Planning the Driverless City

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Abstract

AV technologies have the potential to transform urban landscapes and existing transport systems and networks. Yet, the utopian imaginary of reduced automobile ownership and a new shared economic future sits in tension with suggestions that car dependency, urban sprawl and transport inaccessibility will be exacerbated. The issues are situated in a complex governance landscape involving an influential private sector who are increasingly setting the agenda. The public sector may be forced into reacting to the new innovations by information technology and automobile companies as they are introduced into existing built environments. Drawing on an extensive literature base and interviews with public sector planners, this paper reveals the conceptual gaps in the framing of AV technology – the prospects and limits – and how these are conceived. The paper raises questions about the role urban planning *can* play in the rollout of AVs in order to anticipate and mediate unwanted built environment and socio-spatial impacts, as well as reconciling the ambition of transport innovation with the public purpose of planning.

Key words: autonomous vehicles, planning, governance, urban, disruption

1.0 Introduction

We have reached a ‘critical juncture’ in determining how autonomous vehicles (AVs) will shape our transport systems and policies into the foreseeable future (Docherty et al, 2017, p10). Research into AV technologies continues to articulate their potential to transform urban landscapes and existing transport systems and networks in new ways. However, while global IT companies and car manufacturers are rapidly bringing these new technologies to market (NTC, 2016), there remain competing visions for their role in urban transport. International research from science, engineering and medicine argues that AVs will improve road safety (Glaser et al, 2010), reduce vehicle emissions (Greenblatt & Shaheen, 2015), and lower car ownership by increasing car sharing (Firnkorner & Muller, 2015), as well as create more efficient use of urban space by reducing the need for parking (Burns, 2013, Zhang et al, 2015). Yet the utopian imaginary of reduced automobile ownership and a new shared economy sits in tension with more cautionary tales. This critical literature is concerned with the potential to further incentivise sprawl (Hall, 2012), shift investment away from public transport systems that our cities will still require (Lam et al, 2016), and depart from policy commitments towards transport accessibility and urban containment (Curtis & Low, 2012; Randolph, 2006, p. 54). The literature also illuminates the power of what we might call the ‘mobility industrial complex’ to use emerging technologies to commodify transport in new and complex ways (Frenken, 2017).

While AV technology exists in many distinct forms and with different levels of automation including ‘connected’ vehicles, shared vehicles, driverless vehicles, electric vehicles and tailored vehicles (Burns, 2013), this paper is concerned with the potential impacts of full autonomy: vehicles running without the option of human-driven operation (see SAE International, 2014). As vehicles acquire greater levels of autonomy, the necessary roles of the public and private sectors in their development presents unique challenges for urban planning and for the governance of the rollout of AV technology (Isaac, 2016; Docherty et al, 2017). Private-sector led innovation shows increasing signs of disrupting contemporary urban processes (see Gurran and Phibbs on AirBnB, 2017). Some developers of AV technology and associated new smart technology platforms have a clear intention to disrupt patterns of urban mobility. The potential impact of such change on transport networks and the public and private entities shaping these networks raises important questions for transport planning and policy.

In this paper, we focus on the potential impacts of the AV rollout on transport and urban planning. Employing Kęblowski and Bassens’ (2017) knowledge typology centred around three dominant themes – neoclassical planning, sustainability and political economy - we examine the scholarly literature on AVs to identify the discourses within which AV research is currently undertaken. Their

typology is noteworthy as it allows classification of transport in a manner that enables researchers to factor in the political agendas shaping transport by extending the ‘dual hegemonic debate’ in transport studies beyond the “neoclassical” and “sustainable” position’ to include political economy and the spectrum of forces contextualising the reality in transport (Kęblowski and Bassens, 2017, p.18). By adopting this typology to structure our review, we found three clear types of AV research:

- the neoclassical use of established modelling techniques to predict transport behaviour in an AV future;
- studies within a sustainability discourse that position AVs together with electric propulsion systems as the key to tackling environmental problems in current transport systems; and,
- investigations into the broad political economies into which AV technologies are or might be situated.

This literature review is organised around an exploration of current research within these three themes. The second half of the paper uses these themes to provide a framework to analyse a set of semi-structured interviews with public-sector planners engaged with urban planning and transport policy in Australia. Our initial aim in conducting these interviews was to understand the concerns of planners in the early stages of AV rollout, particularly with respect to consideration of regulation and policy development. A further aim, addressed in this paper, is to compare the questions identified by the interview participants with the issues being considered in the emerging academic literature. In so doing, we aim to facilitate the development of new research agendas by tying preliminary empirical observations to theory in a way that fosters fertile enquiry (Lakatos, 1978; Newton-Smith, 1981). We conclude this paper by highlighting a tension, which our empirical research suggests requires further in-depth examination. This is the tension between the private sector’s ambition for creating new platforms for mobility centred around the commodification of the individual journey (Docherty et al, 2017, p5), with transport planning that positions public transport, well integrated with land use planning, at the centre of public-purpose planning.

2.0 Method and structure of the paper

Our review of the AV literature was guided by the approach articulated by Van Wee and Banister (2016). Examining discourses in scholarly AV research and given our interest in planning and governance of AVs, we began with a systematic search of the occurrence and frequency of articles on the topic of autonomous and driverless vehicles in planning, transport and geography journals.

Querying the Google Scholar search engine for the following keywords - 'autonomous vehicle(s)/car(s)', 'automated vehicle(s)/car(s)' and 'driverless' - we identified 22 scientific journals in the targeted disciplines that had published articles containing these keywords (see Table 1).

Table 1: Literature review outcomes (at April 2017)

#	Scientific Journals	No. of Publications
1	Applied Geography	2
2	Australian Planner	1
3	Case Studies on Transport Policy	1
4	City	4
5	Cities	4
6	Environmental Science and Policy	3
7	Futures	15
8	Geo Journal	1
9	Journal of the American Planning Association	3
10	Journal of Planning Education and Research	6
11	Journal of Public Transportation	91
12	Journal of Transport Geography	21
13	Journal of the Transportation Research Board	288
14	New Scientist	121
15	Planning Practice and Research	2
16	Procedia Engineering	24
17	Sustainable Cities and Society	2
18	Transport Policy	22
19	Transport Reviews	16
20	Transportation	33
21	Urban Studies	3
22	World Transport Policy and Practice	3

In total, there were 666 results generated from these three keywords combined in the disciplines of planning, geography and transport. It should be borne in mind that some articles may have been counted two or three times as they contained two or all three search terms. In comparison, a general search for these keywords on the entire databases covering all disciplines of three significant academic publishers yielded 5,983 hits for Elsevier Science Direct, 603 hits for SAGE Journals and 6,971 hits for Springer Link. Allowing for the inevitable imprecision that comes with these numbers and their extraction process, we observe that only a small proportion of academic publications on autonomous and driverless vehicles are found in planning, geography and transport journals.

Following Van Wee and Banister (2016), a stratified sample of papers were then selected from the 666 results generated from these journals. This sample was selected based on some engagement with issues pertaining to urban planning and governance, such as strategic and land-use planning, land use and transport integration, decision-making processes, and travel behaviour (present and future). Equally we were also interested in any new questions arising in the concluding sections of these papers as they relate to the governance and future planning of cities. Here we were looking to see if governance and planning were being identified as future issues, and if so, how those issues were framed. Structuring our review in this manner allowed us to structure our empirical research in the context of the new research openings articulated across these papers. Discussion of the nature and frequency of the themes addressed in the articles identified in this search will be found in Section 3.

In the second part of the paper, we use the three knowledge typologies, which structured the literature review in the first half of the paper, to analysis our empirical evidence from semi-structured interviews with planners engaged with planning and policy development for AVs in Australia. We examined this evidence to observe the extent to which public sector urban planners share the concerns raised in the academic literature.

Participants for these interviews were sought from those with responsibility for the carriage of AVs at the managerial level within road, planning and regulatory agencies across the Australian public sector. Respondents had considerable knowledge of the issues and responsibility for not only planning but also regulation and service procurement from private firms. Interviews were conducted in March and April 2017 and transcribed manually around key themes.

The research undertaken is qualitative in scope and the results presented are preliminary, but their richness had allowed us to ask wider questions about the current and future governance challenges related to AVs. Fourteen interviewees were targeted - all were public sector employees with an

active role in developing autonomous vehicles within their jurisdiction or on a national basis. Six agreed to be interviewed on the record. Baker and Edwards (2015) stress that provided the sampling strategy is relatively homogenous (our sample were all public servants) thematic saturation should occur after about twelve interviews. With this in mind, for speculative work to build/construct theory, rather than seek to prove anything, we believe that six similar interviewees will yield a moderate degree of thematic saturation, and this satisfied our research in this instance.

We believe it is necessary to explicitly state the difficulties we encountered, not only to set expectations for further research into this area, but also because it raises broader governance issues regarding transparency in planning practice that we are witnessing in Australia (Legacy, Curtis and Scheurer, 2017). It was notable that despite the guarantee of anonymity there was difficulty securing interviews. In one case, refusal came after a request for approval from senior management. Some potential recruits expressed unwillingness to be formally interviewed, not wishing to contradict relevant government positions. Some referred the interviewers on to other colleagues or to national guidelines. This small interviewee pool was not unexpected and was also described in Guerra (2016). A similar phenomenon, that of personal views potentially contradicting the official political line, with potential negative career ramifications, was clearly presented in a report by the Victorian Auditor General (2015).

Section 4 provides a brief context for international readers on the practice of transport planning in Australia. Then, we analyse the content of the interview material in relation to the themes identified in the review of academic literature on planning for AVs. The paper concludes, in Section 5, with questions and issues in the formulation of new research agendas that will be of direct benefit to policy and practice.

3.0 The study of Autonomous Vehicles

Kęblowski and Bassens' (2017) recently articulated a knowledge typology for assessing the ways in which transport planning is addressed in current academic literature. They identified three dominant themes.

These are:

1. *neoclassical* modelling techniques used to predict future travel behaviour;
2. *sustainable development* approaches that position integrated land use and transport planning as critical to delivering sustainability; and,
3. consideration of the ways in which *political economies* shape, and reproduce, certain transport trajectories.

In this section, we employ Kęblowski and Bassens' typology to examine the literature on autonomous vehicles.

Neoclassical perspectives

Working within the tradition of neoclassical planning, the large majority of academic research on AVs focuses on questions about the form that the technology will take, and on modelling the impacts on transport systems of various scenarios generated from the adoption of these technologies. For example, preliminary research examining the expansion of the use of on-demand public transport using AVs (Owczarzak & Zak, 2015) has offered a way to analyse transportation solutions based on AVs and the ranking and comparative analysis of traditional and non-traditional forms of transportation.

A significant focus of this research is on the use of simulation models to better understand AVs as a set of socio-technological relations (Nye, 2007). This approach has led to modelling that considers how AV technology might affect individual travel decisions and behaviour (Azevedo et al, 2016); the performance of the larger transport network (Cohen et al, 2017); as well as the potential to reduce the size of vehicular fleets (Boesch et al, 2016).

Using Boesch et al (p. 118) as an illustrative example, this study showed that "AVs might induce more demand" by making travel comparatively more comfortable and potentially less expensive. Furthermore "[these] comfort and cost factors might also induce mode changes from public transport and [other] 'slow' modes to AVs". While the full implications of such scenarios are not understood, these authors fear that this will impose further demands on existing urban infrastructure and create a new kind of 'equilibrium' through what they describe as 'demand-reducing effects' as travel times increase.

Along with the transformation of transportation systems that AVs will introduce, they will, as full automation is reached, fundamentally change the nature of driving. This has prompted research, using classical stated-preference methodologies, into levels of acceptance of AV technology producing significant insights into potential societal barriers related to perception that may thwart early uptake of AVs by groups of individuals. One such study by Bansal and Kockelman (2016) examined Texans' views on AV technology and found that older and more experienced drivers were less prepared to pay for greater levels of connectivity. This was in contrast to more safety cautious drivers who said that they would be more willing to pay for higher levels of autonomy. These findings suggest that more experienced and confident drivers tended to be less trusting of computer-driven cars. This indicates that perhaps the rollout of AVs will be incremental, aligning

with the rise of a new generation with different expectations for travel and connectivity, which automation facilitates. Other studies examined people's preparedness to pay for increased automation. Ellis et al (2016) examined the demand for driverless vehicles through an online survey of 265 respondents to measure attitudes, concluding that young people were more likely to use driverless vehicles, with the older generation least likely. The interest in understanding attitudes and likely behavioural responses is echoed by Cohen et al (2017), who conclude that deliberative exercises with citizens and other stakeholders need to be conducted to develop our understanding of acceptance and preparedness. Such work is currently underway in New Zealand at the University of Waikato (NZTA, 2017).

Research conducted by Lu et al (2017) also used classical preference measurements to assess likely demand for AVs. This study connected demand for AVs with preferences in relation to housing location. They found that, in the metropolitan region of Atlanta, respondents felt AV technology posed a threat to public transportation systems, leading the authors to conclude the need for a more integrated approach (Lu et al, 2017). Similar sets of conclusions were produced by Thakur et al (2016), and Duranton (2016) who focused on the need for greater levels of integration with land use and urban form respectively, and cautioned that increased mobility may fuel a temptation for more remote living leading to the further expansion of the city. This is a paradigm widely connected to the sustainable transport agenda which we turn to next.

Sustainable development perspectives

While the shift towards a sustainable development orientation in transport planning precipitated a renewed focus in the role of public transport and mixed use urban development (Kęblowski & Bassens, 2017, p7), the sustainable development agenda surrounding AVs focusses more on the perceived opportunities for increasing the uptake of electric vehicles, and benefits to accrue from new shared economies.

Forming a central part of studies into sustainable transport, the integration with land use is a growing area of interest to the study of AVs. This includes how AVs will influence mobility patterns, land use, and how these trends will shape the future city (Alessandrini et al, 2015). This body of research includes studies into the interactions between autonomous vehicles and pedestrians, and into the strategic interactions between human road users and AVs (Millard-Ball, 2016), as well as the impacts this will have on land use (Fuller, 2016). With respect to the latter, Fuller (2016) argues that while there might be grounds for optimism about the potential of AV technology to enable beneficial land use outcomes, achieving more efficient use of land will depend on the redevelopment of sites

previously set aside for parking. It is also important to note that Fuller (2016) highlights the potential for AVs to introduce greater choice across urban form, where restrictions on land supply could be removed to support the development of low and high density neighbourhoods provided at different price points.

Several papers suggested new potential leveraged from the rise of AV technology such as an autonomous taxi network (Brownell & Kornhauser, 2014) and the expansion of car sharing (Firnkorner & Muller, 2015). A series of OECD studies have been produced, including a 2015 study examining the changes that may result from large-scale uptake of AVs on mid-sized European cities, as well as a 2016 study investigating the possible replacement of all car trips with on-demand and shared vehicles. Wadud et al (2016) identify specific mechanisms through which automation will affect travel and energy demand, including GHG emissions, by making mobility more efficient and coupling the rollout of AVs with the rise of electric vehicles.

A review by Milakis et al (2017), encompasses both the neo classical and the sustainable development perspectives, by exploring the 'ripple effect' of AVs onto first order issues related to travel cost, road capacity and travel choices and onto second order issues related to vehicle ownership, location choices and land use, and transportation infrastructure. The impact of AVs on third order effects such as energy consumption and air pollution, safety, social equity, economy and public health clearly position the study of AVs and their impacts into the space of sustainability, but falls well short of considering the urban planning and urban governance challenges raised by the introduction of AV technology, particularly, how AVs will contribute to the shaping of the future city for its citizens. This body of literature suggests that it is difficult to prioritize research themes for AVs because factors influencing the evolution and integration of the technology and its integration into society remain highly variable and/or unknown.

Political-economy perspectives

Much of the research assessed under both the neoclassical and sustainable development frames is technical and quantitative: reporting on the findings generated by employing surveys, scenarios and modelling techniques. This allows very little space for critical engagement with the AV future. Instead, that critical lens is gleaned from a literature base found predominantly in urban geography, sociology and political theory. This is where a focus on the political economy of cities renders visible the intersections between a technological revolution such as AV technology and the emerging governance challenges it presents for an evolving political-economic landscape (Kęblowski & Bassens, 2017). While many of the papers focussing on the theme of political economy raise

important questions surrounding the ethics of AV technology and of wider social questions about the future of mobility and the city, few of the papers dedicated specifically to the study of AVs engage explicitly with these political economy questions. We are attempting to extend the boundaries of analytical enquiry into the future of AVs by engaging with the broader literature on smart cities where a political economy analysis of the forces contextualising the development and rollout of AVs is made possible.

Research on smart cities (Hollands, 2008; McNeill, 2017), smart urbanism (Kitchin, 2014; Marvin et al, 2015), disrupted cities (Graham, 2010), and disruptive technologies (Gurran & Phibbs, 2017) explores the impacts of a wide range of technologies and new infrastructures (for example, Airbnb and Uber) that may upset current city-shaping efforts and decision-making systems. The disruptive dimensions of smart technology on the city are well documented in the literature, but to date there is little comprehensive examination of the specific impact of AV technologies on the efforts of citizens and governments to shape cities in productive and sustainable ways

The critical literature on smart cities also cautions that:

“beneath the emphases on human capital, social learning and the creation of smart communities, lay a more limited political agenda of ‘high-tech urban entrepreneurialism’” (Hollands, 2008, p. 314).

The emergence of AV technology and the drive from the IT and automobile industry falls squarely into the area of *corporate storytelling* and should arguably therefore be subject to further critical discourse across the urban planning and transport planning literatures. This need is recognised by Söderström et al (2014) who characterise the rhetoric around ‘smart cities’ as a form of ‘corporate storytelling’, a concept used to describe the efforts by corporations to achieve wide scale buy-in from decision-makers, politicians and civil society to the notion that technological innovation will be central to realising a range of ambitions held by these groups. This may include protecting the system of automobility upon which AVs:

“will reinforce... age-old discourses espousing technology’s superiority....[and secure] automobility’s endurance ...by a modernist instrumentalist imagining of technology” (Schwanen, 2016, p158).

It has been further argued that the private companies behind AV development and deployment are mobilising their capital as a ‘mobility industrial complex’, although this ‘complex’ contains competing visions for individual behaviour. The ‘disruptive’ IT industry imagines a future of declining private-vehicle ownership and the emergence of urban mobility as a service (see TSC, 2016; VDV, 2015).

Their interest in transport is also driven by a desire to commodify travel time. This can be done, for example, by using data about travel behaviour to allow businesses to advertise to potential customers while they are nearby, and by activating what is now effectively ‘dead-time’ when the attention of drivers must be on the road. In competition, the existing automobile industry is pursuing a vision of growing private vehicle ownership centred on new levels of comfort and performance (VDV, 2015).

AV technology, with its ‘new’ private-sector proponents, has the potential to transform cities in ways not seen since the rise of the private vehicle 70 years ago (Fagnant, 2014; Thomopoulos & Givoni, 2015), and re-shape the role of capital in urban governance, which we define as the set of relations between the public and private sectors and civil society that together inform the development of policy and the distribution of resources in planning (for example, capital and/or private sector expenditure in infrastructure). Research suggests that the rise in AV technology and its rollout in cities is strengthening the set of interrelationships that allow the public and private sectors to partner in planning, but it presents new challenges with respect to “blur[ring] the distinction between private and public modes of transportation” (Caudel & Ratti, 2015, p. 2). This has a direct impact on how accountability in decision-making is attributed and raises new questions for the role of democratic participation of civil society in transportation planning.

This increasing *complexity of transport governance* was the focus of a recent study by Marsden and Reardon (2017). They explored the extent to which transport policy is “becoming less something ‘done by the state’ (or) ‘received by the system’” (p. 239), but rather something that emerges from a diverse, networked and increasingly complex decision-making landscape. They go on to argue the need to query the roles of power, politics, context and legitimacy and how this is shaping transport policy (Marsden & Reardon, 2017, p. 249).

This call is, in effect, a recognition of the impact of neoliberalism on transport policy. Along with others, Gleeson and Beza (2014, p. 4) argue that the privileging of the economic logic and rationalisation will increasingly sit in tension with planning for the public good. The standard response is to demand greater transparency in the details of public-private partnerships (Ingrams, 2017). However, as the capacity for state agencies to direct the shape of urban development is further hollowed out (Streeck, 2016, p. 72) as is the case in Australia where “privatized urban monopolies ... control ever larger parts of Australia’s metropolitan estates” (Gleeson, 2017, p. 183), and corporate ambition is increasingly fused with state power and resources in what we can call ‘*corporatised governance*’ (Paul, 2016, Ch. 2, italics added), remedies must go deeper than simply improving disclosure. Recent evidence from Australia shows that the practice of decision-making for

transport system development is becoming more antagonistic as governments undermine civil-society critics by concealing data on the pretext of restrictions to competition, contractual confidentiality, and limiting access to previously available democratic processes (Legacy et al, 2017).

Visions for the deployment of AV technologies in ways that are likely to reap collective benefits are based on the recognition of the social, economic and environmental importance of mass transit as well as an increasing role for active transport. From this perspective, Lindsay (2016) writing from the *New Cities Foundation*, describes how AV technology could threaten some network segments and strengthen others, meaning that public transport agencies have the opportunity to both rationalise existing operations and expand their market through collaboration with AV providers (see VDV, 2015; UITP, 2017). The International Association of Public Transport (UITP) themselves have raised a concern of public transport systems being marginalised under shared mobility scenarios unless well regulated under a single portal (UITP, 2017). This is an emerging area for research into AVs, with projects newly commenced in many European jurisdictions and being considered by Australian State governments.

In summary, this literature identifies two competing visions for the future of AVs in cities that highlight the different stakeholders currently shaping the rollout of this technology. On the one hand, AVs may reinforce existing automobility-based hegemonies whereby the future of mobility will see that the car remain centre-staged and individually owned. Conversely, others envisage future economies based on sharing which may offer opportunities to meet many of the emerging challenges of the 21st century city. Following the literature, we assert that understanding the extent to which either might prevail requires engagement with the deep political context of AV development. One means for academic researchers to contribute to this work is to understand how planners are dealing with emerging AV technologies.

4.0 Comparing discourses on AV futures: do Australian planning practitioners share the interests of international scholars?

In this section, we analyse the thinking of Australian planners as revealed in a series of interviews conducted in early 2017 (as described in Section 2.0 above). We do this by identifying the extent to which the themes of current academic discourses on AVs as outlined in Section 3 are shared by planners. But, first, we provide a short description of Australian urban planning relative to Europe and North America.

Transport policy and governance context in Australia

Australian city regions are home to most of the population and dominate the political and economic landscape of the nation. While the principal suburban development of Australian cities took place in the era of automobility, they differ from North America in that the inner cores, shaped by public transport, have remained an attractive environment for the middle-class. Twenty-first century development is shaped around increasing polarity between service-rich inner suburbs and car-dependent lower-cost housing development on the urban fringe increasingly isolated from higher-level employment and educational opportunities. While many planners and citizens believe Australian suburbs to be of such low densities that alternatives to car dependence are impractical, careful consideration of the evidence shows that it is political and institutional will rather than the nature of the urban form that prevents greater use of alternatives to the car (Mees, 2010; Curtis and Low, 2012).

Australia is a federation of states with constitutionally and politically weak local government. City governance is largely in the hands of state agencies. This produces a pattern of parallel but separate policies and regulations for urban and transport planning. The national government typically engages in urban planning through attempts to achieve regulatory consistency, but its major role in cities is exercised through its fiscal power as the principal collector of income and consumption tax revenues. It has used this power over many decades to support suburban road expansion (Mees & Groenhart, 2014). Furthermore, neo-liberal policies since the 1990s have increased the role of the private sector in urban transport, most noticeably through the construction of major toll roads (in Sydney, Melbourne and Brisbane). The high profitability of these schemes has led to significant abuses of traditional transport modelling techniques and a shift away from public-sector control of urban planning processes (Maurice Blackburn, 2017; Wiggins, 2017).

Increasingly, political and social interest in AV development in Australia is gathering momentum with the announcement of AV trials (Premier of Victoria, 2016; Government of Western Australia, 2016; ABC News, 2017), references to the potential of AVs in newly released infrastructure strategies (Infrastructure Victoria, 2016), and internationally significant work on regulation of AVs by national agencies (NTC, 2017). The peculiarities of Australian urban politics and patterns of urban development mean that local AV futures will be influenced but not determined by European and North American practice alone. So, it is very important to base research in local experience to observe the similarities and differences with the outcomes of research such as that of Guerra (2016) in the USA.

Moving beyond a neoclassical perspective: predicting and anticipating an uncertain future

Across our respondents, there was strong knowledge of the state of AV technology development and the various positive and negative scenarios that have been articulated in the neoclassical transport planning literature. However, responses to this work centred on the high degree of uncertainty surrounding the form that AV technologies and economies might take and about the potential outcomes for key objectives in sustainability and social equity.

Unsurprisingly, the focus of interviewees was on the process of deployment rather than on the end-states depicted in studies such as the widely-read Lisbon modelling (OECD, 2016). Here, respondents were in the territory of the academic discourse on political economies, but seen through the lenses of their own institutional responsibilities. Respondents acknowledged the restrictions on the scope of public-sector control over AV futures, both because of the role of the private sector in bringing new technologies to the market and because of the specific limitations on public leadership imposed in Australia through local manifestations of neo-liberal political ideologies over several decades. However, there was a recognition that some degree of public intervention is necessary to achieve equity objectives.

There currently appears to be an operative consensus among public sector agencies to follow developments in the AV industry closely, but hold back on policy initiatives that could have real impact – an attitude of ‘watch and wait’, as suggested by this interviewee:

“healthy scepticism is probably always good to have, but I think the challenge will be that if we do see the rollout of AVs happening as expected or quicker, that we will have significant challenges keeping pace with that” (Interviewee 2).

The public sector thus finds itself in a fundamental dilemma. It is clearly required as a significant ‘shaper’ if the rollout of AVs is to occur in alignment with the public interest, yet it remains unclear whether the necessary political support and resources to underwrite such a role need to be forthcoming. There is a significant difference between proactively shaping the rollout of AVs in full awareness of the impact on the public interest that this technological transformation presents, and just waiting for this transformation to take shape. To deny this responsibility could be regarded as failing to act in the public interest.

Engaging with sustainability perspectives: addressing environmental and social costs associated with transport

In advance of the proliferation of automobiles during the 20th century, environmental and social costs associated with car-dependence were inadequately anticipated. These concerns are apparent in our study too and a more measured imaginary of the AV future can be seen in the remarks of

some planners in relation to the social costs of AVs. The questions of access to AVs and the possibility of facilitating greater inequality, are being raised early in its rollout:

“I could imagine a situation in which we actually need to regulate autonomous vehicles almost like a public good, because otherwise they could become something that is purely the domain of the wealthy, or you could have different grades of service and only the wealthy could afford a higher service, access to a higher-quality autonomous vehicle service versus others, and that would further enshrine and embed equity divisions within society” (Interviewee 1).

Interviewees identified the classic tensions between public interests and the profit motive of the private sector, recognising that unless strong regulation or cross-subsidisation occurs, large sections of the community will remain under-served by the new transport technology:

“If we leave it solely up to the market they won’t provide the off-peak stuff. If we are going to tap into the private sector to provide the commercially unattractive services, then we’ll need to subsidise them so we’ll need some oversight in such a mixed model” (Interviewee 5).

This dilemma raises questions about spatial equity, and system coordination, specifically how to ensure that AVs work within an integrated system with existing forms of public transport and land uses. Interviewees also highlighted the potential environmental benefits associated with AVs, if it is the case that AVs will emerge in tandem with electric vehicles.

“I think the issues and risks are fairly well known though, in terms of firstly, on the environmental perspective, whether the shift towards more efficient car technologies will achieve environmental benefits in and of itself, such as electric and hydrogen vehicles. And I think there is an understanding that there is a strong link between autonomous vehicles and more fuel-efficient technologies. But I think again, that relationship will be confirmed and will need to be focused on”. (Interviewee 2).

It was also noted by another interviewee that the rise of AVs will demand that we talk about transport relative to land use; aligning the discussion of AVs in the context of these Australian interviews with the sustainability perspective that recognises significant environmental benefits gleaned from transport and land use integration.

“With regards to land use planning, that’s a really challenging one. Because we suspect that with the introduction of more highly automated vehicles, that these vehicles be used in

different ways. If you move to an automated vehicle service that's providing a shared mobility service and that's on-demand, like an on-demand ride-sharing service, that vehicle would be used differently to the way a private vehicle would be used, in that it would be continually servicing people, doing drop-offs and pick-ups, and many of those will be on our road network. Whereas I suppose a private vehicle usually goes off the road network into a private car park, or commercial car park, and then filtered one by one back onto our road network." (Interview 3).

In particular, the role of regulation in managing the anticipated negative impacts of AVs on people and the environment is an area of significant concern. It positions the conversation about AVs into a comparatively more reactionary space, whereby regulation will likely develop in response to growing awareness of negative externalities and tensions with respect to their interaction with the built form, people and the environment as they reveal themselves. However, in taking a reactionary position to the development of regulation to encourage market-sector innovation, there is a risk that wider social and environmental ambitions for cities will become second-order concerns shaped by a techno-rationalist development of AVs. It is this point that Kęblowski and Bassens (2017) argue is the failure of neoclassical and sustainability perspectives: a failure to impose the social and environmental justice frameworks that could be gleaned from planning policies in western democratic cities may result in a depoliticised space in which AVs are allowed to shape cities without scrutiny. Instead, questions need to be asked, early in the development and rollout of AVs about who will ultimately benefit, and how these benefits are experienced, spatially and over time, across the city.

A turn towards a political economy perspective: renewing the role for urban planning

A majority of respondents saw the role of government agencies in facilitating the implementation of AV technology was to enable the private sector in their development and rollout of AVs. Private firms are interested in securing first mover advantage and in doing so, imposing a standard on the market. They are focussing their attention, through AV trials, on states where elected officials are likely to offer incentives to attract global capital. However, one interviewee argued that while active cooperation between the public and private sector is necessary to enable development, there is also a clear need to manage competing interests in the wake of private sector leadership:

"The issue about the data, the infrastructure ownership, the rules under which people can use infrastructure, and the other data that governments have available as the owner of the assets, the regulatory conditions and the price that needs to be paid in order to use

autonomous vehicles – all of those things require very active and informed governments to be purchasers, regulators, policy makers and partners with the private sector....there is no doubt that the technology and capability sits within the private sector and the question will be, how can government partner smartly and act as an enabler, in a risk-informed way, to get benefits which they might not even be able to see for themselves at this point.”(Interviewee 2).

Guerra (2016, p. 215), in a comparable set of interviews among North American planning agencies, identified a widespread lament among respondents who described the long-range planning process as ‘reactive’ to private sector leadership. Our Australian interviewees echoed this sentiment, though largely without offering concrete strategies how to overcome the dilemma, for instance, of developing “a far more agile way of planning and setting policy, and if needed, setting regulation” (interviewee 6). One interviewee continued by noting that:

“We’ve got to, if it is possible, be far lighter on the regulatory side of things...Regulation is fine, you sometimes need an element of regulation to address an impure market, but if you get that regulation wrong, then you will get those who will take advantage of an imperfect market. And that can often be scale driven” (Interviewee 6).

We look to Guerra (2016) who quotes one of his respondent’s dilemma of ‘pondering the imponderable’ (p. 214): there are still too many unknown factors about the direct and indirect impacts of AVs on urban planning to justify specific investments into the transition on behalf of governments, yet the absence thereof may act to weaken the influence of public agencies in setting the agenda. In departing from Guerra, our interviewees recognised the need to understand the motivations driving collaboration with the private sector:

“I know that there’s been a fair bit of competition among Australian jurisdictions to kind of be the first movers in this place, to create the regulatory environment in which particularly some of these trials can take place. And international players like Google are obviously particularly prominent and I suspect there’s competition between jurisdictions to house Google trials and the like. The capacity of the public sector to engage meaningfully with the private sector to understand the drivers that motivate private sector behaviour is going to be really important” (Interviewee 1).

The concern here is that given the disruptive possibilities of this technology, and the fact that it will be the biggest innovation in transportation in over 70 years, it is problematic for the public sector to solely play a facilitating role. Continued blurring of responsibility between the public and private

sector will tend to reproduce and entrench the existing corporatisation of transport governance and shield the rollout of AVs from possible, and critically important, public scrutiny.

The interviews engaged with key themes arising from the political economies discourse in the AV literature. The themes of 'corporate storytelling', 'corporatised governance' and 'uncertain futures' were all raised, although in some instances these themes were presented in a more implicit manner. This picture of fractured and increasingly undemocratic urban governance provokes the question as to who will be best served in the AV city of the future. While new AV futures are imagined by information technology and automobile companies, often in tandem with elected officials, in the absence of regulatory controls, the public sector and civil society will increasingly be forced into reacting to the new innovations as they are introduced into existing built environments.

Our interviews raise new questions about the complexities of urban transport governance that are evolving with the emergence of AVs. These complexities are rendering visible new questions for policy development, and planning. As Marsden et al (2013: 53) recently argued, the importance of active policy engagement in the context of impending urban disruptions remains central to anticipating and then responding to potential negative impacts; this is also true for AVs. It is therefore critical to consider the role of urban planners in shaping not only the future at this initial early stage, *but also the governance arrangements that will enable active participation of planning in leading the rollout of AVs.*

We join Bruun and Givoni (2015) in urging for further social scientific enquiry into the urban planning impacts of AV technology. It is now critical that the role of urban land use and transport planning be asserted. In cities developed to accommodate the car, particularly in post-war suburbs such as those in Australia, up to three decades of metropolitan strategies have focused on the need for a transition away from the car towards cities designed around public transport (Legacy et al, 2017). Yet there is an imminent risk presented by AVs to this direction if planning and governance matters are ignored. One such risk is that AVs will increase mobility through the promotion of 'mobility as a service'. Here we see the commodification of individual travel driven by corporate actors seeking to benefit from this transformation (Docherty et al, 2017). These were concerns that were barely touched on by our interviewees, but offer an opportunity for further research.

5.0 Conclusion

The central question motivating this research is what role could urban planning play in the early policy development and rollout of AV technology in urban environments? In engaging with this question, we have come to share Kęblowski and Bassens (2017) position that studies of transport

planning need to evolve its critical capacity in a manner that allows the political and economic forces shaping policy and innovation to be brought into clear view. This is the ground in which public and private sectors will together shape the rollout and the penetration of the AV into our future city.

This is as much a question of politics as it is a question of technological innovation and policy evolution. While the impacts related to car-based mobility were previously identified at a time when new forms of movement were starting to reshape cities (Buchanan, 1963), little was done to find lasting solutions to the challenges. Today AVs are presented as the most significant transformation in transportation planning since the advent of the private motor vehicle nearly 70 years ago. Given the confluence of actors in play – public and private – and the competing visions they offer, the challenges that AVs present for policy and strategic planning, are very complex to address (Brown et al, 2009). Currently, however, there is very little political engagement with the details of what an AV future may look like and what it will mean for existing transportation systems and urban planning policies. Neoclassical transport-planning researchers and neo-liberal politics, from their different standpoints, both appear to assume that AVs are inevitable and that the future will self-regulate with limited input from deliberate policy-making.

In seeking to understand the challenges and forces in play, we undertook a literature review in the fields of geography, urban planning and urban transport to examine the prospects and limits for AV technology. In doing so, we engaged with theories of political economy (Kęblowski & Bassens, 2017; Marsden & Reardon 2017; Schwamen, 2016) and urban governance (Gleeson and Beza, 2014; Streeck, 2016, Paul, 2016) drawn from critiques of the neoliberal city to help in the positioning of AV scholarship in transport studies into a more critical area of debate and conceptualisation. From here, we are able to ask questions about the contextual forces not only shaping AV and its rollout but also influencing who gets to decide this shape and how and who it impacts. Further research may wish to extend the scope of this analysis to include other scientific and technical fields. However, in our analysis, we have highlighted the need for urban and transport planning to rise to the pressing challenges from growing levels of inequitable access across the city (Curtis & Scheurer, 2016; Martens, 2016), to the connection between automobility and climate change (Chapman, 2007) and the fragmentation of physical landscapes (Ibisch et al, 2016). The advent of AVs does not necessarily provide answers to these problems. Furthermore, the review of literature and the data from our Australian interviews indicate that we are a long way from a holistic and systematic understanding of the potential impacts of AVs on the physical shape of the city, and the political and social dynamics of the emerging ‘shared mobility’ economy.

In Australia, planners appear to be struggling to imagine the consequences of the coming AV disruption, this is despite the fact that Australian cities are far more car dependent than their European counter-parts, a reality that presents a unique context in which to explore the implementation of AVs in the built environment. Examining the rollout of AVs in the Australian context also offers the opportunity to examine the interaction with a range of different governance contexts - from state to state within a federal system - for the operation and management of future public transport systems. However, despite these opportunities for future research, the constraints of neo-liberal politics that shape the context of planning has led some planners into an almost existential doubt over the extent to which AVs can be shaped by planning and public policy at all. Based on our interviews, planners are aware of the need to find regulatory, planning policy and political instruments to shape the AV future in ways that meet the social and environmental imperatives of rising inequality and climate change, but there is little understanding as how this might be achieved.

The challenge for transport planning researchers is to develop a cohesive and coherent critical theoretical and conceptual framework that brings the potential of AV technology into dialogue with the public purpose of planning (Gleeson and Beza, 2014). This requires the profession, collectively, to identify emerging best-practice in the processes of public policy engagement. This can be done by describing and analysing the range of emerging commercial trials of AV technologies and the associated regulatory and policy responses, and by setting these in the context of evolving commercial power relations, and the international variation in public-sector willingness and ability to engage with the emerging political and economic conflicts with a 'redistributive' agenda. This international variation will include differences in the extent to which political representatives act to either open or restrict the space in which public-sector planners can operate.

REFERENCES

- ABC News (2017) Driverless vehicle technology to be tested at Adelaide Airport, Flinders University, 21 March 2017. Retrieved from <http://www.abc.net.au/news/2017-03-21/driverless-car-trial-at-adelaide-airport,-flinders-university/8373006> [Accessed 22/09/2017]
- Alessandrini, A., Campagna, A., Delle Site, P., Filippi, F., & Persia, L. (2015). Automated vehicles and the rethinking of mobility and cities. *Transportation Research Procedia*, 5, 145-160.
- Azevedo, C.L., Marczuk, K., Raveau, S., Soh, H., Adnan, M., Basak, K., Loganathan, H., Deshmunkh, N., Lee, D.H., Frazzoli, E., & Ben-Akiva, M. (2016). Microsimulation of demand and supply of autonomous mobility on demand. *Transportation Research Record: Journal of the Transportation Research Board*, (2564), 21-30.
- Baker, S.E., Edwards, R. and Doidge, Mark (2012) *How many qualitative interviews is enough?: expert voices and early career reflections on sampling and cases in qualitative research* [Working Paper]
- Bansal, P., & Kockelman, K.M. (2016). Are We Ready to Embrace Connected and Self-driving Vehicles? A Case Study of Texans. *Transportation*, 1-35.
- Boesch, P. M., Ciari, F., & Axhausen, K. W. (2016). Autonomous vehicle fleet sizes required to serve different levels of demand. *Transportation Research Record: Journal of the Transportation Research Board*, (2542), 111-119.
- Boyatzis, R.E. (1998). *Transforming Qualitative Information: Thematic Analysis and Code Development*. London: Sage Publications.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77-101.
- Brown J., Morris E.A., & Taylor B.D. (2009). Planning for cars in cities: Planners, engineers and freeways in the 20th Century. *JAPA* 75(2), 161-177.
- Brownell, C., & Kornhauser, A. (2014). A driverless alternative: fleet size and cost requirements for a state wide autonomous taxi network in New Jersey. *Transportation Research Record: Journal of the Transportation Research Board*, (2416), 73-81.
- Bruun E., & Givoni, M. (2015). Six research routes to steer transport policy. *Nature*, 523(7558), 29-31.

Buchanan, C. (1963). *Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas*. Reports of the Steering and Working Groups to the Minister of Transport. London, HMSO.

Burns, L. D. (2013). Sustainable mobility: a vision of our transport future. *Nature*, 497(7448), 181-182.

Chapman, L. (2007). Transport and climate change: a review. *Journal of Transport Geography*, 15(5), 354-367.

Claudel, M., & Ratti, C. (2015). Full speed ahead: How the driverless car could transform cities. *McKinsey Quarterly*.

Cohen, T., Jones, P., & Cavoli, C. (2017). Social and Behavioural Questions Associated with Automated Vehicles: Scoping Study by UCL Transport Institute. London, UCL Transport Institute.

Curtis, C., & Low, N. (2012). *Institutional Barriers for Sustainable Transport*. Aldershot: Ashgate.

Curtis, C., Scheurer, J. (2016). Planning for Public Transport Accessibility: An International Sourcebook. Abingdon: Routledge.

Davison, G. (2004). *Car Wars: How the Car Won our Hearts and Conquered our Cities*. Crows Nest: Allen and Unwin.

Dia, H. (2016). The Real-time City: Unlocking the Potential of Smart Mobility. Australian Transport Research Forum, Melbourne.

Docherty, I., Marsden, G., & Anable, J. (2017) The governance of smart mobility. *Transportation Research Part A*, Online First.

Duranton, G. (2016). 'Transitioning to driverless cars', *Cityscape: A Journal of Policy Development and Research*, 18(3), 193-196

Ellis, B., Douglas, N., & Frost, T. (2016). November. Willingness to pay for driverless cars. In Australasian Transport Research Forum (ATRF), 38th, 2016, Melbourne, Victoria, Australia.

Fagnant, D. J., & Kockelman, K. (2015). Preparing a nation for autonomous vehicles. *Transportation Research Part A*, 77, 167-181.

Fereday, J. & Muir-Cochrane, E. (2006). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development. *International Journal of Qualitative Methods*, 5, 80-92.

Firnkorn, J., & Müller, M. (2015). Free-floating electric carsharing-fleets in smart cities: The dawning of a post-private car era in urban environments?. *Environmental Science & Policy*, 45, 30-40.

Flyvbjerg, B. (1998). *Rationality and power: democracy in practice*, translated by Steven Sampson, University of Chicago Press.

Frenken, K. (2017). Political economies and environmental futures for the sharing economy. *Phil. Trans. R. Soc. A*, 375(20160367)

Fuller, B. (2016). Cautious Optimism About Driverless Cars and Land Use in American Metropolitan Areas. *Cityscape: A Journal of Policy Development & Research* 18(3): 181.

Glaser, S., Vanholme, B., Mammar, S., Gruyer, D., & Nouveliere, L. (2010). Maneuver-based trajectory planning for highly autonomous vehicles on real road with traffic and driver interaction. *IEEE Transactions on Intelligent Transportation Systems*, 11(3), 589-606.

Gleeson, B. (forthcoming). The Metropolitan Condition. In S. Hamnett & R. Freestone (Eds.), *Planning Metropolitan Australia*. Abingdon: Routledge.

Gleeson, B., & Beza, B.B. (Eds.) (2014) *The Public City: Essays in Honour of Paul Mees*. Melbourne: Melbourne University Press.

Government of Western Australia (2016) Trial of autonomous vehicles, Media Statements, 9 February 2016. Retrieved from <https://www.mediastatements.wa.gov.au/Pages/Barnett/2016/02/Trial-of-autonomous-vehicle.aspx> [Accessed 22/09/2017]

Graham, S. (Ed.) (2010). *Disrupted cities: When infrastructure fails*. New York: Routledge.

Greenblatt, J.B., & Shaheen, S. (2015). Automated vehicles, on-demand mobility, and environmental Impacts. *Current Sustainable/ Renewable Energy Reports*, 2(3), 74-81.

Guerra, E. (2016). 'Planning for cars that drive themselves: Metropolitan planning organization, regional transportation plans, and autonomous vehicles', *Journal of Planning Education and Research* 36(2), 210-224.

Gurran, N., & Phibbs, P. (2017). When Tourists Move In: How Should Urban Planners Respond to Airbnb? *JAPA*, 83(1), 80-92.

Hall, P. (2012). 'Driverless vehicles', *Planning Focus*, Planning Institute of Australia, November..

- Hollands, R.G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City*, 12(3), pp.303-320.
- Ibisch, P.L., Hoffmann, M.T., Kreft, S., Pe'er, G., Kati, V., Biber-Freudenberger, L., DellaSala, D.A., Vale, M.M., Hobson, P.R., & Selva, N. (2016). A global map of roadless areas and their conservation status. *Science*, 354(6318), 1423-1427.
- Infrastructure Victoria (2016) 'Victoria's 30-year Infrastructure Strategy, December 2016', State of Victoria, Melbourne.
- Ingrams, A. (2017). Transparency for Results: Testing a Model of Performance Management in Open Government Initiatives. *International Journal of Public Administration*, 1-14.
- Isaac, L. (2016). 'Driving towards driverless: A guide for government agencies', Parsons Brinkerhoff, WSP. New York
- Kębłowski, W. & Bassens, D. (2017). "All transport problems are essentially mathematical": The uneven resonance of academic transport and mobility knowledge in Brussels. *Urban Geography*, 1-25.
- Kitchin, R. (2014). 'The real-time city? Big data and smart urbanism', *GeoJournal*, 79(1), 1-14.
- Lakatos, I., 1978. The methodology of scientific research programmes. Cambridge University Press, Cambridge.
- Lam, A., Leung, Y., & Chu, X. (2016). "Autonomous-vehicle public transportation system: scheduling and admission control." *IEEE Transactions on Intelligent Transportation Systems* 17(5): 1210-1226.
- Legacy, C., Curtis, C., & Scheurer, J. (2017). Planning transport infrastructure: examining the politics of transport planning in Melbourne, Sydney and Perth. *Urban Policy and Research*, 35(1), 44-60.
- Lindsay, G. (2016). Now Arriving: A Connected Mobility Roadmap for Public Transport. New Cities Foundation
- Lu, Z., Du, R., Dunham-Jones, E., Park, H., & Crittenden, J. (2017). Data-enabled public preferences inform integration of autonomous vehicles with transit-oriented development in Atlanta. *Cities*, 63, 118-127.
- Marsden, G., & Docherty, I. (2013). Insights on disruptions as opportunities for transport policy change. *Transportation research part A: policy and practice*, 51, 46-55.

Marsden, G., & Reardon, L. (2017). Questions of governance: Rethinking the study of transportation policy. *Transportation Research Part A: Policy and Practice*, 101, 238-251.

Martens, K. (2016). *Transport justice: Designing fair transportation systems*. London: Routledge.

Marvin, S., Luque-Ayala, A., & McFarlane, C. (Eds.). (2015). *Smart urbanism: Utopian vision or false dawn?*. London: Routledge.

Maurice Blackburn (2017) Past class actions – Settlement of the Rivercity class action:
<https://www.mauriceblackburn.com.au/past-class-actions/rivercity-class-action/>

McNeill, D. (2017). *Global Cities and Urban Theory*. Los Angeles: Sage.

Mees, P. (2010). *Transport for suburbia: beyond the automobile age*. London: Earthscan.

Mees, P., & Groenhart, L. (2014). Travel to work in Australian cities: 1976–2011. *Australian Planner*, 51(1), 66-75.

Milakis, D., Van Arem, B., & Van Wee, B. (2017). Policy and society related implications of automated driving: A review of literature and directions for future research. *Journal of Intelligent Transportation Systems*, 1-25.

Millard-Ball, A., 2016. Pedestrians, Autonomous Vehicles, and Cities. *Journal of Planning Education and Research*, p.0739456X16675674.

Newton-Smith, W., 1981. *The rationality of science* / W.H. Newton-Smith, International library of philosophy Y. Routledge & Kegan Paul, London.

NTC. (2016). 'Preparing for more automated road and rail vehicles', National Transport Commission: Melbourne.

Nye, D.E. (2007). *Technology matters: questions to live with*, Cambridge: MIT Press.

NZTA. (2017). New Zealand Transport Agency, Active Research Projects. Retrieved from <https://www.nzta.govt.nz/planning-and-investment/nltp-investments/research-programme/active-research-projects/>. Accessed 1st August 2017.

OECD. (2015). *Urban Mobility System Upgrade: How Shared Self-driving Cars could Change City Traffic*, International Transport Forum, Paris.

OECD. (2016). *Shared Mobility: Innovation for Liveable Cities*, International Transport Forum, Paris.

- Owczarzak, Ł. & Żak, J. (2015). Design of passenger public transportation solutions based on autonomous vehicles and their multiple criteria comparison with traditional forms of passenger transportation. *Transportation Research Procedia*, 10, 472-482.
- Paul, E. (2016). *Australian Political Economy of Violence and Non-Violence*. London: Palgrave Macmillan UK.
- Peattie, L. (2001). Theorizing planning: Some comments on Flyvbjerg's Rationality and Power. *International Planning Studies*, 6, 257-262.
- Premier of Victoria. (2016). Victoria leading the way on autonomous vehicle trials, Minister for Roads and Road Safety, Media Release, Melbourne: Retrieved from <http://www.premier.vic.gov.au/victoria-leading-the-way-on-autonomous-vehicle-trials/> [Accessed 22/09/2017]
- Randolph, B. (2006). Delivering the Compact City in Australia: Current Trends and Future Implications. *Urban Policy & Research*, 24(4), 473-490.
- SAE International. (2014). Automated Driving. Levels of driving automation as defined in new SAE International Standard J3016.
- Schwanen, T. (2016) Rethinking resilience as capacity to endure. *City*, 20(1), 152-160.
- Söderström, O., Paasche, T., & Klauser, F. (2014). Smart cities as corporate storytelling. *City*, 18(3), 307-320.
- Streeck, W. (2016). *How Will Capitalism End?* New York: Verso.
- Thakur, P., Kinghorn, R., & Grace, R. (2016) Urban form and function in the autonomous era. In Australasian Transport Research Forum (ATRF), 38th, Melbourne, Victoria, Australia. 2016.
- Thomopoulos, N., & Givoni, M. (2015). The autonomous car—a blessing or a curse for the future of low carbon mobility? An exploration of likely vs. desirable outcomes. *European Journal of Futures Research*, 3(1), 14.
- Transport Systems Catapult. (2016). Mobility as a service: Exploring the opportunity for Mobility as a service in the UK.
- UITP. (2017). Autonomous Vehicles: Threat or opportunity for urban mobility? Press Release, Brussels, 16 January 2017. Retrieved from

http://www.uitp.org/sites/default/files/PR_Autonomous%20vehicles%20-%20threat%20or%20opportunity_0.pdf

Van Wee, B. V., & Banister, D. (2016). How to write a literature review paper?. *Transport Reviews*, 36(2), 278-288.

Verband Deutscher Verkehrsunternehmen. (2015). Zukunftsszenarien autonomer Fahrzeuge. Positionspapier, November 2015

Victorian Auditor General (2015) East West Link Project,
<https://www.audit.vic.gov.au/sites/default/files/20151209-East-West-Link.pdf>, ISBN 978 1 925226 39 3, accessed 20th December 2017.

Wadud, Z., MacKenzie, D., & Leiby, P. (2016). Help or hindrance? The travel, energy and carbon impacts of highly automated vehicles. *Transportation Research Part A: Policy and Practice*, 86, 1-18.

Wiggins, J (2016) Rivercity IPO investors secure \$121m in successful Clem7 class action, Sydney Morning Herald, 1 June 2016, Sydney.

Zhang, W., Guhathakurta, S., Fang, J., & Zhang, G. (2015). Exploring the impact of shared autonomous vehicles on urban parking demand: An agent-based simulation approach. *Sustainable Cities and Society*, 19, 34-45.