

Governance of automated vehicle in the urban transport system: Insight from a willingness-to-use survey and Norwegian cultural context

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ABSTRACT

Automated vehicles (AV) can increase safety, reduce congestion, and provide environmental benefits to the urban transport system. Nonetheless, AV's governance in the urban transport system is challenging. This paper proposes a novel interdisciplinary methodology and contributes to the governance debate from the 'policy' and 'polity' dimensions. We attempt to draw insight from the Norwegian cultural context and a willingness to use AV survey in Oslo, Norway. We then attempt to provide insight into the workable governance approach for AV deployment in the Oslo region, Norway. Our result suggests that less than half of the people in the Oslo region are willing to use AV. Based on our analytical insight, we argue that a workable governance approach for AV that will allay fears of privacy loss while making people feel safe and secure, manage uncertainty, pessimism about technological innovation, and embrace time-honoured Norwegian traditions should be considered to support the deployment of AV in Norway.

Introduction

Automated vehicle (AV) represents a potentially disruptive yet beneficial change to the transportation system with the potential to improve vehicle safety, reduce emissions and congestion, facilitate efficient use of travel time, and change travel behaviour (Fagnant and Kockelman, 2015; Singh et al., 2023; Alexandros et al., 2021; Oldbury and Karolina, 2021). Promoters of AV argue that removing people from the steering wheel will logically result in a vastly reduced number of accidents (Cohen et al., 2020). AV can provide different services, such as on-demand ride services within a fixed route with fixed stops, a fixed route with on-demand stops, or door-to-door on-demand services. AV can provide unimodal or multimodal door-to-door trips (Nemoto et al., 2021).

AV can potentially have positive and negative impacts on the urban transport system. On one hand, AV can reduce vehicle ownership, fleet size requirements, parking demand, labour costs, and cold-start emissions, thereby contributing to safety, congestion reduction and environmental sustainability (Singh et al., 2023; Othman, 2021; Haugland, 2020). On the other hand, if not carefully managed, AV may have adverse environmental impacts such as sprawling land use, increased vehicle miles travelled associated with congestion, and increased travel

time consequences (Nikitas et al., 2021; Etzioni et al., 2020; Freemark et al., 2020). Besides the potential positive and negative impacts, the integration of AV in urban transport system is confronted with governance challenges. One of the critical governance challenges is designing the 'right' spatiotemporal context-dependent governance structure for AV in the urban transport ecosystem. Designing and managing the governance structure is essential for realising the potential benefits of AVs and mitigating the risks (Cohen et al., 2020). This paper attempts to contribute to the governance of AV in the urban transport system debate. Governance is a broad concept, and understanding governance depends on the analytical viewpoint. Governance can be in the 'political' dimension (the actor constellation - range of actors involved in the process of policymaking), 'policy' dimension (political steering - the nature and character of steering instruments in use) and 'polity' dimension (the institutional landscape - in which the actors operate based on a system of rules that shape their actions) (Treib et al., 2005). Institutions are the humanly devised constraints that structure political, economic, and social interactions. Institutions consist of both informal constraints and formal rules in an interdependent manner and consequent political and economic organisations (North, 1991; Schippl et al., 2022; Hrelja et al., 2017).

Informal institutions are not explicitly formulated and written down

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but internalised in community members' hearts and souls; informal institutions change slowly and are not subject to economic calculative behaviour. Individual economic actors, or groups of actors in collective action, are rarely able to purposefully (re)design informal institutions (Correlje et al., 2014). Institutions are also formal and informal norms and rules shaping human interactions and social exchanges. Institutions share with culture the ability to shape individual and collective preferences and attitudes (Kaasa and Andriani, 2022). Informal institutions cannot be fully understood without considering culture, and understanding culture presumes insight into institutions. Culture consists of the unwritten rules of the social game. Culture is the collective mind programming that distinguishes the members of a group of people from others (Hofstede, 2005). Culture is the rich complex of meanings, beliefs, practices, symbols, norms, and values prevalent in a society (Schwartz, 2006). It is impossible to fully understand the governance of urban transport without analysing informal institutional variables. Legal or formal institutions that do not have strong 'informal' support are unsupported legislative declarations rather than real institutions. This does not mean legal rules are unimportant but become important by incorporating them in informal institutions (Hodgson, 2006). Culture matters because it affects attitude, behaviour, and choices, providing an indicative road map to distinguish between proper and improper behaviour in a society (Kaasa and Andriani, 2022). Culture is a primary factor influencing the adoption or acceptance of new technologies and innovation (Yun et al., 2021; Syahrivar et al., 2021).

The process of institutional change is overwhelmingly incremental because the network externalities that arise from a given institutional matrix of formal rules, informal constraints, and enforcement characteristics will typically bias costs and benefits in favour of choices consistent with the existing governance framework (North, 1994). Thus, appropriate governance frameworks to align public and private interests are required to capture the potential benefits, minimise costs, and support the integration of AV in the urban transport system (Docherty et al., 2018). As AVs exemplify radical and disruptive technologies which require informed governance regimes, there is a risk that without appropriate governance regimes, the potential benefits of AV may be lost (Cunneen et al., 2020; Narayanan et al., 2020).

The willingness to use AV is the strength of people's intention to use AV (Keszei, 2020). The willingness to use AV is impacted by culture in a society and can be supported by a workable context-specific governance approach. This paper attempts to contribute to the governance debate to increase willingness to use AV from the 'polity' (focusing on informal institutions from the cultural viewpoint using the Hofstede 6D model) and the 'policy' dimension (the steering instrument a government can use to support AV) adapting the framework developed in Audouin and Finger (2019). Hofstede's 6-D model describes a culture in six dimensions: Power Distance, Individualism, Tough/Tender, Uncertainty Avoidance, Long-Term/Short-term Orientation, and Indulgence. Audouin and Finger (2019) describe five methods of political steering: governing by doing, governing by enabling, laissez-faire, self-governing and governing by authority. Using the Oslo region of Norway as a case study, we conduct and draw insights from a willingness to use survey and frameworks of Hofstede's 6D model and governance (Audouin and Finger, 2019). We attempt to answer the following questions:

- How does Norwegian culture impact the willingness to use AV in Norway?
- What is the workable governance approach to support AV deployment in Norway?

This paper proceeds as follows: Section 2 is the literature review. Section 3 is the methodology. Section 4 presents our results. Section 5 discusses our results. Section 6 is the conclusion.

Literature review

This section presents three streams of related literature to our research: i. AV integration in the urban transport system ii. The willingness to use AV iii. Governance of AV in the urban transport system.

AV integration in the urban transport system

AV is perceived as a disruptive innovation: a new technology with characteristics that are initially unfamiliar to producers and consumers, which may require a major evolution of institutions and infrastructures with the potential to disrupt market structures and lead to behavioural changes (Mackay and Metcalfe, 2002). AV could reduce crashes, ease congestion, improve fuel economy, reduce parking needs, bring mobility to those unable to drive, and dramatically change the nature of travel (Fagnant and Kockelman, 2015; Yun et al., 2021). AV could also increase productivity as commuters can work instead of driving (Mira, 2021). Huber et al. (2021) found that if many passengers regularly use AVs, they have significant advantages over personal vehicles from an environmental viewpoint. AV could play a specific complementary role, such as for the first mile, last mile, micro-transit^a commute or off-peak operation instead of regular buses in a mobility system (Nikitas et al., 2021). AV could be deployed as automated minibuses to transport up to fifteen passengers, offering on-demand, door-to-door services. AV could be combined and connected with other means of transport to provide commuters with optimised travel time, costs, and environmental impact (Fournier et al., 2022). AV's diffusion and potential impact on the urban transport system could depend on its technical product capabilities, environmental and economic performance, and social acceptance (Korbee et al., 2022).

Several recent studies have shown the impact of AV integration in the urban transport system. Fournier et al. (2020) simulated the impacts of AV adoption in Berlin and Stuttgart (Germany). The authors found that AV fleet could lower negative externalities and generate cost benefits for commuters. Bansal and Kockelman (2017) simulated a long-term AV fleet evolution for 30 years to forecast the United States adoption levels of AV under different technology prices, willingness to pay (WTP) and regulatory scenarios. The authors found that rapid reduction in technology costs, rise in people's WTP and supporting policies are required to promote AV adoption. Singh et al. (2023) found that AV could pose additional challenges, such as increased waiting time and the associated inconvenience(s), increased vehicle miles travelled, and could increase congestion due to empty miles. A study in Oslo, Norway, to understand the impact of integrating AV in urban transport shows that in a scenario where all the existing ICEV users switch to AV, there will be drastic traffic reduction in Oslo as about 7 % of the current vehicle fleet will be required to meet transport demand during the peak period (Ruter, 2019). Related studies show similar results, such as the OECD International Transport Forum's Lisbon study (3 %), Helsinki (4 %), Dublin (2 %), Auckland (7 %) and Stuttgart (7 %) (ITF, 2016; Helsinki (2017), Dublin (2018), Auckland (2017), Friedrich et al., 2018). The results illustrate that AV integration in the urban transport system could significantly reduce internal combustion engine vehicles (ICEVs) use, air pollution, accidents, noise, and congestion externalities. Nonetheless, integrating AV would require new transport infrastructure and governance structure.

The willingness to use AV

We discuss in this subsection the willingness to use AV literature. Regarding the share of the population willing to use AV, Zmud et al.

^a Micro-transit commute means a trip to particular locations such as city centres, central business districts, university campuses, airports, shopping malls, and hospitals.

(2016) found that half of their respondents are willing to use self-driving vehicles. Sener et al. (2019) found that around half of their survey respondents in different cities are willing to use self-driving vehicles. Wang et al. (2020) found that a significant fraction of the population is not ready to use AV and is generally reluctant to use AV ridesharing. Panagiotopoulos and Dimitrakopoulos (2018) found that nearly two-thirds of their survey respondents consider they will be late adopters of AV technology. With respect to privacy concerns, Zmud et al. (2016) found that the more concerned a person was about data privacy issues, the less likely their intent to use self-driving vehicles. Ljubi and Ales (2023) found that privacy concerns and perceived safety significantly affect general concerns about the willingness to use AV. Wintersberger et al. (2019) found reduced willingness to use AV due to extreme concern about AV technology.

Regarding the age of respondents willing to use AV, Krueger et al. (2016) found that young people between 18 and 65 years of age and people with multimodal travel patterns may be more willing to use AV. The respondents between 65 and 84 years old are less likely to use AV. The authors also found that service attributes including travel time, waiting time and fares are significant determinants of AV adoption. Regarding safety concerns, Schoettle and Sivak (2014) found that people expressed high safety and efficiency concerns about AV while being optimistic about the benefits. Howard and Dai (2014) found that people are willing to use AVs for the potential safety benefits, convenience, and the opportunity for multitasking while en route. Haboucha et al. (2017) found high hesitation towards automated vehicle adoption. Othman (2021) found that people have high safety concerns about AVs, and the fear of AVs could increase if accident reports increase. Regarding other concerns besides safety and privacy issues, Howard and Dai (2014) found that individuals were most concerned about liability, technology costs, and losing vehicle control.

Furthermore, other scholars found diverse findings: Payre et al. (2014) found that the willingness to use AVs differed from one driving environment to another and is linked to contextual acceptability. Kyriakidis et al. (2015) found diverse public opinion on the willingness to use AV in their cross-country survey. Liljamo et al. (2018) found that people willing to use AV are most likely early adopters. Hofbauer et al. (2023) found that users with lower anxiety and increased self-confidence were more open toward AVs. Othman (2021) argue that AV faces an ethical dilemma, for example, in a crash situation that could influence public acceptance of AV, and previous experience with AVs impacts its acceptance. Syahrivar et al. (2021) found that the more positive the attitude toward AV, the higher the willingness to use AV.

In sum, the results of the willingness to use AV in the literature seem heterogeneous. The results are demographically diverse, context-specific, and a function of the researchers' data and adopted methodology.

Governance of AV in the urban transport system

This sub-section reviews the literature on the governance of AV in the two dimensions applied in this paper: i. steering instruments (policy) and ii. institutional properties (polity) (Treib et al., 2007).

'Polity' dimension of the governance of AV

Tan and Taeihagh (2021) identified a four-stage governance process as the mechanism involved in deploying AVs: knowledge and persuasion, planning and decision-making, implementation, and evaluation. The authors proposed a no-response strategy, prevention-oriented (avert), control-oriented (regulation), tolerance-oriented (reform), and adaptation-oriented (manage policy uncertainty) approach for AV governance. The authors recommend creating an ecosystem that promotes trials and pilots for adopting novel and disruptive technologies and strengthening and developing policy capacity to embrace novel and disruptive technologies. Li et al. (2019) reviewed policy formulation to accelerate the deployment of AV and manage potential uncertainties.

The authors proposed three potential methods of formulating AV policy: (i.) backcasting (looking backwards from the desired future), (ii.) dynamic adaptive (structured approach for designing dynamic, robust plans), and (iii.) policy transfer method (knowledge of policies at a time and place is used to develop policies at another time and place). The authors argue that research to manage future uncertainties of AV in public transport is necessary. Building upon and combining the works of Bulkeley and Kern (2006) and the multi-level perspective (Geels, 2002), Audouin and Finger (2019) proposed five governance frameworks (governing by doing, governing by enabling, laissez-faire, self-governing and governing by authority) for AV integrated in Mobility-as-a-Service (MaaS) governance in the urban transport system. Mladenović et al. (2020) proposed a comparative analysis framework for governance based on the assumed roles of the technology, identified domains and mechanisms of governance, and the assumed actors responsible for steering the development process. The authors found similarities in pro-automation values and context-specific differences outside the domain of traditional transport policy instruments in three European countries.

'Polity' dimension of the governance of AV

Hansson (2020) found that existing regulatory standards, industry self-regulation and international policies and conventions influence regulatory design to form new regulatory standards and shape AV regulatory governance in Sweden and Norway. The author also found that Norway shows a significantly higher level of adjustment flexibility in its regulation than Sweden. Asquer and Krachkovskaya (2021) argue that existing regulatory institutions affect the regulatory response to emerging technologies and are responsible for different trajectories of regulatory development across countries. The authors conclude that policymakers and regulators should appraise the impact of existing regulations on the development of emerging technologies and adjust regulations while anticipating their consequences on further technological developments. Hrelja et al. (2017) argue that informal institutions are important to manage the interfaces between regional and local authorities in Swedish public transport planning. Hrelja et al. (2017) and Rye et al. (2018) found that informal institutions could complement formal institutions to facilitate coordination and achieve effective governance in the European public transport context. Schippl et al. (2022) argue that governance strategies that aim to tap the potential of AVs in supporting sustainable urban mobility should explicitly consider institutional dynamics based on the development of new technical options with changing regulations or policies and 'informal' factors such as routinised practices, societal perceptions, or beliefs of what is 'normal'. Haugland and Tomas (2020) argue that pilot projects produce an understanding of AV's relationship with general traffic and shape the institutional understanding of AV regulation in Norway.

Contribution of our paper

The original contribution of our paper to the literature is as follows:

- We propose a novel interdisciplinary methodology to analyse the governance of AV in the urban transport system. We combine insights from informal institutions from the cultural viewpoint (polity dimension of governance), quantitative willingness to use survey, and steering instruments from the policy dimension of governance.
- We contribute to a broad (public) understanding of the governance of AV innovation to support policymaking.
- We provide context-specific knowledge for academics, policy-makers/analysts, and other stakeholders to understand AV governance issues in the urban transport system.

In the next section, we will discuss the adopted methodology in this paper to answer our research questions.

Methodology

Our novel methodology combines insights from a willingness to use AV survey, informal institutions, and governance.

Willingness to use survey

‘Opinion’ (a market research and analysis company) and ‘Norstat’ (a data collection company) conducted the willingness to use survey for Ruter (the Oslo region’s public transport authority in Norway). ‘Norstat’ collaborated with ‘Data Factory AS’ for Oslo inhabitants’ phone numbers and names. Registered people with mobile phone numbers on the ‘Data Factory AS’ database have an equal chance of being asked to participate in a survey. The questionnaires were designed based on the following determinants: (i) personal technology innovativeness,^b (ii) perceived usefulness/benefit, (iii) safety perception (perceived safety and perceived risk) and (iv) price perception. The determinants are among the empirically proven significant determinants of willingness to use AV in the literature (see Keszey, 2020). The respondents were asked questions on their attitude to technology adoption, willingness to share a vehicle with strangers if it results in a lower price for the journey, perception of self-driving vehicles as a solution to meet their future transport needs, and perception of safety and security of self-driving vehicles to gain insight into their willingness to use AV. The 5-point Likert scale was used from ‘totally disagree’ to ‘totally agree’.

The respondents were contacted on their mobile phone numbers for the interview. The survey was conducted for all citizens over 15 years old in the Oslo region (old Akershus county (Viken), Groruddalen and Ovrig) from Tuesday to Saturday every week in September 2022. The survey was conducted from 16:30 to 21:30 on weekdays (Tuesday to Thursday), 16:30 to 20:30 on Fridays, and 13:00 to 18:00 on Saturdays. There were 1,738 respondents: Groruddalen (615), Viken County (604), and Ovrig (519).

The oldest respondent is 89 years, and the youngest is 15 years, a range of 74 years. The average age of the respondents is 45 years, the median is 44 years, and the mode is 43 years. Based on data from Statistics Norway for 2022 (see Appendix B), the respondents’ age is within the average age range of 47.2 years and 47.8 years in the Oslo and Viken counties, respectively (Statistics Norway, 2023). Among the respondents, 49.8 % were male, and 50.2 % were female. The Oslo municipality is 49.6 % male and 50.4 % female, and Viken County is 50.1 % male and 49.9 % female in 2022 (Statistics Norway, 2023). Therefore, our data is representative of the Oslo region’s population in terms of age, gender and the inhabitants that are likely to use AV.

Informal institution (Norwegian cultural dimension)

Geert Hofstede conducted one of the most comprehensive studies of national cultures with survey data about people’s values in more than 50 countries worldwide for IBM corporation. From one country to another, the results represented almost perfectly matched samples: the results were similar in all aspects except nationality, which made the effect of nationality differences in their answers stand out clearly. The IBM study on different international populations and by different scholars has been replicated and extended for 76 countries over the years (Hofstede Insight, 2023). The detailed methodology is described in Hofstede’s book (Hofstede, 2005).

We draw insight from Hofstede’s 6-D model (Table 1) to discuss Norwegian culture. In Hofstede’s 6-D model, culture is described in six dimensions: Power Distance, Individualism, Tough/Tender, Uncertainty Avoidance, Long-Term/ Short Term Orientation, and Indulgence.

A description of each dimension in Hofstede’s 6-D model has been

^b Personal technology innovativeness is the willingness of a person to try out a new technology.

Table 1
Description of Hofstede’s dimensions. Source: Hofstede (2005); Hofstede Insight (2023).

Hofstede 6D Model	Description
Power distance	The extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally.
Individualism	The degree of interdependence a society maintains among its members
Tough/Tender ^a	Explains people’s motivation in a culture, wanting to be the best (tough culture). A tough culture is a society driven by competition, achievement, and success (for example, winner/best in the field).The motivation in a tender culture is to like what you do. Quality of life is a sign of success; standing out from the crowd is not admirable.
Long-Term Orientation (LTO)/ Short-Term Orientation (STO)	Describes how every society maintains some links with its history while dealing with present and future challenges. LTO means fostering values towards future rewards.STO means fostering values related to the past and present, particularly respect for tradition and fulfilling social obligations.
Uncertainty Avoidance	The extent to which the members of a culture feel threatened by ambiguous or unknown situations and have created beliefs and institutions that try to avoid ambiguous or unknown situations. The feeling is, among other things, expressed through nervous stress and a need for predictability: a need for written and unwritten rules.
Indulgence	Explains the extent to which people try to control their desires and impulses. Relatively weak control is called ‘Indulgence’. Relatively strong control is called ‘Restraint’.

^aTough/Tender culture is also called Masculine/Feminine culture.

applied in different fields to explain the influence of culture on technological innovation (Berghe et al., 2020). Hofstede’s model has been used extensively during recent decades in the theoretical and empirical literature in different social science fields. Hofstede’s model can be regarded as a grounded approach for describing culture (Kaasa and Andriani, 2022). In this paper, we apply Hofstede’s 6D Model description for Norwegian culture (Table 2). We use the cultural dimensions for Norway from the Hofstede 6D model as indicators to discuss the willingness to use AV in Norway.

Governance (policy dimension)

Governance in the policy dimension refers to the ‘mode of political steering’ to distinguish policies according to the steering/policy instruments that a government can use to achieve particular policy goals and certain societal outcomes (Treib et al., 2005). Building upon the framework proposed by Bulkeley and Kern (2006) on public authorities’ governing approaches for governing cities and climate change and the works of (Etzkowitz, 2008) from innovation studies, Audouin and Finger (2019) proposed five governance approaches for governing the development of MaaS in public transport: i. Governing by authority: employing traditional top-down mechanisms to govern. ii. governing by enabling: facilitating and encouraging actions with non-public actors through partnerships and incentives development iii. governing by doing: public authorities take care of the entire service production and delivery and avoid collaborating with private actors. iv Self-governing: governing by ‘showing the way’, and v. laissez-faire: public authorities allow the network of actors to reach a stable state without getting involved. We adopt the framework of Ardouin and Finger (2019) to develop the corresponding actions in developing AV for the five governance approaches (Table 3).

Table 2

Hofstede's cultural indicators. Source: Hofstede (2005), Hofstede Insight (2023).

Hofstede's cultural dimensions (Indicators)	Norwegian Culture
Power distance	- Management facilitates and empowers equal rights decentralised power, people expect to be consulted, control is disliked. - Direct, participative, and consensus-oriented communication
Individualism	- Personal opinions are valued and expressed. - Communication is explicit. - The right to privacy is important and respected. - Leaders focus on the management of individuals.
Uncertainty Avoidance	- Moderate uncertainty avoidance - Moderate structure and planning are required
Tender	- Levelling with others, consensus, cooperation, and sympathy for the underdog - Taking care of the environment and societal solidarity is considered important. - Incentives are favoured. - Interaction through dialogue and 'growing insight' is valued. - The focus is on well-being.
Short-term orientation	- Decision-making is achieved by involving people. - Strong concern for establishing the absolute truth. - Normative in thinking with great respect for traditions. - Prefers to maintain time-honoured traditions and norms.
Indulgence	- Views societal change with suspicion - Moderate restraint - Moderate perception that social norms restrain actions

Table 3

Governance approaches for AV.

Governance approach	Corresponding actions in the development of AV
Governing by authority	- Develop specific legislation/regulations enforcing the development of AV in a top-down fashion. - Procure AV with a third party through traditional tender mechanisms.
Governing by enabling	- Initiate public-private partnerships. - Define vision with strong quantitative objectives. - Provide funding. - Influence negotiations in favour of AV - Leverage AV opponents using horizontal network governance.
Governing by doing	- Develop AV solutions in-house in a closed manner. - Minimise collaboration with third parties
Self-governing	Provide all government employees with an AV solution to show the example for other citizens to follow.
Governing by laissez-faire	- Refrain from getting involved in the development of AV. - Adopt a wait-and-see approach.

Source: Adopted from Audouin and Finger (2019).

Fig. 1 shows the schematic representation of our methodology discussed in sections 3.1 to 3.3. We focus on informal institutions and culture from the 'polity' dimension of governance. Then, we analyse informal institutions from the cultural viewpoint vis-à-vis the quantitative willingness to use AV survey. Then, we draw insight on the appropriate governance approach from the 'policy' dimension of governance.

Results

Willingness to use AV

We discuss the results of the four questions of the willingness-to-use AV in Norway: i. Attitude to new technology ii. Willingness to share a vehicle with strangers if it results in a lower price for the journey iii.

Believe that self-driving vehicles can solve many of the transport needs of the future. iv. Believe that self-driving vehicle is safe and secure. See Appendix A for the full results.

Attitude to new technology

A total of 1587 respondents out of 1738 (91.3 %) answered the question on their attitude to new technology. 739 respondents like new technology and are willing to adopt new technology before most people (Fig. 2). We categorise the 739 respondents as those willing to use AV. The other respondents are either sceptical, late adopters or undecided/uninformed. Since AV is a new technology, we do not include the sceptical, potential late adopters and the undecided or uninformed respondents that responded (I do not know) as willing to use AV.

Willingness to share a vehicle with strangers

A total of 1587 respondents out of 1738 answered the question on their willingness to share a vehicle with strangers if it results in a lower price for the journey. 472 respondents are partially or totally willing to share a vehicle with strangers (Fig. 3). We categorise the 472 respondents as willing to use AV since AV will be integrated in public transport. We categorise those who partially or totally disagree with sharing AV as unwilling to use AV. We assume the undecided or uninformed respondents that answered (I do not know) are unwilling to use AV.

Self-driving vehicle to meet future transport needs

A total of 1587 respondents out of 1738 answered the question on their perception that self-driving vehicle can meet their future transport needs. 649 respondents partially or totally agree that self-driving vehicle' can meet their future transport needs (Fig. 4). We categorise the 649 respondents as willing to use AV. We categorise those who partially or totally disagree that self-driving vehicle' can meet their future transport needs as unwilling to use AV since their response suggests that the respondents do not consider AV as relevant for the future of transportation. We assume the undecided or uninformed respondents that answered (I do not know) are unwilling to use AV.

Safety and security

A total of 1587 respondents out of 1738 answered this question. 441 respondents partially or totally agree that self-driving vehicles are safe and secure (Fig. 5). We categorise the 441 respondents as willing to use AV. We categorise the respondents who partially or totally disagree that self-driving vehicles are safe and secure as unwilling to use AV since their response suggests they consider AV unsafe and insecure. We assume the undecided or uninformed respondents that answered (I do not know) are unwilling to use AV.

In sum, we assume that 27 out of every 100 respondents partly or totally believe AV is safe and secure, 41 out of every 100 believe that AV can meet their future transport needs, 30 out of every 100 respondents partially or completely agree to share AV and 46 out of every 100 respondents like new technology and are willing to be among the early adopters. It is worth noting that each question may have a different weight on the final willingness to use AV for people. For instance, the believe that AV is safe and secure may lead to a higher or lower willingness to use AV than agreeing to share AV with strangers or the believe that AV can meet future transport needs. However, we are unable to model this possible reality in this paper. Therefore, we simplify, using the average of the four indicators. We assume that, on average, 36 out of every 100 people are partly or totally willing to use AV (Fig. 6).

Discussion

Insights from the Norwegian cultural indicators vis-à-vis the willingness to use AV survey and workable governance framework

The colour codes (see Fig. 7) indicate the cultural indicators and the

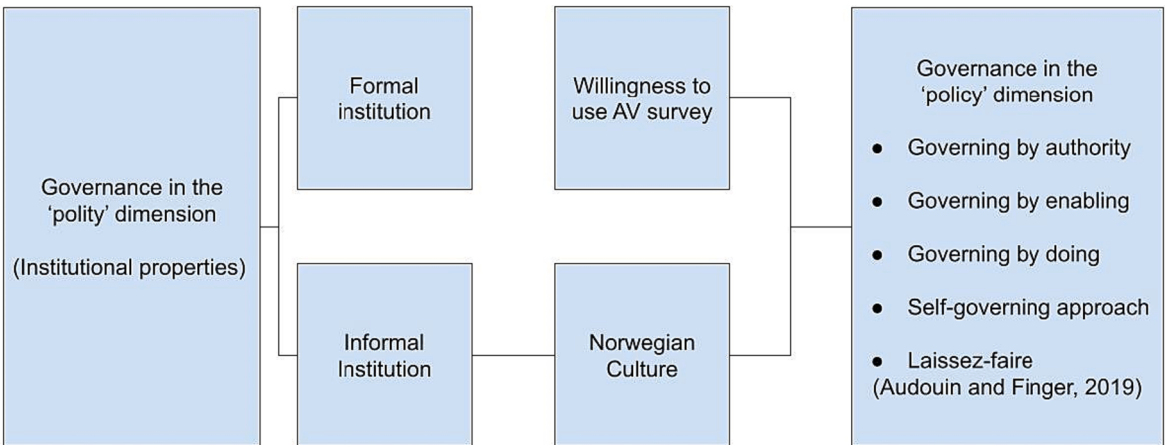


Fig. 1. Schematic diagram of the methodological framework.

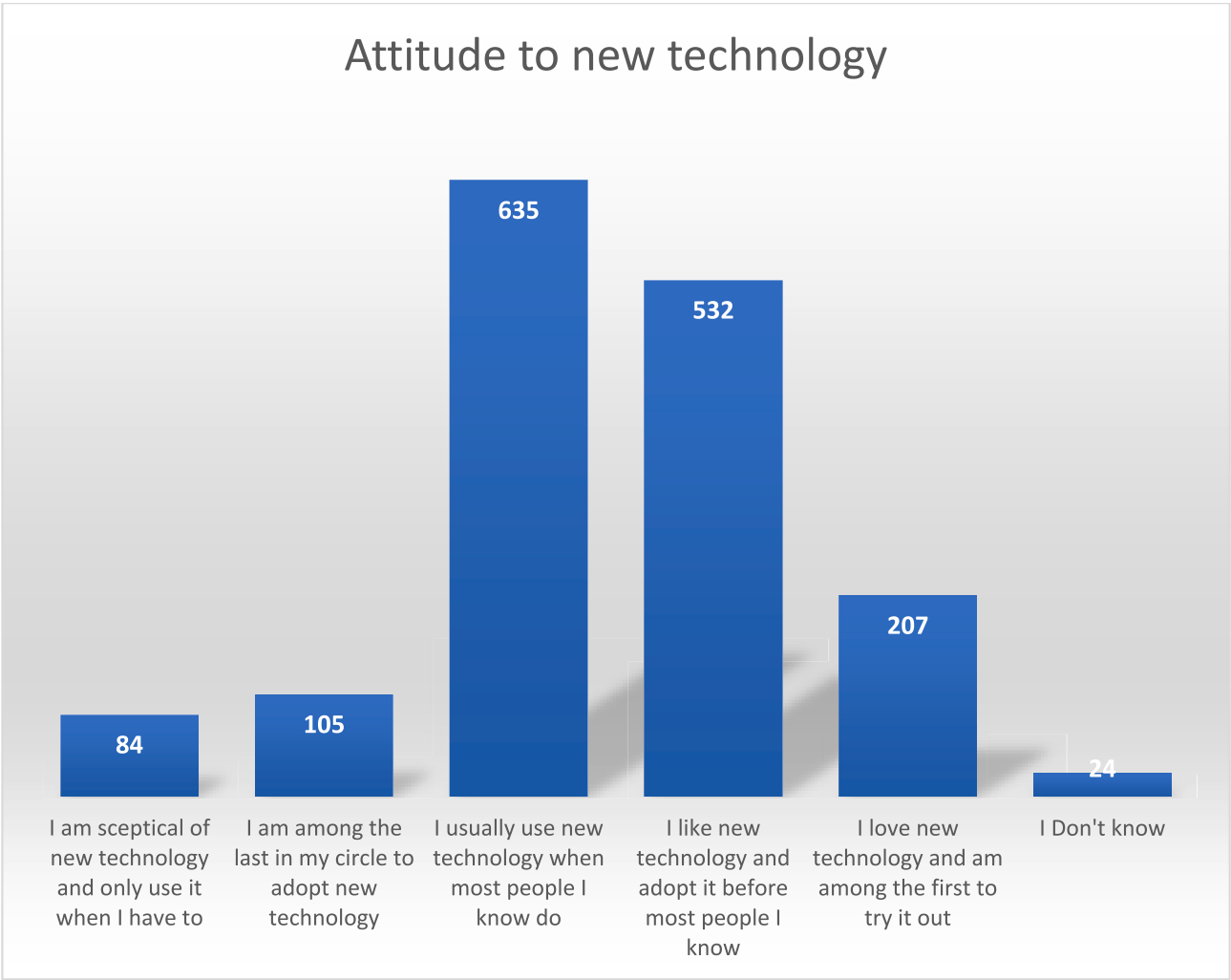


Fig. 2. Attitude to new technology.

governance approach links. ‘Green’ indicates the Norwegian cultural indicators linked to the ‘governing by enabling’ approach. Governing by enabling entails collaborative, cooperative interactions among stakeholders to build consensus and could also be facilitated by incentives. Therefore, we link the power distance, individualism (except ‘the right to privacy’) and the tough/tender indicators to governing by enabling.

We link individualism (‘right to privacy is important’) and short-term orientation indicators (in purple) to ‘governing-by-doing’. Developing AV solutions in-house in a closed manner and minimising collaboration with third parties could help protect people’s privacy, and reduce suspicion of tradition, norms and societal change.

We link uncertainty avoidance and restraint indicators (in blue) to

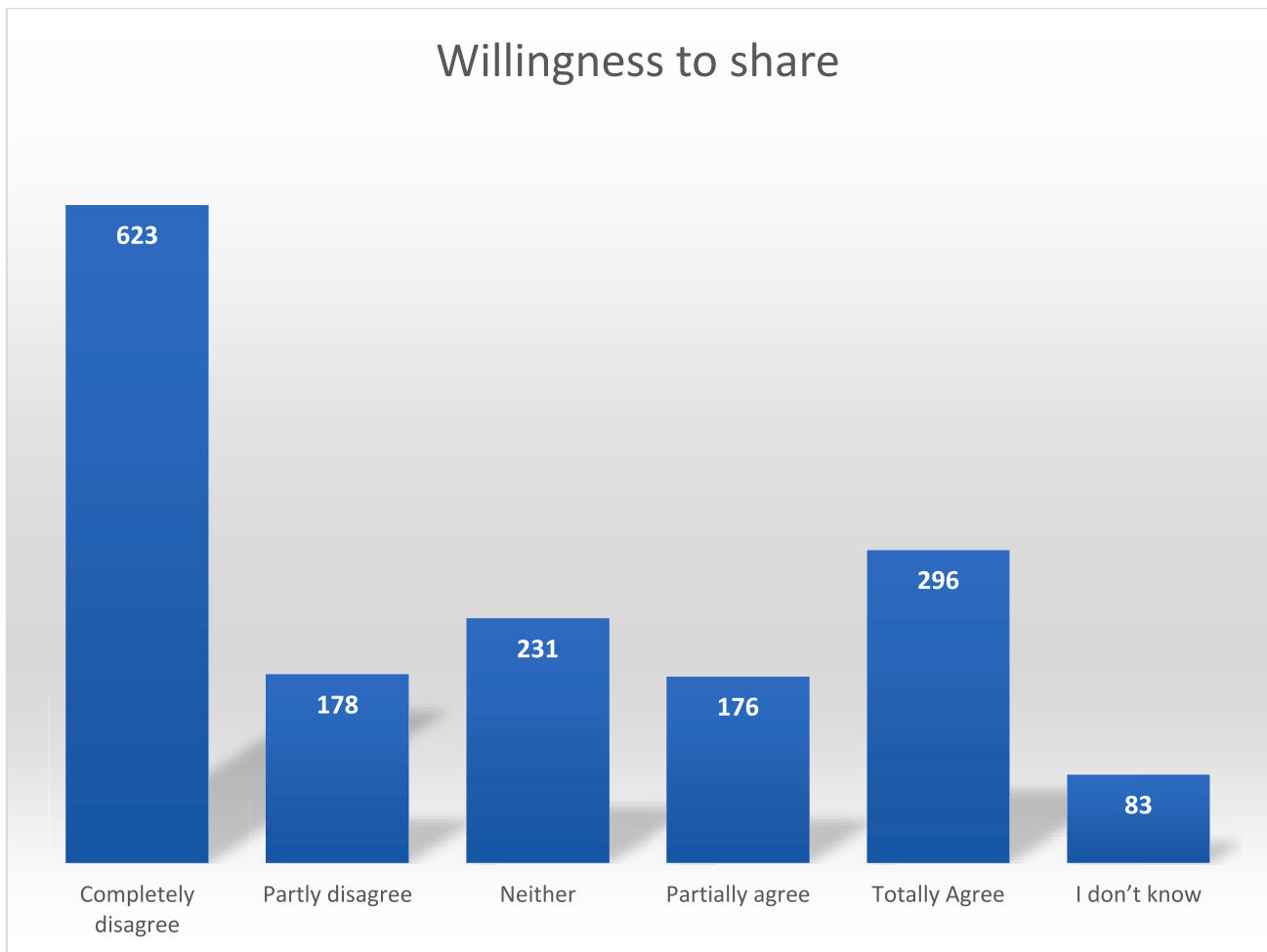


Fig. 3. Willingness to share AV.

the self-governing approach. Self-governing entails governing by 'showing the way'—for example, providing government employees with an AV solution to show citizens examples to follow. Self-governing could help manage uncertainty avoidance and restraint as people could feel less threatened by unknown situations and control their lack of desire for AV— for example, when government employees are using AVs. 'Government by authority' (in black) and 'governing by laissez-faire' (in pink) do not seem to be appropriate governance approaches based on the Norwegian cultural indicators.

Then, we focus on governing by doing, self-governing and governing by enabling for further analysis (see Table 4).

In the Norwegian culture, the right to people's privacy is important, and Norwegians expect their privacy to be respected. If AV threatens privacy, Norwegians could be reluctant to adopt AV. We assume from the willingness to use survey results that 27 out of 100 Norwegians totally or partially believe that AV is safe and secure. Relative to the Norwegian culture, the survey result could have reflected privacy concerns and a need for safety in commuting without a driver or commuting without human security as possible reasons for the high level of concern about the safety and security of AV and, consequently, reduced willingness to use AV. Therefore, we could relate the individualism indicator 'right to privacy is important' in the Norwegian culture to the low perception of safety and security of AV. In this context, 'governing by doing' could be a workable governance approach to facilitate the deployment of AV. The government can develop solutions in-house in a closed manner and minimise collaboration with third parties (for example, private sector institutions), which could make people feel their right to privacy is respected. However, that could depend on the level of

trust Norwegians have in their government. The debate on institutional trust is beyond the scope of this paper. Fig. 7 shows the analyses of the Norwegian cultural indicators vis-à-vis the governance approaches.

Norway is a normative or low short-term oriented society that prefers to maintain time-honoured traditions and norms while viewing societal change with suspicion. People in such societies are strongly concerned with establishing absolute truth, normative thinking, and great respect for traditions. Extreme respect for tradition may impede innovation and cause the abandonment of novel ideas (Hofstede, 2005). Since Norwegians may be pessimistic about AV, their willingness to use the technology may be low. We could relate the short-term orientation indicators of the Norwegian culture to the low perception of safety and security. 'Governing by doing' could help increase the perception of safety and security and the pessimistic view on societal change and its impact on Norwegian traditions and norms.

Uncertainty avoidance in the Norwegian culture could impact AV adoption since the technology is new and its impact is not fully understood. As an emerging technology, the potential deployment of automated vehicles in cities is attributed with significant uncertainties and anticipated consequences requiring responsible governance of innovation processes (Mladenović et al., 2020). The higher the uncertainty avoidance in a culture, the lower the willingness to adopt new technologies (such as AV) or to share AV with strangers. The combination of moderate 'uncertainty avoidance' and 'restraint' with indicators such as the need for moderate structure and planning, and moderate perception that social norms restrain actions coupled with the Norwegian culture's short-term orientation indicators (discussed above) could have reflected in the survey result. From the willingness to use survey results, we

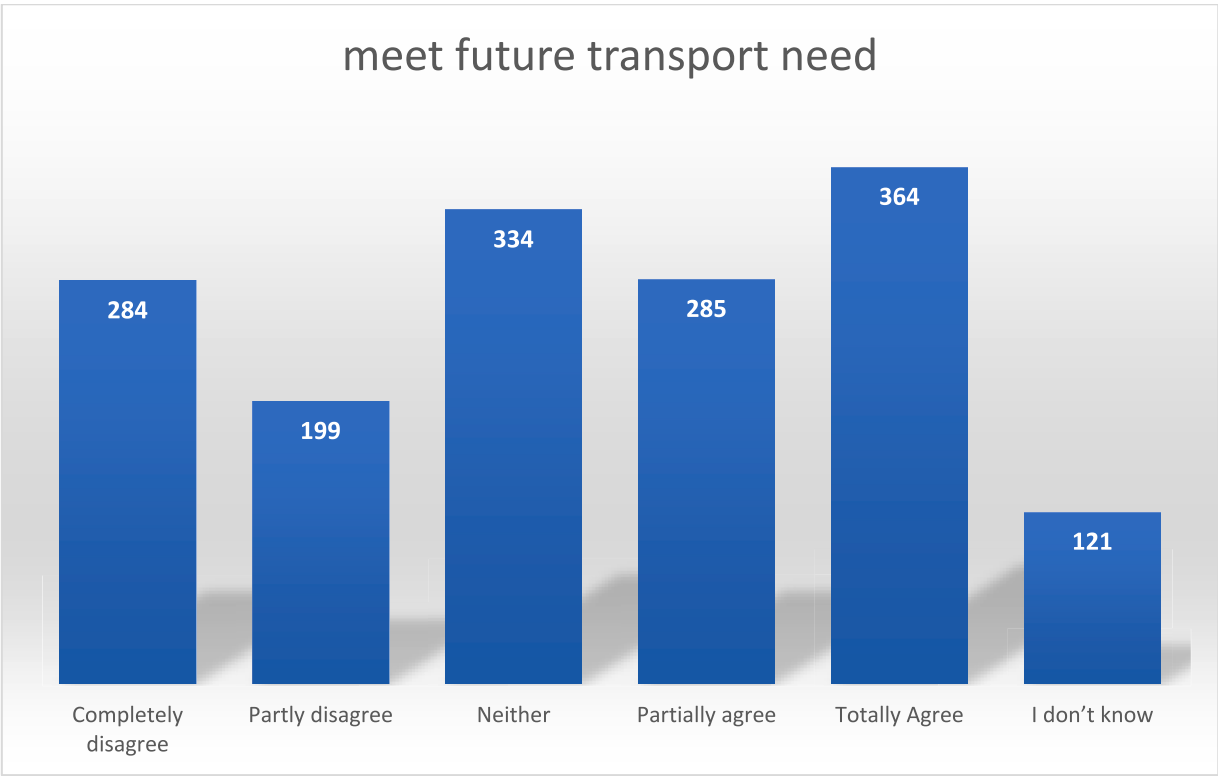


Fig. 4. AV to meet future transport need.

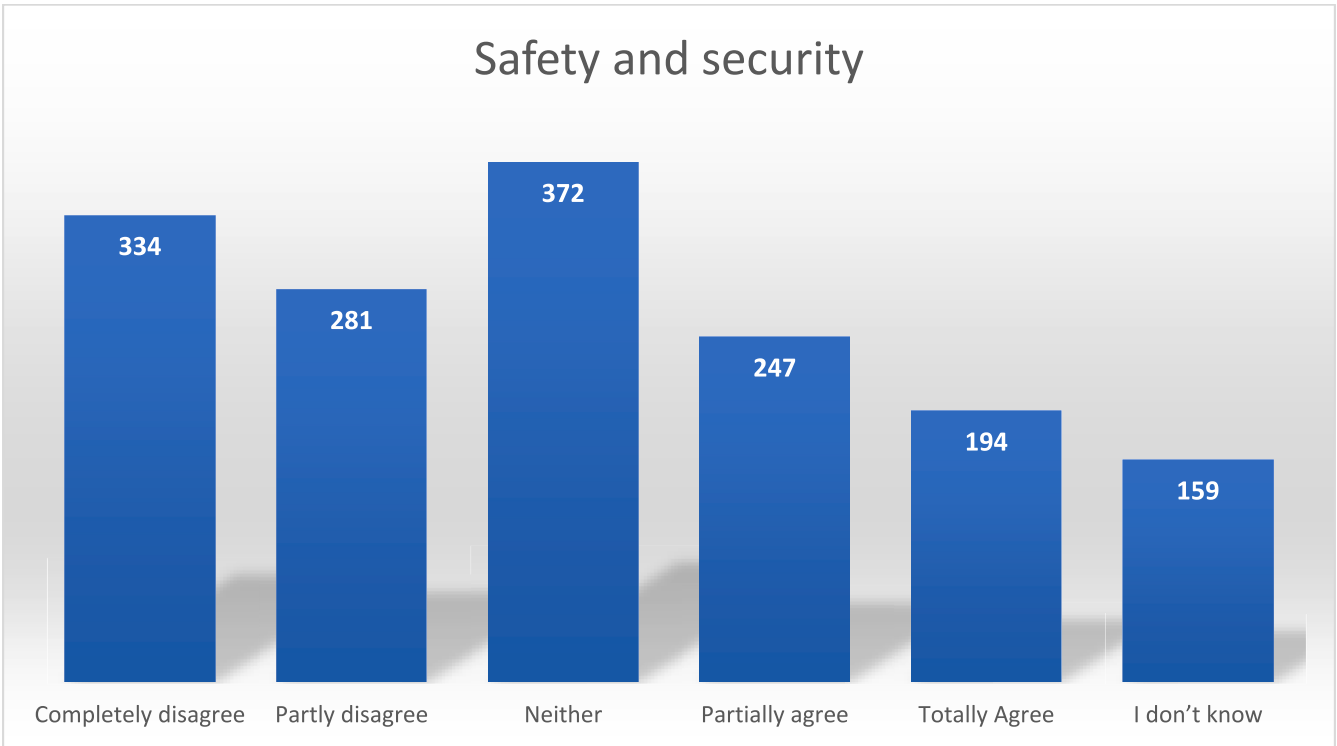


Fig. 5. Safety and security.

assume that 41 out of 100 Norwegians totally or partially believe that AV can meet future transport needs. We also assume that less than half (46 out of 100 Norwegians) like new technology and are willing to be among the early adopters. Only 30 out of 100 Norwegians partially or

totally agree to share AV with strangers, suggesting some ‘restraint’. Based on the insight from the combination of short-term orientation, moderate uncertainty avoidance and restraint indicators and the willingness to use AV, we could suggest combining ‘governing by doing’ and

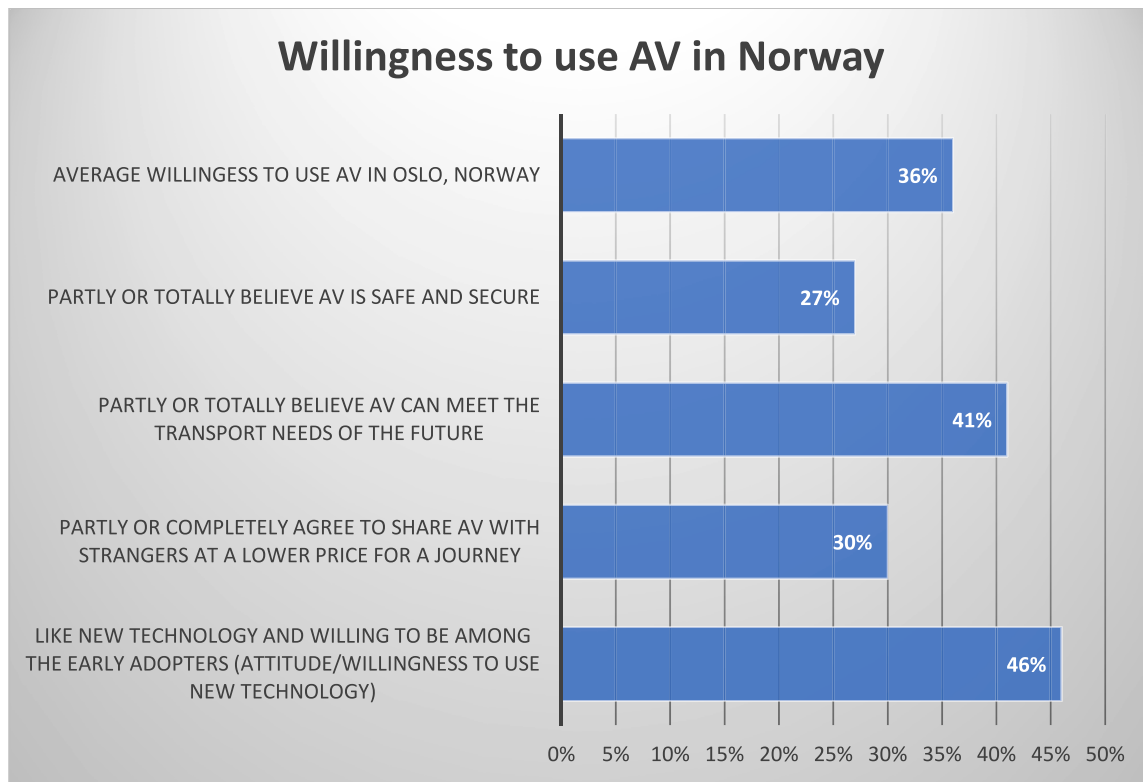


Fig. 6. Willingness to use AV in Oslo Region, Norway.

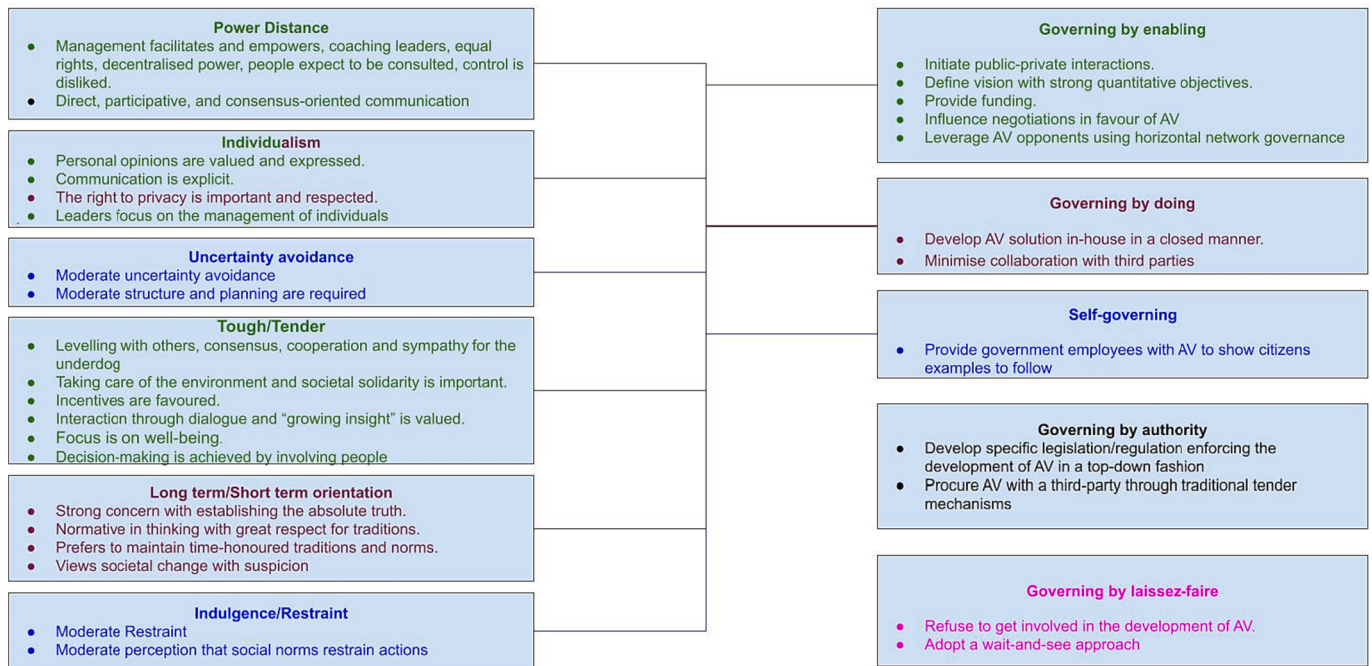


Fig. 7. Analysis of Norwegian cultural indicators and governance in the 'policy' dimension.

'self-governing' approaches to promote AV in Norway. For example, government institutions and civil servants could be the early adopters as an example for other citizens.

The Norwegian culture is tender, which means the softer aspects of culture are valued and encouraged. The cultural indicators include levelling with others, consensus decision-making, cooperation, taking care of the environment, societal solidarity, incentivisation and

interaction through dialogue. Also, the related power distance indicators, such as decentralised power, consensus-oriented communication, and facilitating management, are closely related. Although the 'tender' and 'power distance' indicators may not directly relate to the willingness to use AV, they could serve as enablers to promote AV in Norway. In this context, 'governing by enabling' could be a workable governance approach with features such as initiating public-private

Table 4

Summary of Norwegian cultural dimensions, indicators, and proposed governance framework.

Cultural dimension	Norwegian Cultural Indicators	Impact of cultural indicators on the willingness to use AV	Proposed workable governance approach to mitigate willingness to use barriers based on the Norwegian cultural context
High individualism	The right to privacy is important and respected.	Privacy loss concerns could reflect the low perception of the safety and security of AV and the willingness to share AV with strangers in public transport. → Reduce willingness to use AV.	‘Governing by doing’ could help increase the perception of safety and security and increase willingness to use AV: - Developing AV projects in-house in a closed manner could increase the perception that the government is thorough to ensure that all safety and security concerns are addressed. - Minimising collaboration with third parties could help allay the fear of unnecessary private data exposure to many third parties (such as private sector institutions) or corporate entities.
High short-term orientation	- Strong concern for establishing the truth. - Normative thinking with great respect for traditions. - Preference to maintain time-honoured traditions and norms. - Viewing societal change with suspicion.	Lack of full understanding of AV, disruption of traditional public transport paradigm, and suspicion of societal change could reflect a relatively low interest in new technology, willingness to be early adopters, and believe that AV can meet future transport needs → Reduce willingness to use AV.	‘Governing by doing’ could help address the challenges with the traditional Norwegian culture and pessimistic view of societal change: Developing AV projects in-house in a closed manner with minimum collaboration with third parties could help address the perception of change in tradition, societal norms, and public transport disruption.
Moderate uncertainty avoidanceModerate restraint	- Moderate structure and planning are required. - Moderate perception that social norms restrain actions	Due to uncertainty concerns, citizens should be assured that AV is carefully planned and structured. The perception that social norms restrain actions could affect the willingness to use AV since the innovation is new and its impact is not fully understood. The indicators could also reflect on the willingness to share AV with strangers in public transport → Reduce willingness to use AV.	Combining governing by doing and self-governing by: Developing solutions in-house in a closed manner, minimising collaboration with third parties, and providing all government employees with an AV solution could allay uncertainty fears and ‘restraint’ constraints. Combining the governance approaches could serve as a springboard to promote AV, increase awareness, encourage sharing with strangers, and integrating AV in the public transport system.
Tender CulturePower Distance	- Levelling with others, consensus, cooperation - Taking care of the environment and societal solidarity. - Incentivisation - Dialogue. - Decision-making is achieved by involving people. - consensus-oriented communicationManagement facilitates and empowers. - Decentralised power	These indicators could serve as enablers to increase awareness and willingness to use AV.	‘Governing by enabling’ actions appear to align with the ‘tender’ and ‘power distance’ Norwegian cultural indicators: - Initiating public-private partnerships → Levelling with others, consensus, cooperation, dialogue, consensus-oriented communication, and decision-making. - Providing funding → Incentivisation. - Influencing negotiations in favour of AV → Incentivisation, societal solidarity. - Leveraging AV opponents using horizontal network governance → Decentralised power, dialogue, management facilitates and empowers and consensus-oriented communication.

partnerships, providing funding, influencing negotiations to favour AV, and leveraging AV opponents using horizontal network governance.

Based on the short-term orientation, privacy loss and the combination of moderate uncertainty avoidance and restraint concerns that appear influential on the survey results, we suggest combining governing by doing, self-governing and features of governing by enabling (see Table 5). Nonetheless, governing by doing features such as minimising collaboration with third parties may appear to conflict with some governing by enabling features such as initiating public-private interactions. Therefore, the features should be carefully combined. For example, the AV pilot stage could focus more on governing by doing and

self-governing and some features of governing by enabling, like funding provision (incentivisation). Then, as AV awareness and acceptance increase, a ‘governing by enabling’ approach could be fully adopted in relation to Norway’s tender, power distance and individualism cultural indicators. ‘Governing by enabling’ could promote end-user acceptance and awareness of AV’s environmental benefits based on Norway’s tender cultural indicator. In sum, adopting a governance approach that addresses the high short-term orientation, low power distance, high individualism, tender culture, moderate ‘restraint’ and uncertainty avoidance indicators could help increase the willingness to use AV.

Conclusions

This paper attempts to provide insight into the governance of AV integrated in the Norwegian urban transport system using insight from the Norwegian cultural context and willingness-to-use survey. We analyse informal institutions from the cultural viewpoint using the Hofstede 6D model vis-à-vis a quantitative willingness to use AV survey. Then, we combine insight from the cultural indicators and survey to draw insight on the appropriate governance approaches from the ‘policy’ dimension of governance to promote AV deployment and increase the willingness to use AV in Norway.

The survey result suggests that less than half of Norwegians are willing to use AV in the Oslo region. We assume that, on average, 36 out of every 100 respondents to the survey are either partly or totally willing to use AV. We then suggest that a workable governance approach for AV

Table 5

Proposed governance approaches to support AV deployment in Norway.

Governance approaches to support AV deployment in Norway	‘Governing by doing’, ‘self-governing’ and ‘governing by enabling’.
	- Develop an AV solution in-house in a closed manner. - Minimise collaboration with third parties. - Provide government employees with an AV solution to show citizens examples to follow. - Provide funding. - Initiate public-private interactions. - Define vision with strong quantitative objectives. - Influence negotiations in favour of AV - Leverage AV opponents using horizontal network governance.

integration in the Norwegian public transport system should allay fears of privacy concerns (high individualism) while making people feel safe and secure, allay uncertainty fears, manage pessimism to technological innovation (high short-term orientation), regard time-honoured traditions and address the moderate ‘uncertainty avoidance’ and ‘restraint’ indicators. Also, the cultural indicators should align with the Norwegian culture’s ‘tender’ and ‘power distance’ indicators, such as consensus, cooperation, societal solidarity, incentivisation, dialogue, facilitating management and decentralised power. Therefore, we argue that ‘governing by doing’, ‘self-governing’ and ‘governing by enabling’ should be combined to increase the willingness to use and promote AV deployment in Norway. We also argue that, although ‘governing by doing’ features such as minimising collaboration with third parties may seem to conflict with ‘governing by enabling’ features, they could be systematically combined. Control-related ‘governing by authority’ (traditional top-down mechanisms to govern) and ‘no-control’ governing by laissez-faire may not be suitable for promoting AV in Norway.

We contribute to the literature in three distinct ways. First, we propose a novel interdisciplinary methodology combining insights from the Norwegian culture and willingness to use AV to understand the governance of AV in the Norwegian urban transport system (a context-specific institutional environment). Second, we provide insight into the appropriate governance approach to support AV deployment in Norway. Third, we provide context-specific knowledge for stakeholders to understand AV governance issues in the urban transport system.

Limitations and future research

A limitation of this research is that our assumptions, such as the classification of the undecided or uninformed respondents as unwilling to use AV, may overestimate or underestimate the result of the willingness to use survey, thus impacting our results. Although we do not anticipate that the relatively low number of undecided/uninformed respondents could significantly impact our results and analysis, caution is still needed. Furthermore, the preferences of people change over time. Therefore, it could be argued that respondents who partially or totally agree in September 2022 may disagree later and be unwilling to use self-driving vehicles. Therefore, we suggest an occasional repeat of the survey. Nonetheless, these limitations should be considered when using our findings for decision-making. Further research could be tailored in this direction to understand the best methodology. We also did not delve into the debate on institutional trust. For example, to what extent do Norwegians trust the country’s parliament, legal system, law enforcement agents and politicians vis-à-vis the suggested governance approach (es)? The debate on institutional trust is beyond the scope of this paper. Further research is also required to analyse the actors’ constellation in the policymaking process.

Finally, multi-criteria qualitative and quantitative research and analyses combining culture, governance approaches and quantitative surveys for AV deployment in the urban transport systems in different European spatiotemporal contexts warrant further study.

CRedit authorship contribution statement

Wale Arowolo: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Magnus Larsson:** Data curation, Validation, Writing – review & editing. **Isabelle Nicolai:** Funding acquisition, Project administration, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendices A and B. Supplementary data

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