection area
- Frontage road (technically Mpumelelo Street/Cwango Cres) connecting Philippi Village and Shoprite to intersection roads
- Intersection of New Eisleben Road and Mpumelelo Street (main road access point to Philippi Village)
- Surrounding pedestrian paths and infrastructure (sidewalks, doors, crossings, signs)
- The bus stops on Govan Mbeki Road and New Eiselben Road
- Local business people and traders
- Local shoppers
- Neighbouring homes
- Pedestrians
- Local vehicular traffic
- People committing crimes (mugging, carjacking)
- Local area transport interchanges, notably Nyanga Terminus and Luzuko Interchange

List 4: Other Key Actors in Accessing Solution Space Philippi

- Other origins and destination locations and sites, including user homes, places of business, and institutional facilities (e.g. UCT campuses)
- Roads and associated infrastructure connecting to the rest of the road network
- Various transport/mobility actor-networks (automobiles, minibuses, etc.)

Space and Philippi Village Actors, List 1).

Table 1, List 1 reveals that within the context of transport of human actors to the Solution Space's offices, users' transport access needs vary at different times and in different ways. Some of the different types of trips that these users undergo are commutes, business trips, and travel for class attendance or meetings. These distinctions are important labels for distinguishing between the circumstances in which these trips are situated, although within ANT these labels must be used in a descriptive rather than explanatory or interpretive sense.

By design, the Solution Space actor-network locates itself within the Philippi Village actor-network. While a broad range of actors located in different places, times, and mediums make up Philippi Village, I looked particularly at actors constituting its embodiment at its physical location in the Philippi area of Cape Town. Looking first to the site itself, my research revealed a range of actors that were involved in all or most means for users enrolled in Philippi Village to access the site and facilities there (see *Table 1, List 2; Figure 3: Philippi Village actor-network visualisation*).

My research also revealed other important actors and actor-networks more broadly connected to the Philippi Village location and site which played outsized roles in issues of transport and access, either as mediators, symbols, or key intermediaries relating to access and mobility. These were not necessarily enrolled in the Philippi Village actor-network, and some were even disruptors of that network, but they interacted nevertheless or otherwise played important roles in providing transportation service to the area (see *Table 1, List 3; Figure 4: Philippi area access actor-network visualisation*).

Other actors beyond the local scale were also necessarily implicated in users' activity in accessing Philippi Village and the Solution Space (see *Table 1, List 4*).

Before delving into how various transport actor-networks help construct access to Philippi Village, it is useful to see how mediators of the Philippi Village and Solution Space actor-networks problematise their roles. As we will see, this problematisation is framed around access through motorised transport and specifically the private automobile.

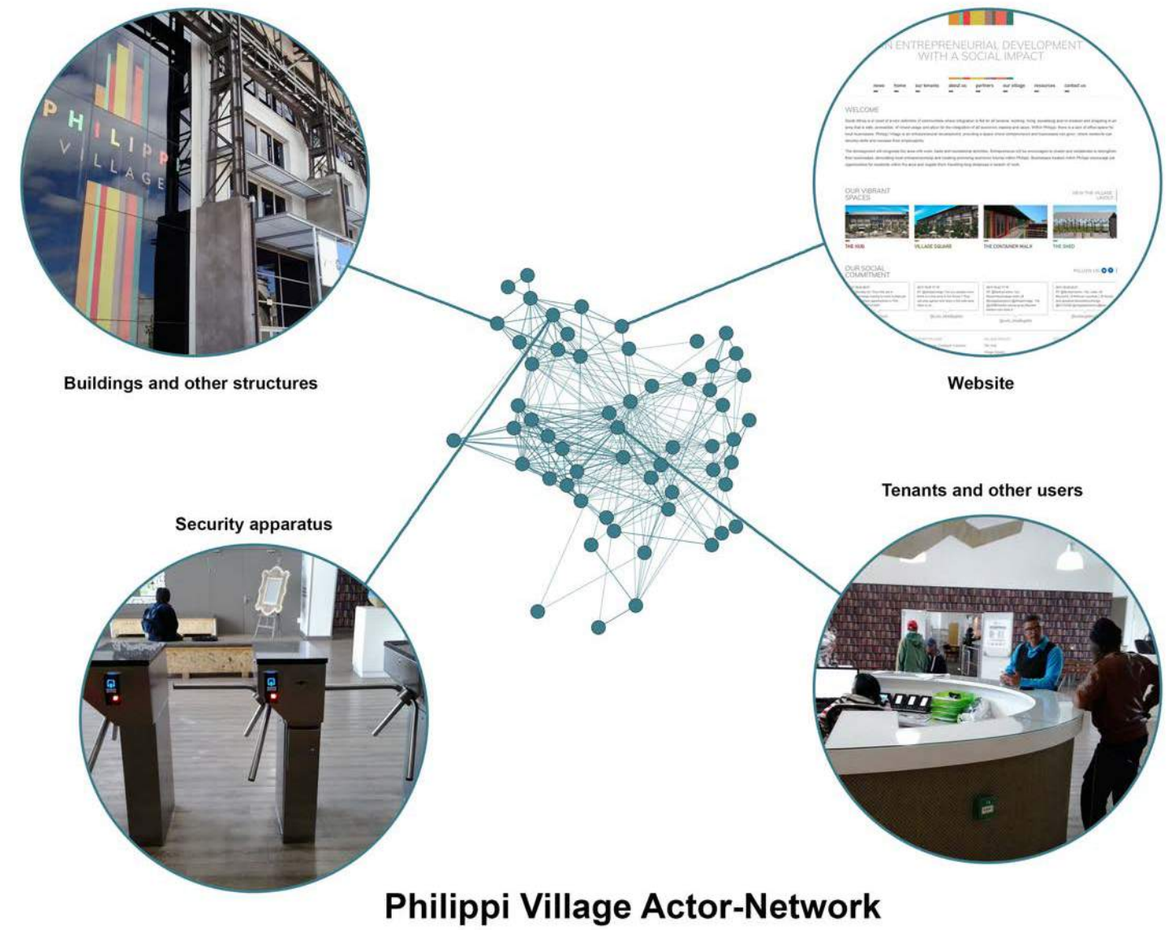


Figure 3: Philippi Village actor-network visualisation

Source: Photographs by Christian Alexander; website image from www.philippivillag.co.za.

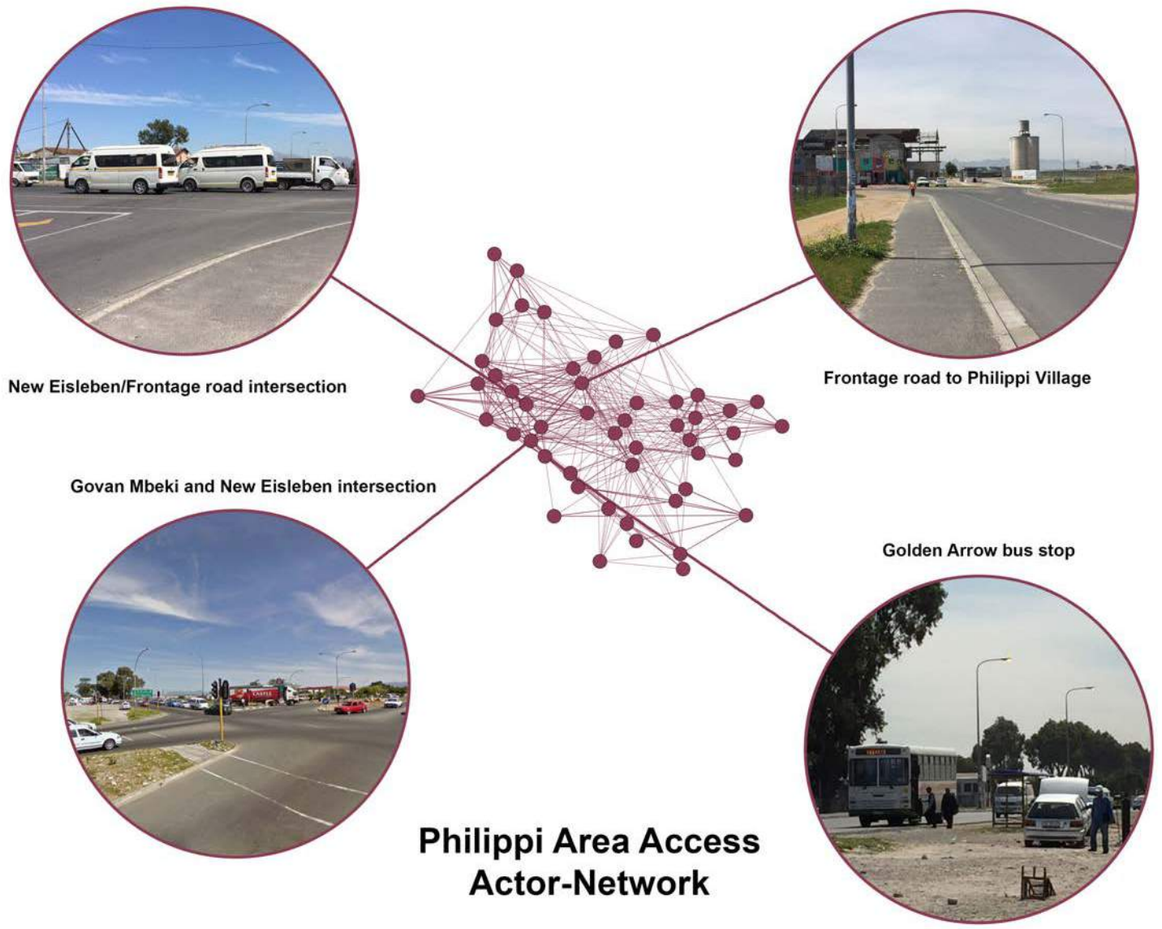


Figure 4: Philippi area access actor-network visualisation

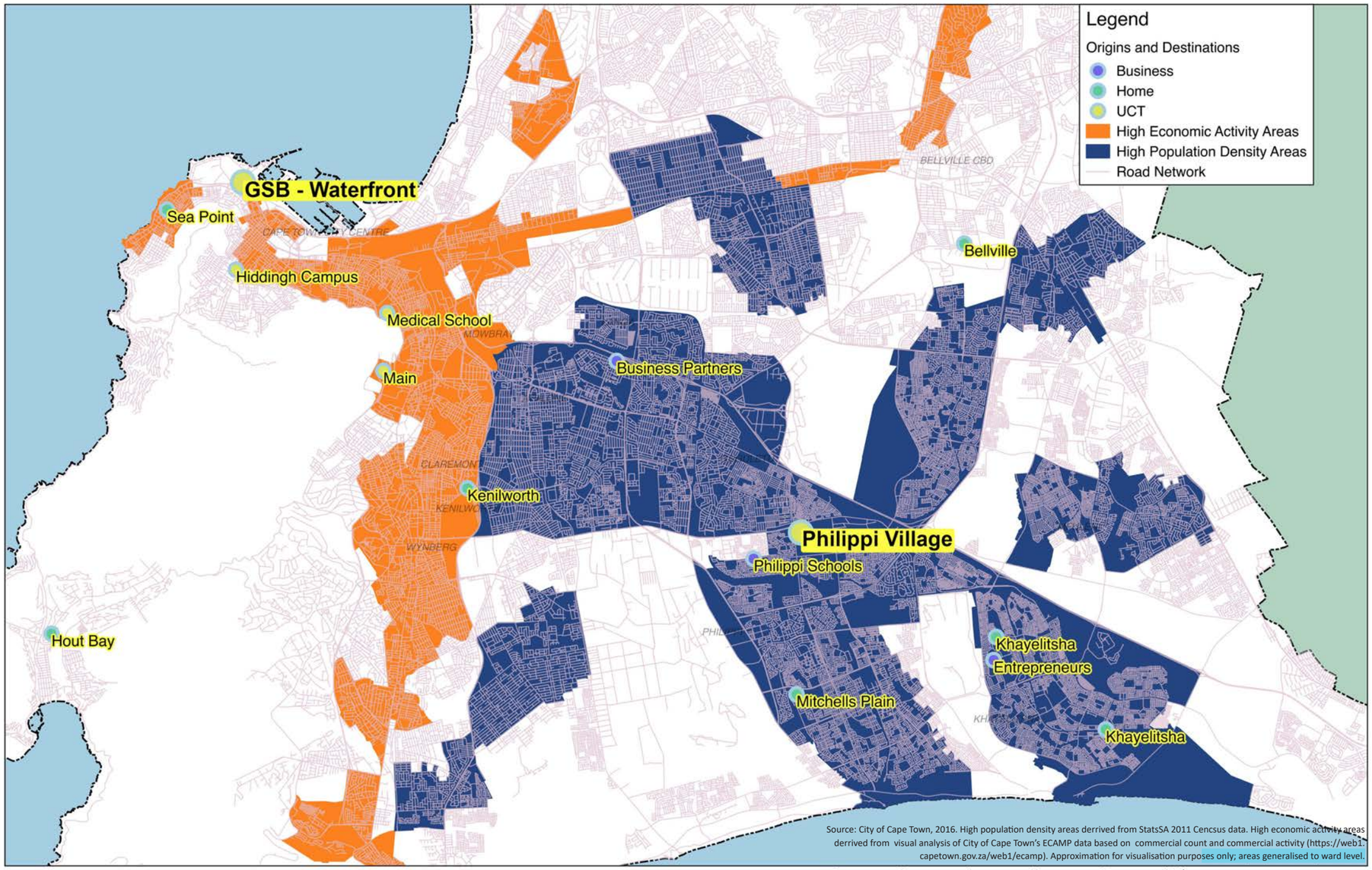
Source: Govan Mbeki/New Eisleben Intersection image from Google Maps Street View 2009; all other photographs by Christian Alexander

4.2.1.2. **Obligatory Passage Points**

The relationships between the actors listed above with respect to access are defined through the problematisation of Philippi Village and the Solution Space Philippi. The physical location of the Philippi Village and Solution Space Philippi, and their spatial relationship to the homes, offices, campuses, and other places of work between which people move dictates to a great extent the perceived need for transporting people to and from the Philippi Village location. In fact, Philippi Village's location disrupts the existing spatial logic of the city and UCT by locating itself far from the usual sites of work and activity, and close to sites whose inhabitants normally must travel significant distances to reach such activities, thereby contesting the previously established transport networks (see *Figure 5: Map of spatial disparity in metropolitan Cape Town*).

This ideation, which is embodied in these actor-networks, is reproduced in the texts and statements by both Philippi Village management and Solution Space staff, students, and users. For example, Philippi Village's website claims that "[w]ithin Philippi, there is a lack of office space for local businesses." It touts Philippi Village as the solution, "an entrepreneurial development with social impact" that offers "a space where entrepreneurs and businesses can grow" and that "will invigorate the area with work, trade and recreational activities" (Philippi Village, 2017). The website also promises that the development will create new economic activities for residents within the area "and negate them travelling long distances in search of work" (Philippi Village, 2017).

Similarly, Solution Space actors indicate the social and spatial justice components of the Philippi Village and Solution Space locations. The Solution Space website identifies its Philippi site as UCT's first "community campus" and "entrepreneurial development zone at the epicentre of Nyanga, Gugulethu, Mitchell's Plain and Khayelitsha" providing "students, alumni, clients and local entrepreneurs in the community a place to meet and engage" (UCT Graduate School of Business, 2017). Solution Space users interviewed echoed this problematisation, highlighting the office's "embedded approach" and "dedicated presence" to address not just spatial but psychological segregation (interview with S1), and to do so "in a very intentional way" (interview with S3) that departed more radically from UCT's more general adherence to the spatial imbalance of the city (interview with S1). Interviewee S2 noted that "the aim for the space [at Philippi Village] is that we need to have an impact on the community of Philippi and surroundings and that we support the local entrepreneurs [by allowing] for this space to form . . . a base for them." In essence, the Solution Space problematisation relates to the need to re-centre the spatial makeup of the city and support economic and entrepreneurial activity in township areas. For Solution Space entrepreneurs, "they get to come through because this is nice and central, because the different members stay in different areas of Cape Town, and this serves them well for all of them to meet" (interview with



Map of spatial disparity in metropolitan Cape Town

Figure 5: Map of spatial disparity in metropolitan Cape Town

S2).

Presenting Philippi Village and the Solution Space office as an ideal meeting ground for entrepreneurs and a means of restructuring spatial and economic inequality is not without its challenges, many of which are embedded in the dominant problematisation of the city. While the Solution Space office at Philippi Village disrupts the established spatial economic structure of the city, the inertia of existing mobilised actor-networks presents obstacles to this new ideation. This challenge is not merely spatial but extends to the problematisation that frames the city. One Solution Space user noted that some entrepreneurs who could use the Philippi Village location might actually prefer working at the Waterfront in certain cases, both because it was easier to set up meetings with others in the CBD and because of the prestige of being located in what is considered a prime location (see interview with S1).

Furthermore, the Solution Space's own conceptualisation of spatial re-centring still embeds an element of overcoming geography. The guiding goals of spatial and institutional integration between GSB campuses establish the issue of access as one of mobility between geographically separated places. The distances between the Solution Space Philippi offices and the homes and places of business of its constituent actors guide thinking about access by compromising the force of proximity and reinforcing the need for mobility for many users of Philippi Village, especially Solution Space users. The UCT employees that staff the Solution Space at Philippi Village do not live in close enough proximity to Philippi Village to walk or bicycle there (see interviews with S1, S2, S3, S5). They must instead make regular trips during peak "commute" times in the morning and evening in order to fulfil their roles within the Solution Space actor-network. Likewise, the entrepreneurs who work out of the Solution Space's Philippi location must make daily commutes from sometimes distant township areas, although their hours may be more flexible (see interview with S3). While these entrepreneurs are generally focused on working in the township areas, including the areas surrounding Philippi Village, their daily activities still often require motorised transport to span the distances established by a city built upon the assumption of motorised transport (see interviews with S3, S6). Visitors and other guests at the Solution Space draw from larger actor-networks associated with UCT, and thus also require mobility to and from Philippi Village. Finally, GSB students periodically have class at Philippi Village rather than the Waterfront site, which is where classes are normally held (see interview with C1). The distance between these locations, and the desire to have students physically engage at the Philippi location, conceive of this activity as motorised transport.

While the locations and sites of Philippi Village and the Solution Space Philippi act as mediators conceptualising access to these actor-networks, their framing of the problem also relies on and informs a strongly mobilised actor-network within Cape Town: the road network. The road network identifies mobility as motorised transport and travellers as drivers and passengers of vehicles that must use roads to conduct their daily lives. The road network, which itself is an actor-network whose constituents—consisting of pavement, territory, construction workers, planners, engineers, bureaucrats, and politicians—work hard to maintain it as a "black-box", establishes itself as an obligatory passage point through which access and mobility to Philippi Village is defined. (see *Figure 6: Obligatory passage point for road actor-network*). Moreover, the road network, while open to multiple forms of motorised transport, facilitates in particular private automobile transport, as is demonstrated by its diffuse pattern and specialised infrastructures, such as parking spaces and traffic lights.

Philippi Village reflects this problematisation of access through motorised mobility in a number of ways. It identifies itself as a site with entryways defined by vehicle access and sizeable private vehicle parking secured through a significant security apparatus (see *Figure 7: Site context map for Philippi Village*). In contrast, physical connections to public transport stops are more removed from the Philippi Village site, with less pedestrian infrastructure and more obstacles for users travelling by other modes (see *Figure 4: Philippi area access actor-network visualisation*).

The views of the actors enrolled in the actor-network also reflect conceptualising access through motorised transport facilitated by Cape Town's road network. In interviews of Solution Space Philippi users, city officials, and minibus taxi representatives, none questioned the need for use of motorised vehicles to access the space, and proposed improvements focused on improvements to motorised transport (see interviews with S1, S2, S3, S4, S5, S6). Several Solution Space Philippi users voiced their preference or assumed reliance on private automobiles: "[Question: what would improve your commute to Philippi Village:] Besides my own car?" (interview with S6), and "I have taken public transport, not to get here . . . obviously because I have a car I'm not going to choose that option [i.e. public transport]" (interview with S4). Human actors thus identified motorised transport as the preferred means of obtaining access to Philippi Village, and they acceded to the road network's proposed obligatory passage point.

One other element that came up consistently in the framing of access to the Solution Space Philippi offices was the issue of crime and safety. All six Solution Space Philippi users that I interviewed brought crime up as a major concern relating to access to the location. This concern was not merely perceived or hypothetical. Three related personal experiences they had of being victims of robberies or attempted robberies within the surrounding neighbourhood while travelling to or from Philippi Village (interviews with S4, S5, S6). Two users' experiences

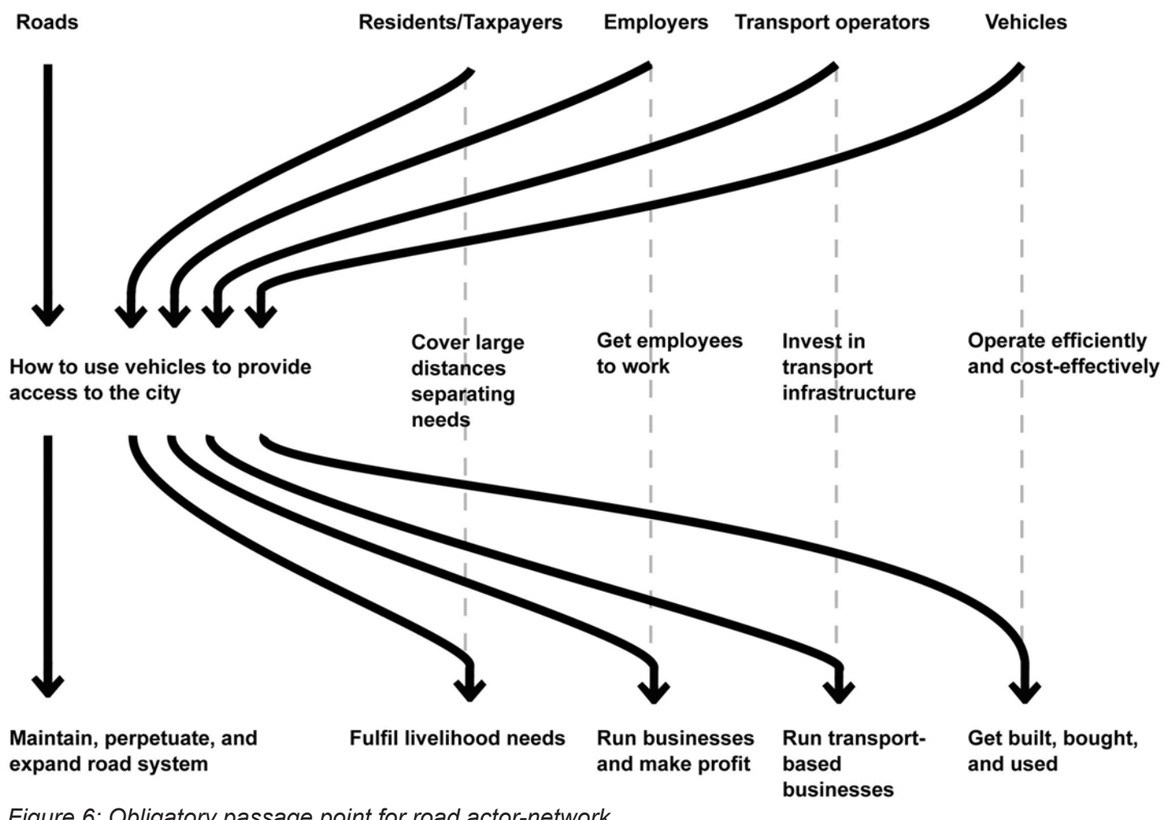
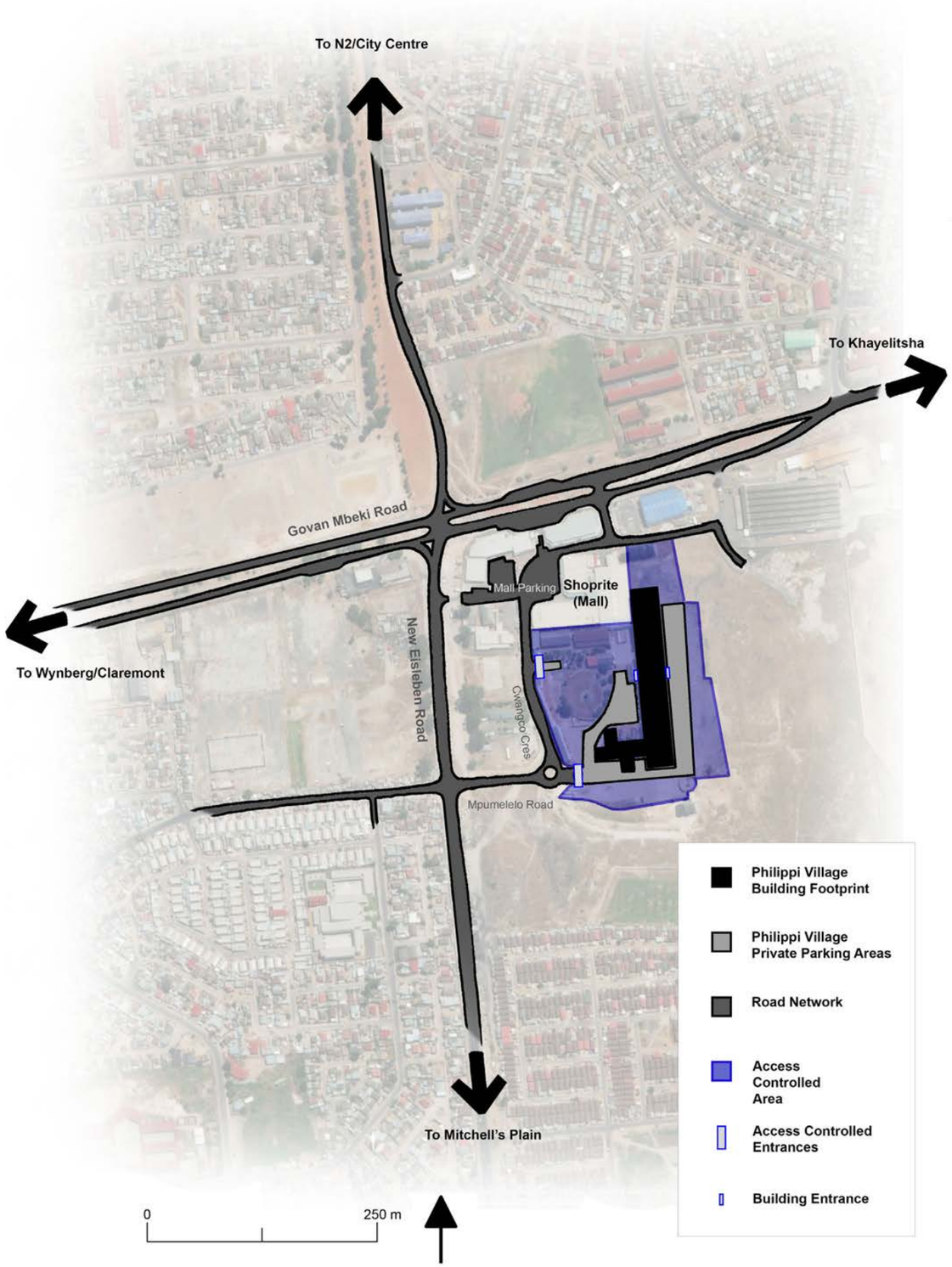


Figure 6: Obligatory passage point for road actor-network

Source: Christian Alexander, based on Callon (1986).

Figure 7: Site context map for Philippi Village



Source: Christian Alexander, based on Google Maps; ESRI, Digital Globe, GeoEye, Earthstar Geographics, and GIS user community

involved waiting for commuter buses to go home on Govan Mbeki Road. The third personal experience involved an attempted carjacking near the closest exit point for the N2 freeway. A fourth interviewee mentioned a carjacking of an Uber vehicle transporting Uber students to Philippi Village (interview with S3), while a fifth recounted a colleague observing the knifing of an Avanza driver just outside Philippi Village (see below for further discussion of Avanza service).

Solution Space users also brought up broader issues of health and safety related to traffic congestion. Several pointed out that the traffic on a portion of the New Eisleben Road passing Philippi Village was chaotic and unsafe due to a general disregard for traffic rules (interviews with S1, S2, S3). Further up the same road, the same user that experienced the carjacking was also involved in a slight automobile accident at nearly the same location several days later (interview with S4). The concerns regarding personal safety raised by the Solution Space interviewees reflects broader perceptions regarding the area as unsafe (See CapeTown Safety, 2017). This is part of a broader perception regarding the danger of Cape Flats and township areas of Cape Town.

In order to address issues of safety, Philippi Village establishes its site's security apparatus as the obligatory passage point for dealing with issues of security and safety of its users. Philippi Village identifies itself and is identified as a "safe" (Philippi Village, 2017) and "secure" (Du Trevou, 2015) place to do business, and many of its constituent actors, including buildings, fences, gates, walls, guards, turnstiles, doors, signs and biometric systems are designed to ensure and project the sense of control and security. This security apparatus helps identify bona fide users of the space. Regular officially sanctioned users register their biometric data with the Philippi Village management, allowing them to scan themselves into the site and building by interacting with electronic scanners. Other visitors must engage with human guards and front desk employees to indicate somehow that they are invited visitors of a tenant. Users and visitors who successfully negotiate the security apparatus at the site entrances are provided with secured parking for their private automobiles. It appears that all Philippi Village users are provided with this parking free of charge (discussion with S2, 3 Oct. 2017).

While all Solution Space users acknowledged crime and safety as a framing issue, some were somewhat more ambivalent regarding this obligatory passage point, not least because of its conflict with the broader problematisation of increasing access and opportunities in township communities. One Solution Space user, S3, identified Philippi Village as "high" on a spectrum of security versus access, stating that the space "is not welcoming, it's not like you feel like you're necessarily [welcome]. Unless you really know what you want, I don't see various people just coming in and wondering in just to come and check out the place" (interview with S3). In contrast, S3 noted the "buzzing" Philippi Shoprite property next door, a space which implied "complete access, zero boundaries and walls," although S3 also admitted that along with this came issues of crime. This user suggested that the real issue was not adequate security apparatus but rather better buy-in from and involvement with the surrounding community. Another Solution Space Philippi user acknowledged the tension between promoting access to the site and maintaining safety: "[A]ccess is, I would say, quite tricky in my eyes because on the one hand the biometric system is serving a purpose, and then, on the other hand, it can be limiting. That's my view" (interview with S2).

Problematised through obligatory passage points structured around the road network and Philippi Village's security apparatus, the issue of access to the Solution Space Philippi offices is a task of moving people to and from relatively distant areas via motorised transport on the road network safely in order to engage in activities constituting the Solution Space actor-network. Access through mobility by motorised transport establishes the frame through which other actors thus vie to establish relationships with each other.

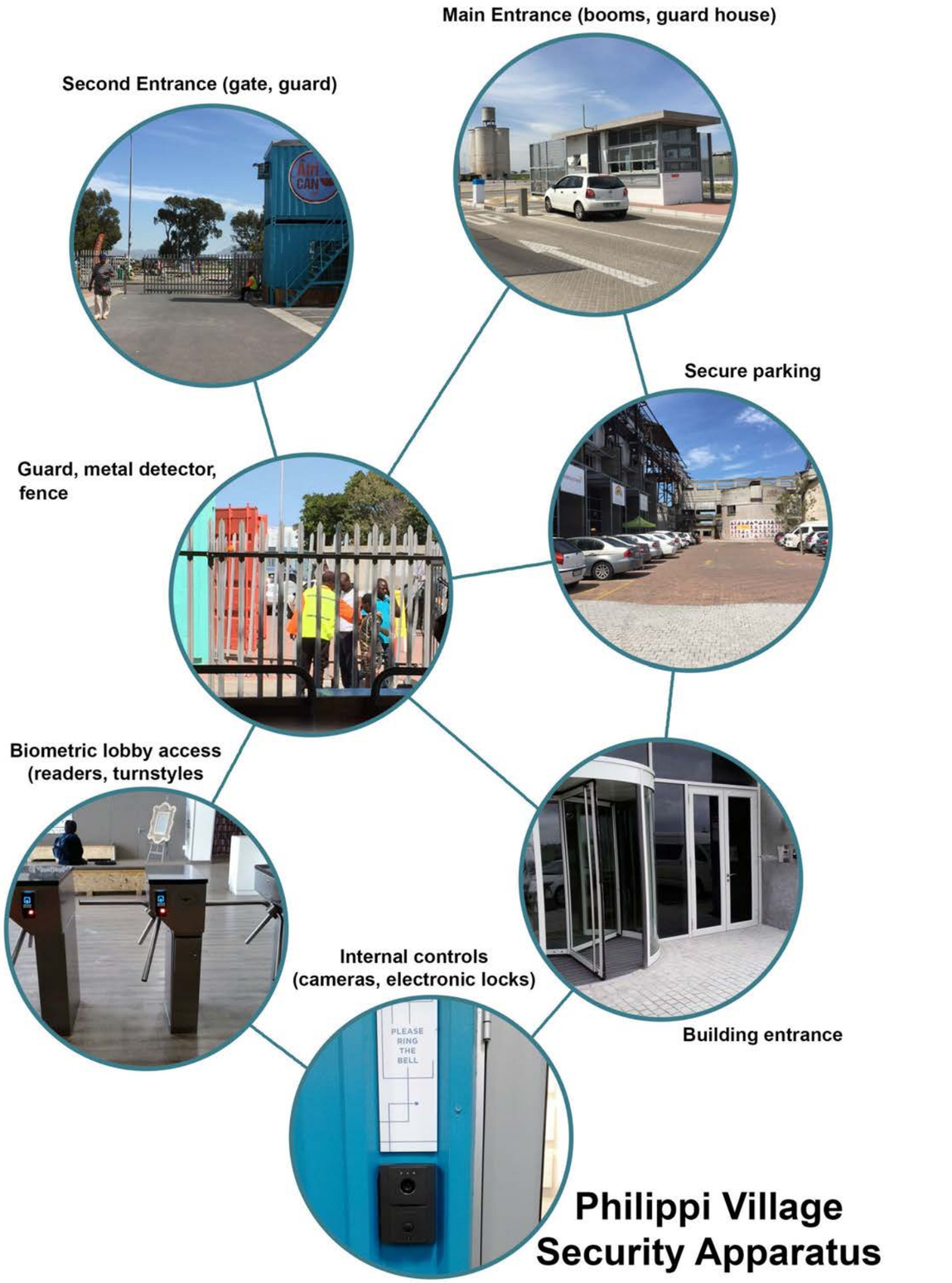


Figure 8: Philippi Village security apparatus visualisation

Source: Photographs by Christian Alexander

4.2.2. Interessement

The Philippi Village actor-network interests users and purveyors of transport through its location and socio-technical constitution, particularly its physical interaction with and connections to the surrounding area. Its interessement activities are primarily focused on offering controlled pedestrian and private (including charter) vehicle access through its security apparatus.

The Philippi Village location interests pedestrians through pedestrian access to its premises and by virtue of its location within walking distance from other locations, including residential areas and areas of high commercial activity, namely the shopping mall and Shoprite grocery store located adjacent to the Philippi Village location. This interessement is nuanced however, for it involves tightly controlled access through a significant security apparatus that includes human guards, metal detectors, pedestrian turnstiles, fences, gates, and walls. Interessement extends only to some of the public, i.e. those who the Philippi Village actor-network has identified as bona fide users of the space (see *Figure 8: Philippi Village security apparatus visualisation*).

Other than pedestrians, the Philippi Village site most strongly interests drivers and vehicles through an assortment of actions, although vehicle access is also monitored and controlled. The Philippi Village site offers vehicle access to the site from the neighbouring road network by way of a frontage road called Mpulelelo Roads/Cwangco Cres (hereinafter also referred to as the "Frontage Road"). There are two public access points onto the secured location surrounding the Philippi Village building, both of which are designed primarily for vehicles, although they also accommodate pedestrians. The "Main Entrance" includes formal infrastructure to accommodate the inspection and controlled access of both vehicles and pedestrians. This includes a security building, booms, and fencing. The "Second Entrance" access point appears to be designed primarily for vehicular access, as it consists of a driveway and rolling gate. My observations and interviews with Philippi Village users make clear that this access point also invites pedestrian access, albeit access that is still secured and controlled by the rolling gate and a security guard with metal detector.

Inside the premises, drivers and vehicles are also interested through parking secured by a significant security apparatus that includes fences, walls, access-controlled gates guarded by security guards, and electronic vehicle monitoring. Access to this area is also afforded to vehicles dropping off passengers and carpools, as well as certain charter buses arranged by users of Philippi Village.

The Philippi Village location also interests other transport actor-networks through its location along established minibus taxi and commuter bus routes, and within an Avanza service zone. However, my observations, interviews, and other research indicate that it is more accurate to describe these other various actors involved in transport to Philippi Village as enrolling the Philippi Village site (or elements of it) as a means of interesting passengers or purveyors of transport in engaging with transport activities, rather than Philippi Village acting as a primary mediator in this relationship. I deduced this conclusion from comparing the work Philippi Village performs to interest pedestrians and vehicles on the one hand, and its efforts (or lack thereof) to physically accommodate public transport on the other.

With respect to the Philippi Village site, the road network interests drivers by providing the primary, and almost exclusive, means of accessing the site. The roads solicit not just drivers of private automobiles, but also minibus taxi and Avanza operators and commuter and charter buses. These actors in turn re-enrol both the Philippi Village site and the road network into their own efforts to interest users of Philippi Village and the Solution Space to be their passengers.

4.2.3. Enrolment

In the context of Philippi Village and the Solution Space, enrolment is indicated by the actual successful nego-

tiation between actors to facilitate access to the site. In a number of instances, this negotiation may mean shifting and re-enrolling other actors in order to accomplish alignment. My interviews and observations indicate that Philippi Village and the Solution Space successfully enrol users to access and use these sites primarily through enrolment in the broader road network. Other actors, such as minibus taxi operators, in turn re-enrol the Philippi Village site and the road network to align passenger interests with their own.

Philippi Village successfully enrols users through its physical connections to adjacent roads, as well as providing access for pedestrians. It further enrols private automobile drivers, carpoolers, and charter service through secure vehicle parking, drop-off and pick-up within the site, and its broader security apparatus to protect drivers. During my observations of the site I saw that many people obtained access by private automobile and walking through Philippi Village's two access points the Main Entrance and the Second Entrance in a controlled manner, as conceived of by the Philippi Village site and security apparatus. The Main Entrance accommodated primarily vehicular traffic. The Second Entrance primarily accommodated pedestrian traffic. My observations also revealed successful enrolment of private and charter vehicle drivers through filled parking spaces during my site visits, and the presence of charter buses that were allowed to enter onto Philippi Village's property (see *Figure 9: Vehicles enrolling in Philippi Village actor-network*).

The Solution Space Philippi site has successfully enrolled the types of users identified in its problematisation—staff, entrepreneurs/visitors, and UCT students—primarily by relying on user enrolment in other transport actor-networks and the Philippi Village site actor-network. The travel patterns of Solution Space users reflected the successful enrolment of Philippi Village users into the road network generally, and the private vehicle actor-network specifically. Of the six Solution Space Philippi users interviewed, three of them accessed Philippi Village by driving there in a private automobile (interviews with S1, S3, and S4). This included one staff member, one start-up employee, and a third person who was simultaneously a student, staff member, and entrepreneur. This third individual indicated that he used his own vehicle both to commute and make other trips to and from other locations within the city related to their work. Another staff member occasionally carpooled home with one of the driving users (interview with S2). Interviews with staff members and other users of the Solution Space indicated that those who owned vehicles used them to commute to Philippi Village (interviews with S1, S2, S3, S4, S5, S6). Solution Space Philippi users used private vehicles for both commutes and other trips (interviews with S1, S3).

4.2.4. Mobilisation and disruption

Philippi Village and the Solution Space Philippi are both relatively newly socio-technical networks, and to an extent they have both been mobilised, although they are not completely stabilised at present. My observations of the Philippi Village site and Solution Space Philippi offices during business hours indicated a fair amount of activity constituting successful actor-network mobilisation: tenants occupying offices, people using the library, visitors attending meetings, academics, entrepreneurs, staff and visitors occupying the Solution Space Philippi offices. Clearly, Philippi Village and the Solution Space Philippi are able to enrol and mobilise actors to facilitate access through their obligatory passage points.

On the other hand, users of the Solution Space that I interviewed noted that both Philippi Village and the Solution Space were still working to gain recognition and identification as a hub for social entrepreneurs and small businesses. One user stated that "[b]ecause it's so very new, even the Village itself is not that well known . . . So people are still . . . not sure when you refer to this place as Philippi Village because they're not sure what you're talking about" (interview with S2). Another Solution Space user noted "no one really knows this space . . . they don't know what's in here for them" (interview with S5). Yet another stated, "I've chatted to people from Philippi and they don't know where Philippi Village is at. That gives you a very strong indication of . . . the lack of visibility in the community" (interview with S3).

Solution Space users, particularly staff, at Philippi Village are particularly aware of issues with mobilising the actor-network, and are working on various means of interesting actors identified in the Solution Space's problematisation. While a strong component of this is work within the local community, for whom access is primarily facilitated by walking, this chapter illustrates how an equally important component of the Solution Space's problematisation rests on a problematisation of access as mobility via motorised transport, particularly by private automobile. Accordingly, the actors involved in negotiating access are key constituents in the Solution Space Philippi's formulation and mobilisation. The following section traces the translation process enacted by various actors to facilitate access to the Solution Space Philippi and Philippi Village.

Figure 9: Vehicles enrolling in Philippi Village actor-network

Source: Photograph by Christian Alexander

4.3 Translating the Transport Actor-Networks Serving the Solution Space at Philippi Village

The problematisations of Philippi Village, the Solution Space, and the road network set up a number of actors and actor-networks to engage in promoting the established framework and to situate themselves as obligatory passage points for "solving" the provision of access to the Solution Space through motorised transport. These include users themselves as drivers of private automobiles, paratransit operators (both minibus taxi and Avanza), charter and commuter bus operators (most notably the Golden Arrow Bus Service), and Passenger Rail Agency of South Africa ("PRASA") officials. All of these networks are interacting and overlapping, disrupting and supporting each other's networks (see *Figure 10: Philippi Village transport actor-network visualisation*).

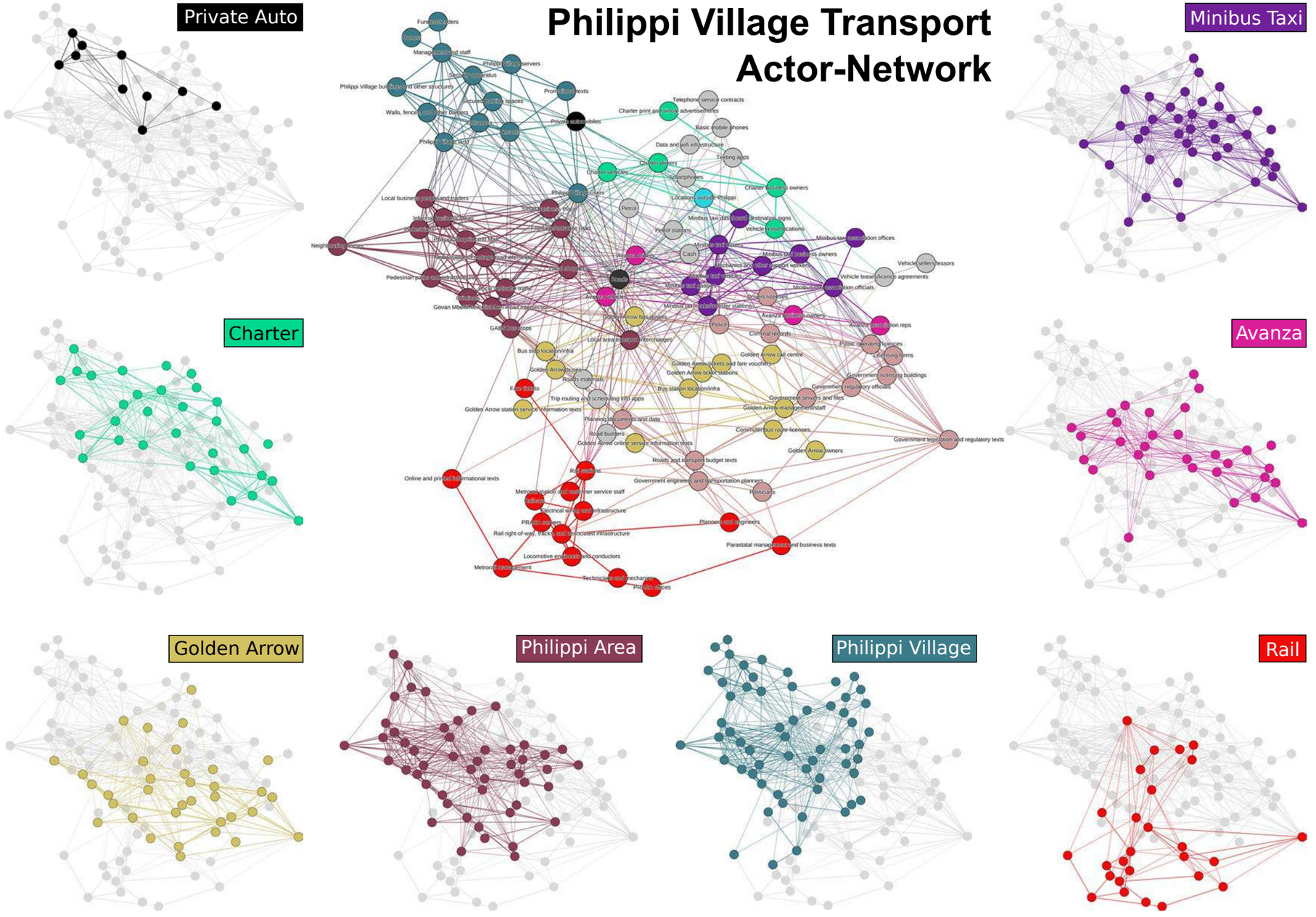


Figure 10: Philippi Village transport actor-network visualisation
(omits detail of government actor-network)

Source: Christian Alexander, using Gephi and Photoshop

4.3.1. Problematisation

4.3.1.1. Identified Actors

The best place, from an ANT perspective, to start in order to describe the transport actor-networks interacting with Philippi Village and the Solution Space Philippi is to look at the actors most closely involved in transportation there. Observations and interviews revealed those with the most direct access: users and operators of private automobiles and charter buses/vans. (see *Table 2: Actors involved in access to Philippi Village, List 1*).

Another group of actors were involved in providing access to Philippi Village through transportation to locations surrounding the Philippi Village site. These primarily consisted of commuter bus transport and paratransit service in the form of Avanzas and minibus taxis (see *Table 2, List 2*).

The interactions between these actors during their enrolment and mobilisation, in turn, implicate other actors that are less visible either because they are not physically present at the Philippi Village or are otherwise obscured through "black boxing" and translation processes. They nevertheless appear important as mediators, symbols, or key intermediaries in these actor-networks and thus deserve to be included in order to better understand the causal chains facilitating transport to Philippi Village.

I identified these secondary actors primarily through secondary research, as well as through interviews and off-site observation (see *Table 2, List 3, 4, 5, 6*).

Both paratransit and commuter bus service provided by private entities, are highly (if not always effectively) regulated. This regulation introduces another host of actors that are implicated in the actor-networks of these services (see *Table 2, List 7*).

In addition to the private or privately-operated modes of transport serving Philippi Village, Cape Town's public transport rail system also serves the Philippi area, with a station located within two kilometres of Philippi Village. Accordingly, this actor-network also constitutes a mode that problematises transport to this area (see *Table 2, List 8*).

4.3.1.2. Obligatory Passage Points

4.3.1.2.1. Road Network Framing and Private Automobiles

Drivers engaging and enrolling in the road-private vehicle actor-network present the most obvious and direct actor-network providing motorised transport to Philippi Village. The relationship between drivers, automobiles, and the road network, and the relative extent of work

List 1: Actors involved in most direct access

- Privately automobiles
- Drivers
- Passengers
- Charter vans and buses
- Charter drivers
- Secured parking spaces inside the Philippi Village property boundaries
- Electronically-read medallions on automobiles
- Fixed and hand-held electronic medallion readers

Reference: City of Cape Town, 2016; TaxiMap, 2017; Golden Arrow Bus Service, 2017; telephone call with GABS customer service line, 19 Sept., 2017; Whereismytransport, 2017

List 2: Actors involved in less direct access

- Golden Arrow buses
- Golden Arrow bus drivers
- Golden Arrow passengers
- Avanza vehicles (Toyota Avanzas)
- Avanza vehicle drivers (observations, interviews)
- Avanza passengers
- Minibus taxi vehicles (Toyota Quantums and others)
- Minibus taxi drivers (observations, interviews)
- Minibus taxi gaatjies
- Minibus taxi dashboard destination signs
- Minibus passengers

List 3: Additional automobile actors

- Government roads staff (engineers, transportation planners)
- Politicians
- Roads budgets
- Petrol
- Petrol stations
- Construction workers
- Roads materials
- Texting apps

List 4: Additional charter service actors

- Vehicle rental locations and representatives
- Computers
- Website and storage servers
- Smartphones
- Communications apps (Whatsapp, Glympse)
- Drivers
- Petrol

Reference: interview with C1

List 5: Additional paratransit actors

- Minibus taxi vehicle owners
- Other minibus taxi and taxi association employees (e.g. rank officials, back office staff, association representatives)
- Minibus taxi ranks and transfer stations (including locally Nyanga and Luzuko)
- Minibus taxi routes, as embodied in texts created by governmental licensing and planning officials and third-party companies
- Petrol
- Cash
- Support service workers (e.g. car washers)
- Petrol stations

Reference: interview with M1 and M2; City of Cape Town, 2017; WhereIsMyTransport, 2017

List 6: Additional Golden Arrow actors

- GABS bus stations
- GABS bus stops and associated infrastructure (signs, benches, coverings, curb-space)
- GABS online service information texts (website schedule and route query system and route timetables)
- GABS station service information texts (destination signs)
- GABS telephone number
- GABS ticket stations
- GABS tickets and fare vouchers
- Petrol stations
- App-based informational texts

Reference: Golden Arrow Bus Service, 2017; City of Cape Town, 2016

List 7: Additional government actors

- Government legislation and regulatory texts (statutes, regulations, and by-laws)
- Licensing forms
- Government licensing buildings
- Route licences
- Licensing numbers, routing, and operator contact information (affixed on vehicles)
- Driver's licences
- Criminal records
- Government regulatory officials
- Politicians
- Police

Reference: Interview with G2

List 8: Additional rail actors

- Metrorail
- Railcars
- Rail stations
- Rail Right-of-Way, tracks, and associated infrastructure
- Locomotive engineers and conductors
- Electrical wiring and infrastructure
- Metrorail station and customer service staff
- Metrorail management
- Planners and engineers
- Technicians
- Fare tickets
- Cash
- Online informational texts (website, route schedules and timetables, route maps
- App-based informational texts
- Parastatal management and business texts

Table 2: Actors involved in access to Philippi Village

conducted by the actors to maintain this network, suggests that the roads themselves are the prime mediator aligning other actors to its problematisation. Of course, as noted above the roads are themselves actor-networks constituted by many other actors. Those that are excluded from this problematisation are those without access to vehicles, which in Cape Town constitutes much of the overall population (see TDA Cape Town, 2014).

4.3.1.2.2. Charter Service

Charter service refers to service where passengers (or their representatives) hire an operator to provide them service ahead of time at a particular time and date and between a particular origin and destination (see TDA Cape Town, 2014). Although charter service is technically distinguishable from services that are organised by employers, schools, and businesses (see TDA Cape Town, 2014), due to the operational and logistical similarities, I have group these types of services together for the purposes of this dissertation due to their similarities.

Charter service businesses and sole-proprietors serve an interesting role at Philippi Village, straddling the boundary between private and public transport. Highly enrolled in the road network, this service competes directly with the minibus taxi network and the Golden Arrow Bus Service ("GABS") at the Philippi Village location, although here there is overlap between actor-network problematisation as both minibus taxi owner-operators and GABS buses and drivers are also engaged in offering charter service. Charter service provides a somewhat better tailored and more reliable service than the public transport and paratransit services (discussed below), albeit at a higher price and with much more organisation and coordination required beforehand (see interview with C1). Passengers or their representatives also play a stronger role as mediators problematising charter service, taking on a more active role to re-align other actors to establish this actor-network (e.g. organising passengers, establishing pick-up and drop-off times, negotiating rates and service contracts with suppliers of charter bus service).

My interview with the charter service owner who provides service to the Solution Space Philippi for the GSB noted that in addition to texting (via Whatsapp), he used the free geo-locating service Glympse, which allowed clients to track his vehicle in real-time on their smartphones (interview with C1). This form of interessement, may or may not be common place with other charter services, is generally not present in the minibus taxi or Avanza actor-networks.

Within this conceptualisation, passengers are thus often associated with more organised entities, such as businesses and employers. For instance, at Philippi Village, one of the tenants, the Desmond Tutu HIV Foundation, employs a fleet of marked minbuses (Toyota Quantums) and sedans to move employees and materials between different sites within Cape Town (interview with P1). The Solution Space and GSB also organise charter service on behalf of users who need transport to the Solution Space from the Waterfront campus (interview with C1).

4.3.1.2.3. Paratransit (Minibus Taxi and Avanza Services)

After the road-private automobile actor-networks, the most observationally obvious problematisation of motorised transport, and the most plentiful and commonly used form of public transport, is the Avanza and minibus taxi services. The Avanza service directly serves the Philippi Village site, while the minibus taxi service serves both major roads connecting the Philippi Village to the rest of the city. These two services are both considered paratransit services, and thus share many similarities in their actor-networks and translation processes, particularly with respect to problematisation.

Like other actor-networks, public transport by Avanza and minibus taxi serving the Philippi Village is defined through framing by its constituent parts: minibus taxi and Avanza business owner-operators, vehicle owners, drivers, other employees, passengers, vehicles, origins and destinations, roads, government officials, laws and regulations, academics and academic research texts, employers, and public transport infrastructure, to name a few. Minibus taxi and Avanza owner-operators exert particular influence though identifying themselves, the drivers they hire, the vehicles they own, and the routes and stations they serve as obligatory passage points for accomplishing this task of transporting the passengers to and from Philippi Village (see Barrett, 2003; Behrens, Ferro, and Golub, 2016; interview with M1 and M2). In this manner, they frame the issue as one of mobility in order to provide access, and of providing a particular form of transport in order to facilitate that mobility (see *Figure 11: Obligatory passage point for minibus taxi actor-network*). Minibus taxi associations, which are constituted and controlled by owner-operators, also serve an important role problematising the structure of service, and position themselves as another critical obligatory passage point for everything from participation in the industry, licensing, routing, scheduling, financing, and many other aspects of the actor-network.

The patterns, territories, boundaries, and routes established as part of the broader minibus taxi actor-network, negotiated among owner-operators and their associations, are an important element framing the ideation of this service to Philippi. This is made clear in the special attention that actors pay to minibus taxi affiliations regarding routes and territory, and by the highly specified and consistently organised manner of service provision. At the Philippi Village site there are highly defined forms of service and routes provided by various elements of the minibus taxi industry (see interviews with S2, S4, and S5). Minibus taxis clearly identify their routes through

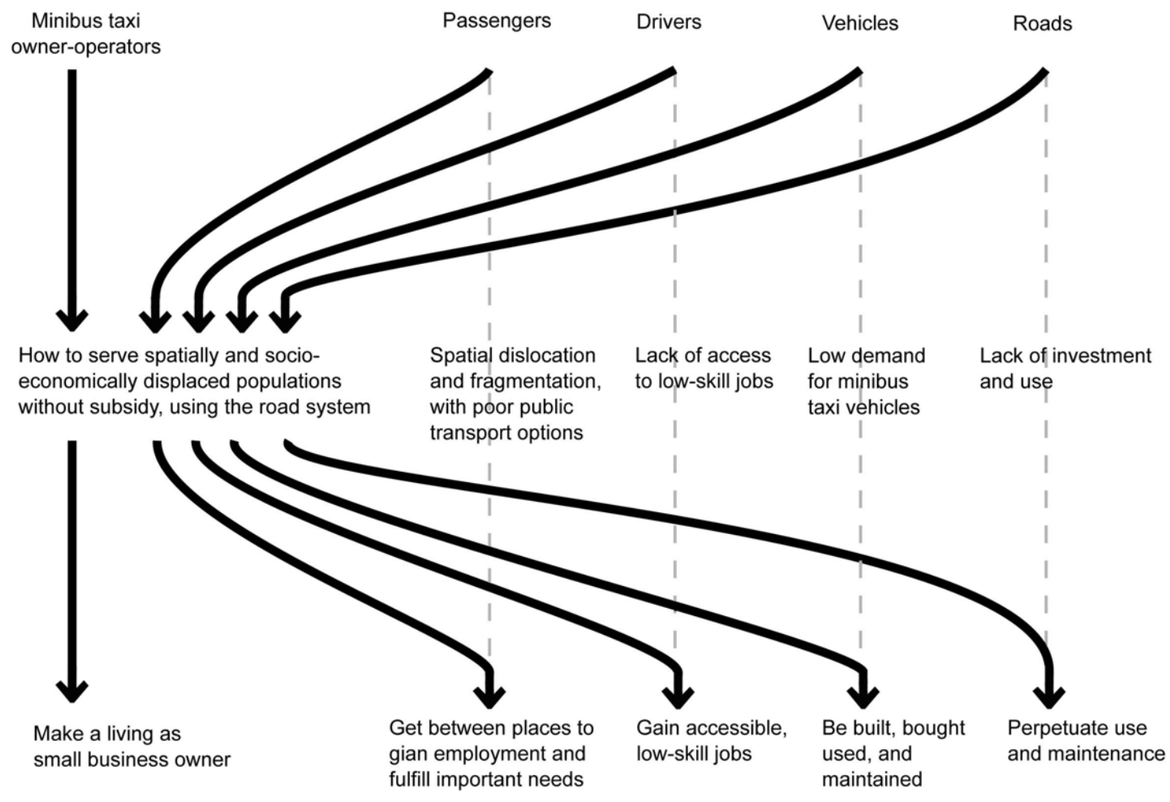


Figure 11: Obligatory passage point for minibus taxi actor-network

Source: Christian Alexander, based on Callon (1986).

Figure 12: Minibus taxi actor visualisations

Source: Photographs by Christian Alexander

written signs and verbal calls to passengers, and the routes they take are predetermined, although within these defined routes passenger wishes as to where to be dropped off may be accommodated. Avanzas provide the most tailored service to Philippi Village users, but their territory is highly defined in order to not interfere with the routes of other minibus taxi service, and in fact is negotiated by minibus taxi associations and coordinated through permanent or semi-permanent minibus taxi ranks and stations (see TaxiMap, 2017; Sustainable Livelihoods Foundation, 2013). These routes are highly framed through the road actor-network, as are other forms of road-based transport.

Minibus taxi owner-operators are assigned and assign themselves qualities that are associated with themselves and their service to the communities in which they live (see Barrett, 2003). This also endows their identification with various attributes that are framed by other actor-networks, including “black” and “coloured”, and the geographically-defined township actor-networks (see Barrett, 2003). These characteristics, which are themselves associations constructed and maintained by their own actor-networks, are generally considered “black boxes” within the problematisation of the minibus taxi network at Philippi and more broadly. As such, they are largely assumed to be fixed and impermeable.

Avanza operators appear to be identified in relation to the minibus taxi network, providing feeder service to minibus taxi ranks, accessing areas that minibus taxis cannot reach, and generally complementing minibus taxi service. Conversations with Solution Space Philippi users indicated that Avanza operators have a lower stature than minibus taxi drivers, and thus may play less of an intermediary role (see discussions with S2 and S5, 4 Oct. 2017). The literature on Avanza service is very limited and an important area for further research.

Passengers within the minibus taxi and Avanza networks at Philippi Village have a more or less assigned role within this problematisation. Within this context, they are the tenants, employees, users, and managers that help constitute Philippi Village and the Solution Space actor-networks who do not have their own automobile. Passengers are broadly defined as anyone who is willing to pay for service. However, the orientation of the service towards passengers travelling to and from the township areas results in an identification of passengers as more likely black and from township areas and less likely to be white or from outside township areas.

Other actors, such as fare collectors (known as “gaatjies” see Schalekamp and McLaghlan, 2016; Majeke, A.C., 2003), taxi rank officials, back office staff, association representatives, minibus taxi support services workers, and consultants, and academics, reinforce the minibus taxi and Avanza networks in various ways by engaging with minibus taxi and Avanza operators and facilitating service. Some actors play more of an intermediary, rather than mediatory, role in the minibus taxi and Avanza service network at Philippi. These include the minibus taxi and Avanza vehicles, cash, and petrol. Their role as intermediaries does not imply unimportance to the establishment of the actor-network. In fact, vehicles play a very significant intermediary role as symbols and designators (see Latour, 2005) of minibus taxis and Avanza service. Passengers identify vehicles offering service by their make and model, normally a 15-seater Toyota Quantum or similar make for minibus taxi service, and Toyota Avanza for Avanza service (interviews with S2, S5, S6). (See *Figure 12: Minibus taxi actor visualisations*).

State actors, including government officials, politicians, regulators, the police, laws and regulations, and planning documents, play a complicated and shifting role in constituting the minibus taxi network. Texts, s, regulators and enforcers shape what constitutes sanctioned minibus taxi service at Philippi. For example, the government granted s are a critical means for owners to establish their right to access and serve passengers at Philippi (see interview with M1 and M2; B2). In this way, the government has sought to insert itself and its texts and processes as an obligatory passage point for service. To

a great extent, they have succeeded, in part by identifying associations as an integral part of the licensing process, thereby providing a role for them and aligning the interests of associations and owner-operators with governmental interests (see interview with G2).

However, the problematisations offered by government officials and minibus taxi operator-owners and associations are often at odds with one another. Minibus taxi and Avanza owner-operators undermine the government's role by manipulating or flouting various legal requirements, including proper licensing, compliance with traffic and safety laws, and employee and passenger rights (see interview with G2; Goodfellow, 2012; Klopp and Mitullah, 2016; Bruun et al., 2016; Cervero, 1997). In some cases, minibus taxi owner-operators seek to mitigate the impact of non-compliance through loopholes, as when operating routes illegally with a charter bus licence, which carries a smaller penalty than operating with no licence at all (interview with G2).

Similarly, government texts and representatives indicate that often times the government's worldview seeks to displace and negate minibus taxis and Avanza operators as an actor in the transport industry (see interviews with G1, B2). For instance, government regulators and texts often seek to prohibit the flexibility of minibus taxi and Avanza service. One particularly prime example is the need to obtain a licence for specific routes (interview with G2), which is particularly at odds with the service provided by Avanzas. Interview information indicates that this discrepancy continues with the implicit understanding by government officials that minibus taxi associations retain a certain amount of self-regulatory authority (see interview with G3). Nevertheless, the problems and solution paths differ between minibus taxi and Avanza owner-operators and government representatives, who each seek to disrupt each other as obligatory passage points.

Problematisation and the establishment of obligatory passage points necessarily require relegating other possible frameworks with which to understand socio-technical interactions. Many of the same actors with roles in the minibus taxi network also take part in other networks, which may disrupt, be disrupted, or align with the problematisation established by the minibus taxi and Avanza networks. Other modes of transport compete (or potentially compete) with minibus taxis for service to Philippi: walking; bicycling; private automobiles; commuter, charter, and local service buses; and (marginally) trains. These activities and assemblages share, to a varying degree, the problematisation established by the minibus taxi network. Briefly, I now turn to a few of these alternative problematisations and obligatory passage points not already discussed that touch upon Philippi Village.

4.3.1.2.4. Golden Arrow Commuter Bus

The managers and owners of the GABS also seek to establish themselves as an obligatory passage point for passengers on their way to and from Philippi Village as part of their greater commuter service catering to township inhabitants. The Golden Arrow service competes for many of the same passengers in the same markets as minibus taxi service, focusing on individuals living in township areas who need reliable transportation to commute to jobs in areas of high economic activity in the city (see Reciprocity, 2008). Golden Arrow routes, timetables, and schedules reflect this focus; highly individualised GABS routes offer reliable transport for relatively limited timeframes during the day (see Golden Arrow Bus Service, 2017). Within GABS problematisation, Avanza and minibus taxi service plays a largely adversarial and excluded role (see Reciprocity, 2008), although there is some overlap and co-problematisation, as is demonstrated in co-location of and service to transfer facilities like the Nyanga terminal.

The orientation of GABS with respect to Philippi Village makes clear that while the intersection of Govan Mbeki Road and New Eisleben Road is identified as an origin/destination, it is not considered a major nexus or activity point. This is indicated by the relatively minimal infrastructure at the actual bus stops serving Philippi Village, and in the lack of designation of this point as a stop in any of the GABS routing or scheduling literature (see Golden Arrow Bus Services, 2017; City of Cape Town, 2016).

4.3.1.2.5. Metrorail

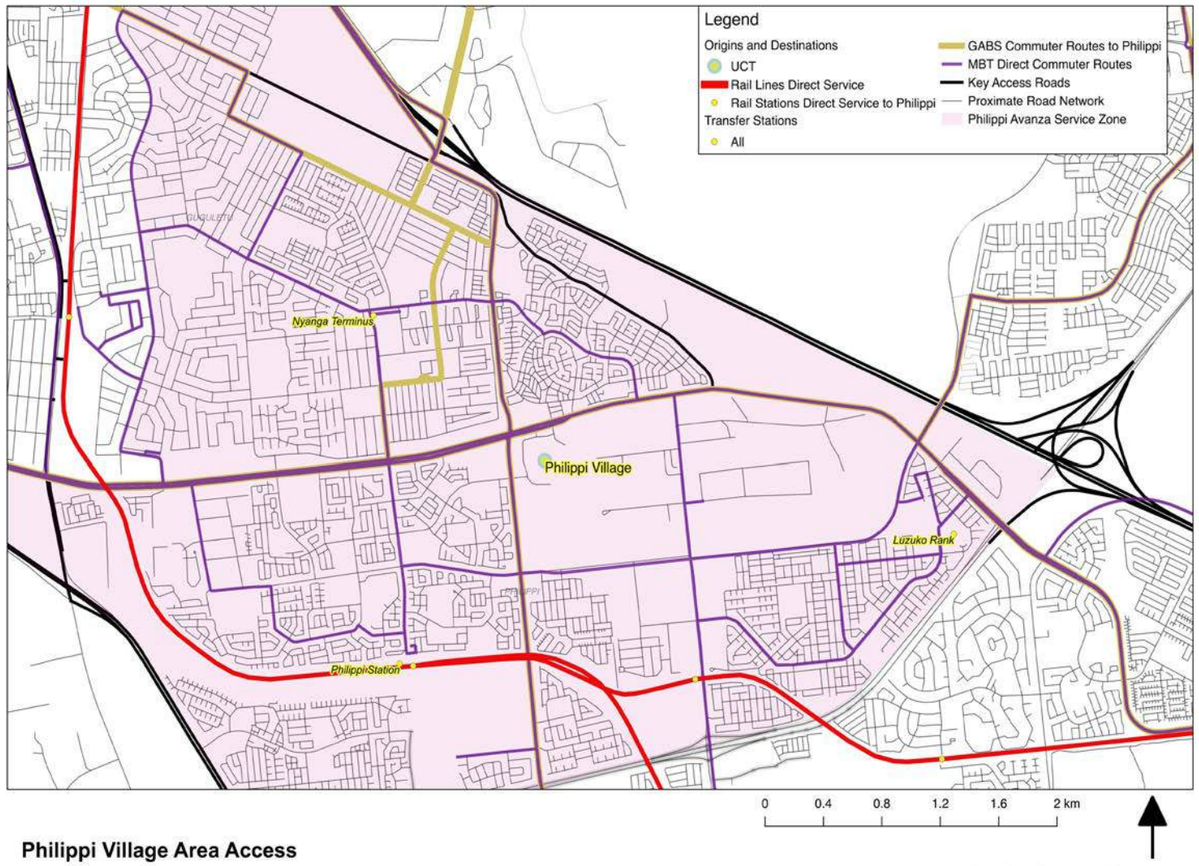
Finally, the parastatal entity PRASA, the owner and operator of Metrorail rail service in Cape Town, also offers an alternative problematisation of transport service that touches upon access to Philippi Village. More than the other problematisations discussed above, this problematisation challenges the road-based actor-network. For instance, a passenger could rely on rail, rather than roads, to cover over three-fourths of the distance between the GSB's Waterfront and Philippi campuses. Metrorail service assigns a limited role to minibus taxi and commuter bus service within its actor-network, for instance by providing transfer areas at major rail stations. However, the lack of apparent planning and coordination of rail activities with minibus taxi operators or GABS, and the direct competition between minibus taxis, GABS, and rail routes for service between township areas and areas of high economic activity both indicate that the rail service problematisation excludes a clearly defined role for these other services. The lack of direct access, or even provision for indirect access, indicates that the Philippi Village location is not defined as a particularly important area of focus for providing public transport service by rail.[9]

4.3.2. **Interessement**

The actor and actor-networks that seek to establish themselves as obligatory passage points for transporting passengers to the Solution Space Philippi engage in strategies to entice other actors to coalesce around their proposed solutions. The actors associated with transport to Philippi Village discussed above, and particularly the primary mediators of each network, seek to interest other actors to interact according to their problematisation (see *Figure 13: Philippi Village public transport service local area map; Figure 14: Philippi Village public transport service sitemap*).

4.3.2.1. **Road network**

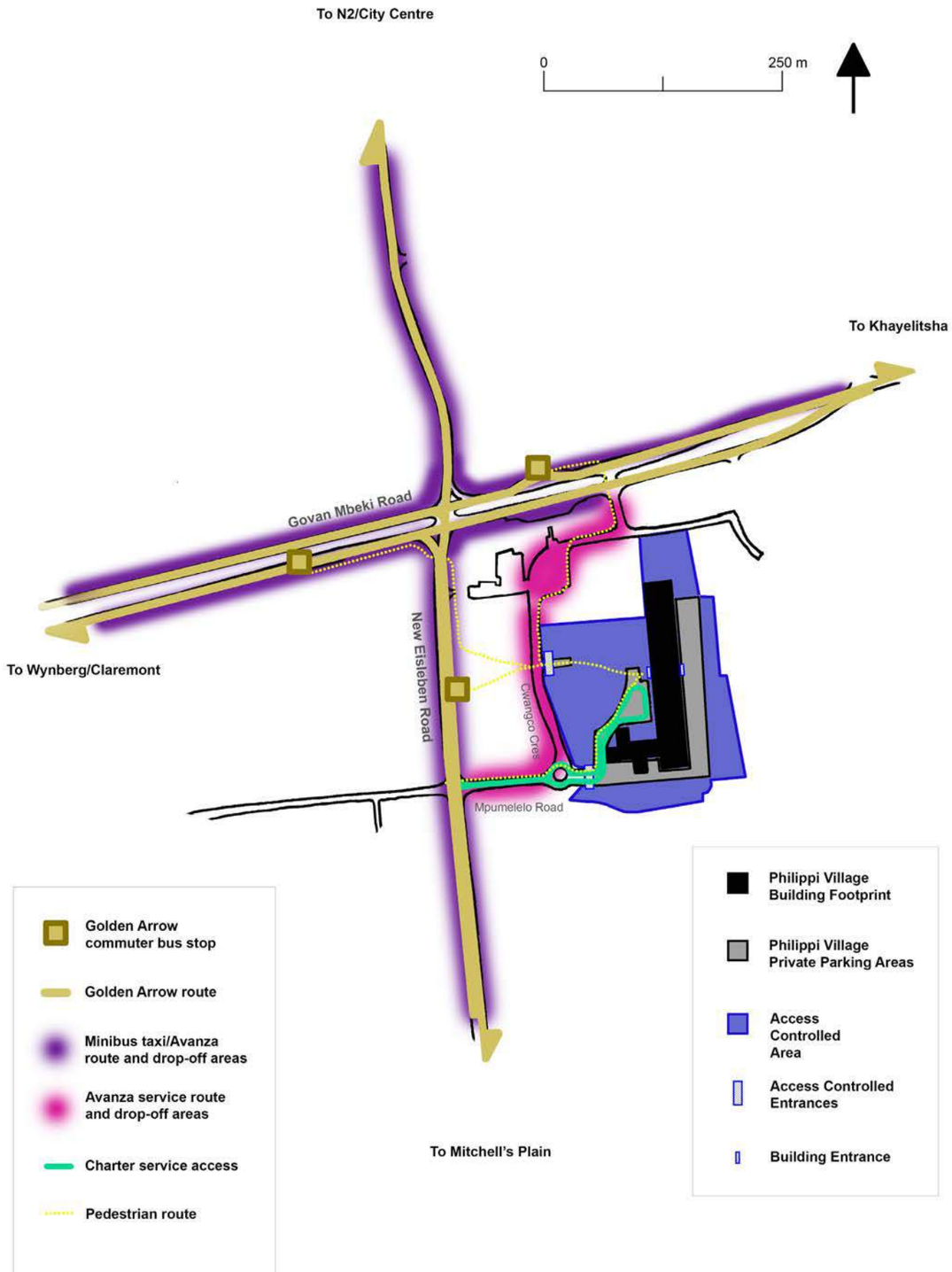
The road network interests drivers in driving its roads by maintaining itself in road-worthy condition with adequate capacity for a significant number of vehicles to travel on it during peak commute times (see *Figure 15: Road access to Philippi Village*). It induces travellers to depend on it and politicians and government officials to invest in its maintenance. The heavy investment in maintaining road systems reinforces similar public and private investments in automobile and petrol production and sale. The road network interests significant government involvement in its perpetuation, including city, provincial, and national budgets, planning processes, traffic rules and police enforcement of those rules, funding for road-



Philippi Village Area Access

Figure 13: Philippi Village public transport service local area map

Figure 14: Philippi Village public transport service site map



Source: Christian Alexander, based on Google Maps; ESRI, Digital Globe, GeoEye, Earthstar Geographics, and GIS user community

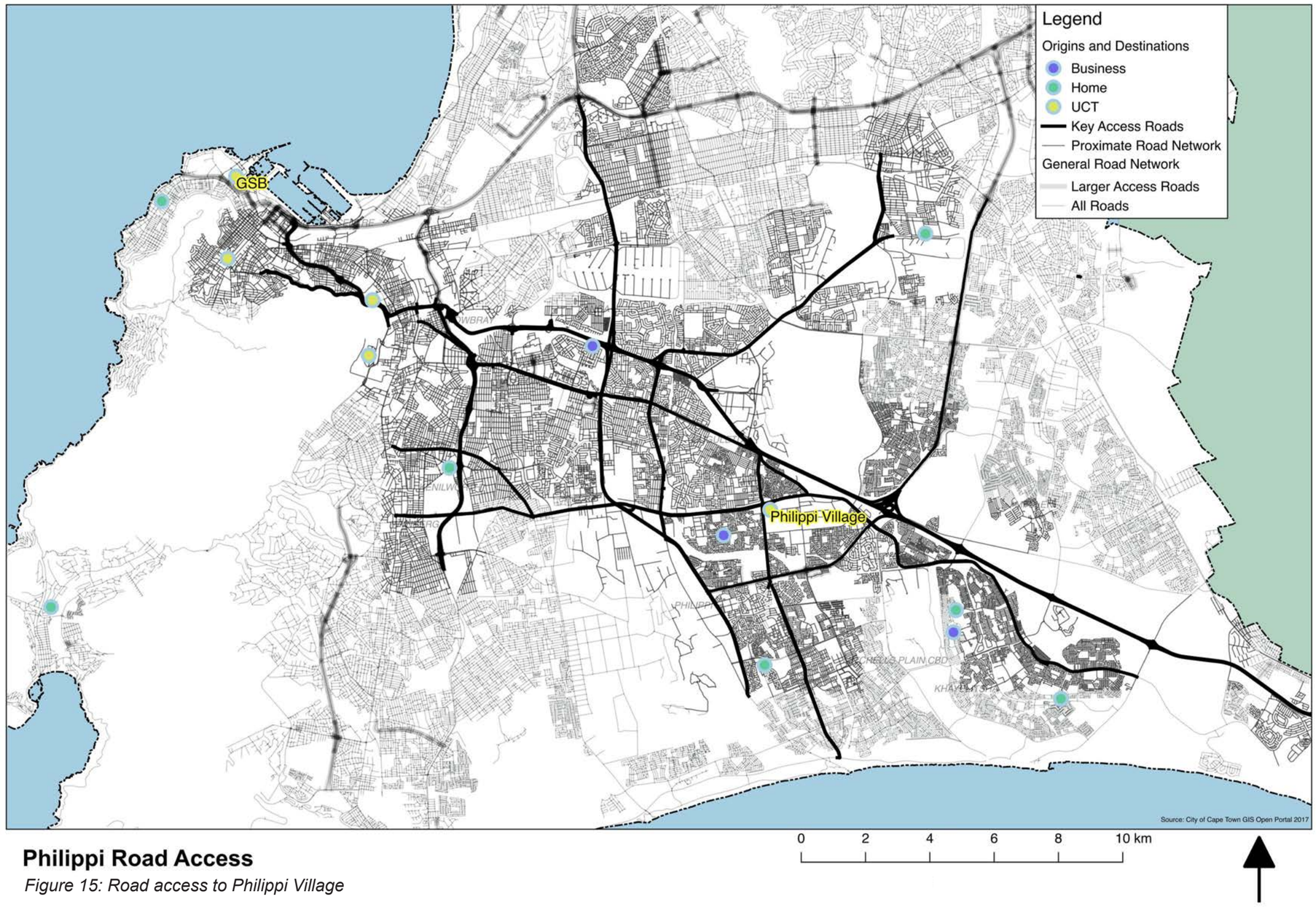
based public transport infrastructure and service, and so on. Within the problematisations of road transport, and access to Philippi Village and the Solution Space Philippi, the actors engaged in establishing obligatory passage points seek to align passengers from Philippi Village through a number of inducements.

Drivers of private automobiles to some extent mediate their own transport actor-networks. They interest vehicles and petrol through transactions and interest the road network by driving over it. As described above, drivers may be seen as a mediator with respect to their unique commutes, but within the greater scheme of the road actor-network, roads themselves are more accurately described as mediating their actions. The dependence of drivers on the roads network is reflected in how these roads dictate and limit the options of Solution Space users who drive to Philippi Village. Options are delimited by available roads and their capacity (see interviews with S1, S3, S4).

4.3.2.2. **Charter Service**

Charter service operators interest many of the same actors as minibus taxi and commuter bus operators, discussed below: licences and permits, vehicles, roads, petrol, drivers, other staff (interview with C1). Some minibus taxi owner-operators and GABS both engage in charter bus activities (interview with M1 and M2). The means of interesting passengers to enrol is significantly different, however, and relies much more on co-interessement activities of self-organised passengers or their representatives.

Charter service operators offer to employers or self-organised groups of employees pre-arranged, reliably consistent service at predictable times that fulfil commuting needs. Charter service operators solicit business through word of mouth (interview with C1) as well as advertising services on vehicles, printed and virtual advertisement texts (see L&S Shuttle Services, 2016). This solicitation occurs not at the time of engagement in services, but well beforehand, and through mediators who negotiate the terms of service. Accordingly, charter service depends on advertising, either through word of mouth or through print or electronic formats (interview with C1).



Philippi Road Access

Figure 15: Road access to Philippi Village

4.3.2.3. **Minibus Taxi and Avanza Service**

Minibus taxi and Avanza business owner-operators do much of the work required to interest other actors in creating the minibus taxi network at Philippi Village. They purchase or lease vehicles and operate them along self-organised routes, or otherwise induce drivers and other employees to do so through payment in cash (see Schalekamp, Golub, and Behrens, 2016). They transact with petrol station operators and maintenance workers to maintain vehicles, and they induce the roads by driving over them.

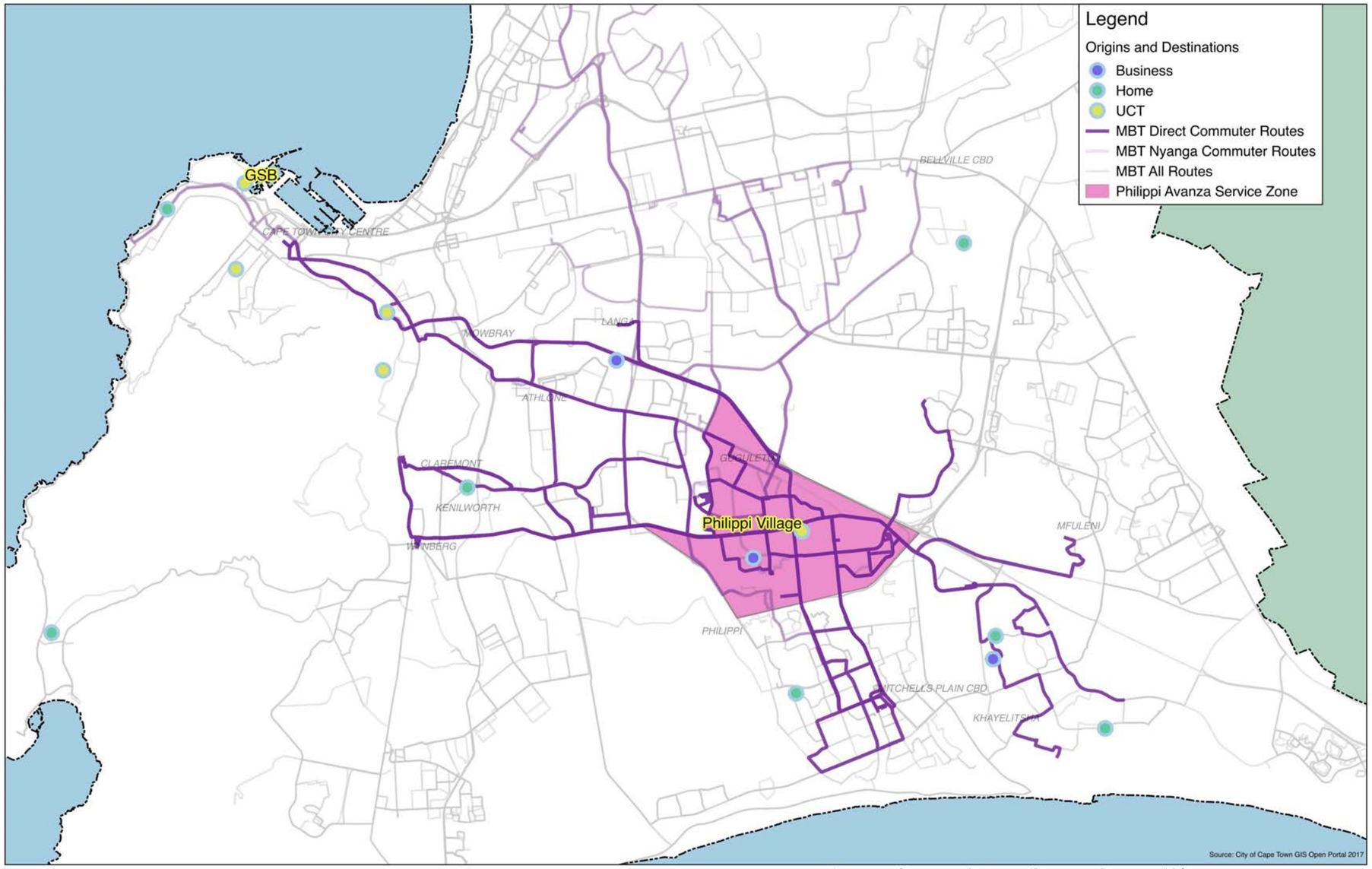
The operators also establish routes to interest potential passengers (see *Figure 16: Paratransit service to Philippi Village*). A major element of minibus taxi service is to connect township residents to areas of economic activity in the CBD and Southern Suburbs through an existing well-established network of routes, ranks, stations, and transfer or interchange locations. During peak periods

there is a higher frequency of direct trips in the direction of normal commutes towards these areas. Otherwise, passengers need to transfer at main transfer stations. To facilitate this, owner-operators have established the Avanza sedan paratransit service, which provides feeder connections to main ranks and stations within certain geographically defined areas of the city.

A number of minibus taxi associations run service along the busy New Eisleben and Govan Mbeki corridors between the Cape Flats township areas and the rest of the city. However, these major minibus taxi routes are not oriented towards service to Philippi Village specifically, and the Govan Mbeki/New Eisleben intersection is not a major minibus taxi transfer or interchange node. As a result, service directly to and from this location is largely incidental to and dependent on service to other destinations. Alternatively, passengers may connect through the established nearby transfer stations, including most notably Nyanga Station, a minibus taxi and Golden Arrow station approximately two kilometres from Philippi Village. Connection to Nyanga Station and other stations in the area are facilitated by local Avanza service.

Minibus taxi owner-operators and drivers solicit (or incentivise gaatjies and other employees to solicit) passengers by driving past Philippi Village and other origins or destinations in predictable patterns and offering transport for a set fee, identifying their travel routes and other travel information through calls, honks, whistles, and signs. Solicitation is facilitated mainly through direct physical interaction. While much communication is verbal, many minibus taxis also include signs on the dashboards to indicate their endpoint destination (e.g. Cape Town, Bellville, Wynberg). They may slow or stop at or near intersections to look and call for passengers.

Avanza drivers similarly call and honk to indicate their services to passengers. One primary strategy for picking up passengers at the Philippi Village site is to “crawl” along the entrance road providing access to Philippi Village and to the adjacent businesses, including a significant mall housing the Philippi Shoprite grocery store,



Minibus Taxi and Avanza Service to Philippi Village

Figure 16: Paratransit service to Philippi Village

which serves as a landmark for the area (see interview with S2). Many Avanzas going past are headed to the Shoprite to pick up or drop off passengers. Avanzas generally do not use signs indicating their routes because their form of service is zone-based rather than route-based (see TaxiMap, 2017). As with the minibus taxis, some Avanza vehicles have stickers indicating their registration with government entities, although many do not.

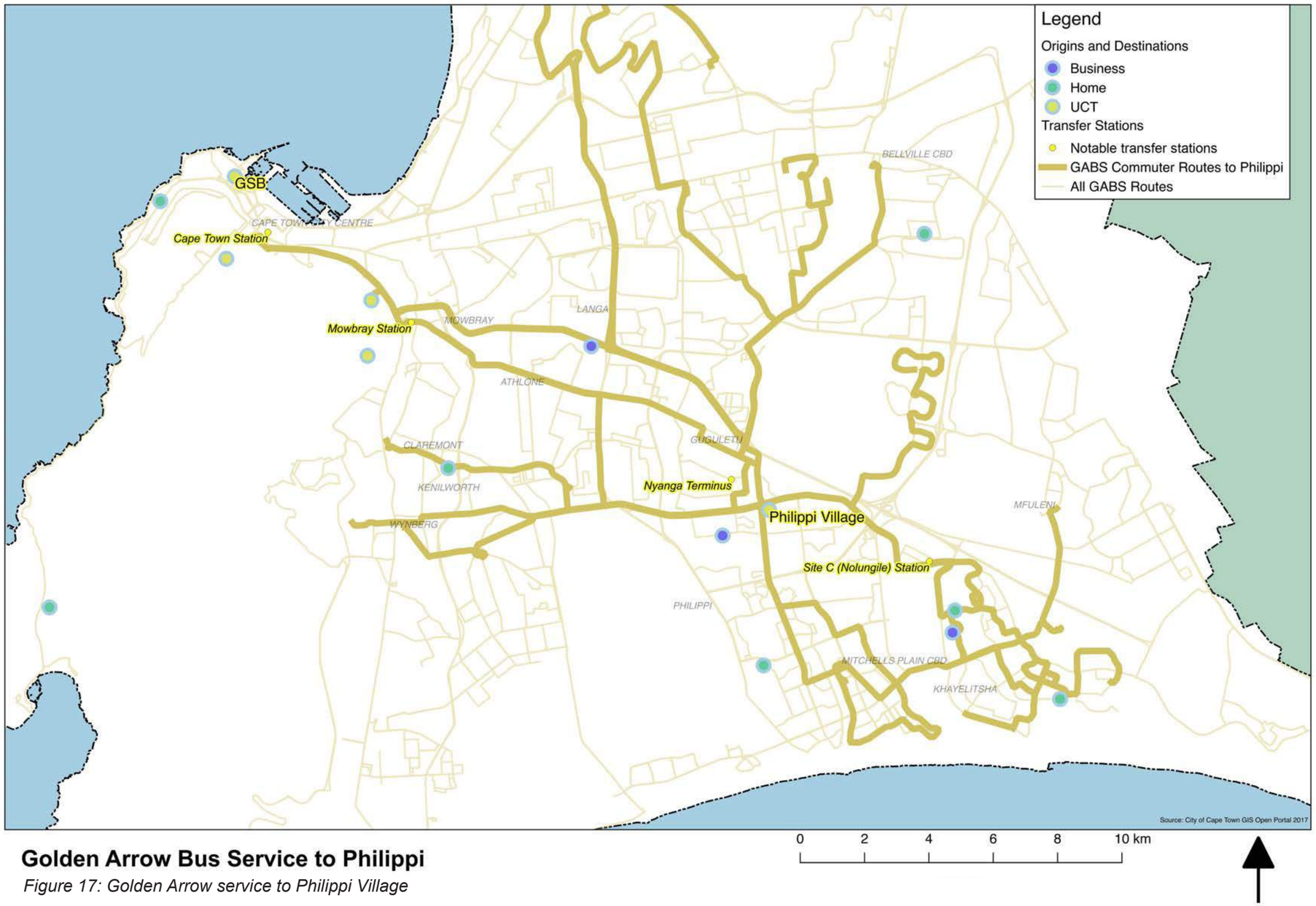
Notably, outside of signs placed on dashboards, and a limited number of signs at some station locations, the minibus taxi industry does not rely on printed or virtual texts or maps to solicit customers. The texts available regarding the routes and service available to commuters are produced by outside parties seeking to enrol the minibus taxi service into their own networks. This includes the City’s collection of geographic information system (“GIS”) data as part of its attempts to enrol the minibus taxi network into its transport plans for the city, as well as websites and publications by private technology-oriented start-ups seeking to find ways of facilitating and monetising better access to minibus taxi network

information (see WhereIsMyTaxi, 2017; TaxiMap, 2017; GoMetro, 2017). A representative of one such outside group indicated that one reason for the lack of such texts was the structure of the service, which while maintaining consistent patterns is generally formulated around providing service between particular destinations, rather than following specific routes (interview with B2).

Minibus taxi operators and drivers also induce use of their service through coercive means at times. This includes threats of violence or actual violence against passengers or actors providing other types of service. The minibus taxi industry in Cape Town and South Africa is well known for enforcing strikes through the use of violence. For example, during the period of this research, Cape Town minibus taxi drivers engaged in service strikes during which the entire transport network serving many of the townships, including the Philippi area, were forced to shut down. Minibus taxi drivers also attacked including Golden Arrow buses and private automobile traffic (see Luhanga et al., 2017).

4.3.2.4. **Golden Arrow Commuter Bus**

Golden Arrow's primary focus is on serving the commutes of township passengers to areas of major economic activity. As with charter and paratransit services, Golden Arrow representatives obtain and maintain s from the provincial government for routes that serve these areas. They also obtain vehicles and petrol through purchase and secure drivers, staff, and other staff through hire. Golden Arrow also interests the City (and vice versa) by offering their services to the public through tender, and receive subsidies from the City for doing so (Reciprocity, 2008).



Golden Arrow Bus Service to Philippi

Figure 17: Golden Arrow service to Philippi Village

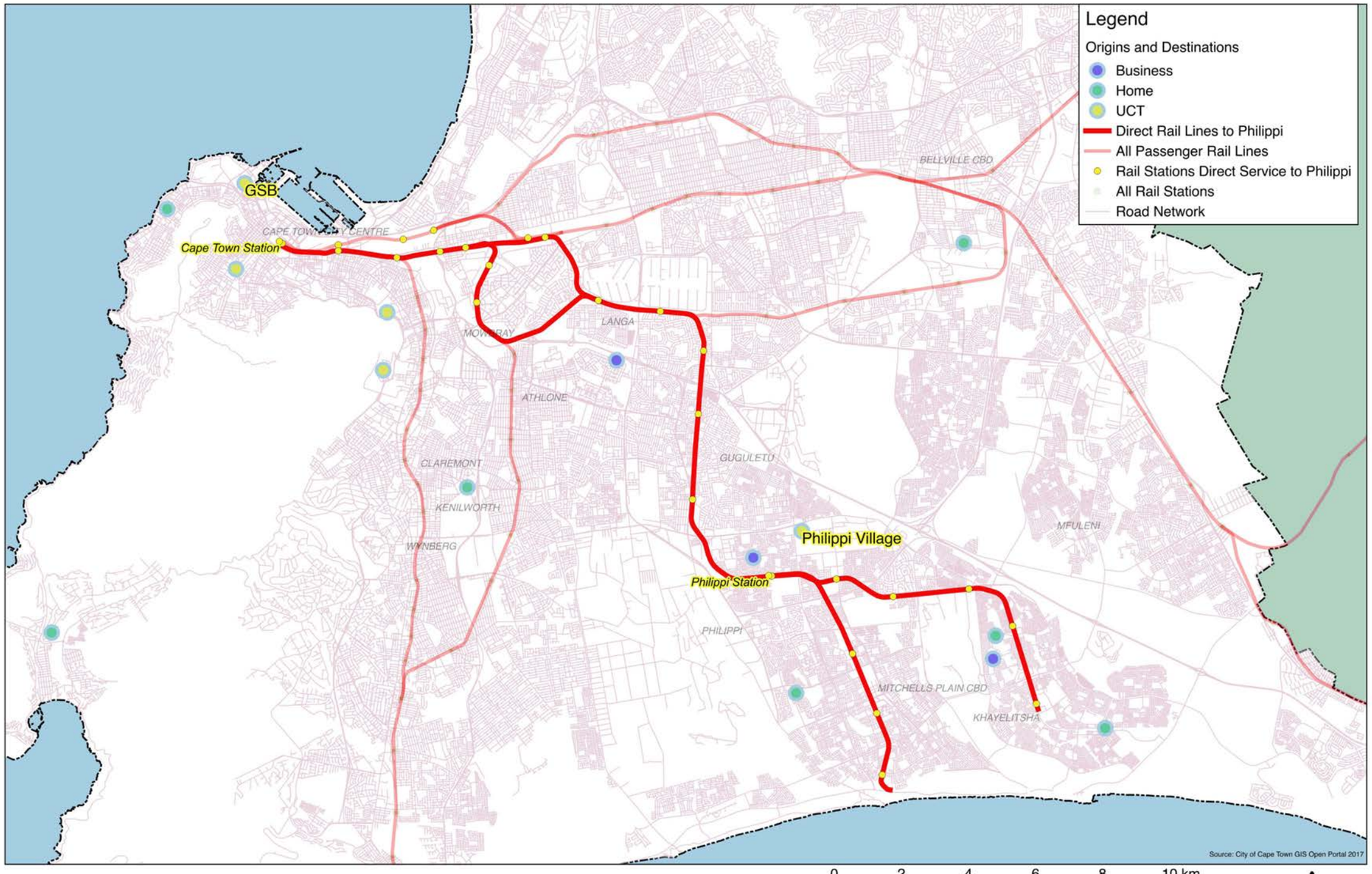
Golden Arrow solicits customers through set stations, schedules, fares, and routes, publicised through advertisement, signs, a customer service telephone number, website, and word of mouth (see Golden Arrow Bus Service, 2017; telephone call). Although Golden Arrow makes more use of texts and technology (e.g. its customer service line) to solicit passengers than do minibus taxi operators, there is no comprehensive legible map or system-wide explanation of service. A review of the spatial data for Golden Arrow routes, service schedules, and other Golden Arrow texts indicates that this may be in part due to the nature of the service provided, which seeks to compete with minibus taxis for peak commuter business (see City of Cape Town, 2016; Golden Arrow Bus Service, 2017). The specific routes between residential and business areas, while generally categorisable in terms of general origin and destination, differ in detail based on each individual trip taken. This allows for Golden Arrow service to put its service within close proximity to a much larger catchment of travellers who can coordinate their trips with the one bus passing their particular location each day in order to make their commute. This particular strategy makes off-peak or spontaneous use of the service, as well as legible representation of routes on a map, difficult (see *Figure 17: Golden Arrow service to Philippi Village*).

At the Philippi Village site, Golden Arrow buses solicit passengers by making scheduled stops at official bus

stops located along New Eisleben and Govan Mbeki Roads. These stops are designated by signs, benches, and indented curbs. However, there is no clear route information provided at the stops, nor any publicly available texts of other recorded information about which particular buses make stops at any given bus stop (see Golden Arrow Bus Service, 2017; City of Cape Town, 2016; informational telephone call with Golden Arrow Bus Service customer service line, 19 Sept. 2017). The nature of the routes and service described above makes off-peak use of this service from certain areas of the city difficult, although Philippi Village's location at the crossroads of routes to Mitchell's Plain and Khayelitsha makes it an easier place to use GABS than other locations.

4.3.2.5. **Metrorail**

PRASA plays an important role in interesting many travellers within the Cape Town area, particularly those located in the township areas. However, its interessement of passengers to Philippi Village in particular can only be said to be indirect at best (see *Figure 18: Rail service to Philippi Village*). This involves scheduled service along rail lines for a set fare. The stations Metrorail serves includes Philippi Station and Stock Road Station, which are approximately 2.1 and 3 kilometres away from Philippi Village, respectively. Rail service is also oriented towards township commuters, but the use of separated rail lines and train-car utilisation means somewhat different issues affect this service. Direct trips originating either from the townships of Khayelitsha and Mitchell's Plain (in the direction of normal commutes) or from the CBD, and stations along the route in between, are direct to Philippi Station or Stock Road Station. Rail trips from other locations in the city require transfers that would take passengers all the way into the CBD and then back out to Philippi Village. In addition, passengers require an additional means of making the trip of 2-3 kilometres between the Philippi Station and Stock Road Station and Philippi Village. Avanza service is available between these stations and Philippi Village (see TaxiMap, 2017).



Rail Service to Philippi Village

Figure 18: Rail service to Philippi Village

4.3.3. Enrolment

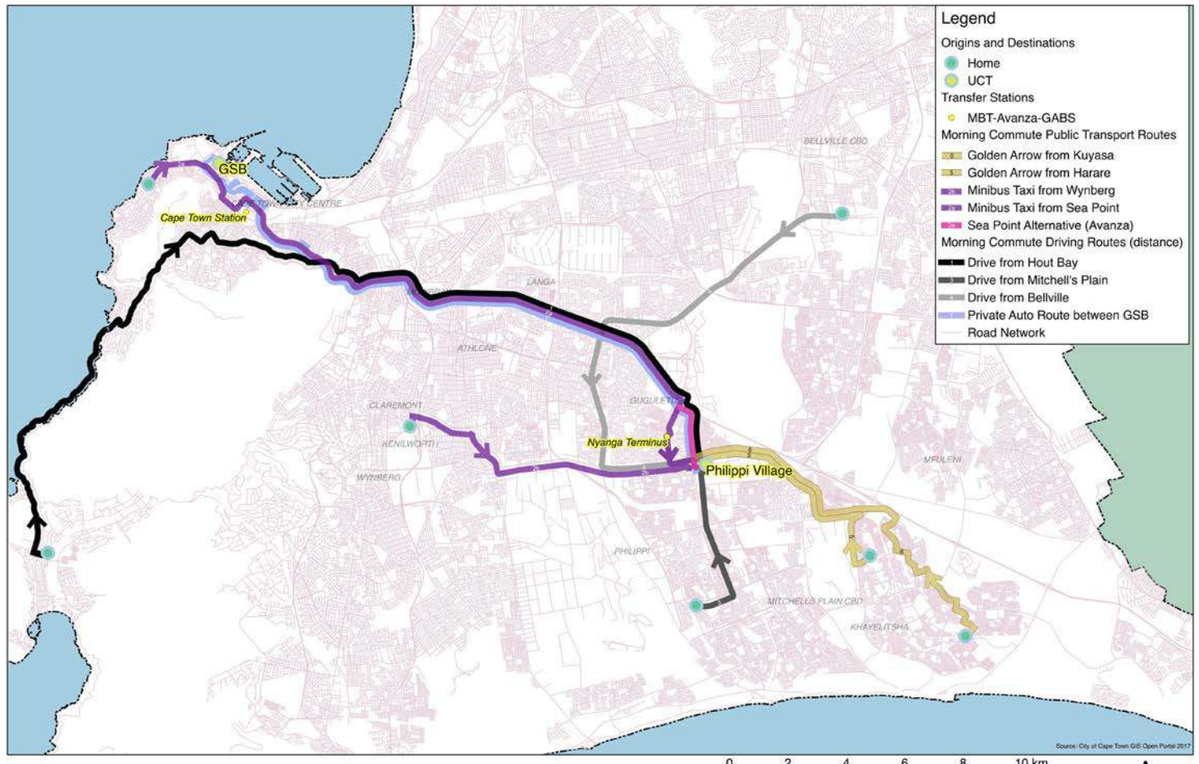
The road network successfully enrols a range of different actors, including other actor-networks that depend on it as an obligatory passage point, such as privately driven vehicles, minibus taxi and Avanza vehicles, commuter buses, and chartered vehicles. The level of vehicular traffic passing along New Eisleben and Govan Mbeki Roads is considerable. As one interviewee put it, speaking about New Eisleben Road, “I call it the main road . . . and on that main road, you find a lot, you find a Bellville taxi, you find a Cape Town taxi, you find a Mitchells Plain Hanover Park taxi . . .” (interview with S2). Traffic, consisting largely of Avanzas, is also considerable along the service road connecting Philippi Village and the adjacent shopping area to New Eisleben and Govan Mbeki Roads.

Within the roads-based actor-network, minibus taxi, Avanza, commuter bus, and charter bus actor-networks also enrol Solution Space Philippi users to varying degrees as means of access to Philippi Village (see *Figure 19: Solution Space morning commute routes; Figure 20: Solution Space evening commute routes; Figure 21: Philippi Village site map showing routes actually used*). While these users have aligned their actions with the problematisations of other actors engaged in mediating these actor-networks, the outcomes and arrangements indicate how negotiations and adjustments took place in order to achieve alignment. To some extent, due to the orientation of the existing transport actor-networks, Solution Space users have had to re-enrol transport actors to accommodate their need for access to the Philippi Village site. In doing so, these actors become mediators of their actor-networks.

4.3.3.1. Example 1: Negotiating minibus taxi enrolment for reverse commuting

While during the peak commuting times there is sufficient demand for public transport systems, particularly minibus taxis and commuter buses, to provide direct (or more direct) service carrying travellers from homes to work in the morning and back to home in the evening, at other times and in other directions travellers must make use of a more segmented service that relies on connections at busy interchange points. These interchanges can add significant time and hassle for passengers. For the users of the Solution Space Philippi, navigating and minimising these connections constituted an important component of negotiating the successful enrolment within a particular type of service.

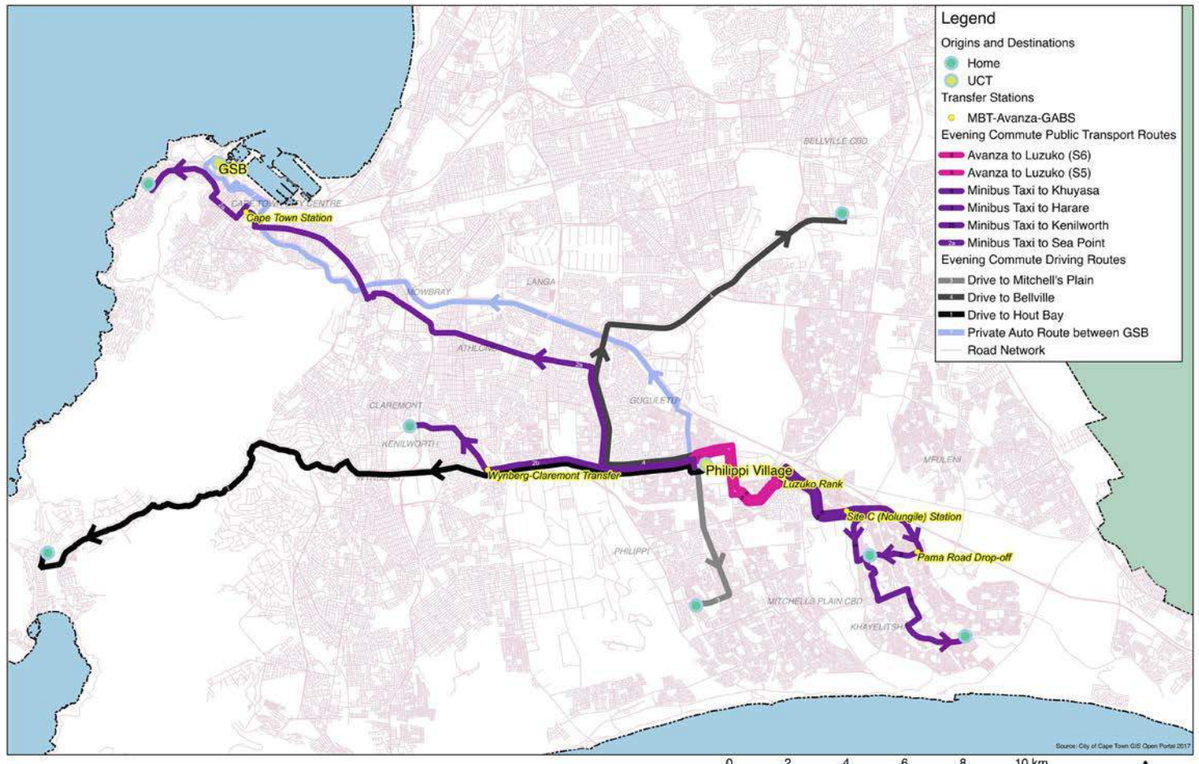
In describing her former daily commute via minibus taxi service between the Sea Point neighbourhood and Philippi Village, one Solution Space Philippi user, S2, described how she negotiated a “reverse commute” that contradicted the general commute patterns into Sea Point and other neighbouring areas from the township areas. In the early days of this commute, S2 described how she utilised the standard routes and transfers required in order to travel between Sea Point and Philippi Village, which during that time of day required a minibus taxi ride from Sea Point to Cape Town Station, followed by a ride from Cape Town Station to Philippi Village via a Lower Philippi route. However, this trip could result in long waits at Cape Town Station for enough travellers to fill up the minibus taxi to depart. Soon, S2 discovered that she could instead hail minibus taxis returning from Sea Point to the Nyanga area near Philippi, cutting out the potentially significant wait time at Cape Town Station. Because fewer travellers made this trip, minibus



Solution Space Morning Commute Routes

Figure 19: Solution Space morning commute routes

Note: routes are approximations of a sample of routes described by research participants.



Solution Space Evening Commute Routes

Figure 20: Solution Space evening commute routes

Note: routes are approximations of a sample of routes described by research participants.

taxis did not normally solicit passengers, but they would agree to take S2 back to the Philippi Village area, where they were returning to take more travellers to Sea Point again. S2 thus negotiated her enrolment in the minibus taxi network to better align with her needs. She noted that minibus taxi operators even suggested exchanging telephone numbers in order to be able to communicate via Whatsapp for pick-ups. However, enrolment of this actor-network did not take place because S2 was not willing to provide personal information such as her telephone number to strangers.

After about a year of this commute, S2 relocated to the Southern Suburbs, nearby the continuation of the Govan Mbeki/Lansdowne corridor that passes by Philippi Village. This busy corridor, the "main road" in her terms, provides her with a similar "reverse commute" opportunity with even less distance to cover and a smaller chance of transfers (interview with S2). In this case, the minibus taxi service along Govan Mbeki/Lansdowne Road was good enough to interest her in moving from her long-time home near the CBD.

4.3.3.1.1. Example 2: Re-enrolling Philippi Village's security apparatus and MBT Avanza service

Coming from the Khayelitsha, Solution Space users S5 and S6 both described using Golden Arrow bus service to reach Philippi Village in the morning and minibus taxi service in the afternoons. Although the Golden Arrow buses provided quick and more direct service between their homes and Philippi Village both in the morning and the evening, S5 and S6 both discontinued using Golden Arrow buses in the afternoons because they had both experienced being mugged while waiting for the bus in the afternoon along Govan Mbeki Road. This was not as much a concern during the morning commute because once they alighted from the bus they could walk directly to Philippi Village. In contrast, waiting for either taxis or buses along this road, even for a short amount of time, exposed travellers to increased risk of crime (see *Figure 21: Philippi Village site map showing routes actually used*).

Instead, S5 and S6 employed the Avanza service to reach further connection points with minibus taxis that were safer than waiting on Govan Mbeki Road. Unlike either the minibus taxi or commuter bus services, Avanza drivers could, due to their smaller size and type of service offered, "crawl" along the service road passing directly by Philippi Village's Main Entrance and Second Entrance. Because of increased safety in numbers, closer proximity to the Philippi entrances, and the presence of businesses and security guards, these were much safer points at which to wait. The Second Entrance in particular, which during my observations and according to my interviews appeared to be used much more than the Main Entrance for Avanza pick-ups and drop-offs, sits across the Frontage Road from an empty lot that is heavily trafficked by people walking between Shoprite and the neighbouring communities (see *Figure 22: Avanza drop-off at Philippi Village entrance*). This lot is also the site of an informal clothing market. Informal traders set up their wares in the open lot and sit alongside the sidewalk next to the Philippi Village entrance, where there is some shade and a fence against which to rest. This, alongside the AfriCAN Cafe and other container businesses next door, creates a thoroughly watched area that establishes a sense of protection and safety in numbers.

The large number of Avanzas coming and going from the neighbouring shopping areas provides high frequency as well, meaning that the wait time to enter into a vehicle is very short, particularly at peak commuting times. Avanzas picking up passengers such as S5 and S6 heading towards Khayelitsha have organised a point of interchange with minibus taxis heading outside of the Avanza zone of service. S5 and S6 would take the Avanza service to an informal taxi station located at the edge of the Avanza operating zone in the direction of Khayelitsha to transfer with minibus taxis providing service to locations closer to home. In this way, negotiation of the

Figure 21: Philippi Village site map showing routes actually used

Source: Christian Alexander, based on Google Maps; ESRI, Digital Globe, GeoEye, Earthstar Geographics, and GIS user community

service results in successful enrolment of S5 and S6 in the minibus taxi network.

Similarly, S2 engaged in re-enrolling the Philippi Village security apparatus to negotiate her larger enrolment in the transport actor-network. S2 is unwilling to wait for minibus taxis along Govan Mbeki Road for the same crime-related reasons. Instead, S2 waits for taxis at the intersection of the service road leading to Philippi Village and New Eisleben Road. This intersection is less exposed, and therefore somewhat safer. In addition, S2 requests that one of the security guards at the Main Entrance escort her to the intersection and wait for her to catch a minibus taxi. In this way, S2 effectively extends the physical footprint of the Philippi Village's security apparatus to accommodate her commute.

4.3.3.2. Example 3: Organising charter service

Solution Space users also engage as mediators of transport actor-networks by organising charter service to address their transport needs. Three examples of this appeared in my research. First, the GSB itself is currently engaging with a charter service company in order to transport students from the GSB's Waterfront campus to the Solution Space Philippi offices (interview with C1). This occurs on a frequent, ad hoc basis without an established contract. The Solution Space uses a service started by a former student of a GSB programme who previously lived in Philippi and who connected with the Solution Space through word of mouth. The cost is significantly higher than public transport, but the level of service, consistency, and flexibility is also better. The use of this service allows for transport that enrols easily

Figure 23: Desmond Tutu HIV Foundation charter vans

Source: Photograph by Christian Alexander.

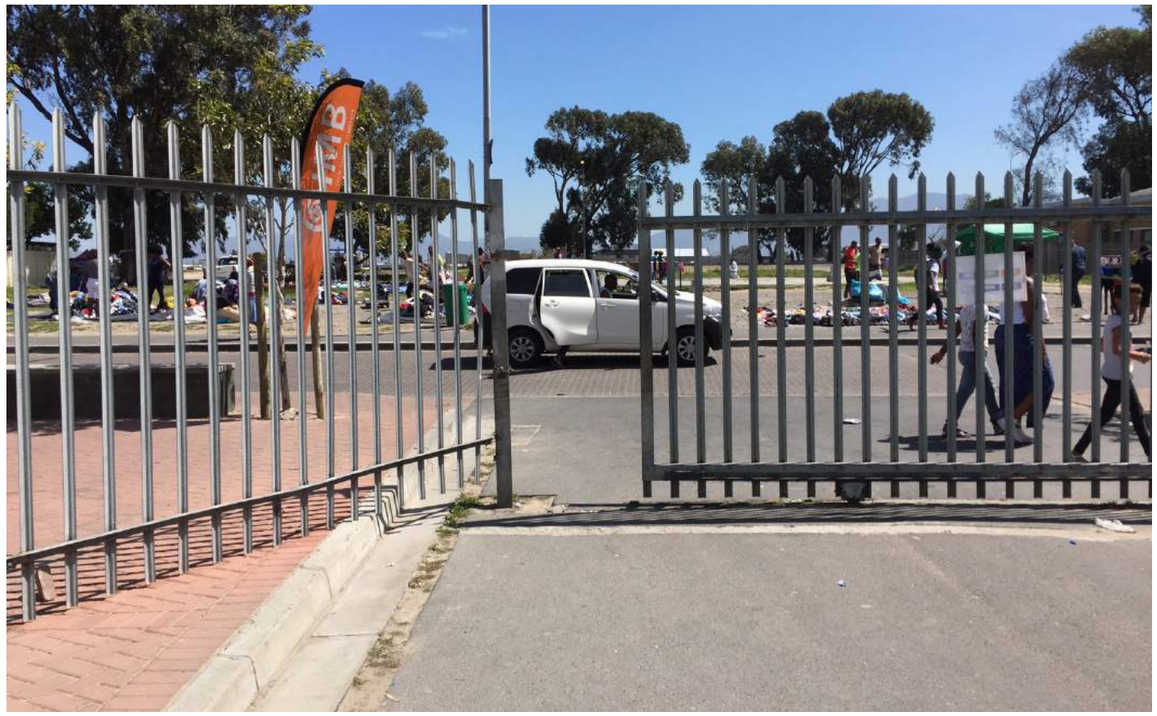


Figure 22: Avanza drop-off at Philippi Village entrance

Source: Photograph by Christian Alexander.

Figure 24: Charter buses inside Philippi Village parking area

Source: Photograph by Christian Alexander.

both within the road network and Philippi Village's security apparatus. However, the ad-hoc nature and lack of a written contract creates a sense of uncertainty for the charter service provider (see interview with C1).

Another example comes from interviewee S5, who late in the research period notified me that she had switched her mode of the commute home from Golden Arrow and minibus taxi service to a transport club consisting of several Philippi Village users who stay in Khayelitsha. The three participants in this transport club met through networking at Philippi Village facilitated by the Solution Space Philippi's liaison and office manager. Participants have engaged with a person who is currently out of work to drive them between Philippi Village and Khayelitsha. For this service, each participant pays a monthly fee which, if the service is used every day, is roughly comparable to the cost of minibus taxi and GABS. The time taken, particularly to get home, is generally much better than the previous use of Avanza and minibus taxi service. The participants alternate between who gets dropped off first. Because they do not live particularly close to one another within Khayelitsha, this means that the trip home varies, but is not generally longer than the former trip via Avanzas and minibus taxis, and is often much shorter. Participants text each other ahead of time to let each other know if they will not be using the service on a particular day.

A representative from another tenant in the building, the Desmond Tutu HIV Foundation, also utilises an apparently well-mobilized charter service (see interview with P1; see *Figure 23: Desmond Tutu HIV Foundation charter vans*). The minibus taxi association representative interviewed indicated that other employers in the building were seeking out charter service to serve their employees (interviews with P1 and M1 and M2). Observations at Philippi Village indicate high use of this service, apparently on a regularised or semi-regularised time schedule, involving both Toyota Quantums and sedans. I was not able to determine the cost of such service, but the marking of all vehicles involved with Desmond Tutu HIV Foundation logos indicates that these vehicles have been purchased or leased by the Foundation itself.

At least one tenant of Philippi Village is a charter service business (see L&S Shuttle Service, 2016), indicating that such services are a well-established form of transport in the area (see also *Figure 24: Charter buses inside Philippi Village parking area*).

4.3.4. Mobilisation and disruption

Successful mobilisation of Philippi Village and the Solution Space is evidence itself of successfully mobilised means of accessing the physical sites of these actor-networks, given the dispersed nature of their constituents. On the other hand, it seems clear from interviews that mobilisation of transport actor-networks is limited, in part due to the disruptive socio-spatial nature of the site itself, and subject to strong disruptive factors. Accordingly, these modes of transport that constitute access are not nearly as mobilised as they are in other parts of Cape Town.

The best-mobilised transport actor-networks at Philippi Village and amongst Solution Space Philippi users is transport by private automobile. Observations at Philippi Village and interviews indicated that the easiest and preferred mode was by private automobile. The highly mobilised road network and private automobile usage more generally in Cape Town no doubt provides critical support to mobilise this actor-network. Given serious concerns regarding muggings and carjackings in the area, it appears that the Philippi Village's security apparatus protecting private automobiles within the site is also critical to maintaining and stabilising this actor-network. However, crime disrupts even this actor-network, as described in the stories of carjackings mentioned in the previous section.

For those not included in the problematisation of private vehicle transport, the other options are even more highly susceptible to disruption due to high crime in the area, as well as commute times. As noted above, two Solution Space users utilised Golden Arrow buses for their commutes to Philippi Village but opted to use Avanza and minibus taxi service to get home after encountering crime along Govan Mbeki Road. Similarly, another user refused to wait for minibus taxis along Govan Mbeki road, instead opting to use minibus taxis that run along New Eisleben Road, which is closer to the Main Entrance for Philippi Village (see interview with S2).

For these users, and for many other users I observed entering and exiting the entrances for Philippi Village, the Avanza service is a critical transport link making it possible to connect people to longer routes. Solution Space Philippi users S5 and S6 used them as part of their daily commute. S2 also used the Avanzas in her previous commute from Sea Point, and still uses them occasionally when the only minibus taxi she can pick up along her new commute is going to the closest major terminal, Nyanga Station, from which she uses the Avanza service (interview with S2). Solution Space user S6 also noted that she had been using Avanzas to make trips out to areas in the local vicinity as part of her job.

However, notwithstanding the use of the minibus taxi service among some Solution Space Philippi users, it was clear from interviews that these networks were fairly tenuous and that the users would likely dis-enrol easily. Solution Space user S6 noted that she and her boss had agreed that she would be driven to sites in the local area that she needed to access, rather than use the Avanzas, because of safety concerns. As noted above, S5 no longer uses minibus taxis to travel to and from work, instead opting to use a self-organised informal charter service. S2 noted unease with using the Avanza service, stating that crime was still an issue: "someone can try and rob the small mini cab [Avanza], or the driver himself can . . . turn on you and want your belongings" (interview with S2). Solution Space Philippi users are thus hesitant to enrol in the minibus taxi network in a stable manner.

Charter service appears to be an increasingly mobilised actor-network at Philippi Village. The GSB, S5, and other tenants (e.g. the Desmond Tutu HIV Foundation), have settled on this option for at least some of their needs. The higher cost of service, as well as the higher need for organisation on the part of passengers or their representatives, may constitute limiting factors for this type of service. However, the strong interessement of the Philippi Village and Solution Space users by the road network, combined with the relatively weak interessement provided by other transport providers, indicates that this may continue to mobilise as a means of providing access to Philippi Village.

The limitations to mobilising public transport options for Philippi also reveal the significance of crime as a serious disrupter. Crime helps establish private automobile and security apparatus as obligatory passage points in providing access to Philippi Village and the Solution Space Philippi. Philippi Village has so far established a strong obligatory passage point around its security apparatus as a means of addressing this problem. Other conceptualisations of how to address this problem have yet to take shape. There are, however, some glimmers that suggest alternative approaches, such as where actors have taken advantage of Philippi Village's security apparatus to promote paratransit services.

4.4 MyCiTi, TNCs, and Actor-Network Disruption

While the last sections described the translation of Cape Town's transport actor-networks at the Philippi Village site, this chapter helps elicit how socio-technical changes might disrupt these translations. The dissolution of actor-networks starts with alternative problematisations, and in this realm there are two clear alternatives that have appeared in Cape Town within the past five to ten years—MyCiTi and TNCs. Applying the impact and potential for disruption of existing actor-networks at Philippi Village provide a mechanism for understanding how socio-technical change may or may not occur at Philippi Village, and how interventions aimed at improving access at the Solution Space might be made more effective.

4.4.1. Translating MyCiTi's Actor-Network

For the past ten years, the City has been engaged in re-problematising public transport service through its MyCiTi integrated public transport programme. The programme, originally proposed by outside consultants in 2007 (Boulle and van Ryneveld, 2015), calls for an integrated public transport system centred around a new bus system based on similar models developed in Latin America. The concept as initially conceived was to establish a series of fixed-route, separated Bus Rapid Transit lines that would serve routes throughout the city. Unlike GABS, the BRT lines would operate more regularized routes on a more consistent schedule, akin to the rail network. Smaller feeder lines would serve the BRT trunk lines, and both would integrate into the city's rail system, which is owned and operated by the semi-public national entity PRASA.

The proposed programme provided the impetus locally and nationally to argue for taking a different direction in public transport, a new "opportunity to lever funding to fast-track investment in public and non-motorised transport" (Schalekamp and Behrens, 2010:373). Soon after it was proposed, the plan was adopted as part of the City's preparation for hosting the World Cup (Boulle and van Ryneveld, 2015). The requirement to operationalise the first phase of service for the tournament created a hard deadline that served to motivate both the City and national governments to move quickly to implement the project (Boulle and van Ryneveld, 2015).

City documents and secondary sources reveal how through the MyCiTi programme the City sought to disrupt the minibus taxi actor-network and insert itself as an obligatory passage point in the public transport context. One of the key elements of the plan, also modelled off of the example of similar implementation in the Colombian city of Bogotá, was the transformation of the minibus taxi industry into a formalised public transport system. This entailed replacing minibus taxi service by requiring minibus taxi owners and operators to formalise and conglomerate their operations into "Vehicle Operating Companies" ("VOC"), which would then be eligible to tender a contract with the City for operation of its MyCiTi bus routes according to the City's specifications (Boulle and van Ryneveld, 2015). The City viewed the project as an opportunity to create an efficient formalised public transport system through a competitive, privatised process in a cost-effective manner that would allow the City to avoid significant subsidisation of public transport (Boulle and van Ryneveld, 2015).

The MyCiTi problematisation also sought to re-align mobility within the city. Under this plan, the Philippi area would constitute a highly connected location, containing direct BRT trunk-line connections to nearly every corner of the city (interview with G1; TDA Cape Town, 2017). This would depart significantly from the radial pattern that currently favours the Cape Town CBD, and would radically shift Philippi's role and identity as a centrally located and well-connected area (interview with G1).

More recently, the City through its Transport and Urban Development Authority ("TDA") has produced documents revising its strategy with respect to minibus taxi integration, now incorporating them into the plan as feeders to the overall network. The City's 2017 transport business plan states that the minibus taxi industry will "play . . . a significant role in the transport solution in providing on-demand and demand responsive services" (TDA Cape Town, 2017:2). It also envisions a "[m]aximum stake for the existing bus/minibus sector in rapid public transport network operation" (TDA Cape Town, 2017:11). This is based on the understanding that minibus taxis will assume "new generation service" features, similar to those utilised by TNCs (see TDA Cape Town, 2017:16). Under this plan minibus taxis will operate primarily as supplemental or feeder service complementing the MyCiTi and rail services (TDA Cape Town, 2017:64). This revised plan nevertheless suggests a radically different role for minibus taxi operators.

The actors involved in MyCiTi reveal the differences in its constitution as compared with the existing transport actor-networks at Philippi Village. As a mode of public transport, MyCiTi most closely resembles GABS through its vehicles and infrastructure; yet a whole new range of actors and actor-networks are present, and require mediators to exert work in order to interest other actors and align their actions (see *Table 3: MyCiTi Actors; Figure 25: MyCiTi actor-network visualisation*).

As initially proposed, minibus taxi owner-operators were simply not identified as an actor in the MyCiTi problematisation, and were thereby excluded from the actor-network (interview with G1). Instead, minibus taxi owner-operators became identified as VOC shareholders, VOC employees, passengers, or non-participants (interview with G1). More recently, the City has been forced to adapt its problematisation to find room for minibus taxi service in the face of its inability to successfully mobilise its actor-network and to enrol minibus taxi drivers in particular (see TDA Cape Town, 2017). However, the language used in the new business plan indicates that the City still envisions tranforming the identity of minibus taxis to a service with TNC-like qualities (TDA Cape Town, 2017).

Interessement of the MyCiTi plan is based on an ambitious amount of work performed by City employees, consultants, and subcontractors to interest other actors. This includes constructing new separated bus lanes and purpose-built stations, platforms and buses. As Pineda (2010) notes with respect to this system's use in Latin America, this special-purpose infrastructure seeks to interest passengers in speedy boarding and alighting while simultaneously excluding conventional paratransit operators from re-enrolling infrastructure, such as high-level boarding platforms, that are not interoperable

Table 3: Key MyCiTi Actors

MyCiTi Actors
• MyCiTi buses • MyCiTi bus stations • MyCiTi labels, signs, stickers, and other forms of trade dress • Petrol • BRT Right-of-Way, lane separations, and associated infrastructure • Bus drivers • Planners and engineers • Metrorail station and customer service staff • Metrorail management • Fare tickets • Cash • Credit cards • Metro cards • Metro card stations • Online informational texts (website, route schedules and timetables, route maps) • App-based informational texts • Operational contracts • City planning texts and business plans • VOC managers and other staff • VOC owners
References: Boulle and van Ryneveld, 2015; Behrens, Ferro, and Golub, 2016; Schalekamp, Golub, and Behrens, 2016.

with conventional paratransit vehicles.

The original form of interessement proposed under the MyCiTi problematisation emphasised the critical role of interesting minibus taxi owner-operators. Owners and operators of minibus taxis would become shareholders and employees of the VOCs or would be given the opportunity to have their minibus taxi operations bought out by the City, with the understanding that they would be required to leave the industry permanently (Boulle and van Ryneveld, 2015). This strategy has shifted somewhat under the most recent iterations, allowing legally operating minibus taxi business to continue as they are currently operated, or as VOCs or Taxi Operating Companies ("TOCs") (see TDA Cape Town, 2017).

As might be expected, without experience managing formal corporate bodies or engaging in government procurement processes, and with promises of largely theoretical benefits in exchange for foregoing established businesses, the minibus taxi owners were initially very resistant to the proposal (see Boulle and van Ryneveld, 2015). As Boulle and van Ryneveld note, "[o]rganising the industry into companies able to run an integrated BRT network represent[ed] a significant departure from [the minibus taxi industry's] historic business model, and a complex process" (Boulle and van Ryneveld, 2015:13). For its part, the City also struggled to negotiate with a diffuse and unregulated industry, an obstacle it sought to mitigate by engaging with taxi associations rather than individual owners (Boulle and van Ryneveld, 2015). Minibus taxi owner-operators, who are essentially small business owners and independent contractors, however, were and continue to be reticent. As one Cape Town member is recorded as saying in other research, "I would never allow another person to negotiate on my behalf around my future without me being present" (Schalekamp, 2013:15).

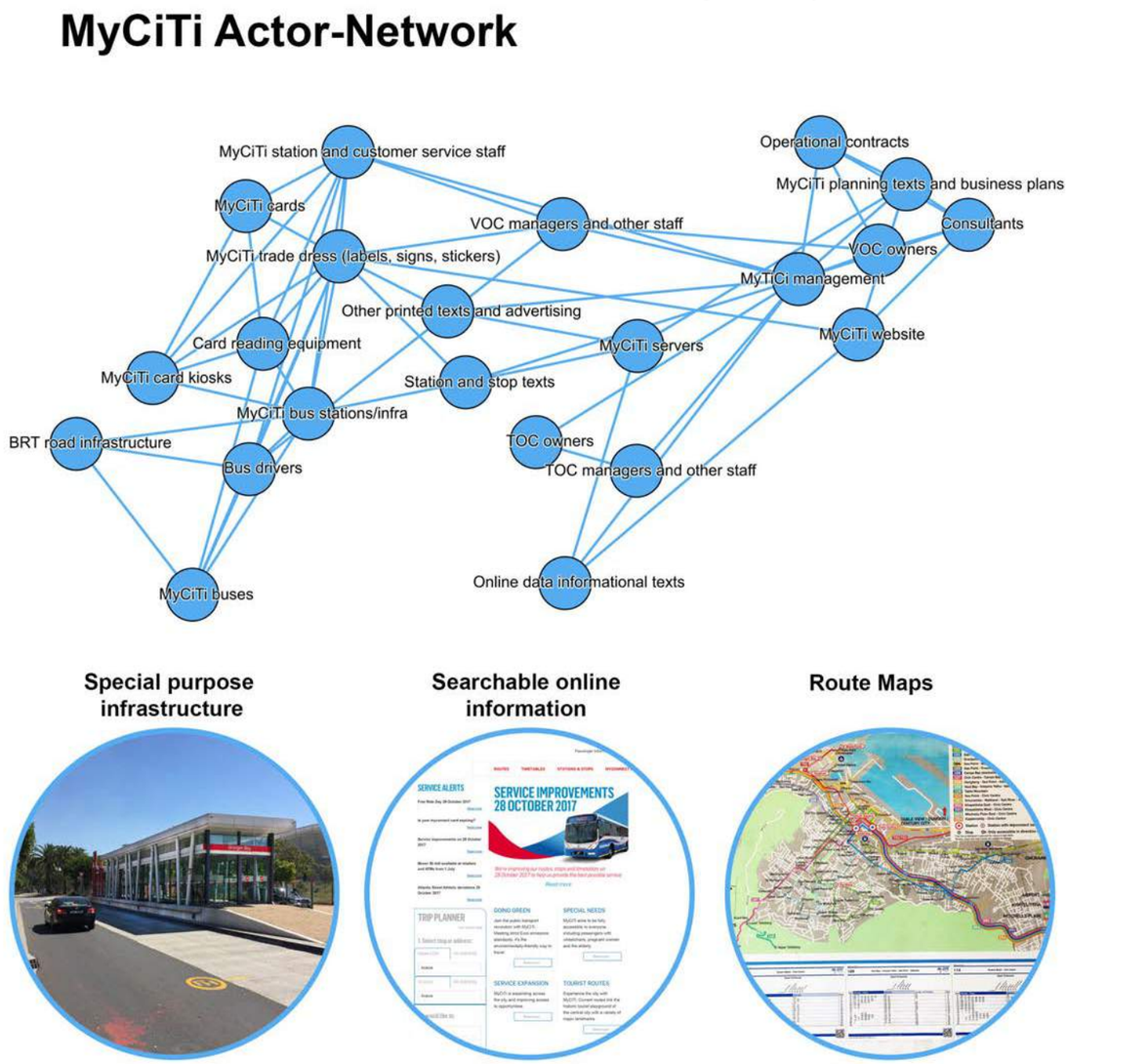
Accordingly, difficulties in enrolling minibus taxi owner-operators have resulted in only limited mobilisation of the MyCiTi actor-network across the city, as the City has acknowledged in its latest business plan (see TDA Cape Town, 2017). Furthermore, there are new questions as to whether MyCiTi officials and representatives will be able to continue to enrol and mobilise the City's politicians, voters, and funders to continue facilitating the transactional interessement required to enrol other constituent actors, including payouts to VOCs, minibus taxi operators, construction companies, and other such subcontractors. The latest business plan notes that payouts cannot and will not continue on the same level as before (TDA Cape Town, 2017).

The City's new business plan is clearly a step to try to address the issues encountered under the original plan. The language referring to incorporating the minibus taxi industry represents a re-problematisation that seeks to enrol rather than exclude the industry. However, the plan still clearly seeks to insert the City as a prime mediator, thereby reducing the agency of minibus taxi owner-operators. Beyond replacement of the main minibus taxi lines with trunk BRT service, there remains the ideation of minibus taxi owner-operators agglomerating and corporatizing for the purpose of "achiev[ing] economies of scale, operational efficiencies, and to possibly provide contracted services to the City over time" (TDA Cape Town, 2017:64). Furthermore, the City seeks to tie the minibus taxi industry to "new generation", TNC-like services, stating that "[t]echnology uptake by the minibus-taxi will be critical, particularly for the envisaged new generation services, providing on-demand and demand responsive services" (TDA Cape Town, 2017:65).

4.4.2. The Prospects for MyCiTi Translation at Philippi Village and the Solution Space

As related to the specific context of transport actor-networks at Philippi Village, the process of problematisation has been formulated (and re-formulated), but interessement and enrolment on a large-scale level are still in process (see *Figure 26: MyCiTi actor-network engaging with Philippi Village actor-network*). The City has been planning a new BRT route along Goven Mbeki Road, which passes nearby Philippi Village (interview with C1).

Figure 25: MyCiTi actor-network visualisation



Source: Photographs by Christian Alexander and MyCiTi.org.za, 2017; Made using Gephi and Photoshop.

This separated lane and new station contest transport to Philippi Village as it is currently structured, and lays the groundwork for a much more radical re-centring of the city's connectivity. City documents and officials also present a new ideation of minibus taxi service in the city, one in which the minibus taxi actor-network is aligned with the City's worldview of public transport, i.e. feeder service based on "new generation" services that support and supplement MyCiTi.

Whether the MyCiTi actor-network will enrol the necessary actors at the intersection adjacent to the Philippi Site will be seen. From a site-scale perspective, new infrastructure could have the effect of enhancing or replicating the security apparatus that actors utilise at Philippi Village to enrol its transport actor-networks, but there is no guarantee of this. Current examples of MyCiTi stations do appear to consider a similar problematisation of safety by creating self-contained and controlled-access facilities through which members of the public need a MyCiTi card to enter. Whether this controlled access has the effect of replicating the security of Philippi Vil-

lage while also providing passengers sufficient passage cannot be assessed at this point. Even whether the City will establish such infrastructure during the initial stages of service is uncertain, since the City has yet to make detailed decisions regarding station location, design, and timing (interview with G1).

Using technology to virtually extend security by better prediction and timing of access could help enrol actors into a MyCiti service provided at Philippi, but this also assumes the introduction of additional actor-networks that require the effort of some mediator to interest other actors to engage. MyCiTi has already sought to interest and enrol technology and mobile phone actor-networks by providing open data for its routes and schedules in electronic format, and by engaging third-party technology companies in building platforms accessible via computers and smartphones that provide real-time data to passengers regarding arrival times. Companies such as GoMetro and WhereIsMyTransport are vying to serve as mediators for these actor-network relationships, and a number of apps are currently available that provide scheduling information on MyCiTi buses, although it is unclear whether the information provided is in fact based on real-time data. Such services could in theory act as a means of reducing waiting times, which might increase travellers' willingness to wait at dangerous bus stops and stations. This would require a high level of coordination and precise execution on the part of smartphones, data and telecommunications services, MyCiTi servers, geolocation trackers, and bus drivers as well. Lengthening the chain of required actors to perform in the actor-network could increase the likelihood of non-cooperation or disruption.

Another possibility is that the current mediators of transport networks, namely the paratransit and commuter bus industry, may seek to disrupt enrolment of actor-networks into a new MyCiTi service in Philippi. They would be motivated to do so by misgivings that they will be displaced by the MyCiTi actor-network, as was envisioned under the previous phase of MyCiTi implementation. This may be truer of the paratransit industry, whose mediators are far different than GABS. Minibus taxi owner-operators and drivers have demonstrated many times in the past their willingness to exert agency and power through protest, both peacefully and violently.

Current Solution Space Philippi users constitute one of the many types of travellers that the City will hope to interest with its new MyCiTi service to Philippi. Given the different and varying needs and situations of these users, enrolment is very much an open question. For users who have adjusted their commutes to better serve their needs, MyCiTi will need to have the right combination of frequency, safety, and cost. S2, who moved to the Southern Suburbs in order to take advantage of the busy minibus taxi corridor serving Govan Mbeki Road, may not see a need to switch to MyCiTi service as minibus taxi service is already addressing her needs. Additionally, it is uncertain at this point whether the MyCiTi system would impact where and how she has to wait for service on her way home, which is currently her biggest concern. S5 has already made arrangements for charter service, and after being mobilised this service may better suit her needs, given that in using public transport she would still

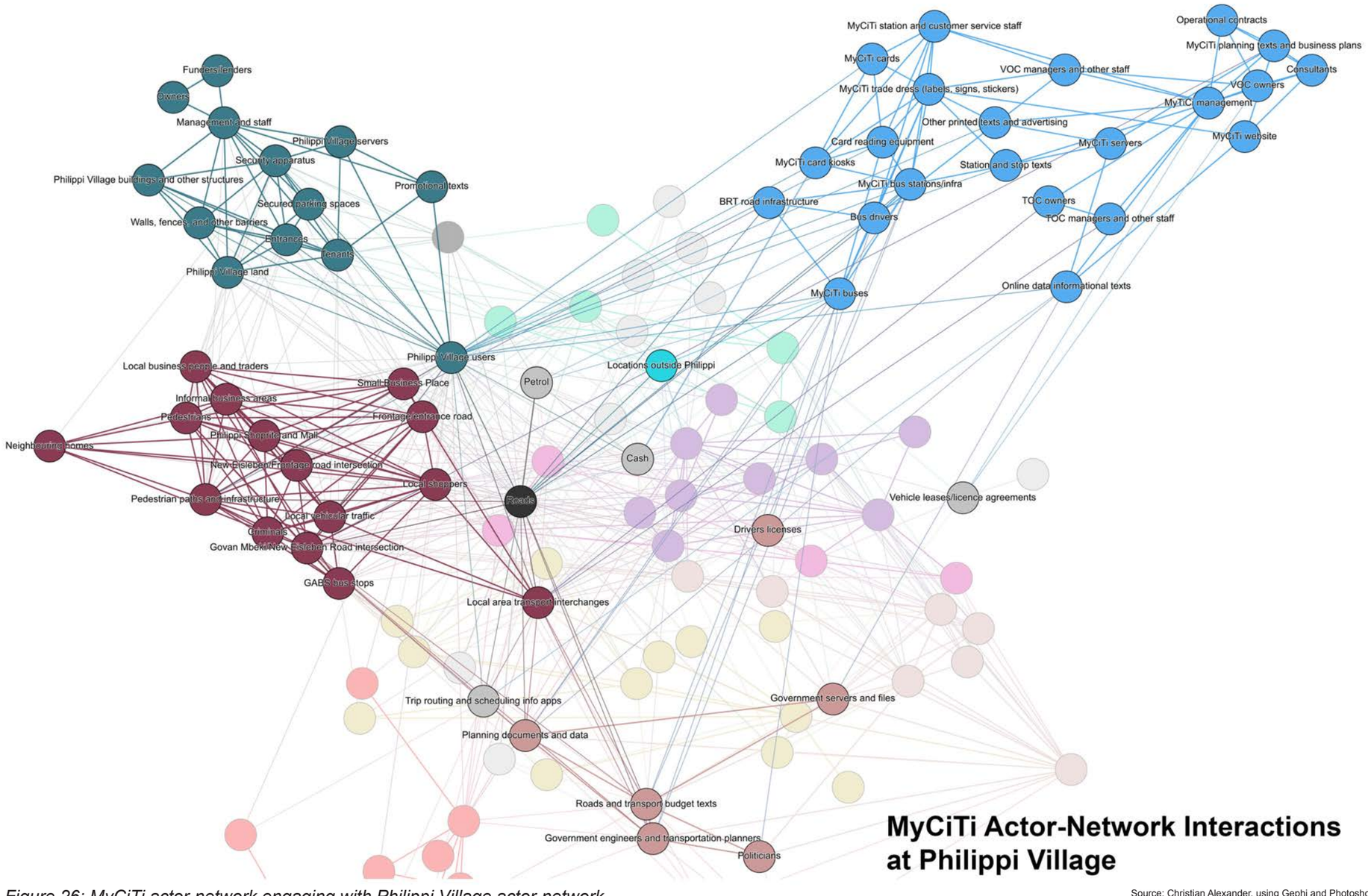


Figure 26: MyCiTi actor-network engaging with Philippi Village actor-network

Source: Christian Alexander, using Gephi and Photoshop.

likely need to make at least one transfer. Such a decision may ultimately come down to cost difference. For the drivers, S1, S2, and S3, their jobs require not just peak time commutes, but also the flexibility to move around during the day. Given their enrolment in the road-private automobile network, their decision to use MyCiTi instead would likely rest on the extent to which the City can disrupt this highly mobilised actor-network in favour of its own road-based system through mechanisms such as tolls, taxes, road reconfigurations, and less investment in systems that benefit private automobiles.

4.4.3. Translating TNCs' Actor-Networks

TNCs also offer an alternative problematisation of transport service that is already engaging with the Philippi Village location, albeit on a small scale. It is also one that the City, through its newest business plan, envisions minibus taxi service enrolling or being enrolled in. Other observers, particularly technologists and academics, have also suggested integrating these two actor-networks.

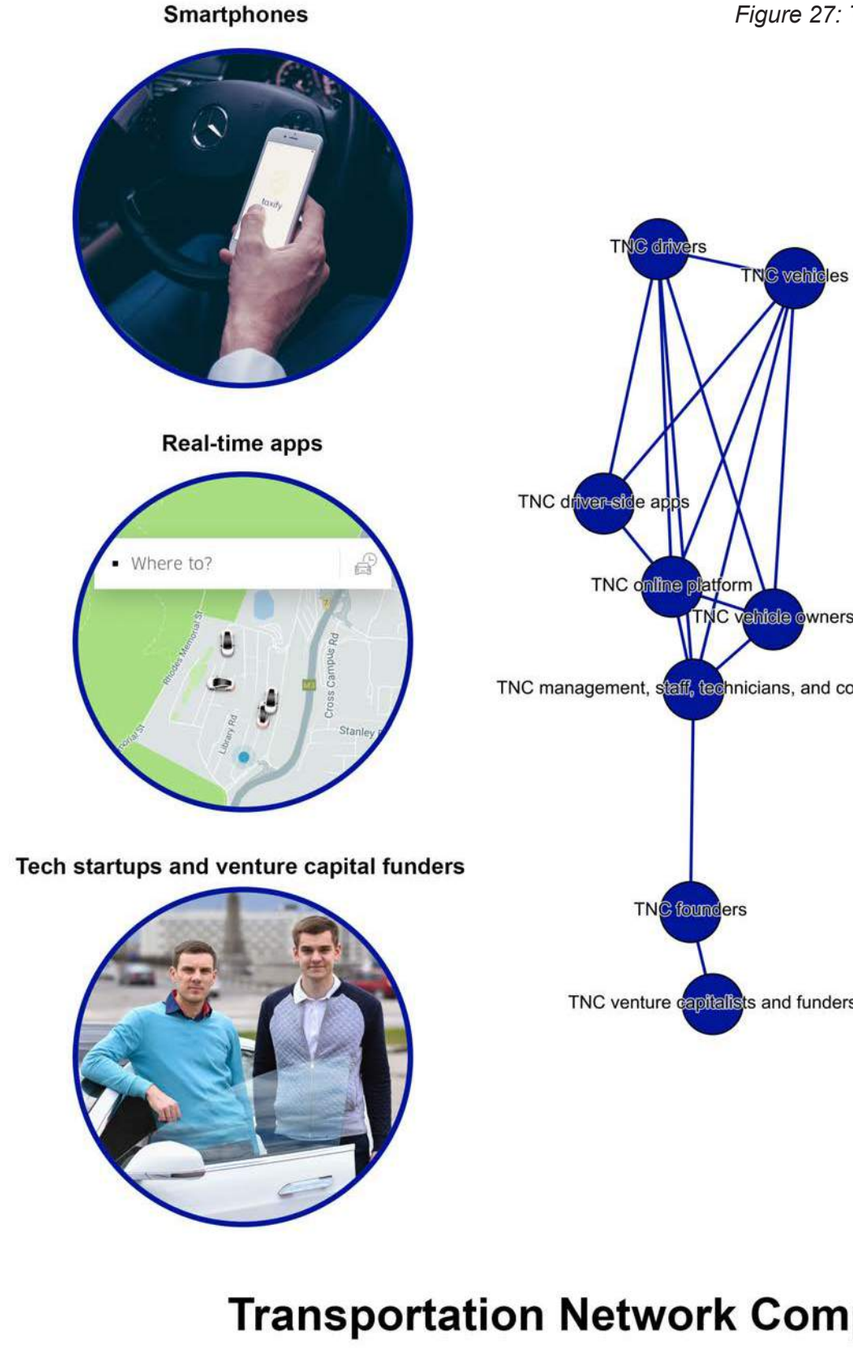
In recent years new information and communications technologies ("ICT") such as global positioning systems ("GPS"), telematics, peer-to-peer networks ("P2P"), sensory equipment, and internet-enabled mobile technologies, including smartphones, have begun to revolutionise the field of passenger transport. In particular, these new technologies have enabled a quantum jump in shared mobility, a concept that may be broadly defined as the "shared use of a vehicle, bicycle, or other [typically] low speed mode of transport that enables users to have short-term access to transportation modes on an 'as-needed' basis" (Shaheen et al., 2015). Shared mobility is not a new concept, and various forms of it, such as carpooling, car-sharing, share taxis, etc., have long histories of successful and even dominant presence in various contexts (see Hahn and Metcalfe, 2017; Oreva, 2016). However, new technologies have increased the potential ease and efficiency of shared mobility, leading to many different innovative forms in the past decade. While technology-enabled shared mobility is still in its formative stages, a number of implementation models have already been established.

TNCs are a broad and evolving category of transport, but they could generally be defined as "provide prearranged and on-demand transportation services for compensation, which connect drivers of personal vehicles with passengers. Smartphone applications are used for booking, ratings (for both drivers and passengers), and electronic payment" (Shaheen et al., 2015:22). Typically, these shared mobility services work by connecting passengers to forms of transport in their physical proximity through a GPS-based shared platform, which is often accessible through a smartphone (Hahn and Metcalfe, 2017). In many cases, the centralised platform calculates and displays for the passenger information regarding route, timing and fare predictions (Hahn and Metcalfe, 2017). The platform also often allows for electronic payment through registering users' and drivers' electronic bank information, and also allows for a user interface to communicate selective information between the user, driver, and the electronic platform managers in order to facilitate trust and ensure service quality (see Hahn and Metcalfe, 2017). In models where the TNC manages the enabling electronic platform, the TNC gets paid a percentage of the fare in return for enabling the user-driver network to be established (Hahn and Metcalfe, 2017). In order to incentivise drivers to respond to changes in demand, the

Table 4: Key TNC actors

TNC Actors
• TNC vehicles • TNC drivers • TNC online platform • Smartphones • "Data" or "wifi" • TNC vehicle owners • TNC driver-side apps • TNC management, staff, technicians, and coders (employees) • "Data" and "wifi" infrastructure (antennas, telephone cables, routers, modems, servers, computers) • Bank servers • Bank managers and technicians • TNC founders • TNC venture capitalists and funders
References: Hahn and Metcalfe, 2017; Greenblatt and Shaheen, 2015; Teal, 2016

Figure 27: TNC actor visualisation



Source: blog.taxify.eu (2017), https://blog.taxify.eu/wp-content/uploads/2015/01/IMG_94751.jpg; Cameraphone shot of Uber platform; Slovakstartup.com (2016) , https://slovakstartup.com/wp-content/uploads/2016/12/Taxify-founders-Martin-left-and-Markus-Villig-right.png.

TNC may also adjust fares based on time and location (Hahn and Metcalfe, 2017) (see Table D).

The TNC problematisation shows the stark contrast in some of the actors involved and mediators of the actor-network as compared to other more conventional forms of public and private transport (see *Table 4: Key TNC actors; Figure 27: TNC actor visualisation*). Here TNC smartphone apps play an outsized role mediating interactions between constituent actors: smartphones, TNC drivers, vehicles, passengers, telecommunications networks, banking computer systems, and TNC servers. Many of the actors identified strongly in this problematisation (for instance, smartphones, telecommunications networks, banking systems, computer servers) play only a marginal role in minibus taxi and GABS problematisations. Unlike in minibus taxi and GABS problematisations, the TNC problematisation assigns more intermediary roles to both drivers and passengers, whose actions and reactions are (theoretically) predictable and predetermined. Because the assignment of critical roles within this actor-network to actors such as bank accounts and smartphones, which are not as strongly associated with or connected to lower income communities from township areas, this problematisation necessarily excludes the identification of people without access to these actors as passengers.

Interessement of passengers begins with uploading the TNC app to a smartphone, which acts as an obligatory passage point through which all requests for service must be made. The app then acts as both a mediator and intermediary, responding to service requests automatically by calculating routes and distances of nearby drivers, and then assigning a driver to the passenger's request. In this context, and unlike with respect to the other forms of transport, the status of passengers and driver-operators as mediators is reduced, and both become more intermediaries responding and depending on the smartphone app.

The new technologically-enabled shared mobility models interest passengers by reducing transaction costs between passengers and transport providers in a number of ways, including through facilitating connections, streamlining payment, and monitoring and controlling transport supply (see Hahn and Metcalfe, 2017; see also Greenblatt and Shaheen, 2015). Such systems can also establish an acceptable level of accountability and trust for users of the networks by, for instance, screening drivers upon registration, requiring personally identifying information such as bank account information, numbers, and names for users of the network, and by allowing users of the network to rate or comment on the service or behaviour of other users in the network, both to other users and to the platform managers/TNCs (see Hahn and Metcalfe, 2017).

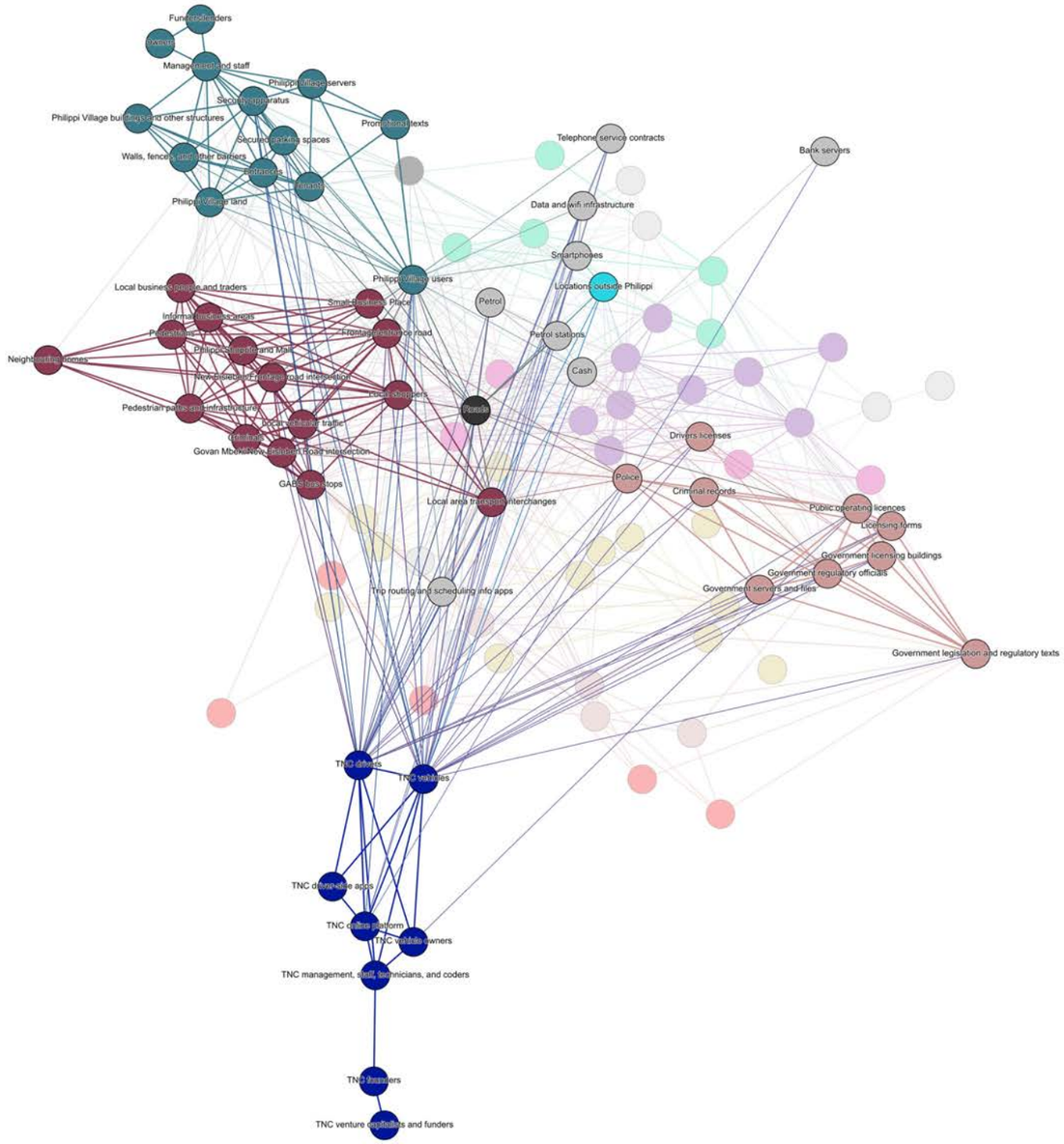
In accordance with its problematisation, TNCs must interest a significantly different set of actors in order to establish its actor-network. It interests vehicle owners and operators to sign up as drivers by offering to mediate solicitation of passengers through apps (see *Figure 28: TNC actor-network engaging with Philippi Village actor-network*). TNCs therefore must also interest software developers to build apps, passengers and drivers to upload apps to their smartphones, banking services to accept payment through its software, etc. This actor-network relies heavily on other actor-networks, including smartphone and telecommunications networks and banking networks, as well as the road network.

4.4.4. The Prospects for TNC Translation at Philippi Village and the Solution Space

As the ongoing translation process of MyCiTi reveals insights about the prospects for its application in the context of Philippi Village, so too does the translation process of TNCs in Cape Town. Two TNCs (Uber and Taxify) offer service to Philippi Village as part of their city-wide service. I personally used both Uber and Taxify to move between Philippi Village and locations around the city, primarily the CBD and Southern Suburbs, but also from the airport.

My experience and observation of TNCs indicate that

Figure 28: TNC actor-network engaging with Philippi Village actor-network



Transportation Network Company Interactions at Philippi Village

Source: Christian Alexander, using Gephi and Photoshop.

this actor-network does a better job of re-enrolling the Philippi Village security apparatus, primarily because it is itself thoroughly enrolled in the road network in which Philippi Village is also enrolled and mobilised. Philippi Village's security apparatus, including the gates and guards, allowed TNC drivers to drop me off within the secured perimeter of the Philippi Village property. In this way, TNC drivers, vehicles and myself benefited from being part of the road actor-network and from the actors that the Philippi Village site enrol in order to interest road actor-network actors. The real-time information regarding pickup likewise allowed me to time my departure from Philippi Village to avoid waiting outside the security apparatus for very long.

There are, however, limitations to this re-enrolment. For instance, the maps showing possible routes and locations for TNC drivers to pick up or drop off passengers does not show any possible routes within the Philippi Village property boundary. Accordingly, it takes extra effort on the part of TNC network actors, in particular drivers and passengers, to negotiate pick up and drop off points that enrol the Philippi Village security apparatus. For drop-offs, this can easily be completed by direct engagement between passenger and driver. For pick-ups from Philippi Village, additional actors, namely the telecommunications actor-network, are required for passenger and driver to communicate with one another. Otherwise, passengers must utilise the controlled and guarded gates as safe areas for pick up, much as Avanza drivers and passengers do.

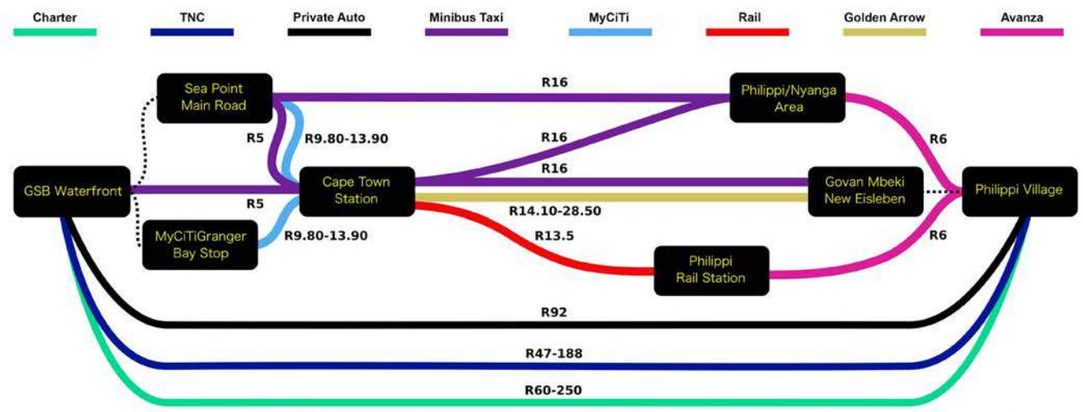
Beyond this locally-important factor, there are a number of other factors that inhibit translating TNC network at Philippi. First, as with the MyCiTi system, the additional and significantly different types of actors involved mean that an unforeseen amount of work is necessary to interest these actors that currently are not involved: smartphones, apps, "data", TNC managers, electronic payment systems and bank accounts. The amount of effort required to interest these actors in each other appears to often be underestimated.

Second, and relatedly, the monetary costs required to align the interessement of drivers and other actors in the current actor-network makes this service potentially too expensive to enrol travellers. Based on fares, current TNC services apparently require a large amount of money in order to interest entrepreneurs and app developers from creating and maintaining the system, resulting in relatively high costs to passengers (although in some cases these costs can compete with public transport). The result is significantly higher transport costs for passengers than those incurred by using the existing minibus taxi and Avanza services. For example, rides between Philippi Village and the CBD cost roughly ten times as much via TNC than minibus taxi (see *Figure 29: Cost comparison of routes between Waterfront and Philippi*).[10] Similarly to the exclusionary impact of car ownership, the costs of enrolling in TNC networks may exclude a large body of the public from identification as passengers.

Due to cost, users may engage in TNCs as an alternative when their regular modes of transport are inconvenient or less safe. Some Solution Space Philippi users I interviewed did occasionally use TNCs such as Uber or Taxify, but not as a means of getting to Philippi Village (see interviews with S3, S4, S5). Instead, this service was used for more irregular trips at times when other options were unavailable or inconvenient, such as trips into town at night for socialising.

The potential for disruption of the TNC actor-network by other mediators, including actors enrolled in the minibus taxi industry, as well as thieves and criminals, is also apparent. Some drivers expressed reservations or warnings about driving or being in the area due to crime and violence against TNC drivers. There also may have been drivers who declined to accept my request for service from Philippi Village, although I did not witness any refusing to provide me service. Some TNCs may foresee this conflict and avoid becoming mired in it, opting to focus on market segments that cater to different clientele. This may be one of the reasons why, for instance, Uber has yet to deploy its Uber pool service in Cape Town or elsewhere in Africa (see interview with B2).

Figure 29: Cost comparison of routes between Waterfront and Philippi



Note that these costs and routes are approximations. Source: Golden Arrow Bus Service, 2017; TaxiMap.co.za; MyCiTi.co.za; WhereIsMyTransport, 2017. See endnote for more information regarding cost estimates.

4.5 Summary

The description above of the actor-networks involved in providing access to Philippi Village and the Solution Space Philippi reveal the complex, overlapping, and fluid nature of these relationships. Using Callon's (1986) four "moments" of translation, I have investigated the various layers of relationships, starting with Philippi Village and the Solution Space Philippi. Their relationship to the city unearths the central role that the road actor-network fills in connecting them to the rest of the city, as well as the similarly important roles of crime within the area and the Philippi Village's security apparatus problematisation.

Next, I have replicated the process of translation of various modes of motorised transport that are situated within these initial problematisations, including private automobile, charter service, Avanza and minibus taxi service, Golden Arrow commuter bus, and Metrorail. These translations indicate how Philippi Village and the Solution Space Philippi prejudge some modes as winners and others as losers, but it also reveals how various actors re-enrol elements of Philippi Village and the Solution Space Philippi in order to stabilise their own actor-networks.

Finally, I discuss the development of two new actor-networks, MyCiTi and TNCs, and the prospects for their mobilisation at the Philippi Village site. My description illustrates how enrolment of the minibus taxi associations into MyCiTi as it is currently problematised is a difficult undertaking, given the radically different identity assigned to minibus taxi owner-operators. My findings also indicate the potential success of TNCs in re-enrolling the heavily mobilised roads network, but also caution against the exclusionary effects of this mobilisation based on the TNC actor-network as it is currently problematised. In both cases, infrastructure- and technology-led approaches risk serious disruption due to a lack of appreciation as to how technical and human actors interact.

The description of the actor-networks involved in access and transport above, although unique to Philippi Village, are broadly replicable in many places within Cape Town. After all, the actors and relationships forming Cape Town's road network, Philippi Village's security apparatus, Solution Space Philippi's connection with UCT, and the modal public transport systems, are all deeply interconnected with other sites and locations within Cape Town. While this story cannot speak for them, it can elucidate larger insights into assemblages we construct for the city. I discuss these insights and some resulting proposals in the following chapter.

5. Insights and Proposals

Given the description above of the various actor-networks engaged in framing and providing access to the Solution Space Philippi, what are the prospects for leveraging these existing frameworks and the socio-technical transformations facing transport in Cape Town to provide improved service for Solution Space Philippi users? This chapter discusses potential points of entry for interventions that might allow Solution Space Philippi users to more effectively use public transport, and particularly the minibus taxi network at Philippi Village, in a manner consistent with the goals and purpose of the Solution Space.

As my discussion regarding MyCiTi and TNCs in the previous chapter highlights, new transport actor-networks in Cape Town rely on the enrolling and mobilising various ICT and mobile technologies. Accordingly, I will address how these new technologies might or might not interact with existing transport actor-networks. However, in line with the socio-technical approach discussed in the literature review chapter, and with ANT, my proposals are not technology-driven, or even particularly technology-focused. Instead, they seek to exploit opportunities revealed by the uncovering of linkages in the actor-networks constituting transport service, while recognising the rising import and role of technology in some of the competing actor-networks being formulated in Cape Town. This chapter also realistically addresses the prospects for these new actor-networks to impact existing transport actor-networks at Philippi Village, given their constitution and relationship to each other.

In keeping with ANT conceptualisation, the analysis and solutions provided focus on the action of actors and actor-networks, and transcend geographic scales. Similarly, although I have paid attention to how the Solution Space Philippi might specifically take action to reformulate its actor networks to better serve its users, I extend my proposals to other actors, including Philippi Village management, City officials, and technology entrepreneurs. My discussion is arranged around six insights, which imply various courses of action that the Solution Space, Philippi Village, and other associated transport actor-networks might take (see also *Table 5: Proposals*).

5.1 Insight #1: Philippi Village, the Solution Space Philippi, and most transport modes are highly enrolled in the road-auto actor-network.

The first insight produced by an ANT-oriented description of the relevant actor-networks is that most are heavily enrolled and mobilised constituents of the road-based actor-networks that dominate Cape Town. Philippi Village and the Solution Space Philippi have engaged in the task of chipping away at the entrenched spatial relationships that drive so much of the city's interactions. They have already proven to be a powerful disruptor to the spatial logic of the city by interesting and enrolling a broad range of constituents to establish a new ideation of what sort of place Philippi is and the purposes for travelling there.

However, this disruption only goes so far in refuting the historical legacy of infrastructure and modal bias as a means of reducing access (see Moosajee, 2014; Simon, 1996). Philippi Village's problematisation continues to enrol in and help mobilise road and private automobile transport actor-networks, notwithstanding the exclusionary and environmentally damaging way in which these actor-networks are translated (see Cox, 2010). As a result, and despite a high amount of public transport service to the area, the public transport access to Philippi Village breaks down in part because there is no place made for it within Philippi Village's actor-network.

For its part, the Solution Space Philippi problematisation necessarily requires motorised transport across great distances. This has been a very intentional decision, one that has sought to build connections between communities that are separated both physically and psychologically. The negative consequence is, however, that this problematisation requires embedding the project in the highly mobilised roads and private automobile actor-networks. As with the dominant modern formulation, access is conceptualised as motorised transport in the service of mobility (see Preston and Rajé, 2007; Litman, 2015; Cox, 2010).

Philippi Village's and the Solution Space Philippi's enrolment within the road and private automobile actor-networks in many ways plays to the strengths of the minibus taxi industry, given that minibus taxis rely on the road network and can better mimic private automobile traffic due to the size of vehicles (see Cervero, 1997). Clearly, however, as it now stands, the industry is not strongly identified as a set of actors included within the Philippi Village actor-network, unlike private automobiles and even charter services. For instance, there is no mechanism for minibus taxis to engage or access travellers through Philippi Village's security apparatus like there is for certain private automobiles. This is largely in keeping with conventional attitudes towards paratransit, which often are not intentionally or consciously accommodated in development, yet nevertheless play a critical role (see Jennings et al., 2016, citing Venter, 2011).

Accommodating minibus taxi or Avanza drivers and vehicles by allowing them access and parking space within the complex or accommodating them at the entrances to Philippi Village might reinforce and better mobilise this actor-network, creating knock-on effects as Philippi Village is better mobilised overall. One striking example of what might be possible if Philippi Village revised its problematisation sits right next door. As one Solution Space user, S3, noted, the Philippi Shoprite parking lot is teaming with activity. This activity includes a street packed with Avanzas "crawling" while picking up and dropping off customers. In fact, this activity appears to be a major enabler of the robust Avanza service present at the Philippi Village entrances. While the arguably chaotic scene in front of the Philippi Shoprite may not be considered desirable from the point of view of the Philippi Village management or landlords, it might align better with the vision of this site as accessible to the community around it. If Philippi Village is to become the hub it seeks to be for the community, it might better attract this activity by approaching Avanzas in the same manner as is done at the Philippi Shoprite location.

This first insight also suggests that TNC and charter services, which likewise are highly enrolled in the road and private automobile network, fit well within Philippi Village's problematisation. Accordingly, there may be a time in the near future where TNC's and charter service may be competing on a larger scale with minibus taxis for passengers to and at this site. To the extent that TNCs and charter vehicles are able to better navigate Philippi Village's security apparatus by way of being identified as private automobile transport rather than public transport, they may have a leg up on the paratransit competition, which is easily identifiable as such from their vehicle make and model, and in some cases registration markings. Whereas Avanza and minibus taxi service compete for customers through high frequency service, charter and TNCs compete by better coordinating services through either mobile technologies (TNCs) or prior planning (charter), or both. While the literature discussed above makes clear that the technology is easily available to provide minibus taxis and Avanzas with this capability, as discussed below, the structural composition of paratransit actor-networks (as well as experience) indicates that it is not merely a question of technical feasibility. This conclusion mirrors the larger critique against technology as conceived under modernist framings (see Simon, 1996; Cox, 2010; Pinch and Bijker, 2012).

One of the risks of catering to TNCs, as with catering to private automobiles, is the high cost of constituting such services, and of the requisite work and resources required on the part of the passenger. This results in a bifurcated level of service where TNCs and private automobiles are well accommodated, while travellers who are excluded from these networks by dint of access to automobiles or the requisite banking and telecommunications accounts (both requiring significant cost) must deal with far poorer transport options. This should be

a central consideration in any assessment of transport and access to the Solution Space Philippi that revolves around TNC service in particular, lest new forms of transport replicate the exclusionary effects created by former technological innovations, such as the private automobile (see Cox, 2010).

Finally, the description of Golden Arrow and Metrorail access to Philippi Village demonstrate the costs of the site's enmeshment in the private automobile actor-network. The GABS story, in particular, is telling. Although the site is located only a couple hundred metres from major Golden Arrow thoroughfares, and should technically be a primary option, at least for some commuters, there is no engagement between these stops and Philippi Village. Setting aside the issue of crime (discussed next), a similar lack of attention paid to integration with any proposed MyCiTi line may hamper use. Indeed, there already appears to be a similar situation playing out at the Solution Space's Waterfront campus, where MyCiTi access is technically available but where integration of the road network allows minibus taxis to offer closer and more frequent service to common points such as Cape Town station. Accordingly, infrastructure must be properly integrated into sites, a task that ANT is particularly well suited to help facilitate.

High enrolment with the road network does not stop at the Philippi Village site, and, just as importantly, is deeply embedded in the rest of the journey involved in bringing actors to the Solution Space Philippi. Even better integration at Philippi Village site will not, for instance, necessarily interest some Solution Space Philippi actors whose homes or businesses are equally tied to the road network. Addressing this issue involves tackling the road actor-network itself. Here different levels of government, which oversee the funding, planning, construction and maintenance of roads, play an important mediator role. To the extent this actor-network is invested in and maintained in a particular manner, it will continue to enrol actors in a particular way. The extent of work and energy exerted by the government to maintain this actor-network should be more fairly compared with the energy exerted to maintain other transport options, such as the rail network and bus systems. Unveiling this "black box" could help reframe the debate around funding and priorities. It is not a foregone conclusion that funding for roads should be much higher than other forms of transport, such as rail and non-motorised transport, or that the roads that are built need to cater most effectively to private automobile, rather than far more efficient and equitable forms of public transport. The ANT perspective is another way to help show that, and further ANT research on the roads and private automobile actor-networks could help make this point.

5.2 Insight #2: Crime and Philippi Village's security apparatus play crucial roles in framing access for Solution Space users.

Crime plays a significant role in shaping the problematisation of Philippi Village access, and Philippi Village's security apparatus is a critical obligatory passage point enabling existing transport options, including paratransit. Much of what shapes access at Philippi Village is conceived of through the lens of mitigating the risk and danger of crime. The high levels of crime distort the normal considerations regarding acceptable waiting and walking times for travelling (see Cervero, 1997), and seriously hamper access to public transport, which relies on passengers engaging in these activities.

In order to enrol identified actors into its actor-network, Philippi Village management emphasizes controlled access and securitised safety. Private automobile drivers are expressly identified as the prime beneficiaries of this security apparatus. Charter services are also able to negotiate preferential access. Even the choice to favour automobiles indicates enrolment into broader problematisation of crime and its solutions in Cape Town, where driving one's own automobile is often seen as the most secure form of transport.

However, Philippi Village's security apparatus also plays a crucial role in enabling paratransit at the site, through its re-enrolment by travellers. Specifically, travellers leverage the security guarding access to the entrances of Philippi Village to serve as protected and watched zones for pick-up and drop-off. These activities suggest that Philippi Village could adjust its interessement of private automobiles to strengthen and further mobilise the security apparatus in favour of paratransit links. Doing so might trigger further mobilisation of the minibus taxi actor-network to accommodate better connections to other origins and destinations.

Refocusing the security apparatus to enrol in the paratransit actor-network at the Philippi Village site could take a number of forms. One potential form would be to modify Philippi Village's security apparatus to recognise Avanzas or minibus taxis as actors allowed permission to enter the facility. Of course, this might undermine other objectives of the security apparatus, namely controlled access to prohibit crime and to instil a perception of safety within the boundaries of the site. However, accommodation of paratransit while maintaining control over access is possible. For instance, Philippi Village could introduce some standard for recognition of bona fide operators.

Fortunately, a robust government licencing actor-network already exists that the Philippi Village security apparatus might be able to re-enrol into its own verification procedure. This would assume that the licencing procedures are sufficient to ensure some level of safety, and that a sufficient number of Avanzas have licences. It would also require enrolling the government licencing actor-network, as well as the minibus taxi/Avanza actor-networks.

Given the relatively low number of visitors at Philippi Village, access onto Philippi Village property may not be sufficient to incentivise Avanzas to enter. On the other hand, it could perhaps incentivise Avanza operators with licences to gain an edge over ones without licences. Government officials, whose goal of licensing paratransit operators would align with this strategy, might also be interested in enrolling and mobilising this actor-network. Given that the current regulations and government procedures poorly regulate the Avanza service, licencing reform here might be necessary in order to better incentivise Avanza business owners to enrol in that network.

Another intervention would be to better accommodate and facilitate pick-ups and drop-offs at the Main and Second Entrances. While these operations appear to work well enough to facilitate this service at the moment, better use and clearer demarcation of the role of this space for that purpose might facilitate use. For example, the entrance could be designed to accommodate waiting Avanzas or provide express space for them to turn around in. Philippi Village could also potentially create sheltered space, or negotiate access to existing sheltered space, such as the AfriCAN Cafe near the Second Entrance, to assist travellers in waiting.

Instead or in addition to allowing access into the site, or improving existing protected meeting points, Philippi Village could also extend the security apparatus to the intersection at New Eisleben Road, which provides access to minibus taxis plying a number of routes. The temporary protection afforded to S2 by having a guard walk her to her minibus taxi spot could be more permanently implemented, perhaps through a regularised escort to or guard, or through cameras positioned at this intersection. One drawback of this could include increasing the costs of an already costly security apparatus. Another is that it may not be effective at deterring criminals. The level of this type of security-by-force-of-violence required to be effective in this area appears to be very high, as is demonstrated by the sizeable security apparatus at Philippi Village, as well as security provisions observed at the adjacent mall.

A potentially more radical intervention would be a re-problematisation of security at Philippi Village altogether. In line with Solution Space user S3's comparison of the Solution Space with Philippi Shoprite next door, security could focus more on better incorporation and integration with the community. Again, examples can be found literally at the front door of Philippi Village, in the form of the informal market that serves to bolster the

sense of security of these areas. Promoting and supporting informal trade like this at this entrance and at the Main Entrance, which also sits along a well-used path but feels more exposed, may help enhance this effect, thereby promoting this critical access point.

Crime is not only a problem at Philippi, and it affects other elements of people's trips between the Solution Space Philippi and other origins and destinations. However, criminal activity and perceptions specifically in Philippi do appear from my research to be a particularly important element disproportionately affecting the trips that Solution Space Philippi users make between Philippi Village and other origins and destinations. The actor-networks facilitating crimes are clearly highly disruptive to the transport access actor-networks.

A better understanding of its elements and the translation process in the area could bring more insights into how to confront it and potentially redefine the identity of criminals. Other research reflects the fact that violent crime is a particularly critical issue in Philippi, as the area is one of the most violent and dangerous in South Africa (South African Cities Network, 2017). This research provides an excellent groundwork for an ANT focus on crime in the area, as well as motivation for partnership with violent crime intervention groups such as Violence Prevention through Urban Upgrading ("VPUU") (see South African Cities Network, 2017, discussing VPUU success in Khayelitsha).

5.3 Insight #3: There is no one-size-fits-all solution to Solution Space users' transport needs.

Solution Space users have a multitude of diverse transport needs that are based on varying factors such as their role at the Solution Space, area of residence and work, day, and time of day. To address these needs, a range of strategies are required and different actor-networks must be employed. Because of this, more flexible transport systems, such as minibus taxi, Avanza, TNC, and charter services, are ideally suited to handle many of these needs (see Cervero, 1997). Conversely, infrastructure-led approaches that ignore context-specific actor interactions are more likely to fail.

Transporting students between the Solution Space at GSB's main Waterfront campus and the Solution Space Philippi is perhaps the easiest issue to address logistically because this trip aligns with the strong road-actor network that transports people from homes in Philippi and other townships to the CBD. While a transfer at Cape Town Station might be required, minibus taxi travel to Philippi Village is relatively easy, and would be particularly so if the trip were to be taken by a group of people (such as a class of students) since they would likely be able to fill up a minibus taxi with less waiting time for other passengers and negotiate drop-off directly at Philippi Village. As discussed above, waiting on the side of the road for a minibus taxi back to Cape Town would be a less safe endeavour, and would require more coordination, or adaptation of some of the interventions regarding the security apparatus described above. This, along with the occasional and planned nature of this use indicates that charter service may be more appropriate. Already, Solution Space staff members have a relationship with an entrepreneur, C1, who could work together to formalise and regularise travel. My interview with C1 indicated that regularising service would benefit his operations, and could also help mobilise the Solution Space Philippi actor-network.

An alternative partner in contracting for charter service would be the minibus taxi associations located in the Philippi area. Because minibus taxis engage in this type of service, it likely would not be difficult to organise this on relatively short notice, particularly if the times for service can be arranged so as to fall outside of peak commute hours. Assuming demand grows, Solution Space Philippi staff will also need to pay careful attention to which minibus taxi associations are involved, as the minibus taxi industry is highly territorialised. Fortunately, the minibus taxi association serving Nyanga has licences to carry passengers to Sea Point, so theoretically territory should not be a problem, although further investigation should be undertaken regarding this issue. What does appear to be clear is that the primary mediator, the minibus taxi association, will work hard to maintain its mediator status. Re-enrolling this actor is probably easier than excluding it, although the Solution Space management should also be prepared to work within the existing minibus taxi actor-network if it is not prepared to handle the effort and cost of acting as a primary mediator.

Commute trips are more difficult to coordinate because there are a widely divergent set of locations between which staff, entrepreneurs, and others travel. At present, carpooling and chartering appear to be the most effective means of improving the commutes of Solution Space users. Because commutes are relatively consistent, it is easier to coordinate and facilitate regular pickup. While minibus taxis can also serve this need, the description in the last chapter makes clear that fully mobilising this option depends on better accounting for the safety of travellers waiting to be picked up at and near Philippi Village.

The occasional or unplanned trips taken by Solution Space users for business are perhaps the most difficult to accommodate within the existing transport actor-network framework because they are not necessarily regularised or consistent. While Avanza service is fairly robust for trips within the local area, there are still concerns of safety, particularly where there is only one traveller who is female. Use of licencing as a form of gatekeeping as discussed above may help distinguish more reputable Avanza drivers. Charter service likely requires more advance notice than travellers can provide, although there may be some charter services located at Philippi Village who might be able to provide responsive enough service. Better engagement with some of the Avanza drivers may also lead to the establishment of some sort of charter service better tailored to the needs of various Solution Space users within the immediate Philippi Area. For the most scattered schedules, private automobiles, or TNC service, may be the best mode available for now.

5.4 Insight #4: Better representation and organisation of passenger interests leads to better service outcomes for passengers.

My findings above indicate that passengers who assert greater agency and who are better coordinated in negotiating their trips are rewarded with better transportation outcomes. This is perhaps a somewhat obvious point, but may be overlooked by both policymakers and providers of transport. Several of the Solution Space users have been forced by the shear circumstances of their commute to find better ways. In one case this has meant moving homes to a location with better minibus access (see interview with S2). In another case, this has meant chartering a private carpool (see interview with S5). These individual negotiations could be reinforced by supporting passenger advocacy within organisational bodies such as the Solution Space.

The Solution Space and GSB have already engaged on this front with respect to transporting students by implementing a charter service, which requires more advance organisation on the part of passengers, but results in better-tailored outcomes. Here the GSB has asserted its agency and assumed representation for a group of travellers. Another example of this institutional-driven organisation is the service provided by the Desmond Tutu HIV Foundation for its employees. There may be opportunities for the Solution Space to re-enrol this existing mobilised network for the benefit of Solution Space users through engagement between the two organisations. Alternatively, in keeping with the Solution Space's goals and priorities, this engagement can take place with minibus taxi associations, who are more than willing to engage in negotiations for charter service.

Mechanisms that can facilitate better networking among passengers could also improve transport outcomes. Solution Space user S5's transition to chartered carpool, which was facilitated by a Solution Space office manager, is an example of the potential for better networking between Philippi Village tenants. Here, technology-oriented actor-networks such as social media could prove

to be a powerful means of self-organisation. While creating new networks might result in better-tailored results, the need to mobilise a greater range of actors suggests that use of existing platforms, such as Facebook, Whatsapp or Twitter, might be better technological facilitators. The key constituent here would be the introduction or organisation of a mediator with the energy and resources to interest and enrol members of the Philippi Village community.

While this solution does not expressly involve the minibus taxi industry, users could better coordinate their own use of this service in order to improve it. For instance, coordinating use among travellers from one particular destination, the Waterfront campus for instance, will likely result in faster and better tailored service—minibus taxis will fill up with a group of students more quickly, and drivers will be more willing to drop students off directly at Philippi Village, rather than requiring them to make a transfer (as happened to me while travelling alone by minibus taxi to Philippi). The literature and prior research during my studies at UCT indicate that minibus taxi owner-operators are opportunists and willing to negotiate and accommodate the needs of passengers (see Cervero, 1997).

This insight also supports an approach to planning focused on the co-production of outcomes between users themselves and planners. Supporting and facilitating solutions to transport problems, rather than seeking to implement an imported vision, will likely result in more successful outcomes.

5.5 Insight #5: Transport actor-networks are generally poorly integrated

The actor-network problematisation narratives and actor-network visualisations presented in the previous chapter, as well as the constitution of service at Philippi Village, indicate that, generally speaking, different modes of public transport are poorly integrated at the moment. The research indicates that this is largely due to the inconsistency and unreliability of practically all forms of service, which leads to an inability to rely on intermodal transfers.

Rail service in particular, which relies heavily on other forms of transport to handle the "last kilometer" problem, is perceived as being particularly unreliable in the Philippi area. Accordingly, it was not even considered or is easily discounted by Solution Space users who I interviewed (see, e.g., interview with S5). Better coordination and consistency regarding rail service requires enrolling a complicated set of actors, a task for which PRASA at present is not capable of performing. While real-time data accessed via mobile technologies could help travellers plan, if the service itself is inconsistent, actors are less likely to mobilise around the actor-network. This goes for road-based public transport as well. Buses and minibus taxis dealing with congestion caused by private automobiles encounter a different and more uncertain form of delay that can hamper the effectiveness of real-time tracking information. To the extent the City is working towards reallocating road space exclusively towards buses and paratransit, it will improve the prospects for excluding the impact of private automobiles as actors disrupting public transport timeliness.

Meanwhile, the minibus taxi and Golden Arrow commuter bus service routes and schedules resemble each other, indicating that they compete for peak commuter traffic rather than complement each other. This was also reflected in the trips of Solution Space Philippi users interviewed, none of whom used intermodal transport, except for Avanza-minibus taxi service. One reason for this appears to be the lack of coordination or overlap between actor-networks constituting the two services, which means that each is identified by the other as an excluded member. In theory, passengers should be able to use Avanza and even minibus taxi service for feeder purposes to access trunk routes provided by Golden Arrow bus routes. This is the plan for MyCiTi as well. However, without better consideration regarding integration, this will not materialise and MyCiTi routes will ultimately become more differentiated and complicated in order to reach customers directly.

5.6 Insight #6: Additional actors and issues of agency likely limit successfully integrating new technologies into the minibus taxi industry

The structure and constituency of the minibus taxi actor-network indicate that integrating ICT and mobile technologies may be contingent on limiting the scope of newly introduced actors and maintaining the agency of minibus taxi owner-operators. Incorporating mobile technologies, such as smartphones, real-time information, and geo-locating technologies into any of these options is feasible, but it is also beset by important factors that limit the prospects for success.

As demonstrated through the comparative descriptions of the actor-networks constituting TNCs and minibus taxis, these two groups share significantly different problematisations and rely on distinctly different actors and roles. Expecting easy translation between these two actor-networks as they are currently constituted is problematic. For instance, incorporating smartphone-enabled, real-time vehicle geolocation information requires a range of actors that link together, including smartphones, data and telecommunications service, etc. It also requires sufficient interessement of other actors, which as demonstrated by the MyCiTi programme, may be much higher than anticipated.

Finally, this relationship fundamentally shifts the power dynamics of the relationship. TNC drivers operate largely as intermediaries, to the point that they could be replaced by driverless cars in the future. On the other hand, minibus taxi owner-operators serve a mediator role, one in which they exert much more power over their actor-network. Again as demonstrated by the MyCiTi roll-out, assuming that actors with a great amount of agency will give up this agency is potentially fool-hardy.

This insight, at the very least, cautions against an over-optimistic view of applying ICT and mobile technologies to paratransit (see Cervero, 1997; Mulley and Nelson, 2016; Teal, 2016; Enoch and Potter, 2016; Schmidt, 2014), and of the application of new technologies more broadly (see Leiren and Skollerud, 2016). As with infrastructure-led projects such as MyCiTi, techno-determinist approaches that unquestioningly accept new TNC models of service risk overlooking the "wicked" (Rittel and Webber, 1973) aspect of public transport provision. This in turn would perpetuate modernist conventions regarding conceptualising access as motorised private mobility (see Simon, 1996; Cox, 2010).

There may be other ways of incorporating minibus taxi owner-operators better into mobilised technological solutions. Innovations that maintain the agency of minibus taxi owner-operators, and that make better use of well-mobilised ICT actor-networks, could be more likely to be successful. One potential idea suggested by the experiences of Solution Space users themselves would be to facilitate transport communication via texting or messaging services. Texting is already a very well mobilised technology already being used by both drivers and travellers, sometimes for the very purpose of coordinating routes. Unlike more extensive app-based services, which rely on more technologically-equipped smartphones, data, and virtual banking services, basic texting requires the minimal service that most adults rely on already.

One limitation to enrolment identified through my research was a reticence to share personal information with strangers. A solution might be an automated texting intermediary, such as a bot, that relayed texted service requests to operators travelling nearby. This sort of technology already exists. Of course, it would take work by parties to interest and enrol both travellers and owner-operators to use this service. However, the work of assembling these actor networks would be much lower than more comprehensive TNC services such as Uber.

Another example is the vehicle-tracking service Glympse that GSB's current charter service provider uses. Glympse uses a charter driver's smartphone's geo-location capabilities to relay to customers where the driver

is, increasing transparency and reducing uncertainty regarding the trip. The orientation and business model of this technology allows the charter service provider to maintain a level of autonomy—he or she selects it as a complement to his or her own business—while also improving communication with customers.

In a similar vein, the City, PRASA, Golden Arrow, and other entities providing official or officially sponsored public transport could support minibus taxi owner-operators as mediators of their own service by providing publicly-facing information facilitating coordination with their own services. The minibus taxi representative interviewed indicated his association's interest in having the City share collected ridership and traffic data with the associations in order to help them better allocate and coordinate their resources (interview with M1 and M2). Real-time information could likewise help owner-operators or dispatchers serve customers in a new way by timing feeder service more efficiently. Driver- and public-facing apps in this manner could be effectively "hacked" by minibus taxi owner-operators to help them improve their own services in a manner that also better serves publicly funded public transport.

Beyond the success in terms of adoption by actors, technological solutions such as the ones above that focus on facilitating the role of minibus taxi owner-operators as mediators may align better with the goals and principles of the Solution Space. After all, minibus taxi owner-operators are entrepreneurs and small business owners from the community. Their insights into existing and new technologies may be more innovative than any provided in detached tech circles. As such, they are identified as exactly the type of actors that fit into the Solution Space Philippi's problematisation.

Socio-technical regimes, such as those established by some TNCs, displace operators as mediators may undermine these goals and principles. Accordingly, focusing GSB students' and Solution Space innovators' efforts on new systems in collaboration with minibus taxi owner-operators may be a fruitful future endeavour at the Solution Space Philippi. This suggestion does not discount the likely difficult negotiation process that would be required to collaborate with minibus taxi owner-operators as co-mediators of transport solutions for Philippi Village. In fact, the challenges of negotiation highlight the importance of Solution Space Philippi users or their representatives asserting agency by taking a more active and coordinated role in interesting and enrolling actors to develop desirable transport outcomes.

5.7 Summary

By looking at my findings through six insights, I have provided a range of possible interventions at many different levels and involving different actors. It is perhaps unsurprising that there is no one silver bullet (or killer app) that will solve the Solution Space Philippi's transport and access problems. However, a better understanding of the interactions that constitute the current actor-networks do provide some guidance as to where and how to act.

First, it is critical to not underestimate the deeply embedded nature of the road actor-network, a reality that mitigates towards seeking strategies that re-enrol this actor-network into potential solutions (Insight #1). Similarly, the particular circumstance at Philippi Village indicates the importance that crime plays in shifting interactions regarding public transport (Insight #2). Solutions could build on the existing Philippi Village security apparatus, as is already being done, or could more radically re-problematise crime and safety.

Third, there is no one-size-fits-all approach, and infrastructure- and technology-led strategies imported from other contexts should, therefore, be viewed with caution (Insights #3). Fourth, passenger agency appears to be an important factor in improving outcomes (Insight #4). Accordingly, empowering passengers by providing them financial or organisational support would likely reap benefits. In this sense, there is great potential for the co-production of planning projects. Fifth, public transport to Philippi Village is generally poorly integrated, and would benefit from a more thoughtful approach to integration by both governmental entities and Philippi Village managers (Insight #5). Finally, starkly contrasting actor-networks constitute minibus taxi actor-network on the one hand and the TNC services MyCiTi actor-networks on the other hand (Insight #6). This indicates that integration between existing and new modes will be difficult unless the roles and interessement of actors, particularly minibus taxi owner-operators and associations, is better outlined. Table 5 fleshes out some of the preliminary proposals drawn from these insights. Any of these could serve as a starting point for more in-depth work.

If some of the conclusions reached and proposals made above seem obvious, it is exactly their obviousness that makes them such powerful sources of agency in perpetuating existing systems and cycles. ANT's usefulness in this process is to unveil and lay bare the assumptions and presumptions we have made about the socio-technical regimes with which we interact.

It is notable that although the insights and potential courses of action discussed above are unique to the Solution Space Philippi's circumstances, these same insights may apply to many other places in Cape Town that rely on the same actor-networks to facilitate mobility and access within the city. While I do not assert that my findings regarding this case study are more broadly applicable, even a cursory look at them indicates that there are connections with the broader transport context in Cape Town.

Table 5: Proposals

Insight	Proposal	Scale	Mediator	Type of Intervention	Intervention examples
Roads Actor-Network (1)	MBT access/infrastructure within Philippi Village security apparatus	Site	Philippi Village owners/management	Physical	Avanza/minibus taxi biometric access; designated priority parking for Avanzas in Philippi Village parking area
Roads Actor-Network (1)	Utilise charter/TNC service	Metro	Solution Space management, Solution Space users	Organisational	Continue chartering service with local transport companies, e.g. Greencab or L&S Shuttle Services
Roads Actor-Network (1)	Integrate pedestrian access with nearby bus and minibus taxi stops	Metro	Philippi Village owners/management; neighbouring property owners	Physical	Public-private partnership for investment in infrastructure along routes and at bus stops
Roads Actor-Network (1)	Reduce auto-oriented investments and/or reallocate investments to public transport	Metro	City of Cape Town; National Government	Physical/organisational	Re-allocation of funding from roads improvement to public transport; establishment of dedicated public transport lanes
Crime/Security Apparatus (2)	MBT access/infrastructure within Philippi Village security apparatus	Site	Philippi Village owners/management	Physical/organisational	Avanza/minibus taxi biometric access; designated priority parking for Avanzas in Philippi Village parking area
Crime/Security Apparatus (2)	Orient Philippi Village security apparatus around Avanza pick-up and drop-off points	Site	Philippi Village owners/management	Physical/organisational	Allocation of entrance space specifically for Avanza service
Crime/Security Apparatus (2)	Extend Philippi Village security apparatus to reach minibus taxi routes and/or commuter bus stops	Site	Philippi Village owners/management	Physical/organisational	Introduce guard escort services or monitoring infrastructure at intersection of frontage road and New Eisleben Road
Crime/Security Apparatus (2)	Bolster support for informal traders as alternative security apparatus at Philippi Village entrances and at other critical areas (e.g. minibus taxi and Golden Arrow bus stops)	Site	Philippi Village owners/management; Solution Space management	Physical/organisational/technological	Investment in infrastructure for traders at Philippi Village entrances; coordinate neighbourhood watch group, facilitated by text or Facebook group
Crime/Security Apparatus (2)	Invest in crime-related research and community interventions	Site/Local Area	Philippi Village owners/management; Solution Space management	Physical/organisational	ANT-oriented crime research; partnership with organisations such as VPUU
Differentiated Trips (3)	Address GSB student needs through chartering service from taxi association	Metro	Solution Space management	Organisational	Continue chartering service with local transport companies, e.g. Greencab or L&S Shuttle Services
Differentiated Trips (3)	Address staff/worker commute needs through carpool/charter service	Metro	Solution Space management, start-ups, and users	Organisational	Facilitate carpooling or charter service among Solution Space users and other Philippi Village users
Differentiated Trips (3)	Address local area business trips through coordination with local Avanza drivers	Local Area	Solution Space management, start-ups, and users	Organisational	Facilitate pre-arranged agreement for service with Avanza drivers
Passenger empowerment (4)	Develop institutional forms of organisation of and advocacy for employees as passengers	Metro	Solution Space management, start-ups	Organisational	Coordination between Solution Space management and Desmond Tutu Foundation for sharing of charter bus services
Passenger empowerment (4)	Utilise existing ICT actor-networks to facilitate passenger empowerment and organisation	Metro	Solution Space users and start-ups	Organisational/technological	Leverage existing platforms, such as Facebook, Whatsapp or Twitter
Poor Integration (5)	Invest in improving consistency of existing public transport	Metro	City of Cape Town; National Government; PRASA; Golden Arrow	Organisational	Investment in rail operational capacity; investment in dedicated public transport road lanes
Poor Integration (5)	Incorporate paratransit stakeholders in the planning and organisation of public transport	Metro	City of Cape Town; National Government; PRASA; Golden Arrow; minibus taxi associations	Organisational	Create committees and positions for minibus taxi representatives; provide funding for minibus taxi integration programmes
Technology aligned with actor-networks (6)	Focus on the production of minibus taxi owner-operator focused technological solutions	Metro	Solution Space entrpreneurs and start-ups	Technological	Technologies and platforms that owner-operators can “hack”, e.g. Whatsapp, Facebook; technologies that are resource-appropriate (text-based vs. smartphone-reliant)

6. Conclusion

6.1 What have I learned?

Using a socio-technical approach, and access to the Solution Space at Philippi Village as a case study, I have sought to investigate whether technological changes in transport can improve access and mobility in Cape Town. I have done this by trying to better understand the current transport patterns and ways in which technology- and infrastructure-led approaches interact through the lens of ANT. The results highlight a number of insights around both the actor-networks that make up a portion of Cape Town's transport map, as well as the assumptions behind the socio-technical relationships we have with our built environment.

The socio-technical approach to planning taken here reveals many of the issues that modernist functionalism and techno-determinism fail to see or address. Rather than conceptualising innovation and technology as linearly progressive, a socio-technical view looks at how humans actually interact with our built environment. This approach is particularly important given the continued dominance of rationalism and functionalism in technology and planning circles, particularly in Cape Town, where the City continues to engage in infrastructure- and technology-led approaches. The impact to urban layouts, City budgets, and livelihoods is critical, just as it was during the past century.

6.2 Where do I fit in?

As this dissertation should make obvious, I have been enrolled through my research in the Solution Space Philippi. While my research investigated the Solution Space Philippi's problematisation from a descriptive standpoint, my impetus and objectives—to consider the prospects for socio-technical change and whether these changes can be leveraged to promote access to the Solution Space—also take as their starting point a normative assumption that promoting and perpetuating the Solution Space Philippi is, in fact, necessary or desirable through socio-technical change. I have accepted as my normative basis a number of assumptions that are at least partially guided by the Solution Space Philippi's problematisation: that there is a need for a social entrepreneurship space in Philippi that the Solution Space can fill; that the Solution Space helps address UCT's historic neglect of the area and its people; that the Solution Space is the appropriate model for improving the prospects for social entrepreneurship in Philippi and the township areas; that the Solution Space Philippi offices and Philippi Village site are appropriate and adequate spaces for achieving the GSB's goals; that the Solution Space's current composition is necessary to implement GSB's goals.

Other elements of my research have been framed by other problematisations to which I have subscribed regarding environmentalism, socio-economic equity, and technological innovation, which I imagine have shown through, but which I highlight again now. My focus on public transport stems from a problematisation produced by environmental and transport industry actor-networks that public transport is environmentally superior to private automobiles. My emphasis on minibus taxis reflects a problematisation reflected in paratransit literature that this mode provides better transport outcomes while producing successful small businesses and entrepreneurs from disadvantaged communities. My preoccupation with technology reveals a problematisation of technology as a gateway for change—a problematisation that is in turn challenged by the socio-technical and ANT literature I discuss in this dissertation. I have aligned these interests with the Solution Space's own mandate through this dissertation.

I was interested (in both the common the ANT sense) in conducting this research by the requirements of my programme at UCT and by suggestions from my dissertation supervisors, who offered to provide access and support for a dissertation that would look at transport to the Solution Space Philippi. Along the way, one of my advisors interested me in using ANT as a theoretical lens upon which to base my analysis, while the other interested the Solution Space Philippi management in accommodating me by offering the prospect of help with issues of transport and access to Philippi Village. These actions reveal the way in which UCT's academic actor-networks are also enmeshed in the Solution Space.

Through my enrolment, I interacted with actors to construct and perpetuate a number of actor-networks, including the Solution Space. I accessed Philippi Village using various modes of transport, primarily TNCs; I occupied physical space within the Solution Space Philippi's offices; I interviewed users of the Solution Space Philippi and Philippi Village, as well as other actors; and I interacted, replicated, and manipulated various texts associated with the Solution Space.

My enrolment process produced a new set of actors into the Solution Space Philippi actor-network: texts, maps, and figures all telling the story of access to the Solution Space Philippi, while also seeking to align other actors and induce them to enrol in my propositions for improving transport access. Through my research, I identified what I describe as insights into the transport actor-networks serving Philippi Village. These include: the central role of the road and private automobile actor-networks in framing access to the site; the high influence of crime on how access is viewed and resolved; the varying transport needs of Solution Space Philippi users; the benefits of passenger agency; the poor integration of public transport modes; and the divergence between existing and new transport actor-networks in actors enrolled and mobilised.

From these insights, I laid out a range of potential options to enact change, and assess whether in some cases change is more or less likely to result in enrolment and mobilisation for the benefit of Solution Space users. A common theme in these options is the ability to create new alliances between existing mobilised actor-networks, such as the road system, Philippi Village's security apparatus, and public transit modes serving Philippi Village. This strategy is founded upon the assessment that the work performed to enrol and mobilise new actor-networks is often underestimated, and that enrolling existing actor-networks is easier than displacing these actor-networks with new ones.

I also question the inference made by some stakeholders in Cape Town's public transport actor-network, including City officials and private industry alike, that the minibus taxi industry and TNC-like services can be easily aligned. This scepticism is based on the vastly different actors, mediators, and obligatory passage points that each actor-network establishes, notwithstanding the fact that both services share significant similarities in their enrolment in the roads and private-automobile actor-networks and in their style of service offered.

My conclusion is that if the minibus taxi industry is to maintain its problematisation and incorporate TNC-like technologies, it must be on very different terms than the manner in which the current TNCs serving Cape Town are structured. Reconceptualising how these technologies are implemented could help facilitate this transition. However, much of the discussion regarding the application of ICT and mobile technologies to the minibus taxi industry appears to take for granted the problematisation established by TNCs.

My own translation into the Solution Space actor-network is mobilised through my texts and actions, but time will see if my proposals will be translated through the network. From a methodological basis, my research can be assessed based on whether it accurately describes the interactions amongst the actors studied. From a normative basis, success could be defined by how compelling my explanation, assessment, and conclusions are regarding how things work and what is to be done in order to make things work "better", as defined by the problematisations to which I subscribe.

6.3 Reflection on ANT as a planning process more generally

Through this dissertation, I have sought to demonstrate how ANT can be applied as a theoretical and

methodological tool for addressing challenging planning problems. (Translation by the readers of this text will determine whether or not I have been successful!) Producing an ANT description of the actor-networks constituting transport access to the Solution Space Philippi and Philippi Village reveals the power of ANT as a tool for revealing actors, causes, and relationships that are hidden by the assumptions we make in perceiving reality around us. Its dedication to an empirical understanding of relationships between actors forces a form of objectivity that mitigates against subjective inferences regarding cause and effect. While this is an important achievement in all disciplines, it is particularly useful in planning, where theoretical insights are not spared from the harsh light of practical application. Once a planner distinguishes between problematised positions and their negotiation—between mediators' narratives and empirical interactions—the real work of finding opportunities to re-organise socio-technical relationships can begin.

In addition, embedded in ANT is the ability to see motive and bias through a self-referential check of one's own relationship to the actor-networks with which one engages. This is particularly important to addressing the age-old issue in planning discourse regarding representation and speaking for others. Yes, through ANT the scholar (or planner) must speak for other actors in describing the actor-network, and in that process may well (or even likely) misrepresent these actors. However, this is always the case, whether or not ANT is used. Faithful adherence to observation means that the scholar (or planner) cannot misrepresent what actually occurs. Nor can she purport to represent her description as that of others, since she is necessarily but one actor, producing texts and images that constitute actors themselves. These actors will either help construct a new reality, or fall flat when others fail to enrol and mobilise in the project. This reality, which ANT expresses, is indeed what always is happening when planners make plans, but is rarely acknowledged. ANT cannot provide a normative theory of planning, but it can make clear what normative theory the planner uses to produce her plans. This is an important step in addressing the inherent "wickedness" (Rittel and Webber, 1973) of planning problems.

6.4 Where do we go from here?

The implications of this dissertation for future research are multiple and varied, and suggest a number of paths. With respect to the specific goal of improving transport at Philippi Village for Solution Space Philippi and other users, the previous chapter outlines a range of potential solutions that Solution Space management and users could pursue. This includes both internal projects as well as larger interventions that would require coordination or commitment from other actors, such as the Philippi Village management and the local minibus taxi association. These solutions cover both organisational as well as design-led interventions, but also include opportunities for technological and business innovations that are properly contextualised and developed within a better understanding of the relevant actor-networks.

The insights presented in the previous chapter also provide guidance for government officials and policymakers. The City needs to work harder at articulating a clear identification for the minibus taxi actor-network if it chooses to continue with its strategy for expanding MyCiTi and the TNC networks. This identification should acknowledge the agency that minibus taxi owner-operators and associations currently retain. The City should also promote investment in technologies that seek to enrol rather than exclude minibus taxi operators or reduce their role to intermediaries. Finally, all levels of government should reassess the commitment to perpetuating the road-based actor-network as it is now constituted in light of its broader environmental and developmental goals.

With respect to planning theory, this research reveals the usefulness of ANT as a tool for planning analysis, and as a mechanism for laying the groundwork for a good understanding of relationships between different actors. It would be useful for the profession to continue to explore the prospects for applying ANT in the context of co-production processes. Further ANT studies regarding transportation in Cape Town in particular would help build a mosaic of snapshots that could better inform policymakers. The ANT methodology used here does not need to be confined to transport, however, and could be used in many other contexts.

ANT's relational approach reveals new possibilities for better understanding how society constructs itself. As the rate of technological development continues to accelerate, and as we move beyond modernist paradigms, the capacity to understand this facet of life will become more important, for both planners and policymakers. These insights can unearth new potential for planning more intentionally, leading ultimately to outcomes that reflect our collective wishes.

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Endnotes

1 See also discussion of Taaffe et al. (1963), in Simon (1996:39-40).

2 These terms are not necessarily used consistently and various groups of academics have staked out claims to or attributed particular nomenclature (see, e.g., Adsal et al., 2007:22, noting the term “socio-technical” as associated with technologically determinist field of industrial sociology).

3 Conventional lore traces the term “paratransit” to the United States in the early 1970s, where scholars and policy advocates used it to refer to unscheduled public transportation service complementing conventional fixed-route and fixed-schedule public transport services (Bruun and Behrens, 2016; Cervero, 1997). The term’s etymology—“para” meaning alongside and “transit” referring to public transportation (Behrens, McCormick, and Mfinanga, 2016)—reflects its coinage in the Global North (and the United States particularly). However, paratransit, so defined, has been around for much longer, both in the United States and elsewhere. For instance, motorized paratransit has been around for nearly as long as the mass-produced automobile, where, in the United States, unlicensed motorists began to offer trolley passengers rides for a nickel (or ‘jitney’, a colloquial term for this sum, and also for paratransit) (see Cervero, 1997).

4 There are, however, other forms that also exists, often informally, in large Global Northern cities such as New York and Miami (see Cervero, 1997). Those services, which vary considerably in size and type of service, go under other more colloquial names, such as “dollar vans” and “hacks” (Cervero, 1997).

5 There are a number of different forms of this type of service, including carsharing, ride-sharing, ridesourcing/transportation networking, and e-hailing. While private “start-up” companies currently dominate this space (Molla and Bhuiyan, 2017), other operational forms exist, from non-profit (see Ride-Austin, 2017), and “sharing economy” models, to publicly funded ventures.

6 ANT literature often uses the term “actant” to distinguish anything that acts from “actor”, which is the source of an action (Latour, 1992, note 11). ANT scholars use this semiotic and definitional difference to help avoid the pitfalls of traditional sociology and colloquial use of the term actor, which tends to obscure agency through characterisation (see Latour, 2005:53-54; Latour, 1992:164-66 (discussing *morphisms*)). In order to be more accessible, I have stuck to the term actor, which I believe is more easily understood, but have hopefully conveyed that this term as I use it extends beyond human actors to encompass any that can physically interact with another physical entity.

7 See definition of “interest” at Wiktionary. 2006. Available; http://en.wiktionary.org/wiki/interest [visited 1 Nov. 2017].

8 While small amount of literature available regarding such service in Cape Town referred to it as “Amaphela”, the Solution Space users interviewed in this research almost universally referred to it as “Avanza”. For this reason, I have generally used the “Avanza service” label.

9 Interestingly, it appears from the City’s freight rail line data that Philippi Village and the Philippi Industria do appear to have been problematised as places of access for industrial and freight rail purposes, as rail right-of-way exists connecting Philippi Village to the larger rail network farther north beyond the airport (see TDA Cape Town, 2017). This right-of-way’s disuse for railroad purposes (and use for other purposes) indicates a lack of enrolment and mobilisation of this particular problematisation.

10 Figure 29 cost information based on the following: Minibus taxi route costs are based on interview with S2, information from Taximap.co.za, and personal experience (note that routes and costs may vary). Avanza costs are based on personal experience and interview information with S5 and S6. Rail cost information based on WhereIsMyTransport Public Transport iPhone app. MyCiTi costs from MyCiTi fare estimator, MyCiTi.co.za. Charter service cost based on interview with C1 (one-way service R200-250 per car, divided by 1-4 passengers, 15 passenger van half day R1200, full day R1800). TNC service cost based on actual trips between CBD and Philippi and estimates from the Uber iPhone all (on-way service R188 per car, divided by 1-4 passengers. Private auto driver cost estimate based on SARS rates per kilometre (http://www.sars.gov.za/Tax-Rates/Employers/Pages/Rates-per-kilometer.aspx), and average mileage in South Africa (http://investorchallenge.co.za/what-is-the-average-south-africans-biggest-expense/). Equation is = [Fixed cost of vehicle (R50,924km/yr divided by R20,000 km/yr average kilometres driven) plus maintenance costs (41.2 cents/km) plus fuel costs (101.8 cents/km)], multiplied by distance (22km). This assumes a solo driver.

Appendices

Appendix A: Forms of Paratransit Service*

	Business and Regulatory Features					Operational Features					
Types of Service (examples)	Organisation	Payment	Public Accessibility (demographic)	Regulation	Formality	Vehicle type/capacity	Service configuration (departures to destinations)	Request Type	Routing Type (Flexibility)	Schedule Type (Flexible)	Frequency/Timing
Meter Taxis	Private commercial (corporate, small business, association; sole-proprietor)	Cash/credit	Public (higher income)	High	High (variable)	Bicycle, motorcycle, sedan, van	Many to many	Curb hailing	High	High	High
Ridesourcing/E-hailing/TNCs (Uber)	Private commercial (corporate)	Cash/credit/e-bank	Public (higher income)	Moderate (increasing)	Moderate to high	Sedan, van	Many to many	E-hailing	High	High	High
Dial-a-ride	Public	Farecard	Public (qualified - e.g. disabilities)	High	High	Van, minibus	Many to many	Pre-arranged (telephone/website)	High	High	Low
Ridesharing/carpooling	Community	Free/cash	Public (membership)	Low	Low	Sedan	One to one	Pre-arranged	Moderate to High	High	Varies
Car-sharing/car-pooling	Private commercial (corporate); community	Free/credit	Public (geographically based)	Low	Low	Sedan	One to one	Pre-arranged	Moderate to High	High	Varies
Shared Taxis (sedans)	Private commercial (small business, association; sole-proprietor)	Cash	Public (lower income)	Moderate	Low	Sedan	Few to few	Curb hailing	Moderate to High	High	High (varies)
Jitneys/minibus (minibus taxis, dolla dollas, jeepneys)	Private commercial (small business, association; sole-proprietor)	Cash/voucher	Public (lower income)	Moderate	Low (variable)	Van, minibus	Many to many	Curb hailing	Moderate (different types - circulators, transit feeders, areawide)	Moderate (varying)	High (varies)
Commuter Midibus/bus	Private commercial (small business, association; sole-proprietor)	Cash/voucher	Public (lower income)	Low to high	Moderate	Midibus, bus	Few to one	Stops	Low	Low	Low, peak
Charter (e.g. Shuttles/Vanpools/ Buspools)	Private (corporate; small business)	Cash/voucher	Private (employees)	Low	Moderate	Van, minibus, midibus, bus	Variable	Stops	Low	Low	Low

Key:

Types of Service - Examples

- Meter Taxis – Yellow Cabs (New York); Unicabs (South Africa)
- Ridesourcing/E-hailing/TNCs – Uber (global), Taxify (Europe, South Africa)
- Dial-a-ride – transit disability services (United States)
- Ridesharing/carpooling – Blablacar (Europe), D.C. Slug Line (United States)
- Car-sharing – Zipcar, Car2Go (United States)
- Shared Taxis – “gypsy taxis” (United States) “Amaphela” and “Avanza” (South Africa)
- Jitneys/minibus – Jitneys (United States), matatus (Kenya), dolla-dolla (Tanzania); Jeepney (Philipines); minibus-taxi and kombi (South Africa)
- Commuter Midibus/bus
- Commuter vans – Minibus taxi (South Africa)
- Shuttles/Vanpools/Buspools – Hotel airport shuttle

Business and Regulatory Features

- Business Entity Formation (private corporate; private small business; private association; private sole-proprietor; non-profit; community-based; public)
- Public Accessibility (public (cash); public (card/membership); qualified public; employer-sponsored)
- Regulation (highly regulated monopoly <---> unregulated open market)
- Formality (formal <---> informal)

Operational Features

- Vehicle type/Capacity (single-occupancy; 2-4; 6-10; 6-15; 10-60; 15-30; 30-60)
- Service Configuration (one/few/many <---> one/few/many)
- Request Type (curb hail; e-hail; dial/advance reserve; stop/stations)
- Routing Type (fixed <---> flexible)
- Schedule Type (fixed <---> flexible)
- Frequency (high <---> low; peak)

*Sources: Based on Cervero (1997:15); Behrens, McCormick, and Mfinanga (2016:1-7).

Appendix B1 – List of Primary Research Activities

ID	Date	Activity	Participants	Location	Notes
1	2017-02-13	Informal site visit	--	Philippi Village - Solution Space	Preliminary meeting with Solution Space staff regarding proposed research
2	2017-03-03	Informal site visit	--	Philippi Village - Solution Space	Attended workshop presented by Herrie Schalekamp at UCT Solution Space at Philippi Village for minibus taxi owner-operators and employees
3	2017-06-24	Site visit - observation	--	Philippi Village	Observation of inside facilities; pictures of facilities, parking, Secondary Entrance and Main Entrance
4	2017-06-24	Interview	S1	Philippi Village - Solution Space	41 minute recorded interview with Solution Space user (management)
5	2017-07-04	Site visit - observation	--	Philippi Village	Observation of New Eisleben and parking lot traffic from Solution Space offices
6	2017-07-04	Interview	S3	Philippi Village - Solution Space	35 minute interview with Solution Space user (student/staff/ entrepreneur)
7	2017-07-04	Interview	S2	Philippi Village - Solution Space	50 minute interview with Solution Space user (staff)
8	2017-07-04	Interview	S4	Philippi Village - Solution Space	23 minute interview with Solution Space user (start-up employee)
9	2017-07-04	Interview	S5	Philippi Village - Solution Space	37 minute interview with Solution Space user (staff)
10	2017-07-04	Interview	S6	Philippi Village - Solution Space	31 minute interview with Solution Space user (start-up employee)
11	2017-07-04	Interview	P1	Philippi Village	Interview with tenant representative (Desmond Tutu Foundation)
12	2017-07-06	Interview	B1	CBD/Green Point	Interview with tech company representative
13	2017-07-07	Interview	G1	CBD	33 minute interview with City official
14	2017-07-14	Interview	M1 and M2	Philippi Village	9am interview with minibus taxi consultant (M1) and minibus taxi association representative (M2).
15	2017-07-17	Interview	J1	UCT Jammie Shuttle offices, Rosebank	Interview with UCT Jammie Shuttle representative.
16	2017-08-13	Interview	B2		Interview with tech company founder
17	2017-09-19	Interview	G2	Western Cape transport licencing offices, Cape Town	Interview with Provincial government licencing official
18	2017-09-19	Telephone call	--	UCT	Telephone call to Golden Arrow Bus Service call centre for route information
19	2017-09-28	Site visit - Observation	--	Philippi Village - Solution Space	Included informal unstructured conversations with S2; discussion of preliminary diagrams of transport patterns; observation at Main Entrance, Secondary Entrance, Shoprite Philippi and intersection of New Eisleben and frontage road
20	2017-09-29	Observation	--	Cape Town Station	Observed minibus taxi and Golden Arrow operations at Cape Town Station
21	2017-10-03	Observation	--	Cape Town Station - Philippi Village	Trip from Cape Town Station to Philippi Village via minibus taxi and Avanza
22	2017-10-03	Site visit - Observation	--	Philippi Village - Solution Space	Included informal unstructured conversations with S2 and S5; discussion of preliminary diagrams of transport pattern; observation at Main Entrance, Secondary Entrance, and Philippi Village parking lots; observation of New Eisleben and parking lot traffic from Solution Space offices
23	2017-10-14	Observation	--	GSB Waterfront campus	Site visit to GSB Waterfront Solution Space offices
24	2017-10-17	Interview	C1	GSB Waterfront campus	Interview with charter service owner-operator
25	2017-10-19	Interview	G3	Western Cape transport licencing offices, Cape Town	Interview with Provincial government licencing official

Appendix B2 – Sample of Interview Transcripts(S2)

2017-07-04
(50:53)
…
[Q3: What are your own challenges with accessing the Solution Spac?]
…
In my first … first visit here, when I got that Shoprite taxi, it actually took me all the way to, went through there [pointing] and went and dropped others and it came around, and it came about, and [I went] 'hello', 'ok', and it came about … all the way, and then I was the last person, as it was heading back to town, so it actually did a whole [trip] with me, and then I said, 'ah but I'm supposed to get off there', [and] he's like 'ok, well you'll be the last person' because it collected and dropped off and it collected on the way and then it dropped me off here, and then it went to town with that group of people.

On the way here, remember I was on the taxi rank. It was full, it was with people. But it didn't take this route as it came … it used another--it came from down there [pointing], and then it came up all the way up because there is Samora Machel and other people that needed to get off there and then it took that other route all the way up and then it turned back and came.

So, that's why I was like, ah, I don't see myself having to use, to travel like this 'cause now its like i've spent an hour and something, just doing the drive about. … This was like in Sea Point, but now I know that if I take a Lower taxi, it takes me straight, and its usually like 30 minutes. But if I take a Nyanga, or, what did they call it? Nyanga or what? I forget now. But its the same taxi as a Wynberg Claremont. 'Cause when those guys come, they offload in Nyanga terminus, then they head back and collect people going to Claremont. So if I take the Nyanga one, then its going to drop me off at the terminus, and then I must take the mini taxi. I try to stay away from, from that because it means I must pay double fee. Uh, but if push comes to shove and I'm like really late [and] there's no Lower taxi coming, then I take the Nyanga one. Like for example this morning there was a taxi going to Samora, and the guy said 'don't worry, you're not going to pay, you can just pay one of the mini taxis but I will drop you there, I'll just give you a free lift, and then you can get on. You get those, but I don't like to take those, I'd rather take one that's coming straight. … Because also with that, there's also quite a couple of things that one needs to take into consideration, safety and all of that. … Yeah so I feel it much much better, but the challenge is having to go home in the afternoon, because I can't go and stand there on my own, I always need to ask someone, one of the guys to walk me there. [How long do you wait normally?]. Not long, anything from 5 to 15 minutes, but there's been time when I waited like 20 minutes because I'd left the office at like 10 past six or quarter past six [and] that time there's not that many people going to--cause most of the people are going to Wynberg or Claremont to work, ah, and at that time they start to … go down. However, if I were to stand in the corner there, there's still quite a couple coming from that road, so that's why I love this area here, there's a lot of Wynberg Claremont taxis, a lot of them. CODETA taxis. Also there is a lot of … CATA. There's a mix actually, there's a CATA and CODETA, because CODETA wants to be coming from this route down here mostly.
…

Appendix B3 – Sample Interview Questions

List of interview questions for Solution Space Philippi users:

Q1: What is your relationship to the Solution Space, and what is your perception of its mission?

Q2: How do you currently perceive access to the Solution Space, and what are the current general challenges in accessing or using this space?

Q3: What are your own challenges with accessing the Solution Space

Q4: What are the ideal outcomes for transport access to the Philippi campus?

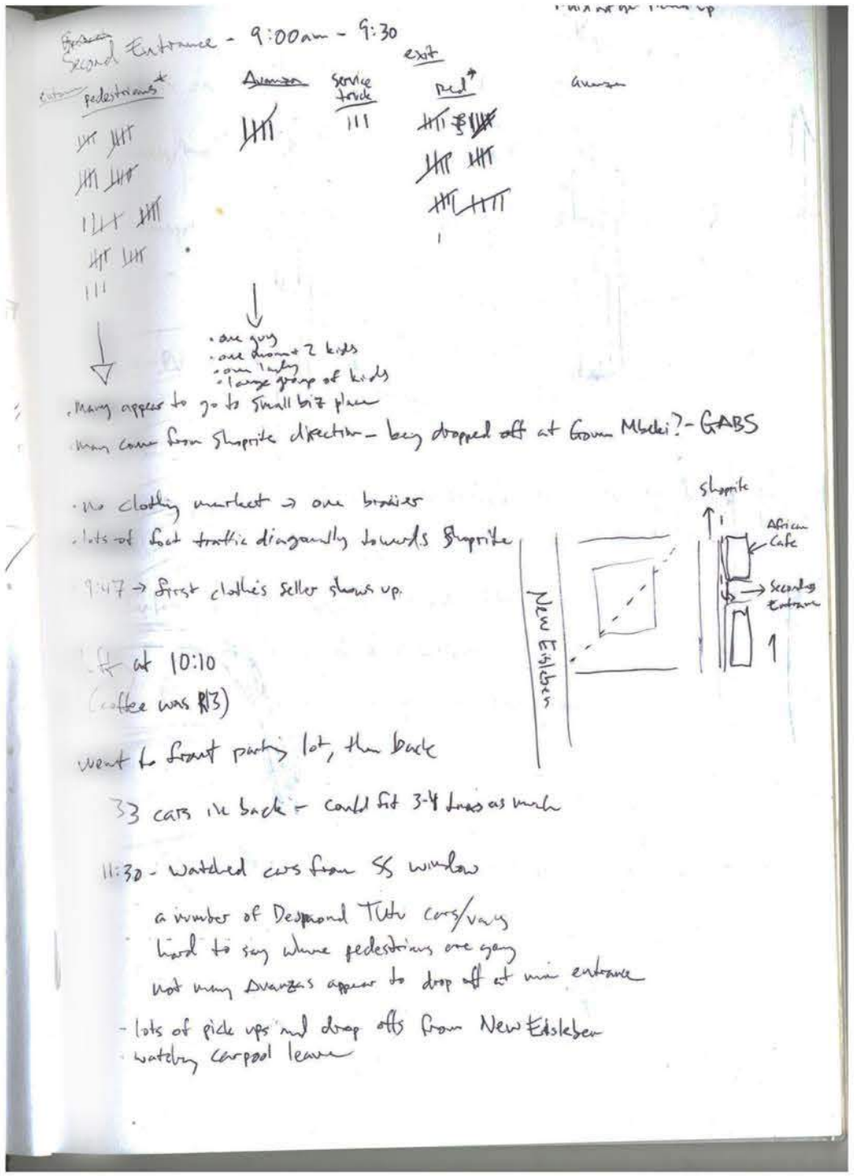
Q5: What transport modes do you normally use for school/work?

Q6: Are you aware of any new technologies that might help you with your commutes for work/school?

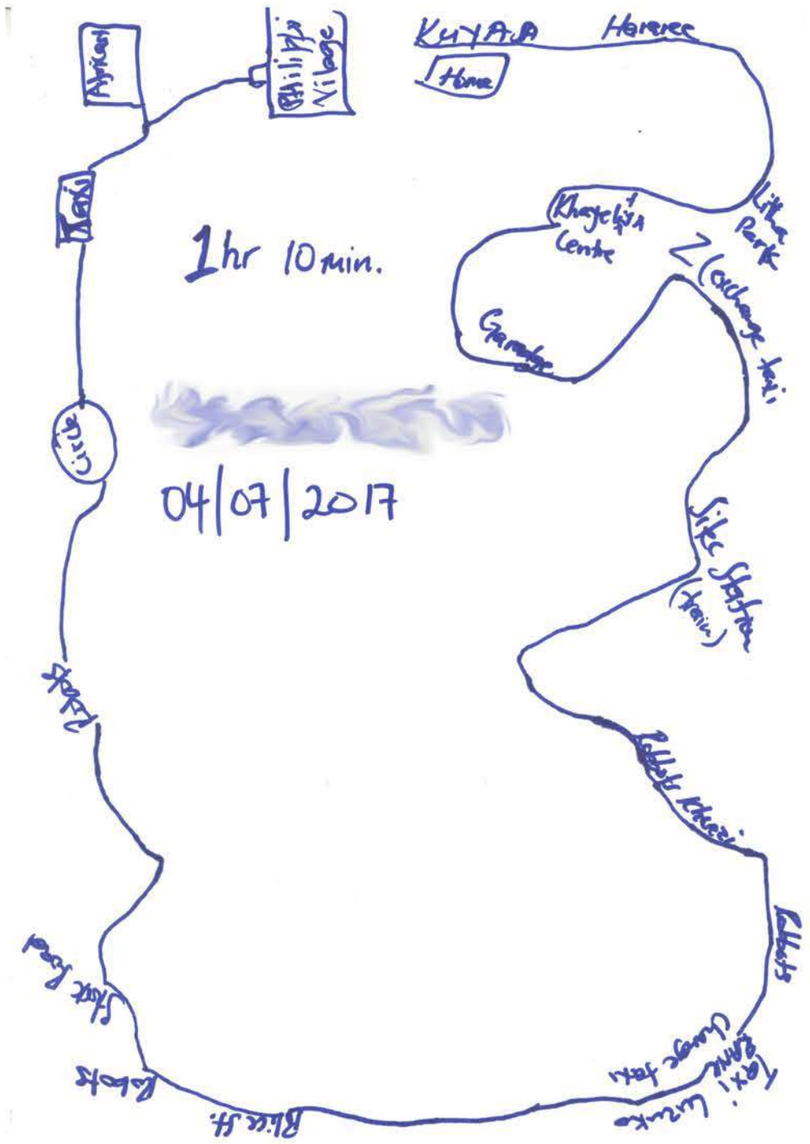
Q7: What are the major benefits and challenges to new public transport technologies?

Q8: Please visually depict your route to school/work (open ended)

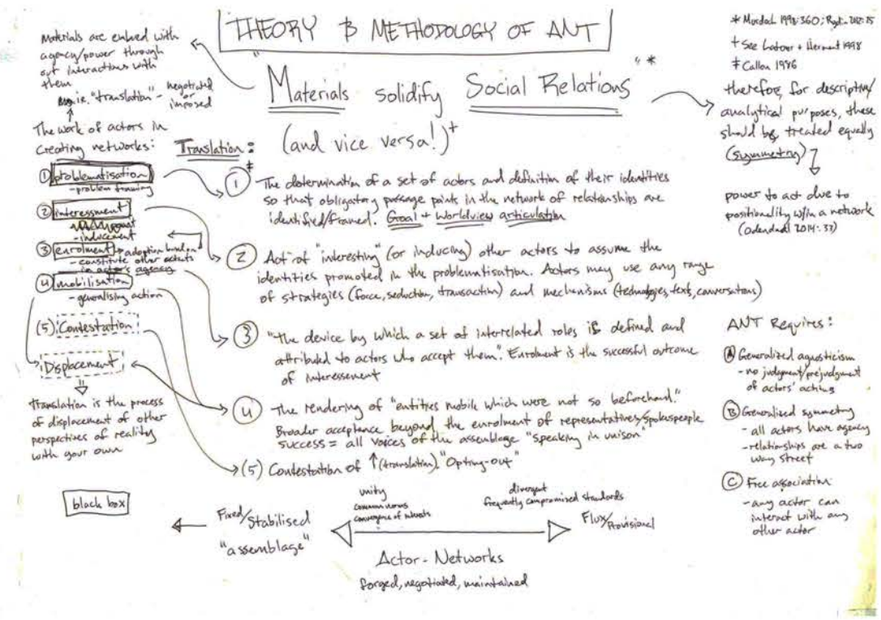
Appendix B4 - Sample Field Observation Notes



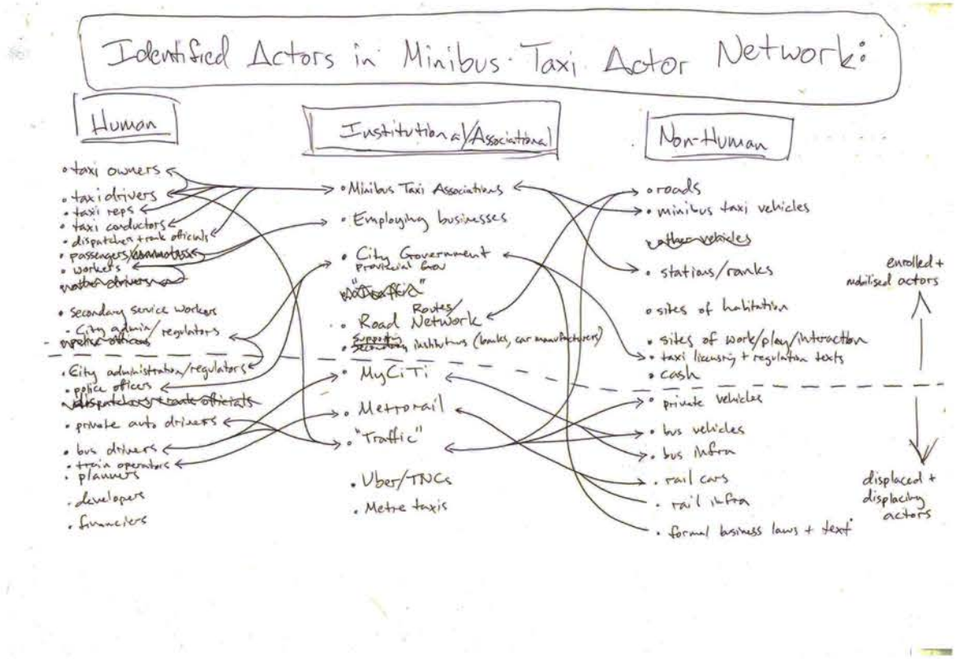
Appendix B5 - Sample Cognitive Mapping Exercise



Appendix B6 - Sample Notes on ANT Process



Appendix B7 - Sample Notes on ANT Actors



APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data.The objective of submitting this application *prior* to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook**(available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/usr/ebe/research/ethics.pdf

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Christian Alexander
Department		Architecture, Planning & Geomatics
Preferred email address of applicant:		clbalexander@gmail.com
If a Student	Your Degree: e.g., MSc, PhD, etc.,	MCRP
	Name of Supervisor (if supervised):	Nancy Odendaal
If this is a researchcontract, indicate the source of funding/sponsorship		NA
Project Title		From Street Corner to Smartphone: Assessing the Prospects for Socio-Technical Transformation in Cape Town's Minibus Industry

I hereby undertake to carry out my research in such a way that:
- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Christian Alexander	Signed by candidate	21 - 4 - 2017

APPLICATION APPROVED BY	Full name	Signature	Date
Supervisor (where applicable)	Nancy Odendaal	Signed by candidate	21 - 4 -2017
HOD (or delegated nominee) Final authority for all applicants	Click here to enter text.		

Application for Approval of Ethics in Research (EiR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

questions in Section1; and for all Undergraduateresearch (Including Honours).			
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.	G. Sithole Click here to enter text.	Signed by candidate	23 May 2017

	RESEARCH ACCESS TO STUDENTS	DSA 100

NOTES

1. This form must be **FULLY** completed by all applicants who want to access UCT students for the purpose of research or surveys.
2. Return the fully completed **(a) DSA 100** application form **by email**, in **the same word format**, together with **your: (b) research proposal inclusive of your survey, (c) copy of your ethics approval letter / proof (d) informed consent letter** to: Moonira.Khan@uct.ac.za. You application will be attended to by the Executive Director, Department of Student Affairs (DSA), UCT.
3. The turnaround time for a reply is **approximately 10 working days**.
4. NB: It is the responsibility of the researcher/s to apply for and to obtain **ethics approval** and **to comply with amendments that may be requested;** as well as **to obtain** approval to access UCT staff and/or UCT students, from the following, at UCT, respectively: (a) **Ethics:** Chairperson, Faculty Research Ethics Committee' (FREC) for ethics approval, (b) **Staff access:** Executive Director: HR for approval to access UCT staff, and (c) **Student access:** Executive Director: Student Affairs for approval to access UCT students.
5. **Note:** UCT Senate Research Protocols requires compliance to the above, **even if prior approval has been obtained from any other institution/agency. UCT's research protocol requirements applies to *all* persons, institutions and agencies from UCT and external to UCT who want to conduct research on human subjects for academic, marketing or service related reasons at UCT.**
6. **Should approval be granted to access UCT students for this research study, such approval is effective for a period of one year from the date of approval (as stated in Section D of this form), and the approval expires automatically on the last day.**
7. **The approving authority reserves the right to revoke an approval based on reasonable grounds and/or new information.**

SECTION A: RESEARCH APPLICANT/S DETAILS

Position	Staff / Student No	Title and Name	Contact Details (Email / Cell / land line)
A.1 Student Number	ALXCHR002	Mr. Christian Alexander	alxchr002@myuct.ac.za / 0817343587 / +15056999049
A.2 Academic / PASS Staff No.			
A.3 Visitor/ Researcher ID No.			
A.4 University at which a student or employee	University of Cape Town	Address if *not* UCT:	
A.5 Faculty/ Department/School	Engineering and Built Environment / Architecture, Planning and Geomatics / Planning		
A.6 APPLICANTS DETAILS If different from above	Title and Name	Tel.	Email

SECTION B: RESEARCHER/S SUPERVISOR/S DETAILS

Position	Title and Name	Tel.	Email
B.1 Supervisor	Nancy Odendaal	+27 (0)21 650 2365	Nancy.Odendaal@uct.ac.za
B.2 Co-Supervisor/s	Herrie Schalekamp		herrie.schalekamp@uct.ac.za

SECTION C: APPLICANT'S RESEARCH STUDY FIELD AND APPROVAL STATUS

C.1 Degree – if applicable	Masters Degree in City and Regional Planning
C.2 Research Project Title	From Street Corner to Smartphone: Assessing the Prospects for Socio-Technical Transformation in Cape Town's Minibus Taxi Industry
C.3 Research Proposal	Attached: Yes [ ] No [ ]
C.4 Target population	
C.5 Lead Researcher details	If different from applicant:
C6. Will use research assistant/s	Yes [ ] No [ ] If yes- provide a list of names, contact details and ID no.
C.7 Research Methodology and Informed consent:	Research methodology: Case study Informed consent: Yes
C.8 Ethics clearance status from UCT's Faculty Ethics in Research Committee /Chair (EiRC)	Approved by the UCT EiRC: Yes [ ] With amendments: Yes [ ] No [ ] (a) Attach copy of your UCT ethics approval. Attached: Yes [ ] No [ ] (b) State date / Ref. No / Faculty of your UCT ethics approval: 23/ 05 /2017_ Ref. /Faculty.: G. Sithole

SECTION D: APPLICANT/S APPROVAL STATUS FOR ACCESS TO STUDENTS FOR RESEARCH PURPOSE
(To be completed by the UCT - ED, DSA or Nominee)

	Approved / With Terms / Not	* Conditional approval with terms	Applicant/s Ref. No.:
D.1 APPROVAL STATUS	(i) Approved [ ] ~~(ii) With terms~~ ~~(iii) Not approved~~	(a) Access to students for this research study must only be undertaken after written ethics approval has been obtained. (b) In event any ethics conditions are attached, these must be complied with before access to students.	ALXCHR002/ Mr. Christian Alexander

D.2 APPROVED BY:	Designation	Name	Signature	Date of Approval
	Executive Director Department of Student Affairs	*Dr Moonira Khan*		*12 June 2017*

~~HR194~~	ACCESS TO UCT STAFF FOR RESEARCH PURPOSES	UNIVERSITY OF CAPE TOWN IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

NOTES

- Forms must be downloaded from the UCT website: http://www.uct.ac.za/depts/saqweb/forms/forms.htm
- This form must be completed by applicants who are requesting to access UCT staff for the purpose of research.
- A copy of the research proposal as well as the Ethics Committee approval must be attached.
- It is the **responsibility of the researcher/s to apply for ethical clearance** from the relevant Faculty's Research in Ethics Committee (RIEC).
- If you are requesting staff information, you are required to complete the HR Information Request Form (HR190) and submit it together with all the required documentation.
- The turnaround time for a reply is **approximately 10 working days unless specified as urgent.**
- Return the completed application form and all the above documentation to Joy Henry via email: joy.henry@uct.ac.za; or deliver to: For the Attention: Executive Director, Human Resources Department, Bremner Building, Room 214, Lower Campus, UCT.

SECTION A: APPLICANT DETAILS

	Mr.		Christian Alexander
	0817343587		alxchr002@myuct.ac.za
	ALXCHR002		
	University of Cape Town		

SECTION B: SUPERVISOR DETAILS

Nancy Odendaal	+27 (0)21 650 2365	Nancy.Odendaal@uct.ac.za
Herrie Schalekamp		herrie.schalekamp@uct.ac.za

SECTION C: APPLICANT'S FIELD OF STUDY (if applicable) / TITLE OF RESEARCH PROJECT / STUDY

	Masters Degree in City and Regional Planning
	From Street Corner to Smartphone: Assessing the Prospects for Socio-Technical Transformation in Cape Town's Minibus Taxi Industry
	☒ Yes ☐ No
	3
	1 hour
	See above
	☒ Yes ☐ No

SECTION D: FOR OFFICE USE (Approval status to be completed by the Executive Director, Human Resources or Nominee)

		26/05/2017
		29/05/17

INFORMATION SHEET & CONSENT FORM

University of Cape Town Graduate School of Business MTN Solution Space at Philippi Village Transportation Stakeholders

Research title: From Street Corner to Smartphone: Assessing the Prospects for Socio-Technical Transformation in Cape Town's Minibus Taxi Industry

Hello, my name is Christian Alexander and I am conducting research towards a masters degree in city and regional planning. I am researching how technological changes might be leveraged through collaboration with transportation stakeholders to better address Cape Town's public transport needs, and would like to invite you to participate in the project.

What the project is about:

Briefly, I am interested in how users and providers of informal and flexible public transport, primarily the minibus taxi industry, might leverage technological changes to improve transportation options in Cape Town. As a case study, I want to understand how such technological changes might be received or used by users and providers of transport that serve the facilities (i.e. Philippi Village) hosting the University of Cape Town Graduate School of Business MTN Solution Space, which is located in Philippi, Cape Town. I would like to interview people who are involved in the MTN Solution Space and people who are or might be providers of transportation to the MTN Solution Space at Philippi.

Your rights, what information will be gathered, and how I will use it:

Your participation is completely voluntary. If you choose not to participate, there will be no negative consequence. If you choose to participate, but wish to withdraw at any time, you will be free to do so without negative consequence. However, I would be grateful if you would assist me by allowing me to interview you. You may also state what you will allow me to use in my research.

Your participation in this research will consist of responding to questions regarding your role in and perspective on public transportation access to Philippi Village, your knowledge and familiarity regarding various technological innovations related to public transportation, and your willingness to engage in new transportation practices. In addition, or in the alternative, I may ask to observe you and your role in the provision of public transport.

Aside from the satisfaction received from contributing to the goals of this research, there will be no direct benefit to you for participating in this research. There is also little foreseeable risk of harm to you for participating, and I will make every reasonable effort to avoid making you feel upset or uncomfortable. Although I may request personal information for the purposes of communicating with you and establishing generalised data regarding transportation patterns and practices, I will not disclose personal or personally identifiable information to anyone for any purpose without your express consent. The interview and observation results will remain confidential, and all resulting records will be destroyed within a reasonable time after completion of the research. I will also preserve the anonymity of respondents when publishing and discussing the results of my research, unless you expressly authorise me to do otherwise. To the extent I reasonably can and you allow, I will follow up with you regarding the results of my research before publishing it (note this may require me to request personal information such as telephone numbers, email addresses, or physical addresses), as well as after it is published.

By signing below you acknowledge the terms above and agree to participate in this research.

Name of participant ..... Date .....

Signature of participant .....