

Rethinking engagement in urban design: reimagining the value of co-design and participation at every stage of planning for autonomous vehicles.

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Abstract

Purpose

The practical demonstrations and research which led to the preparation of this paper involved a combination of stakeholder engagement, policy debate and the practical demonstration and testing of autonomous vehicles. By adhering to a design approach which in centred on participation and human-centred engagement, the advent of autonomous vehicles might avoid many of the problems encountered in relation to conventional transport.

Design

The research explored how a new and potentially disruptive technology might be incorporated in urban settings, through the lens of participation and problem-based design. The research critically reviews key strands in the literature (autonomous vehicles, social research, participatory design), with allusion to current case study experiments.

Findings

Although there are numerous examples of AV research concentrating on technical aspects alone, this paper finds that such an approach appears to be an unusual starting point for the design of innovative technology. That is, AVs would appear to hold the potential to be genuinely disruptive in terms of innovation, yet the way that disruption takes place should surely be guided by design principles, and by issues and problems encountered by potential users.

Originality

What sets this research apart from other studies concerning autonomous vehicles was that the starting point for investigation was the framing of AVs within contexts and scenarios leading to the emergence of wicked problems. It begins with a research position where the potential uses for AVs are considered in a social context, within which the problems and issues to be solved become the starting point for design at a fundamental level.

Practical Implications

The research carries significant implications for practice in that it advocates locating those socio-contextual issues at the heart of the problem definition and design process, and ahead of technical solutions.

Keywords

Urban design, Autonomous Vehicles, participation, co-design, people, case studies, planning

Introduction

‘New technologies tend to expand what we can do, but do not necessarily indicate what we should do.’

(Litman, 2019)

This paper draws on the experiences of the Interreg North Sea Region funded projects ART-forum (Automated Road Transport) and PAV (Planning for Autonomous Vehicles) which implemented five urban AV pilots (in Aalborg, Almere, Hannover, Inverness and Varberg). It proposes that we should explore and draw on the potential insights which may be gained through designing AV initiatives using stakeholder participation as a core methodology.

The research was cognisant of the fact that the problem(s) to which AVs present a solution are likely to be affected by the situation, background, goals and wider context of stakeholders. It is also vital to appreciate that the lens through which individual or groups of stakeholders view the world will deeply affect the perceived usefulness and likely impact of any new technology. As noted by Robinson *et al.* (2021), who explored the use of lensing within policy making, the “worlds” of scenarios can be presented and understood in terms of perspectives which then require further elaboration and interpretation. For example, key stakeholder groups affected by AVs are diverse, and the “problem” to which AVs may present a potential solution will vary between cases:

- Vehicle manufactures (need for additional revenue)
- Drivers/passengers (comfort, safety)
- Mass transit companies (replacement or redeployment of human resource)
- City authorities (desire for smart transport planning)
- Pedestrians (safety)

Therefore, the central research path concerned how stakeholder engagement can help to ensure the realisation of cities which are socially sustainable, and where new and emerging technologies such as autonomous vehicles can work in service of that goal.

Contextual Background

Throughout urban planning history, newer transportation systems have repeatedly cast aside and oppressed older travel methods. For instance, during the 20th Century, cars dominated roads as the sole method of transport, as dictated by modernist urban planning ideals, thus marginalising cycling and walking (Gaio and Cugurullo, 2022).

It is important to note the political background against which these shifts in planning ideology took place. Automobile domination was the result of car manufacturers’ government lobbying during the 20th Century. Convincing politicians that cycling and walking are a danger to people’s lives due to the presence of cars has resulted in the oppression of these active travel methods (Gaio and Cugurullo, 2022). As a result, automobiles became the only so-called “safe” form of transport available, one that “is neither socially necessary nor inevitable but has seemed impossible to break from” (Urry cited in Cugurullo and Gaio, 2022).

Thus, the introduction of cars was largely imposed, with no stakeholder consultation. In fact, citizens often protested the construction of motorways and/or the domination of automobiles. For instance, the Netherlands’ famous adoption of cycling as a mainstream form of transport originated from a

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3 social campaign concerned about children's safety; it highlighted the number of children killed every
4 year by motorists (Gaio and Cugurullo, 2022). It is worth noting that the Netherlands did not have
5 car manufacturers to lobby against the development of cycling infrastructure.
6

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8 However, in most parts of the world, the shift towards cars caused significant social, economic,
9 environmental, and urban challenges that cities face today. For instance, increased access to cars as
10 a quick transportation method allowed people to live farther away from their places of work (which
11 is mostly in cities), thus contributing to urban sprawl (Gavanas, 2019).
12

13 Perhaps, however, one of the most notable negative impacts of car-centric planning is the
14 disintegration of walkable cities and with it the lack of social interaction and placemaking, qualities
15 of which Jacobs (2011) and Gehl (2011) have long observed their decline and thus advocated for. For
16 instance, Jacobs (2011) observes in her book *The Death and Life of Great American Cities* that
17 attempts to predict, shape, or control people's behaviour through urban design ends in failure, with
18 the result being cities that promote social alienation, lack of security, lack of social interaction, and
19 lack of life. Her views were later confirmed through Gehl's (2011) public life studies on urban
20 planning. In a more recent study, the work of Lotfata *et al.* (2022) serves to draw attention to the
21 changes, pressures and potential of urban walking in the context and aftermath of the COVID-19
22 pandemic, and to place the importance of mobility in a social, health and economic context.
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26 Therefore, it can be said that the widespread use of private cars, urban sprawl, and inefficient and
27 unequal use of space in cities have hugely contributed to undesired spatial ramifications and to a
28 general poor state of society's health (for example as discussed by Rojas-Rueda and Turner, 2016).
29 These issues, in addition to environmental sustainability, paint the broad strokes of what current
30 problems cities face today as the result of the machine city ideology. They therefore need to be
31 accounted for and placed at the forefront of discussion when considering implementing a new
32 technology such as autonomous vehicles, which has the potential power to exacerbate these
33 detrimental effects on people's health and wellbeing.
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36 37 Current AV Research

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40 'It [AVs] is a disruptive technology that has the possibility of bringing positive as well as
41 negative outcomes to stakeholders.'
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43 (Strömberg *et al.*, 2021, p.9)

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45 Studies predicting the future of autonomous vehicles vary greatly, ranging from the hopeful and
46 optimistic to the more careful and critical. This is because sufficient data needed to assess whether
47 autonomous vehicles will exacerbate current planning problems or resolve them is lacking (Gavanas
48 2019), and current hypotheses often seem contradictory. For example, one argument for AVs claims
49 that they will reduce the number of cars on the road. This can be achieved by incorporating them
50 with planning concepts such as transit-oriented development (TOD) whereby high-density areas are
51 located near public transport systems. In this scenario, AVs can assist with TODs by connecting
52 people who live farther away with public transport networks, thereby helping people cover the 'last
53 mile' of their destinations (Duarte and Ratti, 2018). This hybrid solution would in turn help reduce
54 cars on the road and increase public transport uptake. Still, AVs can never truly replace public
55 transport in terms of sustainability, capacity, and efficiency since the latter is a denser form of
56 transport that occupies less road space.
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3 In addition, AVs can be used in ridesharing schemes, also decreasing cars on roads. However, the
4 answer is not simple nor straightforward. For instance, AVs can exacerbate urban sprawl as they
5 would alleviate the stress and exhaustion caused by driving. This can provide an incentive for people
6 to live farther away from cities as commuting becomes more enjoyable and efficient (Duarte and
7 Ratti, 2018), thereby increasing the number of cars.
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10 Another potential benefit to AV adoption is the freeing of parking spaces. In a scenario where AVs
11 are moving 70% of their time (as opposed to 5% of the time with motor vehicles), constantly picking
12 up and dropping off users, AVs can free parking spaces within cities (Duarte and Ratti, 2018). This
13 can mean more public space availability. It can also mean less on-street parking, leading to smaller
14 streets and therefore denser and more compact cities.
15

16 Finally, in the same way that 20thC cars oppressed active travel methods, there is a well-founded
17 concern that autonomous vehicles will oppress them again, specifically cycling, a much-needed
18 method of sustainable transport in cities. This will give commuters less transportation choice and
19 will be in direct opposition to current planning's sustainable and social goals where cycling provides
20 a cheap, environmentally friendly alternative to driving (Gaio and Cugurullo, 2022). Other vulnerable
21 road users will potentially be impacted by the encroachment of autonomous vehicles as well:
22 pedestrians and those who use wheelchairs, skateboards, or other micro-mobility methods.
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26 In that respect, AVs could be seen as potentially the most innovative and promising (Fagnant and
27 Kockelman, 2015), yet the most disruptive intervention that would profoundly remodel our cities
28 and socio-spatial organisation in terms of land planning and use (Legacy 2019; Yigitcanlar *et al.*,
29 2019). While some studies have considered the politics of sustainability transitions (Avelino *et al.*,
30 2016; Chatterton, 2016) and others have explored the political implications of low-carbon transitions
31 in building standards (Affolderbach & Schulz, 2016) and energy (Bouzarovski & Simcock, 2017;
32 Petrova, 2018), research on mobility transitions more often focuses on technological change as the
33 starting point of inquiry. Technologically driven sustainable mobility solutions (such as electric
34 bicycles and delivery drones) are abundant; however, transport scholars agree that focusing on
35 technology alone is insufficient and can be counter-productive (Banister *et al.*, 2013; Ferreira *et al.*,
36 2017). Little, if any, attention has been paid to parallel theorisations of mobility transitions
37 originating from a concern for social justice. In fact, scholars of environmental justice and just
38 sustainability have long argued that a singular focus on carbon emissions may lead to a new world of
39 mobility that fails to address structural asymmetries of power (Chatterton, 2016; Swilling & Annecke,
40 2012). Chatterton (2016, p. 403) observes that "there remains a reluctance to name and advocate
41 for the more radical nature of transitions that society needs to embark on to address the huge
42 challenges it faces". In the same vein, narrowly framing AV issues on technological benefits or
43 legislative matters to accelerate AV introduction conceals the multitude of social issues integral to
44 AV implementation, such as the contemplation of alternative mobility scenarios; the
45 interrelationships between people, vehicles, and real/perceived scenarios; and the consequences of
46 those relationships.
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50 Scholars believe stakeholder engagement can play a key role in bridging this gap. For instance,
51 Shibayama *et al.* (2019) highlighted that a collaborative approach among all stakeholders, including
52 governments, citizens, companies, and planners, is a key step for AV deployment to complement
53 sustainable mobility goals. However, there is a lack of research comparing different stakeholders'
54 points of view and assumptions about autonomous vehicles despite this comparison being crucial for
55 the successful implementation of AVs (Strömberg *et al.*, 2021). This includes engagement with active
56 travellers such as cyclists (Gaio and Cugurullo, 2022), whose input is needed to avoid another wave
57 of active travel oppression.
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3 It is therefore argued that public engagement activities and research in social science could play an
4 active role in recommending alternative routes to achieve sustainable future mobilities, determining
5 the success of AV technology, and contributing to imperative discussions about social justice. As
6 Graham, 2010 (quoted in Cohen *et al.*, 2020) highlights, '*We should not wait for an AV-related*
7 *infrastructural disaster.*'
8
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10 Research on driverless vehicles is relatively well developed within the technological field, while social
11 science research on the likes of users' experiences with driverless vehicles and the societal
12 opportunities and risks of the technology are limited (Heikoop *et al.*, 2020; Yeo and Lin, 2020a).
13 Existing studies that investigate user perspectives often focus on 'user acceptance' (see Nordhoff *et*
14 *al.*, 2017). Several studies find that among potential users there is an overall positive attitude
15 towards driverless vehicles (e.g. Mouratidis and Cobeña Serrano, 2021; Nordhoff *et al.*, 2018; Rehrl
16 and Zankl, 2018; Salonen and Haavisto, 2019), but it is also emphasized that "[...] *a positive attitude*
17 *does not imply that people will be willing to adopt them*" (Roche-Cerasi 2019, p. 172).
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20 The specific and often quantified focus on the positive and negative experiences of driverless
21 technology may indicate broad support for driverless vehicles, but it often remains unclear in these
22 studies what nuances exist in informants' answers and what factors are actually measured. For
23 example, studies have found that users' 'positive attitude' to driverless vehicles may be due to the
24 anticipation of what these technologies will be able to contribute in the future (López-Lambas and
25 Alonso, 2019), not least because only a very few have actual experience with the technology.
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28 There is also a potential discrepancy between users' ideas about, enthusiasm for and expectations of
29 driverless vehicles and the real technological development and limitations that the vehicles have
30 (Nordhoff *et al.*, 2017; 2019; Mouratidis and Cobeña Serrano, 2021). Studies point out, for example,
31 that despite a positive attitude towards driverless shuttles, several informants do not find them
32 practical in their current form (Roche-Cerasi, 2019; Mouratidis and Cobeña Serrano, 2021; Nordhoff
33 *et al.*, 2019). Finally, the research in the area has also faced criticism for being based on an
34 assumption that technological breakthroughs unilaterally determine people's reality, with people
35 reduced to passive recipients of driverless technology (Yeo and Lin, 2020a).
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39 **The Case for Stakeholder Engagement and a Human-centred** 40 **Approach** 41 42 43 44

45 'The question is not when AVs will arrive or how to accelerate that arrival. Instead, we
46 should be asking where the technology would be appropriate, who is likely to benefit, who
47 the stakeholders are, what form it could take and what ends should be prioritised.'
48

49 Tennant and Stilgoe (2021)

50 The questions oscillating around AVs need to be re-framed so that the focus shifts from
51 technological advancement to understanding and addressing the problems and challenges people
52 face. This can occur by 'putting technology "in its place" in terms of understanding and respecting
53 the contexts in which it might be deployed,' (Cohen *et al.*, 2020, p. 2). When focusing on urban
54 planning issues, this shift of perspective towards a human-centred approach can provide research
55 context that addresses how AVs may be an innovative mobility 'solution' whilst drawing on social
56 science and collaboration.
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3 In that regard, the gradual introduction of autonomous vehicles into existing built environments
4 could potentially be seen as an opportunity for a fundamental rethink of detrimental aspects of the
5 current relations between urban spatial planning and transportation systems, facilitating sustainable
6 mobility and complementing active travel. However, innovation such as that potentially emerging
7 through automated transport cannot be led as a monologue, and AVs should not be seen as an all-
8 encompassing solution before identifying the often complex urban problems which they could
9 address or ameliorate.
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12 However, and often in advance of necessary ongoing public debate and engagement being
13 established, autonomous vehicles are being developed and tested not only in private laboratories
14 but also on public roads, often in complex mixed mobility scenarios (Arvin *et al.* 2021, Pereira *et al.*
15 2019). Thus, it can be argued that postponing the questions and scrutiny into the purposes and
16 consequences of this potentially disruptive technology is somewhat foolhardy.
17

18 Furthermore, the urban systems including all road structures intermeshed with the AV worlds could
19 become an enormous digital depository of tangible personal data having an immediate and immense
20 impact on security, privacy, and freedom. The future algorithms and data politics (ownership, bias,
21 sharing and use of information) could become an important aspect of understanding the
22 accountability in crash/crime/safety investigations (Winfield and Jirotko, 2018; Stilgoe, 2018) as well
23 as exposing the fragility of the systems' benefits.
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26 Finally, a spectrum of feelings may be associated with introducing such novel technology as self-
27 driving vehicles on the roads, from excitement and enthusiasm to the uncomfortable sensation of
28 dooming, inevitability, and thus helplessness (Martines Diaz *et al.*, 2018; Wolf, 2016). The reality is
29 very much nuanced when it comes to assimilating new [potentially highly disruptive] technology,
30 and arguably, what may be required is a notion of humbleness about predicting the future as well as
31 identifying its limits without succumbing to the seductive quality of technology (Mindell, 2015) and
32 the hype around it. The apprehension associated with the new technology and the moral dilemmas
33 of security and privacy potentially leading to a '[d]ystopic digital Orwell-ization of self and society'
34 (Urry, 2007, p.276) need to be considered with broad issues of ethics and safety; people [in human-
35 machine interactions] have always been active agents and should be categorised as more than just
36 consumers whose lives can simply fall under 'datafication' of everyday life to create their user
37 profiles.
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40 To demonstrate the importance of stakeholder engagement in the AV discussion, a study conducted
41 by Strömberg *et al.* (2021) revealed and compared urban planners, future users, and AI developers'
42 hopes and concerns regarding AV deployment. The three groups shared the same hope, namely for
43 AVs to become a more sustainable transport method and to provide their users with more services.
44 However, they also agreed that the dispersal of AVs would conflict with urban sustainability goals
45 such as reducing carbon emissions and car dependence.
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48 Beyond that, the groups had different views when it came to the technology's implementation. For
49 instance, urban planners and developers predicted changes in travel demand, where there would be
50 fewer cars on the road. This, on the other hand, was not entirely found among future users, with
51 opinions ranging from a reduction in demand due to ride-sharing options to the increase of "chaos"
52 in city centres (Strömberg *et al.*, 2021).
53

54 In addition, developers hoped that AVs could save municipalities infrastructural investments by
55 using existing roads to their full capacity rather than investing in train infrastructure. However,
56 urban planners pointed the need for major infrastructural changes to accommodate AVs, with one
57 claiming that it wouldn't be cheap (Strömberg *et al.*, 2021).
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3 Interestingly, future users were the only group to highlight inclusivity and social justice. They
4 discussed potential job losses resulting from AV implementation and discussed the need for a robust
5 system (i.e., software that does not freeze or cause mishaps) to allow those who cannot drive, such
6 as wheelchair users, to ride AVs safely. They also brought a more humanistic perspective to the
7 discussion, imagining how people would feel inside autonomous vehicles and how they can be
8 rescued in the event of an accident. They had a heartfelt concern that allowing technology to dictate
9 the future blindly would oppress societal values such as equality and sustainability. They also
10 highlighted concerns regarding the lack of an authority figure in vehicles for safety, a role currently
11 understood to be undertaken by bus drivers (Strömberg *et al.*, 2021).

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15 In addition, they expressed concerns that AVs would become too attractive to users, eventually
16 becoming the one preferred transport method over cycling or walking (active travel), a view like the
17 one argued by Cugurullo and Gaio (2022).

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19 Finally, future users questioned the motives behind AV development, with one stating “is it about
20 money, or about the environment, or many of the other aspects? What is the main purpose of it?”
21 Interestingly, developers shared the same questions. “... in the grand scenario, what is the role of the
22 AV?” and so did urban planners “What do we want? What should we work for?” (Strömberg *et al.*,
23 2021, p. 8).

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26 In conclusion, the groups agreed on the complexity of AV planning and had similar hopes for their
27 positive implementation; however, they differed in how this implementation needs to take place
28 and had different concerns regarding their negative consequences. Future users brought the human
29 factor to the AV implementation issue. Where planners spoke from an urban perspective and
30 developers spoke from a technological one, future users brought to the table more human-centric
31 issues such as people’s interactions with and feelings towards autonomous vehicles, inclusivity, job
32 losses, and active travel oppression, among other societal values. As a result, future users were more
33 concerned about the social implications of AVs, something that other stakeholders did not dwell on
34 or explicitly mention. It has been highlighted through other studies that stakeholder engagement is
35 necessary to uphold these societal values.
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39 Self-driving Cars as an Open-ended Social Experiment

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42 ‘If technological issues continue to dominate the research effort, questions of huge societal
43 importance will be either missed or dealt with superficially.’

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45 (Cohen *et al.* 2020)

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47 AVs will be ‘attached’ (Stilgoe, 2020) and connected in many ways to the world around them and will
48 have profound cultural and social consequences (on top of spatial, infrastructural, legal, and
49 environmental issues). Stilgoe (2020) explicates that attachments can be defined as commitments,
50 relationships with people, objects, institutions, and infrastructures - the crucial points where the
51 technology would meet the ‘real world’. When attachments are not considered or omitted on
52 purpose and certain technology assertions go unquestioned, the world and the cities we live in may
53 be pressured to adapt to AVs rather than the other way around. ‘Expressions of desire to re-
54 engineer the world for the sake of AVs are common among developers’ (... , p.151), demanding
55 spatial and infrastructural changes and forcing people to behave in more ‘predictable’ ways to
56 accommodate technology. This ‘mechanistic’ point of view is similar to the one commonly held
57 during the 20th century following the introduction of motor vehicles; cities were seen as ‘a territory
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3 to be bounded, mapped, occupied, and exploited, [and] a population to be managed and perfected,'
4 (Donald, cited in Robbins, 1998).
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6 Conversely, acknowledging the aforementioned would lay foundations for a more inclusive
7 establishment of AVs, one that makes the introduction of the technology a means to societal goals
8 (safety, sustainability, improved urban environment, accessible mobility, and mobility justice) rather
9 than an end in itself. It can be said that AVs and 'the places and lifestyles that are created around
10 them represent an open-ended social experiment that urgently needs to be democratised' (Stilgoe,
11 2020).
12

13 Furthermore, Stilgoe (2020) explains how the obsolete 20th century mechanistic view can repeat
14 itself: whereas motor vehicles mandated traffic lights, jaywalking laws, and car parks, autonomous
15 vehicles could introduce dedicated lanes, new pedestrian rules, smart infrastructure, and digital
16 high-definition maps. He further highlights that '*[t]he story currently being told by self-driving car
17 developers downplays these aspects. The car, we are told, will be smart so that the world around it
18 does not have to be; artificial intelligence will do everything a human driver can do and more. This
19 "myth of autonomy" will, if swallowed whole, lead to some bad decisions.*' (Stilgoe, 2020). In
20 addition, there are myriad ways in which the promise of autonomy could turn into a set of demands
21 and a 'self-fulfilling prophecy' (Van Lente and Bakker, 2010). As the claims surrounding new
22 technologies start to be believed in, adjustments would naturally happen.
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25 Thus, this technologically deterministic view should be confronted as it often oversimplifies and
26 superficially translates the problem—mainly human error into the simple solution—the initiation of
27 ultra-aware artificial intelligence. This needs to be coupled with resisting the 'hype' around AVs,
28 targeting the needs of those who often lose out from innovation, and enabling new collaboration to
29 flourish.
30

31 As noted by Legacy *et al.* (2019, p. 91), 'the emergence of AV technology and the drive from the IT
32 and automobile industry falls squarely into the area of corporate storytelling and should arguably
33 therefore be subject to further critical discourse across the urban planning and transport planning
34 literatures.' In this vein, we recognise the importance of scrutinising technologies at an early stage
35 before they become commonplace. The narrative built around AVs must not be asymmetrical and
36 mainly derived from commercially driven aspects of technology or interests that would not
37 necessarily accord with public interests. In fact, Strömberg *et al.* (2021) appear in sharp contrast with
38 what the media and tech companies circulate about AVs. Interestingly, this gap between reality and
39 media hype was a concern that developers highlighted during their discussions.
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3 For instance, WSP and Farrells asserted that “*driverless and autonomous vehicles are coming, and*
4 *they will be transformational,*” (as cited in Skinner and Bidwell, 2016, p. 4). They proposed the
5 concept of an “AV zone” within the city, an area where pedestrians and cyclists share space with AVs
6 without motor vehicles. It asserts that such a scenario is safe and prioritises people and cyclists over
7 cars, highlighting that roads will be shared among all three (Skinner and Bidwell, 2016). However, AV
8 developers from Strömberg *et al.* (2021)’s study have expressed their concerns regarding over trust
9 in the technology as well as the challenges of integrating AVs in shared space scenarios such as this
10 one. In fact, during scenario-building, an engineer in object detection, radar sensors, and neural
11 networks has suggested an AV-only zone, with “no motorcycles, no manually operated cars, not
12 even bicycles” as the easier way to implement AVs. Cugurullo and Gaio (2022) have also highlighted
13 artificial intelligence’s weaknesses in identifying cyclists. Thus, ‘as human behaviour is oftentimes
14 unpredictable and far from being automated, driverless transport modes will somewhat have to
15 acquire ‘additional social intelligence’ (Camara *et al.*, 2020, p. 1) to function in complex socio-spatial
16 environments. This consequently confirms their concerns about a 3rd wave of oppression for cyclists
17 and other vulnerable road users.
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22 Finally, incorporating new technologies is not always the answer. In fact, the opposite is sometimes
23 true. In 2017, traffic lights were removed from a busy intersection in Amsterdam to reduce the
24 number of people who disobey traffic signals (Gaio and Cugurullo, 2022). The result was successful
25 and is an example of removing technology as a solution as opposed to adding it. This demonstrates
26 the dangers of implementing technology for technology’s sake, where people are forced to adapt
27 themselves to technology rather than developing it to adapt to their needs (Gaio and Cugurullo,
28 2022) as tech corporations often advocate (Stilgoe, 2020). This is why new transport solutions need
29 to be ‘socially progressive rather than reinforcing already entrenched inequalities and repressive
30 ideologies,’ (Bissell *et al.*, 2020, p.128). This can be achieved by thinking about autonomous futures
31 in new ways that integrate public consultation in every implementation stage (Bissell *et al.*, 2020).
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36 Approaches Adopted for Stakeholder Engagement

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39 As part of the PAV project activities, each of the pilot representatives was encouraged to implement
40 open, regular and longitudinal public engagement events as forming the AV implementation
41 journey.
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43 It can be argued that to achieve success, the involvement of representatives from across the
44 relevant societies who might be affected by AVs and later planned projects should be ensured;
45 stakeholders should not be limited to expert groups or those in positions of power (decision makers
46 only) the same way the narrative built around AVs should not be based on technologically-mingled
47 and commercial aspects only. The intention underlying the engagement activities is also to establish
48 and then implement a process through which a group of stakeholders, selected in response to the
49 demands and aspirations of each pilot study, are able to provide guidance and feedback to each of
50 the local project teams, whilst also engaging in activities throughout the planned work, and
51 extending from the design stage through to the delivery, monitoring and evaluation of projects on
52 site. Qualitative methods need to be designed (customized) to identify and analyse (some of the)
53 “*unfolding relations between technology and society, spaces where human agency may be found*
54 *despite the structural grammar set by automation.*” (Yeo & Lin 2020, p. 5).
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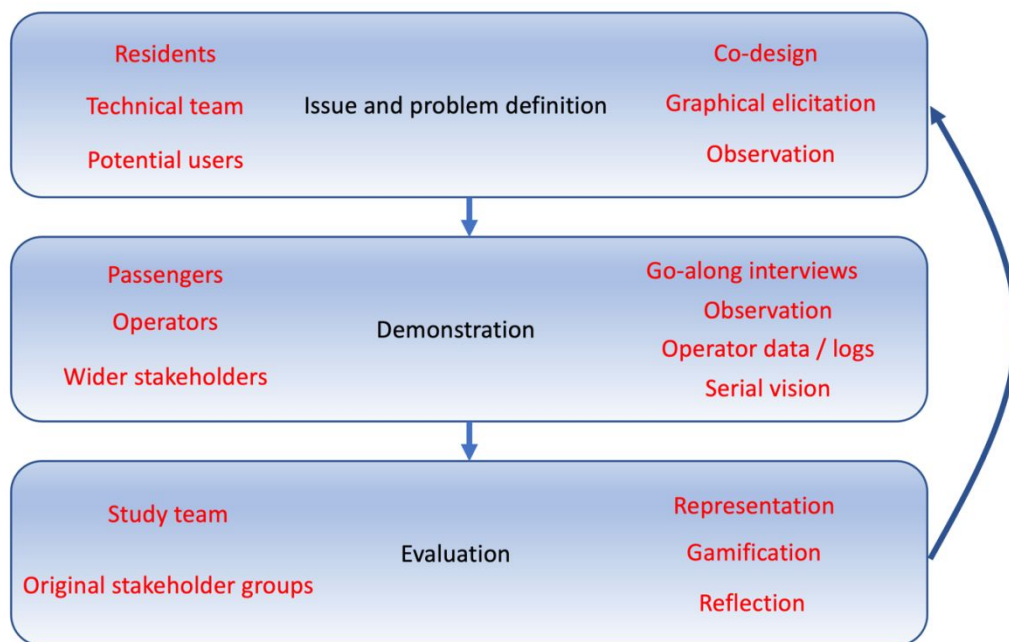


Figure 1: suggested longitudinal approach to AVs and stakeholder engagement

Studies from around the world have revealed that there are important unresolved questions about where, how and with what benefits the technology can be used. For example, in Aalborg East, the Smartbus trial was set up to investigate the technology as a means of pursuing practical and social purposes in a concrete urban context and as part of the ongoing social transformation of an existing urban area. In line with this broad intention, the task description for Aalborg University's study was not bound by special hypotheses or fixed boundaries in relation to what knowledge the study specifically could or should produce. Because the use of driverless technology is a new field, it has been a research goal in itself to collect the richest and most nuanced material possible about the concrete encounters between technology, city and people, herein insights into the route's specific spatial characteristics and design, the ways the shuttles were used and who used them, and the narratives about place and identity in which the shuttles were embedded.

The Aalborg study of how the driverless shuttles and the transformation of Astrupstien affected life on and around the path took place over a number of years, from the initial studies in 2017 to the end of the project in 2021. Throughout this period, the shuttles gave rise to interviews, informal conversations, workshops and observations about driverless technology, the district's qualities and challenges, and the path's many uses.

The study of these concrete encounters between technology, city and people demonstrates, among other results, that the trial brought about new narratives in and about the district of Aalborg East. The users of the path generally embraced the shuttles, although there were also some who found them disruptive to the general flow of the path. There was initially a concern among some residents that vandalism would be committed on the shuttles or that the artwork in the tunnel and on the shuttles' garage would be destroyed. Many ultimately reported finding it positive and uplifting that the furnishings and decoration were allowed to remain undisturbed. Several expressed their view of the Smartbus project as a positive contribution to the district's development because it meant that Aalborg East was associated with innovation and solutions for the future rather than social problems or vandalism. Others questioned whether the money would have been better spent on other initiatives in the district. All in all, the trial has added a new chapter to the compilation of narratives

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3 about social problems and strong counter-narratives about unity, colour and diversity that exist in
4 and around Aalborg East.
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6 The study incites further curiosity as to the development of a community approach to driverless
7 technology. The richness of the interactions that took place in and around the shuttles, between
8 shuttle users, path users and operators, warrants continued curiosity about how driverless mobility
9 can be brought into play as an element in sustainable mobility development and urban
10 development. It is possible that the experience could be used to investigate whether a community
11 approach to driverless technology can be further developed, one that integrates mobility, local
12 community development, social work and the quality of public spaces to follow new model, e.g. in
13 the form of a collaborative project where local actors, such as businesses, leisure facilities, transport
14 companies, housing associations and nursing homes, join together in implementing a local citizen-
15 oriented driverless service bus.
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19 Case study Research and AVs 20

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22 It may be argued that the urban realm is a highly contested area where many stakeholders, systems
23 and agents have often conflicting demands and expectations. The infrastructural and thus built
24 environment changes intrinsic to cities and their [re]development have had immense - occasionally
25 unintended - social, cultural, and environmental implications (Tierney, 2017). As the technological
26 advancement paralleled with mobility and societal progress turn toward the widespread adoption of
27 AVs, a series of uncertain and once more unintended planning consequences might be expected
28 (Pangbourne *et al.*, 2018). Furthermore, stakeholder engagement might offer a means of assessing
29 mobility needs unbiased. As Servou *et al.* (2022) highlight, conducting urban experiments is often
30 done based on preconceived notions that the subject of experimentation is positive, thereby leading
31 to biased results. By involving stakeholders from different backgrounds while simultaneously
32 bringing them together under one goal, namely sustainable mobility, different points of view,
33 discussions, and solutions can be brought forth, thereby reducing absolutist, biased solutions.
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36 Different urban contexts will require different solutions, which stakeholders can highlight and/or
37 clarify. As Servou *et al.* (2022) indicate, scalable experiments are not always viable because it cannot
38 be assumed that what works in one area will work in another. This is because the context is often
39 different, thereby making a “one solution fits all” approach detrimental.
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41 Research is often associated with the search for answers that are universally applicable across
42 locations and social contexts and that are easily transferable to projects or applications elsewhere.
43 In the study of people and society, however, this type of transferable knowledge has often been
44 shown to be illusory. As one of the method’s proponents, Flyvbjerg (2010, p. 466), noted in an article
45 concerning case studies, this is not because no attempts have been made: “*Despite persistent*
46 *attempts to develop context-independent and predictive theory as in the natural sciences, in the*
47 *social sciences you always end up with context-dependent knowledge*”.
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50 A consequence of studying phenomena in their social and spatial context is that the descriptions
51 that emerge can rarely be summed up unambiguously in a single unified argument. The case
52 presentation consists of perspectives and experiences which are characterized by the complexity of
53 lived life and people’s mutually contradictory perceptions. Our goal has been to highlight the co-
54 existence of these different perspectives and the importance of considering all of them meaningfully
55 when discussing AV development. Indeed, the matter itself is multi-faceted and complex, with many
56 different factors coming into play.
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3 It is suggested that future research should explore and apply findings in relation to the potential for
4 AVs to extend the use of shared mobility (following work by Narayanan, 2020; Tian *et al.*, 2021),
5 rather than to further increase the number of vehicles using road space, albeit though new
6 technology. Likewise, the effects of context on the implementation of AVs will be critical, with the
7 methods applied in the case of Aalborg suggested as a route towards establishing user and
8 community needs. Coupled with this, the importance of having political and democratic processes
9 capable of supporting and enabling such engaged design is critical (following, for example, the
10 seminal work of Jensen 2011; and more recently that of Aoyama and Leon, 2021). Indeed, recent
11 work (AlWaer *et al.*, 2021) described how such governance of democracy requires clear and shared
12 follow-up planning, an agreed action programme and a delivery mechanism to ensure that
13 aspirations are met.
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18 Discussion and conclusions

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20 This paper argues that the implementation of AVs first requires the contextualised application of co-
21 design methods (following Sanders and Stappers, 2008; Yang *et al.*, 2021) used to help stimulate
22 debate, facilitate understanding, and help to open a dialogue with potential end-users and to engage
23 stakeholders early in the process of its development and regulatory deployment. As noted by Cohen
24 *et al.* (2020), *'the technology, if it is to succeed in its own terms, must work with and incorporate the*
25 *social complexities of the real world'*.
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28 However, the reality of many mobility interventions is that they do not take place within the holistic
29 consideration of urban areas, wherein complex intersectional interactions between mobility, health,
30 inclusivity, economics and suchlike can be addressed. The well-established importance of
31 longitudinal evaluation of mobility interventions (as described by Mertens *et al.*, 2019) within a
32 research context, is often difficult or even impossible to implement within the context of larger-scale
33 projects. This may be due to disconnections between inception, procurement, initial application and
34 running, in terms of budgets and parties involved. What is perhaps more troubling in the context of
35 emerging technology of AVS, including their connectivity with wider urban systems, is that the great
36 majority of applications and studies have taken the form of demonstration or pilot projects, where it
37 is difficult to identify and engage with 'real' end users, let alone explore how the projects would
38 cause change or be a disruptive force within urbanism.
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42 Autonomous vehicles will have profound impacts on our quality of life, our streets and immediate
43 neighbourhoods. The nature of the changes will largely depend on how and whether we respond to
44 the challenges ahead and guide the questions we would ask as citizens, and professionals closely
45 involved with developing or negating the technology. It is believed that the participation of users at
46 the design stage carries the potential to greatly improve results and modal shift.
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48 During the 20th Century, *"Cyclical transport mode oppressions were the result of the political*
49 *agendas, histories of infrastructure, societal norms, technologies, energy access, and geopolitical*
50 *alliances,"* (Gaio and Cugurullo, 2022). Lobbying played a key role then, with auto-manufacturers
51 advocating for various policies that are to their advantage. Today, the "politics [of AI] are driven by
52 Great Houses of AI, which consist of the half-dozen or so companies that dominate large-scale
53 planetary competition." (Crawford, 2021, cited in Gaio and Cugurullo, 2022, p.11). In fact, AV
54 developers from Strömberg's study alluded that opposition to their companies' visions would get
55 them labelled as "whistle-blowers". This is too similar of a situation to that of the 20th Century, with
56 a concentrated few having the power to shift the political scene in their favour, yet again without
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the engagement of other stakeholders, much to said stakeholders' detriment (Gaio and Cugurullo, 2022).

On the other hand, it is well-documented through Gehl (2011) and Jacobs (2011) that human-centric urban design contributes to liveable, thriving cities and is in line with sustainable mobility goals. AVs then can be a double-edged sword, where thoughtful implementation can complement the current shift towards active-travel, public transport, and 15-minute cities. Otherwise, it can perpetuate car-centric design, for "emphasizing technology first and incumbent dominant modes of transportation will result in similar outcomes to historical transport oppression," (Gaio and Cugurullo, 2022, p.8). A key way to avoid this is through stakeholder engagement and collaboration between academia, politicians (governments), users, and auto-manufacturers, with the shared goal of making cities more sustainable, liveable, and sociable. Empirical evidence and research need to inform policy-making and subsequent urban planning, and democratisation of the process plays a key role in averting a technocratic future. Otherwise, history is bound to repeat itself.

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