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&

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MSc Thesis

Autonomous Cars as Public Technology: Aspects and Approaches for the Social Acceptance and the Co-production

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Abbreviations List

Abbreviation	Meaning
ADAS	Advanced Driver Assistance Systems
AI	Artificial Intelligence
AV	Autonomous Vehicle
AVAM	Autonomous Vehicle Acceptance Model
CCS	Carbon Capture and Storage
CPHA	Public Health Association of Canada
CTA	Constructive Technology Assessment
DM	Deficit Model
EuroNCAP	European New Car Assessment Programme
GM	Genetically Modified
ICT	Intelligent Communication Technologies
OTA	Office of Technology Assessment
R&D	Research & Development
PES	Public Engagement in Science
PT	Public Transport
PUS	Public Understanding of Science
S&T	Science and Technology
STS	Science and Technology Studies

1. Introduction

During the last decades, there has been an international trend towards increased involvement of the public in the decision making processes, a concept that is mostly referred to as "public participation". In the United Kingdom, for example, this trend has become a practice in both national and local government level and in several domains, such as transport planning, the environment and health care[1].

A somehow general definition of public participation is "the practice of involving members of the public that are getting affected by a research issue or a technology development in its agenda setting, decision-making, and policy-forming activities. This definition enables distinction of participation situations from non-participation situations, with the latter being associated with more traditional models of governance where elected policy makers, often supported of nominated experts, are responsible to set policy without further public reference[2]. However, in the public participation field, unfortunately, the key concepts are often not well defined, even after several decades of relevant research interest. Some researchers might even disagree with the scope of public participation related activities or in defining the participation's effectiveness[3]. Similarly, mechanisms for enacting the participation concept (i.e. methods, techniques, tools, etc.) in some cases are not clearly defined, ranging from simple surveys to complex deliberative approaches.

Participation and engagement of the public should reflect the overall integration of relevant groups in decision-making processes and consequently in the distribution of power. Arnstein (1969), writing about citizens' involvement in decision-making processes in the United States, used the symbolism of a ladder that showed participation ranging from high to low, presenting participation levels ranging from non-participation, referred to as manipulation and therapy, until citizens' control at the top rung. More specifically, the ladder is a guide of who has power when important decisions are being made throughout the different stages. Although the ladder is a simplification, it helps to illustrate the gradations of citizens' participation[4].

[1] Chwalisz, C. (2017). Citizen engagement in politics and policymaking: Lessons from the UK. Available at: http://www.populus.co.uk/wp-content/uploads/2017/07/Citizen-Engagement-Report-002.pdf

[2] Rowe, G., & Frewer, L. J. (2005). A typology of public engagement mechanisms. Science, Technology, & Human Values, 30(2), 251-290

[3] Rowe, G., & Frewer, L. J. (2004). Evaluating public-participation exercises: a research agenda. *Science, technology, & human values*, *29*(4), 512-556.

[4] Böhler-Baedeker, S., & Lindenau, M. (2013). Why is Participation a challenge in sustainable urban mobility planning?

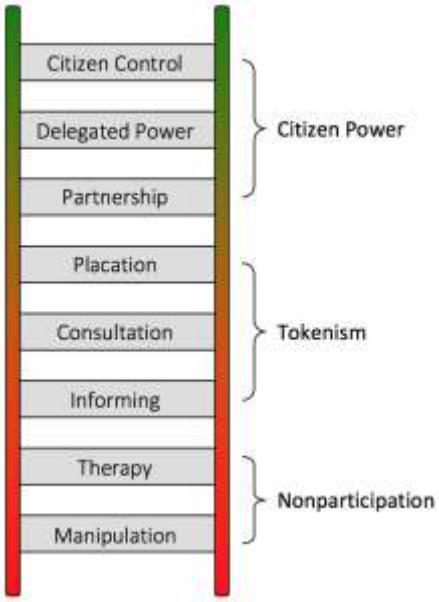

Figure 1: The Arnstein ladder of citizen participation[5]

During the last years, the concept of public participation has also become central to transportation research. There has been policy shift towards integrated transport, which have created a new framework for transport planning, with important implications for public involvement. In this context, the issue of autonomous cars is a crucial topic, with questions related to vehicles taking over control from drivers, change of mobility habits, ethical decisions concerning the machine vs. human, as well as the imperative need of training for adapting to this technological evolution, are some of the key issues and challenges relevant to the emergence and integration of autonomous vehicles in the road public transport regime.

The aim is to study the technology of autonomous cars as public technology and thus to provide a study and the evaluation of the public and experts' perceptions in relation to the technology and its integration in the transport system. The objectives of the thesis are: a) to provide an overview of the current acceptance level and degree of public participation in the development and integration of the autonomous cars, b) to conduct a survey among experts, in order to unravel their understandings, views and priorities in relation to the technological implementation, c) to provide an in-depth study of the experts' view in relation to the risks, the vulnerabilities, the pitfalls and the knowledge gaps in the process of public participation in the design and the evaluation of the technology. The main and key research questions are: a) what have been the experts' views and representations of the publics and the public participation in the integration of autonomous cars in the transport system? b) can we identify different approaches, views and representations between the public and the experts in the technological domain of autonomous cars?

[5] Arnstein, S. R. (1969). A ladder of citizen participation. Journal of the American Institute of planners, 35(4), 216-224.

2. Methodology

The notion of 'framing' spans several social science disciplines and theories. Framing emphasizes certain elements of a message and uses certain language or imagery to create particular associations or meanings; as such, framing provides "interpretive shortcuts" to reduce complexity of information processing for audiences[6] [7]. Critically, and consistent with persuasion theories[8], framing is most effective when is consistent with the audience's prior understanding and values[9].

While public perceptions of autonomous cars have been investigated over the years, much less is known about experts' experiences and attitudes towards public engagement in the development and diffusion of autonomous cars technologies. The thesis presents a mixed-methods study, which aims to address this knowledge deficit, with a view to improve engagement efforts and grounding them in the public engagement evidence base.

The methodology applied for this thesis has been based on the combination of different methodological approaches, namely the following:

- Analysis of more than 80 technical and policy reports to investigate and analyse the public framings relevant to autonomous vehicles (Section 3);
- Critical analysis of existing cross national surveys of the last 5 years, related to user acceptance issues and to the involvement of the public in the development of the AVs' technology (Section 4);
- Development of a survey on issues regarding the level of public acceptance of autonomous cars and the necessity and level of public involvement. This survey has been addressed to experts of the transportation system in general and the sector of autonomous vehicles in particular (Section 5.2);
- Conduct of Interviews with 3 experts from different sectors of the autonomous driving area, namely policy, industry and research (Section 5.3).

The use of this multi-dimensional method has helped to achieve a broader scope, including the user's own perspective on autonomous cars through the analysis of the bibliography and the pre-existing surveys, as well as experts' perception of public's opinions and level of acceptance of the autonomous mobility.

[6] Nisbet, M. C., & Newman, T. P. (2015). Framing, the media, and environmental communication.

[7] Chong, D., & Druckman, J. N. (2007). Framing theory. *Annu. Rev. Polit. Sci.*, *10*, 103-126.

[8] Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. In *Communication and persuasion* (pp. 1-24). Springer, New York, NY.

[9] Whitmarsh, L., & Corner, A. (2017). Tools for a new climate conversation: A mixed-methods study of language for public engagement across the political spectrum. *Global environmental change*, *42*, 122-135.

3. From Public Perception to Engagement to Technological Change: Social Sciences Approaches

Studies and research projects related to the development of emerging technologies have always been an integral part of the R&D process, while many of them have been approached from different and diverse academic perspectives, having also been benefited from these new conceptual perspectives. In this respect, history, sociology, and philosophy of technology constitute paradigmatic examples.

During the last decades, citizens have shown an increasing interest and concern over issues related to the development of technology, related mainly to the regulation, management and elaboration of technological policies. This development demands a comprehensive knowledge of the interaction between society and technology and this is where STS (Science and Technology Studies) steps in, a field that examines how society, politics, and culture affect scientific research and technological innovation. Recent scholarship influenced by the approach of Sheila Jasanoff, is stressing the importance of the co-production idiom in studying the interaction of science and technology with society. It is stressed that in order to unravel the interaction between society and techno sciences we need to study the institutions of knowledge making, the public representations, discourses and the identities of scientists and engineers as well as of communities and relevant social groups.[10]

Studies on public perception are highly important not only for the analysis and interpretation of future scenarios, related to the constant development of technologies, but mainly for the identification of public policies required to avoid undesirable effects of technological achievements and advancements, which maybe be considered as beneficial in general or by specific parts of the population[11].

The 1960s represented a turning point for social research related to the development of technologies, as it has been signalled as the period when public opinion, mainly in the industrial advanced democracies, became aware of the key role that the citizens could play in the process of shaping technological innovation (namely design, assessment, implementation and evaluation)[12]. Debatable environmental problems, with emphasis on nuclear energy and issues related to technological advancements came to the foreground of public concern[13] [14]. In 1972, the Office of Technology Assessment (OTA) was established in the USA to examine issues concerning new or expanding technologies, to assess their impacts and to analyse alternative policies, in order to avert crises. Studies making significant contributions in areas of concern to Congress have dealt with offshore energy systems, solar energy, automatic train control, and the Computed Tomography Scanner[15]. Although, the Office of Technology Assessment closed on September 29, 1995, nowadays there is interest to revive it, since

[10] Jasanoff, S. (Ed.). (2004). *States of knowledge: the co-production of science and the social order*. Routledge.

[11] Luján, J. L., Moreno, L., Hickman, L. A., & Porter, E. F. (1993). The social study of technology: the case for public perception and biotechnology.

[12] Cutcliffe, S., 1989, "Science, Technology and Society", National Forum: The Phi Kappa Phi Journal 69: 22-25.

[13] Brown, J.R., 1989, "Introduction: Approaches, Tools and Methods", in J.R. Brown, ed., 1989, Environmental Threats: Perception, Analysis and Management, Belhaven Press, London.

[14] Winner, L., 1986. The Whale and the Reactor. A Search for the Limits in an Age of High Technology, University of Chicago Press, Chicago.

[15] US Government Accountability Office (1977). The Office of Technology Assessment. Available at: https://www.gao.gov/products/103962

technology issues do not seem going away any time soon[16]. This initiative was followed by other relevant practices related to the assessment, management, and policy analysis of technologies in the USA and other Western countries, while new Parliamentary Offices and Committees on Ethics have been also created. An important milestone for the development and establishment of this trend, which also coincides to a key point in the development of STS, was the turn of the STS field, in the mid-80', towards the technology studies, as an addition to the range of interests reflected in science. One of the results of this expansion of STS focus, is the development of the Constructive Technology Assessment (CTA)[17]. The main idea of CTA is that social problems, which are related to technology, may and should be addressed through the involvement of many different actors, who take part at the technological design and implementation processes, including also social actors, such as consumers, citizens, employees, corporations, social groups, etc.[18]

At present, the need for the institutions to undertake studies on public perception in order to legitimate the use of new technologies is more opportune than ever. Technology is a mediator in a complex sequence of interaction between social structures and actors, as well as their socially constructed tools. But as some aspects, like information and communication, are at the core of human action, the transformation of the technological instruments of knowledge generation, information processing, have far reaching implications, adding specific social effects to the broader pattern of social causation[19].

3.1 Public perception and the deficit model

The Deficit Model (DM) is a term coming from the field of STS used to describe the general public's negative attitudes towards science and/or certain scientific applications (i.e. genetically modified food, nuclear power, nanotechnology) by referring to the public's scientific ignorance. The model is based on three (3) assumptions[20]:

I. ***The public holds negative attitudes towards science and/or certain scientific applications.*** In other words, a big percentage of the general public is unwilling to use or even accept certain scientific and technological applications, while also many members of the general public show a general mistrust of science.

II. ***The public is ignorant of the relevant, basic scientific facts***. This is an alternative wording of the argument that the general level of scientific knowledge is higher among scientists than among the general public.

III. The basic idea of the deficit model is that ***the lack of knowledge is the main or sole reason for the negative attitudes***. This could be interpreted that if the general public knew more, it would also be more willing and open to accept the scientific applications (and/or the science), in which now it opposes***.*** The negative attitudes are considered as mistaken or even as some kind of anomaly.

[16] S. Moss (2019). You have 48 hours to become a tech expert. If only this office could help. - Gingrich slashed the Office of Technology Assessment. It's time to bring it back. Available at:
[17] Konrad, K., Rip, A., & Greiving-Stimberg, V. C. S. (2017). Constructive Technology Assessment–STS for and with Technology Actors. *EASST review*, *36*(3).
[18] Gale, T. (2005). Constructive Technology Assessment (Encyclopedia of Science, Technology, and Ethics). Available at: https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/constructive-technology-assessment
[19] Castells, M. (1999). The social implications of information and communication technologies. *UNESCO's World Social Science Report*.
[20] Siipi, H., & Ahteensuu, M. (2011). The deficit model and the forgotten moral values.

According to this kind of thinking, since technological advancements will be implemented in any case, negative attitudes and opposition towards them are likely to cause many kinds of problems and since the 1980s, this theory has dominated, leading to the adoption of a common practice towards the education of a public perceived as misinformed. Within these deficit model initiatives, the solution for increasing public interest and support for science and technology development is to provide them with more information, including its benefits to society[21].

However, a large body of literature has now identified significant problems with the deficit model and numerous critiques have been formulated against it and the assumptions upon which it has been based. Beginning with the first and core assumption of the deficit model that the public's opinion can be changed by providing more information and –this way- increasing their "scientific competence". In other words, the DM assumes that as soon as scientific competence increases, a positive attitude towards science and technology will definitely follow. Nevertheless, it has been proved that some of the most informed members of the public continue to maintain an attitude of opposition and suspicion towards some technologies (i.e. nanotechnology), which has often originated from the information received.

Another criticism about the deficit model, maybe also the most important one, concerns the fact that it disregards "lay" knowledge. Although expertise is conceptualized in narrow terms as something acquired only through formal education, it is important to get problematised by what is meant by lay knowledge or public understanding. The term "lay knowledge" describes the "robust empirical approach to understand, explain and assign meaning to contingencies of everyday life, which are usually naturally represented as stories and presented in narrative forms"[22]. There are numerous studies that demonstrate publics often having very sophisticated understandings of science and technology in ways that scientists do not, usually coming from own personal experiences. The deficit model overlooks these different ways in which the general public may understand science, including the critical social perspectives, by equating the public understanding of science with the scientific literacy. Solid examples of lay knowledge can be considered the cases of the sheep farmers in the United Kingdom after the Chernobyl nuclear disaster[23], while also the work of Steve Epstein, who has studied the role of lay knowledge in AIDS research[24].

From the above we can conclude that modern science has also shaped the strategies used to communicate about science and due to the fact that its social, cultural, and political dimensions are not widely considered and discussed, there seems to be no need to take lay knowledge into account. The field of STS is built upon numerous studies presenting how science and technology are not objective, contrary to the prevailing view, while also demonstrating how values and biases shape S&T in multiple ways, such as the questions that

[21] Phillips, C. M. L., & Beddoes, K. (2013). Really Changing the Conversation: The Deficit Model and Public Under-standing of Engineering.

[22] Popay, J., Williams, G., Thomas, C., & Gatrell, T. (1998). Theorising inequalities in health: the place of lay knowledge. *Sociology of health & illness*, *20*(5), 619-644.

[23] Wynne, B. (2016). Misunderstood misunderstanding: social identities and public uptake of science. *Public understanding of science*.

[24] Epstein, S. (1995). The construction of lay expertise: AIDS activism and the forging of credibility in the reform of clinical trials. *Science, Technology, & Human Values*, *20*(4), 408-437.

are being asked and researched, the ways that data are collected and interpreted, the interests served, etc..[25]

Alternatives to deficit model exist and have been widely discussed in fields such as STS and alternative approaches have arisen, describing the relationship of science and technology with the public, in different ways and to varying degrees and emphasising the importance of "two-way dialogue" between science and technology actors and the public.

The rapid pace of biomedical science over the past 20–30 years contributed dramatically to this change of perception and understanding of science and technology but also on the way people engage to them. This has been accompanied by increased concern among the general public, reinforced by controversies such as genetically modified (GM) food, bovine spongiform encephalopathy (or 'mad cow' disease), radioactive waste, mobile phones, etc.. In addition, some emerging biotechnologies have also challenged the public and their imaginary about how they want their society to be.

As these developments and changes took place mainly in the 1990s, governments (with the UK as a pioneer) funded large-scale programs of public science education (i.e. science centres, education programs, TV and radio shows), which have been described as "public understanding of science" (PUS). However, these initiatives were based on the deficit model and the belief that public acceptance of science would be increased if people learned more about it.

But since the situation was not getting any better, at the beginning of 21st century the UK government assigned to the House of Lords Committee on Science and Technology to conduct a relevant research, whose report marked a turning point in science communication worldwide[26]. A key finding of the inquiry was that these kind of educational activities were no longer enough to engage the public. Instead, the report pointed out the need for dialogue, particularly when ethical issues arise.

This public engagement in science (PES) model aims to inform, stimulate and include the general public in a decision-making process that takes under consideration the opinions, expertise and values of all parties involved. A comparison between the deficit model and the public engagement model is being presented in Table 1 below, coming for the Working paper prepared for the Lockhart review on human cloning and embryo research, conducted by Jeannette Salisbury and Barbara Nicholas[27].

Table 1: Comparison of deficit and public engagement models of science communication [28]

	Deficit Model	**Public engagement model (PES)**
Aims	***To increase public sympathy for science by telling people more about science***	***To stimulate and inform debate and to increase public awareness of science processes***

[25] Phillips, C. M. L., & Beddoes, K. (2013). Really Changing the Conversation: The Deficit Model and Public Under-standing of Engineering.

[26] House of Lords (2000). Science and Technology Reports. Available at: https://publications.parliament.uk/pa/ld199900/ldselect/ldsctech/ldsctech.htm

[27] Salisbury, J., & Nicholas, B. (2005). *Review of public engagement in the development and oversight of emerging technologies ('science and society')*. Working paper prepared for the Lockhart review on human cloning and embryo research. Canberra: Biotext. Available at: http://www. biotext. com. au/about-other. html# engaging.

[28] Ibid

Methods	***One-way***: tells people about science	***Two-way:*** encourages feedback and debate
Scope	***Narrow:*** considers issues within narrow scientific paradigm	***Broad***: considers science issues within social context that allows values and feelings to be included in discussion
Starting position	Science is good (people just need to understand it better)	Open minded (different parties may come with different viewpoints but process seeks consensus)
Benefits & Risks	Benefits highlighted by the overall enthusiasm of the science presenter and/or funding imperatives and/or bias for positive results	Allows benefits to be presented realistically, and risks and uncertainties admitted
Fears	Not expressed	Expressed
Ownerships	Exclusive (technology is owned by scientists)	Inclusive (technology is owned by the community)

3.2 Engaging with publics: Theoretical approaches

Public engagement is important for several reasons, while there are three main rationales for this: *normative, substantive, and instrumental*[29]. This means that public engagement should involve all individuals who are being affected by each decision, as it can have different results, namely the following:

- improve the quality of decision-making by using different and diverge sources of opinions, knowledge and values;
  raise public awareness, increase public acceptance, as well as enhance trust in experts, and/or government[30];
- consider ideas, concerns and everyday knowledge;
- improve the knowledge basis.

As Smith, Stirling and Berkhout[31] (2005, p.220) summarise: "*Under a normative view, participation is just the right thing to do. From an instrumental perspective, it is a better way to achieve particular ends. In substantive terms, it leads to better ends*".

When choosing approaches or designing methods for achieving public engagement, there are both conceptual and practical issues to be considered, in order to be able to choose the method that will help succeed what one intended. Several studies have been made that have identified a range of issues need to be taken into account when organising a public engagement exercise, indicatively the following[32]:

- What is the agenda and what are the questions being asked?

[29] Fiorino, D. J. (1990). Citizen participation and environmental risk: A survey of institutional mechanisms. *Science, Technology, & Human Values*, *15*(2), 226-243.
[30] Whitmarsh, L., Swartling, Å. G., & Jäger, J. (2009). Participation of experts and non-experts in a sustainability assessment of mobility. *Environmental policy and governance*, *19*(4), 232-250.
[31] Smith, A., Stirling, A., & Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research policy*, *34*(10), 1491-1510.
[32]Salisbury, J., & Nicholas, B. (2005). *Review of public engagement in the development and oversight of emerging technologies ('science and society')*. Working paper prepared for the Lockhart review on human cloning and embryo research. Canberra: Biotext. Available at: http://www. biotext. com. au/about-other. html# engaging.

- Is the agenda led by the citizens, or is its purpose to inform policy that is already shaped in some way? Which questions are coming for the policy makers and which ones from the public?
- What outcomes are likely to be seen as useful?
- What institutional and political constraints exist?
- What is the scope of the engagement? It takes place within the context of a research project (to get information for the decision makers, or is it an exercise in democracy?
- What are the time frames?

According to Rowe and Frewer's (2005) typology for public engagement mechanisms, there are three concepts of engagement or public participation[33]:

Public communication →	in which the citizen is a passive recipient of information
Public consultation →	in which information also flows to the sponsors of the engagement from the public
Public participation →	in which to the public is involved in a two-way dialogue.

The choice of public engagement type and approach is very important and it's essential to be selected, according to the purpose of the engagement and the role of the public in the decision-making process.

In various occasions, scientists are supported in their efforts for public engagement by relevant professionals (i.e. public engagement practitioners), who have experience and expertise in conducting public engagement, thus can more easily connect scientists to relevant members of the publics and can also train scientists for their engagement and support them during the process.

Below, there is a description of different types of public engagement with different goals and approaches.

Table 2: Public engagement methods and approaches [34] [35]

Participation method	Nature of participants	Description of method	Examples/References (indicative)
Policy Deliberation (i.e. public opinion surveys, public advisory committees,	Policy deliberation approaches provide opportunities for a variety of stakeholders to participate in a dialogue and exchange of views	These approaches may focus on long-range planning perspectives, continuous public consultation and institutional self-	• Emerging issues related to nanotechnology and synthetic biology (United States, mid-2000s). • Radioactive sites in United States (Feldman and Hanahan 1996)

[33] Rowe, G., & Frewer, L. J. (2005). A typology of public engagement mechanisms. *Science, Technology, & Human Values*, *30*(2), 251-290.
[34] Rowe, G., & Frewer, L. J. (2000). Public participation methods: a framework for evaluation. *Science, technology, & human values*, *25*(1), 3-29.
[35] American Association for the Advancement of Science. Many Approaches to Public Engagement. Available at: https://www.aaas.org/resources/communication-toolkit/many-approaches-public-engagement

Participation method	Nature of participants	Description of method	Examples/References (indicative)
focus groups etc.)	about science policy. Potentially all members' national or local population; realistically an important proportion of them.	reflection in response to public input[36].	• Genetically modified food in the United Kingdom (Vidal 1998) • Biotech surveys (Davison, Barnes and Schibeci 1997).
Public Dialogue	Interested citizens, limited in number by the size of the venue.	In public dialogue approaches, the goal is to promote dialogue, considering that informal discussions with the public can result in simultaneous learning by both the public and the experts. This kind of events also serve as opportunities for experts to enhance their own communication knowledge, skills, and experience. Such initiatives provide a chance for all participants to examine scientific issues under diverge opinions and values[37].	• Science cafés are typical forms of venues that "host conversations between scientists and the public about current science topics." They are usually small in size, taking place in cafés, restaurants, bookstores, etc. and they are open to everyone, offering an opportunity to engage citizens who otherwise would have the opportunity to get involved in discussions about science, technology, and the surrounding societal issues[38]. • Science festivals consist a new form of dialogue-based engagement, appearing to be rapidly expanding. Festivals usually bring together temporary exhibits, museum-type activities, scientists, art organisations, students, and members of the general public[39].

[36] Bucchi, M., & Trench, B. (2014). Publics and their participation in science and technology: changing roles, blurring boundaries. In *Routledge Handbook of Public Communication of Science and Technology* (pp. 141-155). Routledge.
[37] Ibid
[38] Navid, E. L., & Einsiedel, E. F. (2012). Synthetic biology in the Science Café: what have we learned about public engagement?. *Journal of Science Communication*, *11*(4), A02.
[39] Jensen, E., & Buckley, N. (2014). Why people attend science festivals: Interests, motivations and self-reported benefits of public engagement with research. *Public Understanding of Science*, *23*(5), 557-573.

Participation method	Nature of participants	Description of method	Examples/References (indicative)
Knowledge Co-Production	Small groups selected to represent views of various stakeholders groups or communities.	These public engagement types concern intentional collaborations, where members of the public engage in the process of research to generate new science-based knowledge.[40]	• Research program designed to produce scientific knowledge, with a participatory approach, in support of evidence-based management decisions of the Ningaloo Marine Park in Australia. • Cases studies of urban forestry in the U.S for sustainable planning and management of environmental resources to address climate change Mitigation and Adaptation. • Interdisciplinary project evolved into a knowledge co-production scheme. The process involved Researchers, coffee farmers, regional and national practitioners and policy makers (Gov. agencies, NGOs), and other academia working on climate change adaptation in the agricultural sector in Latin America[41].
University-led Cooperative Engagement	Key stakeholder groups, such as farmers, coastal land owners, minority groups, and industry members.	The emphasis in such initiatives is on trust-building and social learning, coming from cooperation with key stakeholders. They are most likely led by Universities and/or deploy university-based networks, resources, and infrastructures[42].	Perceptions of climate variability and change as well as the preferred approaches for climate-related training in extension from four states (Alabama, Florida, Georgia, and South Carolina)[43].

[40] Shirk, J., Ballard, H., Wilderman, C., Phillips, T., Wiggins, A., Jordan, R., ... & Bonney, R. (2012). Public participation in scientific research: a framework for deliberate design. *Ecology and society*, *17*(2).
[41] Djenontin, I. N. S., & Meadow, A. M. (2018). The art of co-production of knowledge in environmental sciences and management: lessons from international practice. *Environmental management*, *61*(6), 885-903.
[42] Diehl, D. C., Galindo-Gonzalez, S., Dourte, D. R., SLOAN, N. L., BARTELS, W. L., FURMAN, C., & FRAISSE, C. W. (2015). TOWARD ENGAGEMENT IN CLIMATE TRAINING: FINDINGS FROM INTERVIEWS WITH AGRICULTURAL EXTENSION PROFESSIONALS. *Journal of Rural Social Sciences*, *30*(1).
[43] Ibid

Within the above approaches varying degrees of public engagement exist, ranging from informing to co-creating. The features of any participation or engagement methods will not act alone, in order to determine which approach is the most effective. On the contrary, a variety of contextual and environmental factors always interact with the characteristics of each method to prove whether it will be effective or not and suitable for each specific context or not, depending also to the desired outcomes. Thus, while one approach may be appropriate in a certain situation, a different one may be more suitable under different context, while also the combination of some approaches could also be required in some cases.

While public participation and engagement requires resources such as skills, time and money, it generates numerous advantages, by providing new information, different ways of perception on the same issue, as well as motivation to address problems. The public tends to have more informed involvement and a higher level of interest when given opportunities to identify priorities, shape decision-making parameters or influence policy outcomes[44].

Participatory decision making can limit delays, mistakes and barriers during a policy development. Stakeholders are usually more likely to accept a decision made in a participatory manner, even when it is not their individually preferred outcome, because they believe the outcome was reached fairly. Moreover, inclusive participation can create relationships of trust and improved communication among parties, valuable prerequisites for policy implementation and for addressing problems.

The following table provides an overview of some main barriers preventing effective participation and stakeholder engagement, and strategies how to avoid these.[45]

Table 3: Common barriers in participation processes and how to overcome these, (source CH4LLENGE (2013))[46]

Barriers	**Description**	**Strategies to overcome barriers**
Aim and purpose of participation are unclear	Clarification of the aim of the participation in order to understand the needs of certain groups (e.g. people with mobility difficulties; parents and guardians of young children etc.)	Determination of *who should be involved:* - demographic representation if the aim of participation is to draw on public knowledge, or to understand public experiences - members of groups if the aim is to understand needs of specific groups Determination of *what form of participation is appropriate:* - forums allowing debate to use lay or expert knowledge - questionnaires or interviews for gathering experiences - question and answer session for helping to explain decisions

[44] Garrett, M. (Ed.). (2014). *Encyclopedia of transportation: Social science and policy*. SAGE Publications.

[45] Quick, Kathryn S. 2014. Public Participation in Transportation Planning. In Encyclopedia of Transportation: Social Science and Policy, edited by Mark Garrett, pp. 1132-37. Thousand Oaks, CA: Sage Publications.

[46] Böhler-Baedeker, S., & Lindenau, M. (2013). Why is Participation a challenge in sustainable urban mobility planning?

Barriers	Description	Strategies to overcome barriers
		Determination of *when to involve:* - explain how public or stakeholder involvement influences decisions. - show people that their participation makes a difference.
Accessibility of participation	Barriers to participation occur: - if people cannot physically reach a venue in which participatory events occur; - if information is not provided in a format that can be clearly understood.	Consideration of aspects such as: - can people attend after work? - is there provision for children at events" - is there wheelchair access" - what is the availability of transport to the venue? - how is material distributed (consider e.g. that online questionnaires are cost effective and have broad reach, but may exclude some groups of people)? - how opportunities for participation are publicised? - is information presented in clear language that can be understood by a lay person? - is information provided in braille, large text and audio formats? - is information translated into different languages?
Public reluctance to engage in participation	- Groups that face forms of social exclusion or discrimination may have little trust in formal participation. - People feel they have little free time to give to participating. - People feel that their word does not count and that the decision-making process remains opaque despite consultation.	While there are no simple answers to problems of reluctance to participate, it is probable that interest will increase to the extent that people see the relevance to them of participating, and feel that the processes are transparent and wort their trust.
Institutional barriers to participation	- Limitations in institutional resources, and difficulty in securing required resources. - Institutional cultures which place low priority on participation.	Might lead to poorly planned participation or a failure to take reliable results of participation, which may lead to loss of public trust.
Limits of participation	- Awareness about the limits of what participation can achieve. - Ensure that only appropriate claims are made for the participation.	- Avoidance of claims that participants represent the public when only some stakeholders are involved - Avoidance of claim that the "public"' have expressed a specific view when there is substantial disagreement among the public.

Barriers	Description	Strategies to overcome barriers
Dissatisfaction with the involvement process	Effective participation can involve members of the public organising themselves and determining among themselves what are relevant questions and challenges to put to decision-makers.	- Identification of stakeholders and groups to be involved carefully so that no one is ignored. - Communication with them regularly and discussion of their involvement and influence. - In case of the public dissatisfaction with the involvement process, action need to be taken as early as possible proving that their concerns are considered.

3.2.1 Some recent examples

Areas of biotechnology and genetic modification are on the focus of initiatives of public engagement. For example, genetically modified food is constantly a focus of reports and surveys on public attitudes to technologies and of attempts related to public engagement, such as the "UK GM Nation?" experiment in public engagement. This effort included 9 foundation workshops; a program of debate, including 6 national and regional conferences, smaller county-level meetings, and local meetings; a research component to give emphasis on selected issues; official material and a website, where people could post comments and learn more about the progress of the debate[47]. Another example that can be mentioned is the Irish consultation while also developing its policy in GM food. After a call for submissions, they realised a two-day consultation debate, with a panel of stakeholder representatives (industry, science and NGOs). The debate sessions has been chaired by an independent panel.

Moreover, the Australian Law Reform Commission decided to promote community education and debate about the technologies involved to the protection of human genetic information, and that this was not an area to be left to experts. They didn't just provide information, but they also organised public forums and meetings with various professional, interest and community groups[48]. In 2000, the Public Health Association (CPHA) of Canada was commissioned to conduct a public consultation concerning the issue of xenotransplantation. In order to achieve it, they have used 4 tools (1) a general population survey in which 1519 randomly selected participants took part, (2) a stakeholders' survey, (3) a web-based survey and (4) 6 regional forums, in which of 20 again randomly selected people participated spending a weekend together, with presentations from transplant recipients and experts, questioning, and discussion[49].

3.3 Engaging with the publics: Evidence and Issues

As the public engagement approaches and methods move from theory to practice, several dilemmas come up, which provoke the question of whether and in what degree the notion of public engagement could act as a potential solution to the problems of science

[47] Barbagallo, F., & Nelson, J. (2005). Report: UK GM dialogue: separating social and scientific issues. *Science Communication*, *26*(3), 318-325.

[48] Weisbrot, D. (2012). The ethical, legal and social implications of umbilical cord blood banking: Learning important lessons from the protection of human genetic information. *Journal of law and medicine*, *19*(3), 525.

[49] Einsiedel, E. F. (2002). Assessing a controversial medical technology: Canadian public consultations on xenotransplantation. *Public Understanding of Science*, *11*(4), 315-331.

governance. The idea that policy-making of science could get improved through the establishment of open dialogue between scientists, policy-makers and the public seems to be undoubtable. If the scope is to enable and encourage technological choices that promote public good, who would be better to be asked than the public themselves? This means that if public engagement takes place at the beginning of the development and emergence of a new technology, this should lead to the reduction of public controversy.

During the past few years, engagement is being established as an integral part of research, which has become increasingly accepted by those funding and conducting research. So, it is probably time to think about the quality and impact of these activities, as well as about the dilemmas that have come up. For instance, a particular concern, which is almost automatically drawn, is the question "who should take part in engagement activities"? Although this is of course expected to vary according to the particular context, there are still some technological and scientific developments that are currently emerging, like nanotechnology, where the answer to this question could be "everyone". However, and since something is definitely better than nothing, as well as for practical reasons, small-group discussions is mainly the method through which dialogue is being enabled.[50]

Public or community engagement practices need to build an evidence base. Evaluating and monitoring of engagement processes is important and anyone planning an evaluation should be aware of whose agenda is being promoted and on whose terms the evaluations take place. Monitoring and evaluation of public engagement is an area that can be challenging. The identification of the most fitting approach, when faced with a wide range of objectives, audiences, agendas and mechanisms for engagement is of crucial importance. Developing an evidence base of what fits better specific contexts could be vital for engagement practitioners and scientists that are increasingly getting involved in this field. *Monitoring and evaluation should be about finding out what is or is not working*. It should focus on learning, action and design tools and will often draw on social research methodologies. However, it is also vital to monitor key information, in order to complete a final evaluation[51].

At its essence, public engagement it is not just about providing information or disseminating results but about discovering ways to cover the gaps between two or more different knowledge systems and cultures (i.e. between scientists, policy makers and community members). Part of the reasoning behind engagement is a belief that it will improve the quality of research. But there is also another aspect of it that has to do with holding scientists accountable for their actions and ethics effects.

In monitoring and evaluation processes, impact of public engagement is also being examined, that is whether engagement efforts are achieving the goals that were initially set. The term "impact" is typically used to describe a direct causal influence of an action (or a project) that can be measured. However, this definition of "impact" is not applicable when it comes to public engagement activities. Simple and linear cause–effect relationships are not suitable to describe social interventions, where multiple actors and relationships make things much more complex. As a social process, public engagement activities require a different evaluation that

[50] Sturgis, P. (2014). On the limits of public engagement for the governance of emerging technologies. *Public Understanding of Science*, *23*(1), 38-42.

[51] Aggett, S., Dunn, A., & Vincent, R. (2012). *Engaging with impact: How do we know if we have made a difference?*. Welcome Trust.

will be able to capture this complexity. The main purpose of these activities is to empower communities to engage with the tools and values of science but "translated" in their own terms. Engaging communities affected by research is a necessary factor related to good practice and ethics in the research enterprise and better understanding of science.

3.4 Public participation in Transport

Public participation includes stakeholders in making and implementing public policies and programs of government agencies, political leaders, or non-profit organisations. It has become a fundamental feature of governance in a wide range of public issues and plays an important role in a variety of transportation-related activities too, including planning, formal policy making, program and service design, and evaluation. Notably, the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 imposed new requirements for public involvement in the planning process in the United States. Public participation can be designed in a variety of ways, guided by a few key questions about its purpose, the stakeholders, and the evaluation measures.

Public participation in transportation takes a range of forms, including simply informing stakeholders of decisions that are being made, soliciting and using their input on programs or policies under consideration, or collaborating with them to identifying and address problems. Transportation policy stakeholders are those with a stake in the decision, which may include the general public and/or groups with specific interests, because of their geographic location, transportation needs or related concerns. Transport planning is a frequently controversial area with highly debated decisions that also require, in the light of democratisation of politics, public acceptance. The involvement of stakeholders and citizens can legitimise decisions and moreover, lead to new, innovative governance models balancing different positions and interests.

There is no formula for doing public participation well. Like transportation services or infrastructure, public participation needs to be designed for its particular context. Regardless of the specific strategy, policy makers and planners must consider several critical factors in designing and managing successful public participation, i.e. clarifying which parts of the decision are open to discussion and change, ensuring public trust in the process, working with experts and other perspectives, and being accessible to all stakeholders.

There are many methods for involving the public in transportation planning, from a public hearing before the elected or appointed body making a decision to more inclusive approaches in which stakeholders are involved in the identification of problems and co-production of solutions. In the past decade, transportation agencies around the world have involved the public in a number of ways: [52]

[52] Quick, Kathryn S. 2014. Public Participation in Transportation Planning. In Encyclopedia of Transportation: Social Science and Policy, edited by Mark Garrett, pp. 1132-37. Thousand Oaks, CA: Sage Publications.

Table 4: Types of public participation in transport[53]

Type of public participation	Description
Advisory boards	Groups of stakeholders recruited to provide guidance on a policy area or project. Members may be selected by elected officials, commissions, public administrators, and project managers. They may be intended to represent the public at large, to bring a particular perspective (for example, an advisory committee on disabled transit riders), or to incorporate a range of stakeholder groups. Advisory groups may meet regularly, as needed, or for a limited term to address a particular question. They do not generally have policymaking authority, and their influence on policy agendas and outcomes is mixed.
Project review teams	These teams help transportation professionals to evaluate possible transportation projects. They may rank projects from a pool of proposals, or simply share comments and raise questions for transportation professionals to incorporate into their reviews.
Collaborative performance measurement	Collaborative performance measurement brings together service providers with stakeholders to evaluate service or project performance. It can be used to evaluate performance problems, but also to identify and address situations where different parties have divergent goals and expectations for a service.
Focus groups and workshops	Focus groups and workshops help professional staff or political leaders to gain additional perspectives on a problem through consultation with interested stakeholders or with members of the general public. Participants may be given a set of questions or issues to discuss or be invited to comment on a policy. The consultations can be designed for a variety of purposes, such as gaining information about issues of greatest concern to constituents, involving a program's users in its performance evaluation, or improving a project so that it is more politically feasible or more responsive to client needs.
Deliberative polls	Trademarked method for identifying the questions that the general public would have about a policy issue if they became better informed and discussed them in depth with people with differing viewpoints. These polls can lead to better communication strategies about transportation policies. Participants are randomly selected, prepared with a briefing packet, and invited to attend a deliberative forum in which small, facilitated groups discuss the issue and decide together which questions about the policy that they would like to pose to experts and decision makers. Organizers later relay their questions to the media, policy makers, or experts.
Planning charrettes	Collaborative design exercises that allow stakeholders to directly experience, manipulate, and play with design components through games, simulations, maps, field trips, or other objects or experiences. They typically incorporate a variety of media, such as 3-D models, photography, and rendered landscape images. The models can be shaped to communicate which parts of a project are fixed (for example, lane width) and which are flexible. Planning charrettes can help the public to understand transportation options and communicate their questions and suggestions to engineers and planners. Using mixed media may be associated with greater public satisfaction with the outcomes.

[53] Ibid

Type of public participation	Description
Structured public involvement	Structured public involvement (SPI) involves the public in every decision phase, from defining the nature of the transportation problem and to creating the scope for the policy to setting design goals and refining the options together. Recommended as a best practice for involving the public in design decisions, it occurs through focused explorations and strategizing about separate pieces of the policy. Piece by piece, participants suggest ideas and make modifications concerning each piece until there is general agreement, and then integrate it with other pieces of the policy. When convening these processes, transportation professionals must be responsive to multiple perspectives, help non-expert participants understand the technical aspects of the policies, be competent facilitators, and be willing to cede some of their decision-making power.
Interactive optimization tools	Interactive optimization tools involve the public in manipulating a fixed set of resources to choose among a menu of policy options. In some designs, users can move back and forth between setting performance criteria (for example, persons moved per hour) or resource parameters (for example, a total budget) and the menu of projects, so that they can see the interplay between them. Frequently they use an online platform.
Participatory action research	Participatory action research involves researchers working with interested parties to perform research driven by their questions and concerns. Activities include gathering and analysing data, identifying problems to address, or generating and evaluating policies. Developing these community-led initiatives requires technical assistance. Some researchers provide pro bono support, or sometimes transportation agencies provide consulting support. Generally, institutional actors must have buy-in in order for the resident-driven contributions to be taken seriously.
Geographic analysis of public comments	This analysis uses geographic information systems (GIS) to identify geographically based needs for additional outreach about transportation decisions, and to identify geographically specific patterns of feedback about projects.

3.4.1 Key Challenges

As beneficial public participation may be for the decision-making process and/or the development of a policy or a technology, at the same time it can be also challenging to organise it effectively. For example, there is always the risk of organising the participatory actions at a late stage, when nothing can be changed anymore, or completely ignore the results. Moreover, public participation may be treated as purely advisory, while the public expects to be more affective. In such cases, public participation may result in disappointment[54].

The challenges that can be met during a public participation process may differ from internal to external ones. Lack of resources, mainly financial, as well as lack of time, difficulty of

[54] Mostert, E. (2003). The challenge of public participation. *Water policy*, *5*(2), 179-197.

obtaining the required interest, non-existence of appropriate training (when needed) and/or lack of coordination of the involved parties, are just some indicative examples of internal challenges that could be mentioned.

On the other hand, there are also the external factors that may cause barriers in the public participation, which often may be more significant and difficult to overcome. Lack of awareness, understanding or even interest on the process is a very common case that cause low levels of public involvement, while another important factor is the competing interests of members of the public that might prevent them from cooperating[55].

Although some of these challenges may occur in different areas and issues, there are also differences among sectors and topics addressed. Thus, the challenges described above are valid for different research and development areas, including transport. For example, within a study implemented for the Carbon capture and storage (CCS), in which experts' attitudes and experience with public engagement were reported, similar challenges were also described, including the broader problem of appropriate communication of a complex and technical topic to the general public, together with the fact that the public is perceived as generally unaware of both CCS technologies, as well as lack of suitable materials and communicators, lack of familiarisation with the process, etc. [56]

In this context, also various challenges usually arise when designing and managing successful public involvement in transportation policymaking, indicatively referring to the following ones, as the most common and most likely to occur [57] [58] [59]:

Trust and legitimacy issues

A main problem often faced by the public when it comes to participation and engagement processes in transportation issues and processes is that their involvement does not seem to influence decisions, , since there are very few things that can change in the policies or projects already decided and finalised, causing a dissatisfaction to interested parties and stakeholders. Time is an important element of involving and integrating the public in the decision-making process. Consultation of stakeholders during the launch of such processes allows policy-makers to better shape the scope, priorities or the key performance indicators. Another important issue is that policy makers should also make known the aspects that can and cannot be decided through a public participation process. For example, several transport parameters are mandated by law, a fact that limits the power of the public to influence an outcome. Moreover, since transport initiatives are usually carried out in a multi-jurisdictional environment, it may be difficult for involved members to define which services are responsible for what actions or to participate in many institutions involved.

[55] Giering, S. (2011). *Public participation strategies for transit* (Vol. 89). Transportation Research Board.
[56] Xenias, D., & Whitmarsh, L. (2018). Carbon capture and storage (CCS) experts' attitudes to and experience with public engagement. *International Journal of Greenhouse Gas Control*, *78*, 103-116.
[57] Quick, Kathryn S. 2014. Public Participation in Transportation Planning. In Encyclopedia of Transportation: Social Science and Policy, edited by Mark Garrett, pp. 1132-37. Thousand Oaks, CA: Sage Publications.
[58] Institute for Transportation and Development (ITDP). The Online BRT Planning Guide - Challenges to Public Participation. Retrieved from: https://brtguide.itdp.org/branch/master/guide/public-participation/challenges-to-public-participation
[59] European MSP Platform. Stakeholder involvement - Main issues. Retrieved from: https://www.msp-platform.eu/faq/stakeholder-involvement

Diversity and Equity issues

In transportation policy making –as in many other fields- diversity and equity in access to public participation are particularly major concerns. For example, individuals of higher socioeconomic status are more likely to have more opportunities to participate (i.e. due to more time, money, civic engagement skills, etc.), and of course exert more influence. This leads to the result of no proper and inclusive representation in participation and engagement efforts of the opinions and knowledge of the public at large. Nevertheless, in transportation, low-income communities usually have a higher interest in policy and planning discussions (i.e. related to PT transit services). In order to include them also in the participation process, alternatives processes and participation and communication channels may be necessary, in order to collect their feedback.

The concept of the "public" is multifaceted in the transportation sector and this is why can be complicated and also challenging to ensure a sufficient level of diversity without classifying constituents into stakeholder groups that do not capture their full range of interests (i.e. bicyclists is not a homogenous group, as it includes recreational riders, long-distance riders, commuters, etc.). Transport professionals also have to ensure that they are not very focused on the direction of organised groups of special interest, as this may exclude the general public and raise the risk of providing to the unrepresentative minority with too much influence on policy making[60].

Evaluation of Public Engagement outcomes

The evaluation of the public-engagement effort is the final step and a very important one, as it allows policy makers to learn from the implementation, so that they can adopt and promote the current engagement type of activity, changes or even replace it completely. This is why the evaluation process needs to be included from the beginning of the design process: What are the expected results, and how will they be measured and evaluated? For example, some specific Key Performance Indicators (KPIs) need to be defined, as the typical measures (i.e. number of participants, and relevant demographic information about them) is not adequate for meeting and evaluating most of the goals of public participation.

These kinds of challenges are only some indicative examples that could also apply to the field of autonomous driving. This field, which is a relatively new area of research, as well as an area that is established -in terms of legislation and policy - almost from scratch, is definitely expected to face difficulties in the involvement and engagement of the public, due to the fact that unawareness is yet a common ground[61].

[60] University of Oxford (2016). Smart Technologies and Public Participation in Transport Planning. Available at: https://podcasts.ox.ac.uk/smart-technologies-and-public-participation-transport-planning

[61] Quick, Kathryn S. 2014. Public Participation in Transportation Planning. In Encyclopedia of Transportation: Social Science and Policy, edited by Mark Garrett, pp. 1132-37. Thousand Oaks, CA: Sage Publicationst

4. Understanding the Publics

4.1 Autonomous cars: An introduction and description of critical issues

An autonomous car is a vehicle that is capable of sensing its environment and moving with little or no human input[62]. To be able to do so, autonomous cars combine a variety of sensors (i.e. radars, Lidars, sonars, GPS, etc., together with advanced control systems that interpret this information and help the vehicle identify appropriate navigation paths, as well as obstacles and relevant signage.[63] [64]

SAE International, which is a U.S. based, association and standards developing organisation for engineering professionals, initially established as the *Society of Automotive Engineers* and currently with emphasis on various transport industries such as automotive, aerospace, and commercial vehicles[65], has identified the "Levels of Driving Automation" standard that defines the six levels of driving automation, from no automation to full automation (see **Error! Reference source not found.** below)

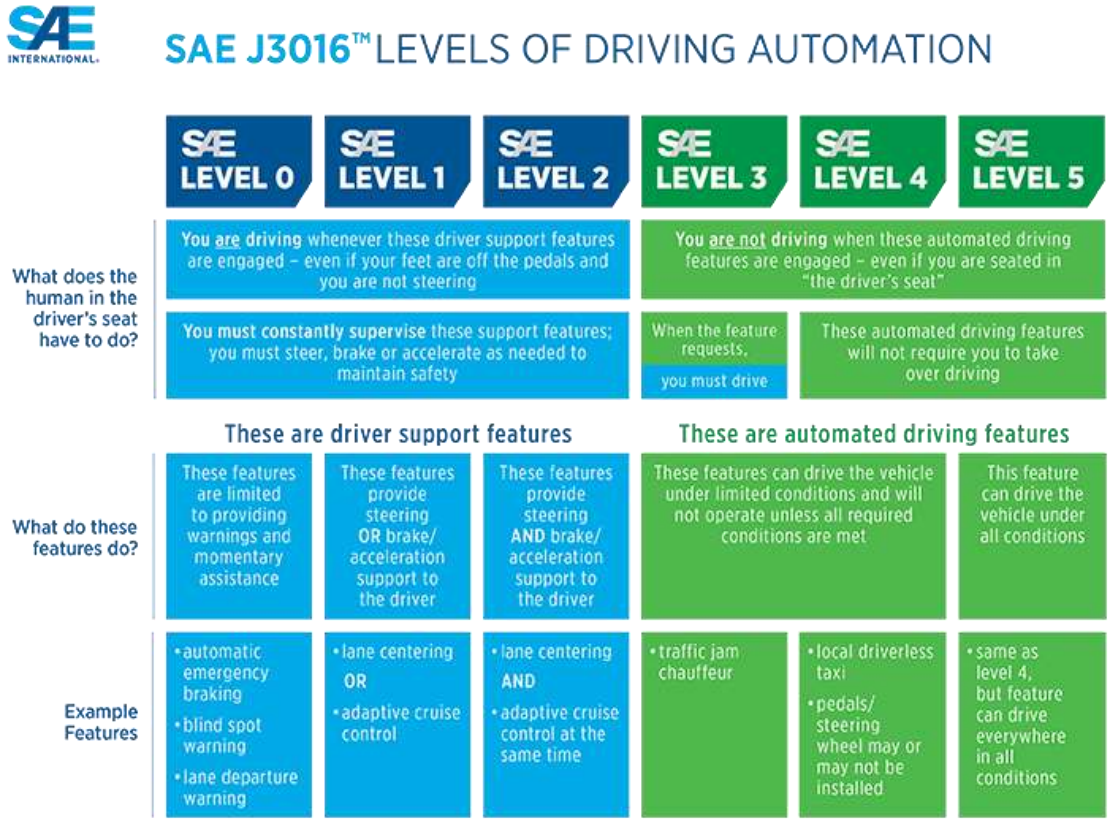

Figure 2: SAE identified levels of autonomous driving

[62] From Wikipedia (https://en.wikipedia.org/wiki/Autonomous_car#cite_note-1)

[63] Lassa, Todd (January 2013). "The Beginning of the End of Driving". Motor Trend. Retrieved 1 September 2014.

[64] European Roadmap Smart Systems for Automated Driving Archived 12 February 2015 at the Wayback Machine, European Technology Platform on Smart Systems Integration (EPoSS), 2015.

[65] https://www.sae.org

Although autonomous and self-driving cars used to exist only in sci-fi films, during the last years they are becoming a reality. Companies like Lexus, BMW and Mercedes have already started developing such vehicles, while Tesla has already tested its Tesla's driverless Autopilot system on UK roads[66]. Google and Uber are also working on their autonomous technology and although fully-driverless cars are still at a piloting stage, partially automated technology has been around for the last years.

However, developments in recent years have mainly focused on technological and material advances leaving somewhat behind and less developed issues that are inter-related, such as public acceptance of connectivity and automation (e.g. safety, data privacy, reliability issues), to the development of user-friendly and appropriate Human-Machine Interfaces (HMI) and ethical decision making. A clear challenge of the transport sector remains the lack of an evidence-based assessment of real user behaviour in autonomous vehicles (and possible mitigation solutions), related also to gender, age and ability factors with and without the assistance of Intelligent Transport Systems (ITS) and in different scenarios (i.e. technical failure) and operating environments (e.g. urban, rural, etc.).

4.1.1 Legislation

The 1968 Vienna Convention on Road Traffic, subscribed to by over 70 countries worldwide, establishes principles to govern traffic laws. One of the fundamental principles of the Convention has been the concept that a driver is always fully in control and responsible for the behaviour of a vehicle in traffic[67].The progress of the connected and autonomous technology that is used and allowed to take over the functions of the driver is against this principle, leaving gaps in the existing legislative and policy framework. This is the reason why an amendment was recently proposed to allow self-driving vehicles on public roads in countries governed by the treaty.[68]

Additionally, in response to such rapid technological developments and in view of the self-driving vehicles progress, governments—both local and national—have already begun to develop strategies in order to address the challenges that may result from the introduction of such vehicles. For example, in 2013, the government of the United Kingdom permitted the testing of automated cars on public roads, as until then all testing of robotic vehicles were being conducted on private areas[69]. One year later (2014), the Government of France announced that testing of automated cars on public roads would be also allowed in 2015, as 2000 km of road would be opened through the national territory, especially in Bordeaux, in Isère, Île-de-France and Strasbourg, while during the 2015 ITS World Congress, a conference dedicated to intelligent transport systems, the very first demonstration of autonomous vehicles on open road in France was carried out in Bordeaux[70]. Again in 2015, the Federal Department of Environment, Transport, Energy and Communications in Switzerland

[66] Moldrich, C. (2016). Tesla Autopilot review: We test Elon Musk's autonomous tech in the UK. Retrieved at: https://www.alphr.com/tesla/1003022/tesla-autopilot-review-we-test-elon-musk-s-autonomous-tech-in-the-uk

[67] GAR – 1968 Vienna Convention". 1 December 2017. Archived from the original on 1 December 2017. Retrieved at: https://web.archive.org/web/20171201050545/https:/globalautoregs.com/rules/157-1968-vienna-convention-on-road-traffic

[68] UNECE (2016). UNECE paves the way for automated driving by updating UN international convention. Retrieved at: https://www.unece.org/info/media/presscurrent-press-h/transport/2016/unece-paves-the-way-for-automated-driving-by-updating-un-international-convention/doc.html

[69] "UK to road test driverless cars". BBC. 16 July 2013. Retrieved 17 July 2013.

[70] "Des véhicules autonomes sur route ouverte à Bordeaux en octobre 2015". usine-digitale.fr.

(UVEK) allowed Swisscom to test a driverless Volkswagen Passat on the streets of Zurich[71], while from April 2017, public road tests for development vehicles are also allowed in Hungary[72].

The necessity and urgency of such changes in the European policy and legal framework has been increased by some incidents related to the autonomous cars, such as the fatal accident involving a vehicle being driven by itself took place in Florida on 7 May 2016, when a Tesla Model S electric car was engaged in Autopilot mode or when, on March 2017, an Uber test vehicle was involved in a crash in Arizona when another car failed to yield, flipping the Uber vehicle.

4.2 The anatomy of public perception of autonomous vehicles

The emergence of Autonomous vehicle (AV), commonly referred to as driverless cars, has captured the public's attention and interest. AV's research, mainly due to the potential of autonomous vehicles to offer a multitude of advantages to the travellers and therefore influence their daily routines is an area of great public interest. On the other hand, it is also essential to monitor the public's opinion on this particular technological development. However, the main obstacle that remains - from a user's perspective - is the development of trust towards this technology.

Road transport automation has now arrived at our doorstep; it is not anymore a future possibility but an issue of time. Within the latest ERTRAC Roadmap on Automated Driving[73], user awareness, acceptance, engagement and training formulate the first priority challenge. Questions related to vehicles taking over control from humans, modification of mobility patterns and experiences, cost of commuting in the future, ethical decisions of a machine vs. a human type, as well as the need for new training incentives, in order to adapt to this technological evolution, are some of the key issues that are still to be researched. Apart from private cars, automation is already a reality in public transport vehicles (of all modes), airplanes being the pioneers, with their first autopilot systems dating early in the 20th century. Since then, relevant systems are used for the operation of rail (i.e. trains and subway), the autonomous ship is also an emerging concept, while road public transport has already begun the introduction of automated vehicles, with several examples throughout Europe. The penetration of automated vehicles is expected to bring a revolution to the transport system as we know it. According to an OECD/ITF report[74], up to 9 out of 10 conventional cars could become redundant under certain circumstances, while the International Association of Public Transport (UITP)[75] highlights that there are various applications for autonomous vehicles as part of a diversified PT system, which will enable performing all demanded trips with 80% fewer cars.

Self-driving vehicles have also become a popular topic in the media, as well as being the focus of various surveys attempting to gauge the public's perception of such vehicles. Even though

[71] "Swisscom reeals the first driverless car on Swiss roads". Swisscom. 12 May 2015. Archived from the original on 28 September 2015. Retrieved 1 August 2015.
[72] "Zalazone home page". zalazone.hu. Retrieved 24 January 2018.
[73] ERTRAC Working Group "Connectivity and Automated Driving", Automated Driving Roadmap - Status: final for publication, Version 7.0, May 2017
[74] OECD/ITF, Urban Mobility System Upgrade, How shared self-driving cars could change city traffic, 2015.
[75] UITP, Policy Brief: Autonomous vehicles: a potential game changer for urban mobility, 2017.

technology is almost there, it is a crucial issue whether humans are ready to abandon the driving task and board on a vehicle with no driver present. The EC 2015 Eurobarometer survey[76] showed that 61% of participants throughout the EU stated that they don't feel comfortable travelling with driverless cars, while they were more positive to the option of transporting goods using such vehicles, while a recent relevant survey in the US[77] found that 64% of respondents expressed concern also about sharing the road with driverless cars. However, acceptance of road automation seems to be increasing with time as, according to the 2017[78] and 2018[79] Deloitte global automotive consumer studies, people throughout the world are becoming convinced that travelling with autonomous vehicles is safe, with the acceptance rate going from 45% to 72% in Germany and from 37% to 65% in France (in just one year).

There are many factors that are expected to influence the acceptance and engagement of the ongoing transition period, like the recognition of benefits, customisation with the new types of vehicles, provision of incentives, etc., along with the way to address several concerns around the use of automation (e.g. lack of trust to the system, cybersecurity issues, liability issues in case of accident, loss of driving competence, less joy of travelling, etc.). The level of automation is also a significant factor for the user acceptance. Level 3 automation (i.e. conditional handing over the vehicle control to the driver) has the largest requirements on the human machine interface and many experts and OEMs propose to skip it and introduce only Level 4 vehicles. The technological requirements for Level 4 and the costs are however much higher if the driver cannot be considered as fall back, while the benefits of Level 3 include the early availability, the increase of legal acceptance and it is a promising migration path for user acceptance of automated vehicles. Moreover, by involving the drivers and the public in general smartly in the Level 3 automated driving tasks, a mutual understanding of the automation should be developed and trust can be built stepwise. Experience also plays a significant role, as shown by a driving simulator study[80] on automated vehicles, where increased levels of trust and comfort were reported by the participants throughout their time in the simulator. Furthermore, another crucial aspect, based on the 2017 OECD report on the transition to Driverless Freight Transport[81], is looking into the professional drivers' current and future acceptance and adoption of solutions, is key for safeguarding the business-as-usual of the industry, without endangering the social and economic viability of the people working in it.

4.2.1 Configuring the publics and their variety of perceptions

Within this context and way of thinking, summarised in "*the fast development of AEVs requires public* acceptance" a number of studies and surveys have been realised in various countries concerning different types of usage. It is also essential to evaluate willingness to pay for new services and for which purposes - and when - respondents choose to switch from existing alternatives. Although an increasing number of surveys are being conducted, this section

[76] European Commission, Autonomous Systems, Special Eurobarometer 427 / Wave EB82.4 – TNS Opinion & Social, 2015.
[77] European Commission, Autonomous Systems, Special Eurobarometer 427 / Wave EB82.4 – TNS Opinion & Social, 2015.
[78] Deloitte, 2017 Deloitte global automotive consumer studies, 2017.
[79] Deloitte, 2018 Deloitte global automotive consumer studies, 2018.
[80] Schwarz, C., Gaspar, J., Brown, T. 2018. Demographic Observations in Conditionally Automated Driving in a Simulator. TRB 2018.
[81] ITF/OECD, Managing the transition to driverless road freight transport, 2017.

provides an overview of different users' dimensions currently being investigated and survey methods employed.

According to the majority of the surveys, technical security is the major concern for AVs. Besides, privacy security, laws and related standards should be enacted during its development.

Starting with a survey examined public opinion regarding self-driving-vehicle technology in three major English-speaking countries (namely Australia, UK and USA) in 2014[82], the majority of respondents stated that had previously heard of autonomous or self-driving vehicles and had a positive initial opinion of the technology, together with high expectations about its benefits. At the same time, although the majority of respondents expressed a desire to have this technology in their vehicle, it was also unwilling to pay extra for the technology. Moreover, the majority of respondents expressed high levels of concern about riding in vehicles without driver control, including self-driving commercial vehicles, busses, and taxis, as well as about security issues related to self-driving vehicles. Comparing the responses from the 3 countries, the respondents in USA expressed greater concern about riding in self-driving vehicles, data privacy, interacting with non-self-driving vehicles, self-driving vehicles not driving as well as human drivers in general, and riding in a self-driving vehicle with no driver controls available.

This study also revealed that females expressed higher levels of concern than did males, while relevant results same up at a study comparing 16 different studies for AVs public acceptance from 2012 to 2016 (in 2017)[83], pointing also out that men are more open to this technology than women.

Another factor identified as important is age. More specifically, assessing age of the respondents as a factor, only Roedel et al. (2014)[84] observed a stronger intention to use autonomous vehicles with an increasing age, justifying this referring to the physical limitations that prevent older people from driving. However, six other studies worldwide conclude that younger people are more open to the introduction of autonomous vehicles.

In the Special Eurobarometer 427[85], conducted in 2015 by TNS Opinion & Social at the request of Directorate-General for Communications Networks, Content and Technology (DG CONNECT), 27.801 respondents from different social and demographic groups were interviewed in their mother tongue. The results revealed that at least three out of ten people in Poland (35%), the Netherlands (34%), Denmark (33%) and Sweden (32%) would feel comfortable with the idea of travelling themselves in autonomous cars. In contrast only 12% of people in both Cyprus and Greece say they would feel comfortable travelling in an autonomous or driverless car. It's worth noting that an absolute majority of respondents in 23 Member States claim that they would not be comfortable doing this. Again, men seem more likely than women to feel comfortable travelling in an autonomous vehicle (27% vs. 16%),

[82] Schoettle, B., & Sivak, M. (2014). A survey of public opinion about autonomous and self-driving vehicles in the US, the UK, and Australia.

[83] Becker, F., & Axhausen, K. W. (2017). Literature review on surveys investigating the acceptance of automated vehicles. *Transportation*, *44*(6), 1293-1306.

[84] Rödel, C., S. Stadler, A. Meschtscherjakov and M. Tscheligi (2014) Towards Autonomous Cars: The ffect of Autonomy Levels on Acceptance and User Experience, paper presented at the Proceedings of the 6th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, Automotive UI '14, 11:1—-11:8, New York, NY, USA, ISBN 978-1-4503-3212-5.

[85] European Commission. (2015). Special Eurobarometer 427: Autonomous systems. *Report*.

while responders aged 15-24 are more likely than those aged 55 or over to feel comfortable travelling in an autonomous vehicle (27% vs. 16%). Additionally, the education level has been also taken under consideration in this study, showing that participants who finished their education aged 20 or over are more likely than those who left school at 15 or under to feel comfortable using an autonomous vehicle (28% vs. 11%).

As time passes and the technology of autonomous cars is getting more mature, and more communicated to the public, the levels of public acceptance increase. Deloitte implements each year a Global Automotive Consumer Study with the participation of many users from many different countries, where several issues, autonomous cars included, are being investigated. The study that took place in 2017[86], showed that skepticism towards autonomous vehicles in Western Europe (with emphasis on Germany) and the US is a major issue, as for example only 28% of all German respondents believed that fully self-driving vehicles will be safe, while customers in all participating countries greatly fear security issues and were very concerned of someone hacking into their car and putting their personal safety at risk. On the other hand the countries with the greatest acceptance level and demand for self-driving technologies from the participating countries (Brazil, China, France, India, Italy, UK and USA) were China and India. The 2018 Deloitte Global Automotive Consumer Study[87] included 22.177 consumer responses across 15 global markets and the users were presented more positive towards autonomous cars, in comparison to the previous years' results, mainly in safety related issues (see Figure 3 below).

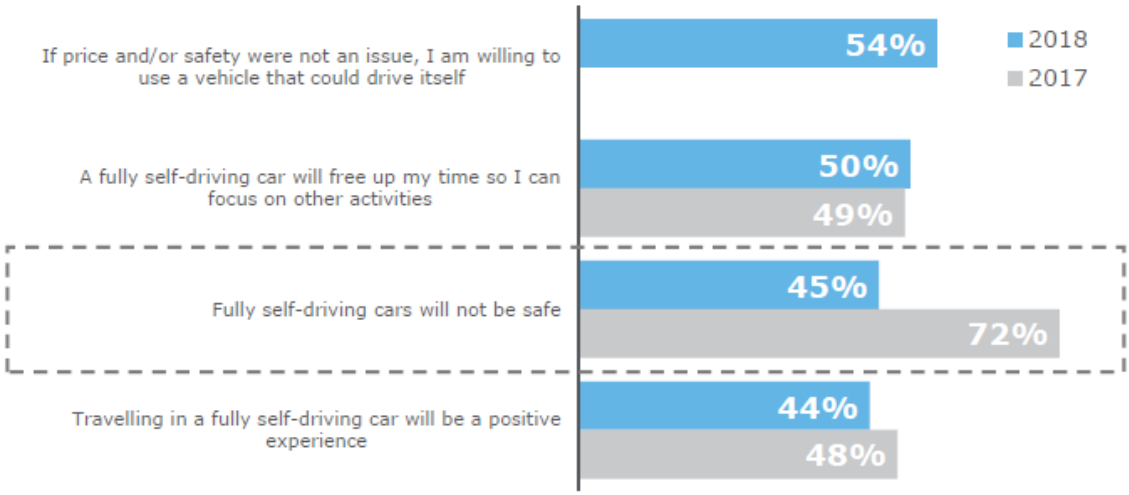

Figure 3: Users' opinion on fully self-driving vehicles in 2018 in comparison to 2017 (Source: Global Automotive Consumer Study, Deloitte 2018[69])

More specifically, younger people were found more accepting of self-driving vehicles, but, almost half of older consumers were at least open to the idea of using fully self-driving vehicles (assuming price is not an issue). Of course safety concerns were still expressed by the study

[86] Deloitte (2017). Global Automotive Consumer Study. Retrieved from: https://www2.deloitte.com/de/de/pages/consumer-industrial-products/articles/global-automotive-consumer-study.html

[87] Deloitte (2018). Global Automotive Consumer Study. Retrieved from: https://www2.deloitte.com/it/it/pages/consumer-business/articles/cip-automotive-trends-millennials-consumer-study.html

participants, with half of them (50%) requiring the governments' regulation and approval of self-driving cars.

In the next year's study of Deloitte (2019)[88], safety and security concerns are again expressed by the participants, however in lower rates (see Figure 4), with the participants feeling that media reports of accidents involving AVs have made them cautious of the technology, while the desired level of government involvement, regarding the development and use of AVs, is again very high (see Figure 5).

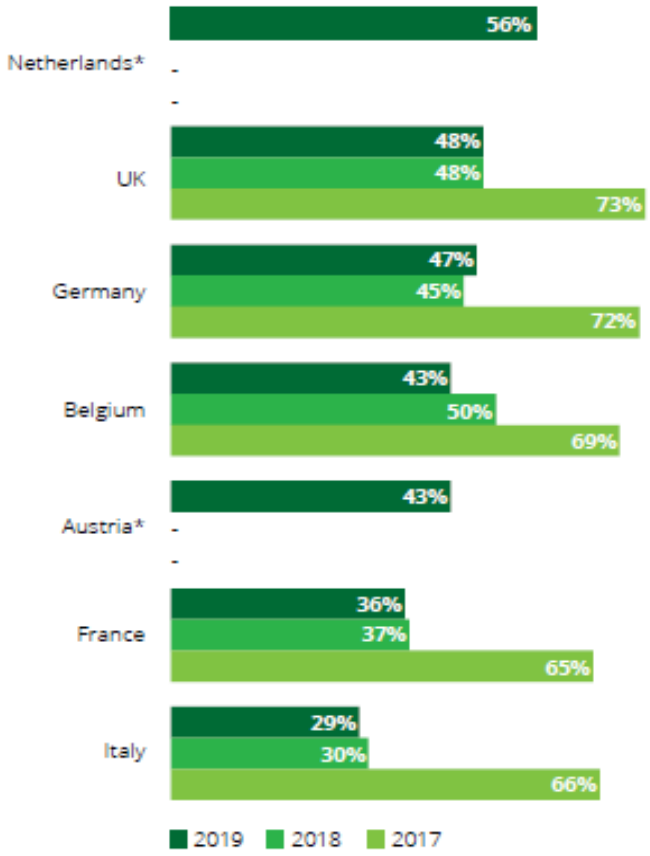

Figure 4: Comparison of safety concerns rates during the 3 years of the Deloitte's studies for autonomous cars (Source: Global Automotive Consumer Study, Deloitte 2019[70]).

[88] Deloitte (2019). Global Automotive Consumer Study. Retrieved from: https://www2.deloitte.com/gr/en/pages/consumer-business/articles/2019-Global-Automotive-Consumer-Study.html

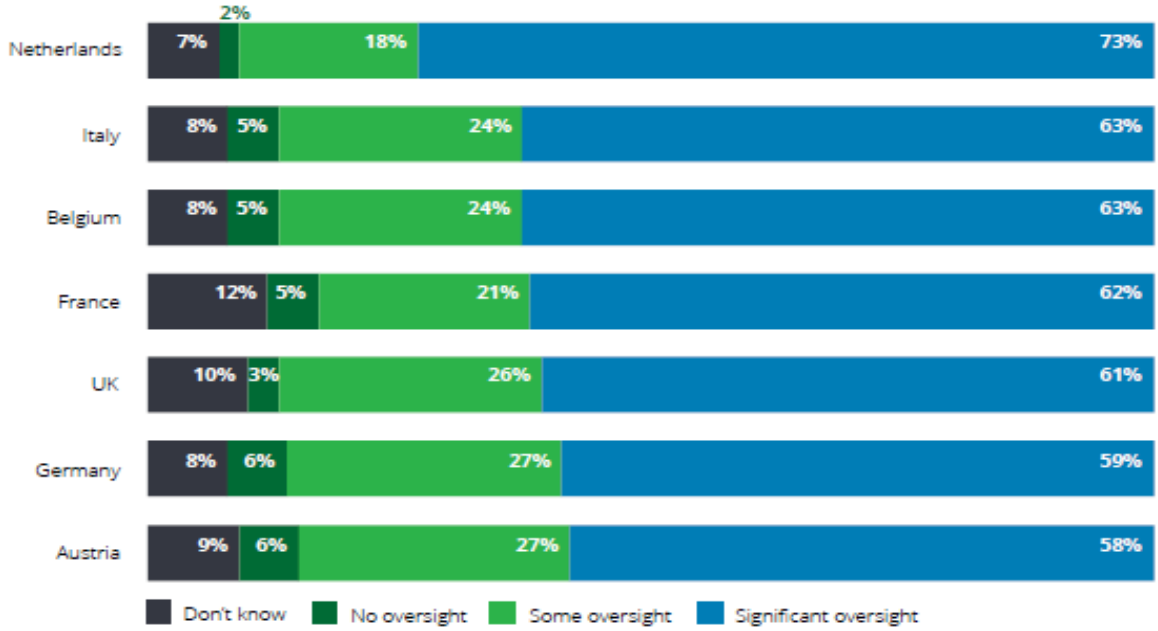

Figure 5: Level of government involvement desired regarding the development and use of AVs (Source: Global Automotive Consumer Study, Deloitte 2019[70]).

In 2019 another study has been published, which introduced an Autonomous Vehicle Acceptance Model (AVAM) This model of user acceptance for autonomous vehicles was adapted from existing models of user acceptance for generic technologies[89] and consists of a 26-item questionnaire, combined with six scenarios that present different levels of autonomy. When tested with an online questionnaire, the AVAM showed high internal consistency, as also consistency to prior relevant research results. Participants were presented to be positive about autonomy of high levels (4 and 5), but ratings across almost all AVAM factors showed a significant preference for lower level autonomy.

According to the short overview of the surveys' results presented above throughout the last 5 years, public interest in autonomous driving has increased. In media news coverage, autonomous cars are often presented as a solution to many of the traffic problems. However, the term "autonomous driving," is not yet clearly defined in the public discourse and while sometimes autonomous driving reflects to driverless cars, others to partly automated driving. Moreover, it is not clear what kind of potentials or risks are involved, or what challenges still need to be overcome reaching to autonomous cars. In this context, public engagement and acceptance should be brought into the discourse of autonomous driving at an early stage. The technology of autonomous vehicles is expected to bring changes across the whole range of mobility, influencing different levels of society. So, in order to know which the essential issues are, and to control the consequences where necessary, it is important to identify the significant influencing factors, like the publics' involvement, participation and acceptance of the technology[90]

[89] Hewitt, C., Politis, I., Amanatidis, T., & Sarkar, A. (2019, March). Assessing Public Perception of Self-Driving Cars: the Autonomous Vehicle Acceptance Model. In *Conference on Intelligent User Interfaces (IUI'19)*.

[90] Maurer, M., Gerdes, J. C., Lenz, B., & Winner, H. (2016). Autonomous driving. *Berlin, Germany: Springer Berlin Heidelberg*, *10*, 978-3

5. Understanding the Experts

5.1 Experts and their discourses on autonomous cars

The technological perspective of autonomous driving is just one aspect of many, as autonomous cars are expected to so have a direct impact on our transport system and society in general. Many critical questions arise: What are the prospects concerning data security? How the "driving robots" are expected to improve transport safety and how this is proved? In what form will insurance companies assume liability for autonomous vehicles involved in accidents in the future?

According to the experts and policy makers, there can different factors behind a decision to support new technologies or technological applications and the same applies for the technology of autonomous cars. Policy makers may choose to promote a technology that is considered to solve specific problems and pressures in society (i.e. transport safety, or environmental and congestion issues) or in order to enhance the competitiveness of a domestic industry[91]. As Edler and his colleagues have said: "Public innovation policy aims to strengthen the competitiveness of the economy or of selected sectors, in order to increase social welfare through knowledge creation and economic success"[92].

Regarding the technology of autonomous vehicles, it has to be mentioned that the reaction of experts from several disciplines has differed. What attitudes and expectations do (potential) future users, and the public in general, bring to the new technology of autonomous cars? Together with the technical developments in this sector, this question is moving into ever-greater focus, as it is clearly expected that a future switch from conventional to autonomous cars will bring important changes to the whole network of road users. In this framework, the question of participation and acceptance keeps coming up. The development of this technology in relation to the issue of the public involvement and acceptance has generated new research agendas and challenged policy makers and experts to take under consideration the technological and social aspects of this rapidly evolving technology. In the European Union as well as internationally, the urgency for early harmonisation of standards is leading the discussions, in order to prevent the problems that will be probably caused by incompatible standards in different world regions (i.e. via United Nations Economic Commission for Europe (UNECE) regulations). In addition to the above, the role of ICT in the automotive industry of the future in relation mainly to data protection and privacy concerns, societal debates and decisions[73].

5.2 Surveying Experts' Understanding on Public Engagement

During the realisation of this master dissertation, a questionnaire has been developed (Annex 1), in order to examine the perception of transport experts (directly or indirectly related to

[91] Schreurs, M. A., & Steuwer, S. D. (2015). Autonomous driving-political, legal, social, and sustainability dimensions. In *Autonomes Fahren* (pp. 151-173). Springer Vieweg, Berlin, Heidelberg.

[92] Edler, J. Kuhlmann, S. Smits, R.: New Governance for Innovation. The Need for Horizontal and Systemic Policy-Coordination, Report on a Workshop held at the occasion of the 30th anniversary of the Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe, November 2002. Fraunhofer ISI Discussion Papers Innovation System and Policy Analysis, No. 2 (2003)

the development of the autonomous vehicles technology) as to whether users accept or are ready to accept this game changer of the road transportation system, what are the main benefits that see in this technology but also which the greatest risks. Moreover, emphasis has been provided on the involvement and participation of the public in the evolution of autonomous cars.

This survey has been transferred in an online format https://www.surveymonkey.com/r/SYT8X7B), so as to be more easily disseminated to the stakeholders and analysed. It has been forwarded to different consortia of European research projects relevant to autonomous driving issues, which include experts in various files, such as ICT and AI experts, legal experts, academia and research institutes' representatives, psychologists, etc.

The survey remained online for a month and 38 responses were collected from different countries (see Figure 6). Most participants belong to the age group of 31-45 (see Figure 7), while the vast majority of respondents were males (see Figure 8), a percentage that is consistent with the under-representation of women in the European transportation sector.

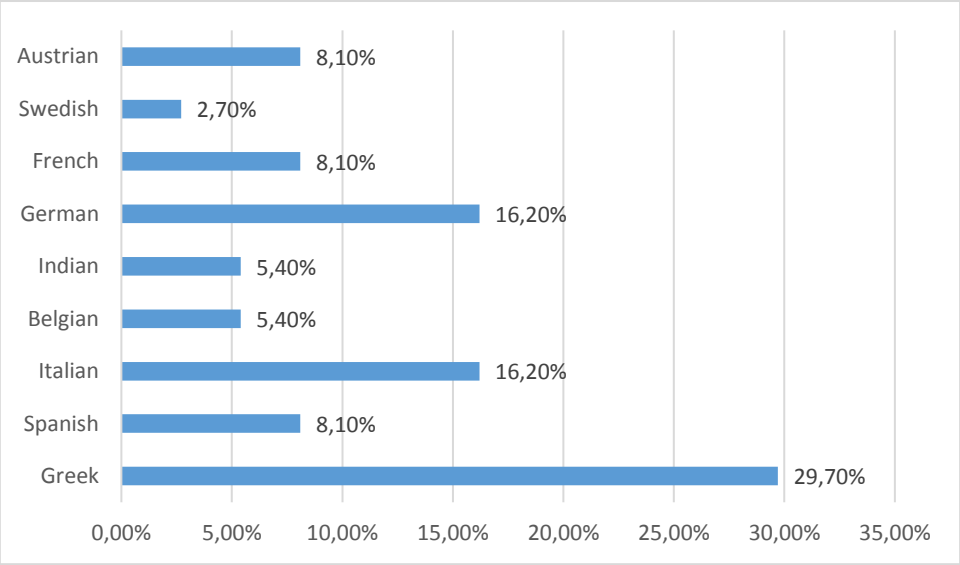

Figure 6: Nationality of survey's respondents

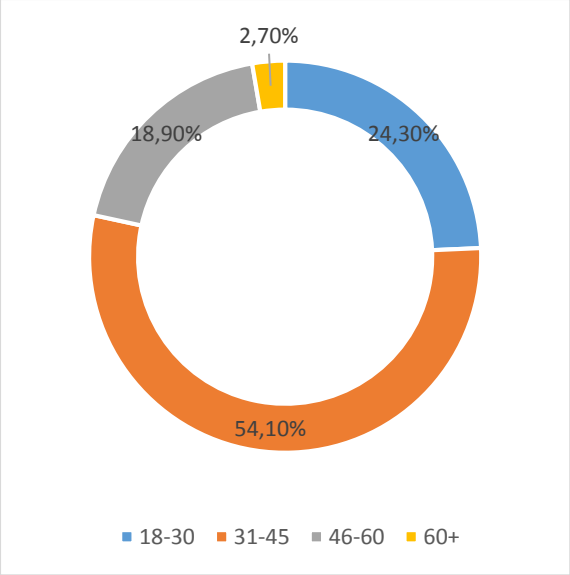

Figure 7: Age of survey's participants

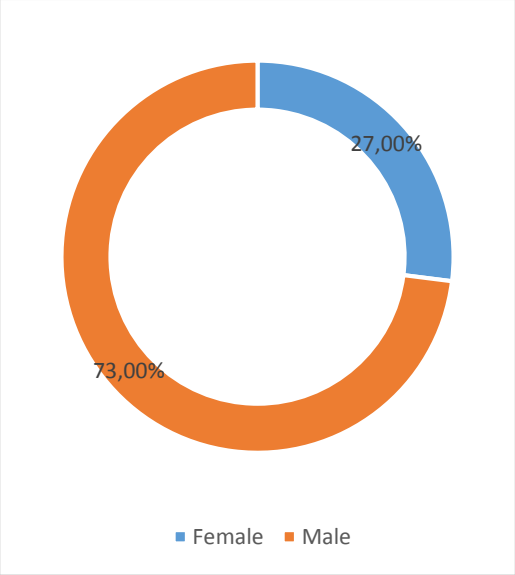

Figure 8: Gender of survey's participants

Moreover, most of the participants in this survey were experts in the field of ICT, C-ITS, AVs and other innovative technologies, while there were also big representation of engineers, human factor experts, as well as transport planning and management experts. More details on the categorisation of the participants' professional background and years of experience can be found in Figure 9 and below. Finally, few more than half of the participants (53%) have formed experience with issues related to public acceptance of and public engagement to autonomous cars.

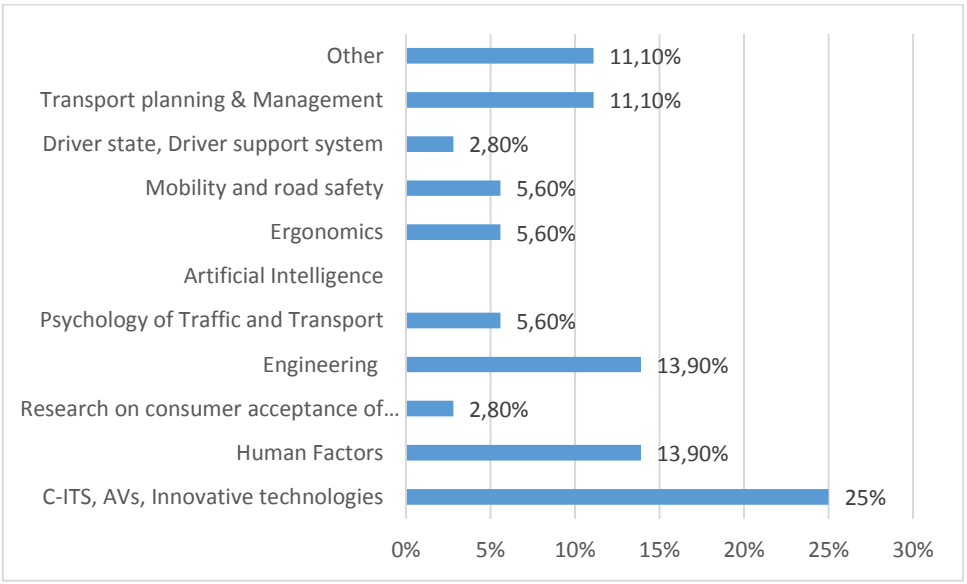

Figure 9: Filed of expertise of survey's participants

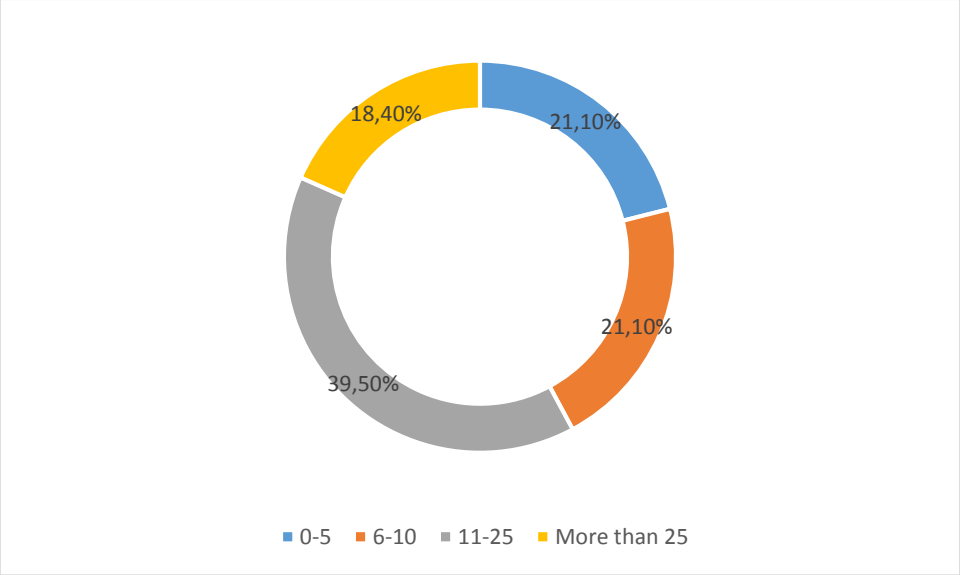

Figure 10: Years of experience of survey's participants

Analysing the answers of the experts that answered this survey regarding the acceptance and involvement of the users to the development of autonomous cars technologies, 50% of them stated that the public's general opinion regarding autonomous and self-driving cars is positive (Figure 11). Familiarity through mainly publications in media and awareness campaigns resulted in an acceptance enhancement from roughly 29% to 58%. However, as has also been pointed out in section 4.2.1, they mentioned that the public is still sceptic till the operational, legal and insurance issues are better framed and consequently better understood. It has been also pointed out that these type of cars are not yet deployed in real urban environments, therefore any benefits are not perceived clearly by the general public. They tend also to have different or diversified opinion depending on the reason behind the automation (i.e. automation is more accepted if it would be enabled to support an incapacitated driver; i.e. a sleepy driver) and any cultural or geographical characteristics (cities promoting technology deployment against traditional cities, IT/ ICT usage and comfort, prior experience with ADAS functions, etc.). As there were considerable doubts when deploying autonomous systems to the public, some public events took place for discussing about the challenges and implications of the technology. To the organiser's surprise, all were positive and rather demanding that the technology and systems should be used rather yesterday than tomorrow.

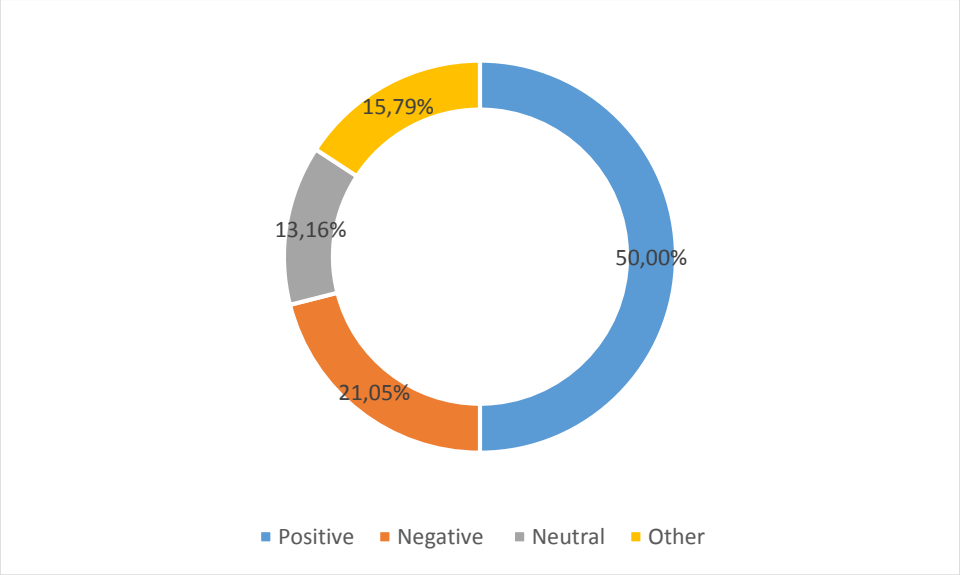

Figure 11: Public's and users' general opinion regarding autonomous and self-driving cars

Regarding the experts' perception for the public's intention to use AVs, most experts (47%) stated that, assuming AVs come into the market, users intend to use them regularly. However, the second largest proportion of experts (29%) claims that users are not going to change their current transport mean (Figure 12). This difference of opinion is also evidence of the somewhat confused situation in the field of autonomous cars, which is to a large extent due to the fact that users are still not really directly involved in the development of the relevant technologies, resulting to them having a quite confused and unclear perception of autonomous cars and their use. According to the experts' opinion, which is also consistent with the above conclusions of Chapter 4, acceptance is gradually increased but not to the level to be considered affective and persuasive. Most users are expected to hesitate to use them at the beginning, while there many factors that differentiate the opinions among users, such as the user's age (i.e. elderly people seem to prefer AVs because they will give them the opportunity to be mobile much longer).

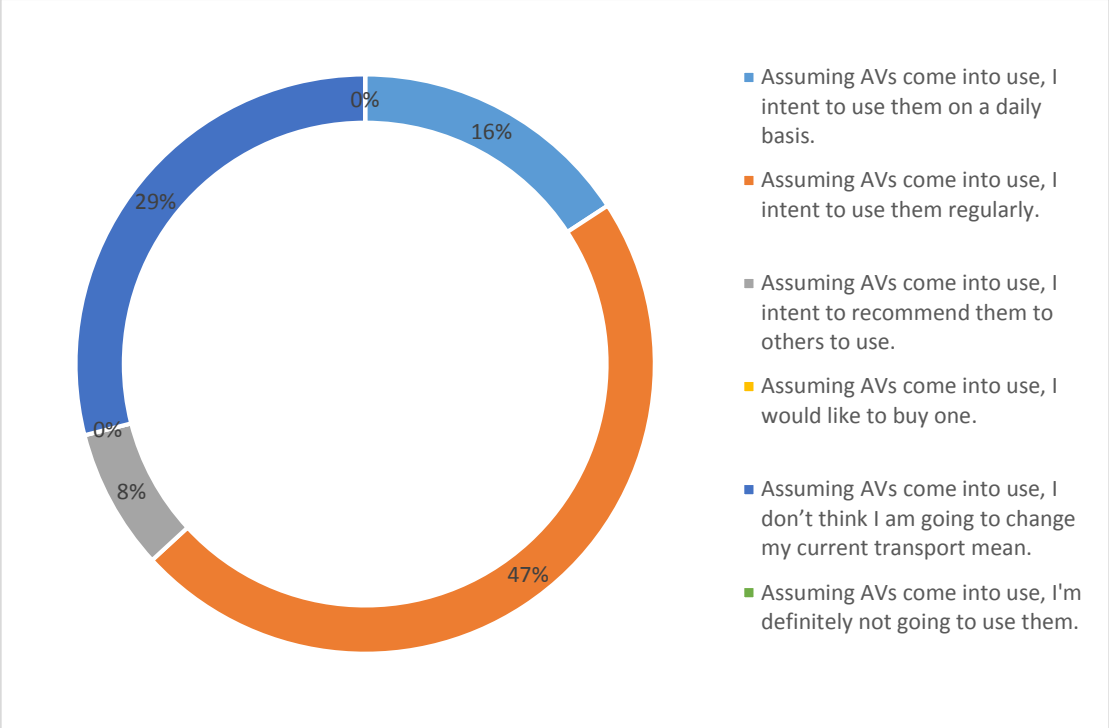

Figure 12: Experts perception rates with regard to the public's intention to use AVs

Moving on to the description of the ***main benefits*** the public considers when it comes to the use of autonomous cars in the transportation system, most participants believe that the reduction of accidents, as well as the reduction of the accidents severity are the main aspects that users consider as positive outcomes of the AVs use, while the reduction of traffic congestion and the improved emergency response to accidents / crashes follow (Figure 13).

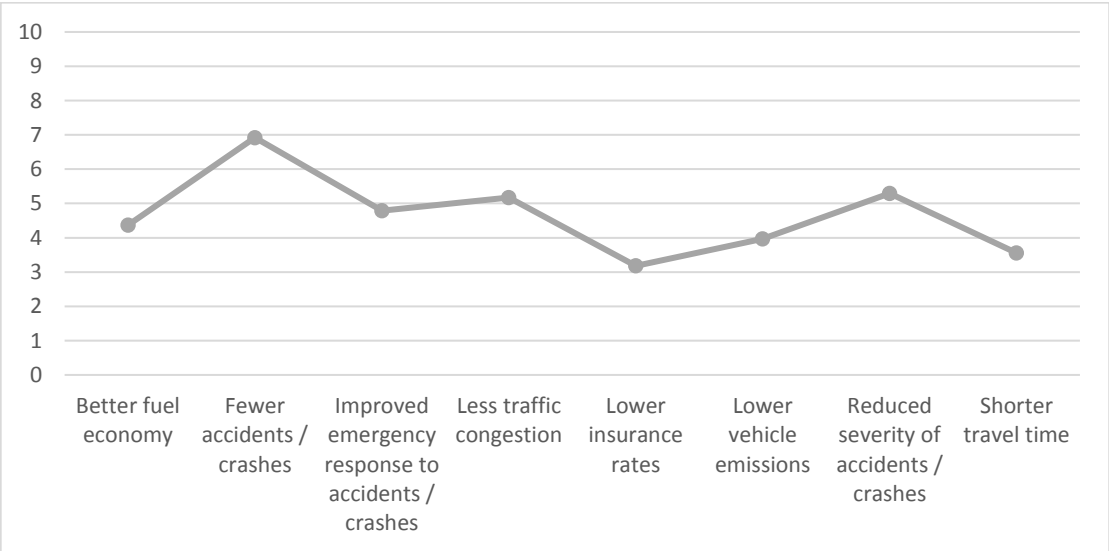

Figure 13: Perception of experts regarding the main benefits that the public considers when it comes to the use of autonomous cars

On the other hand, regarding the description by the experts of the ***main concerns*** the public considers when it comes to the use of autonomous cars, emphasis is provided again on safety issues, with the top priority being the safety consequences of equipment failure or system

failure, following by the concerns about the interaction with non-self-driving vehicles and vulnerable road users (i.e. pedestrians and bicyclists), as well as issues related to security of system and vehicle (Figure 14).

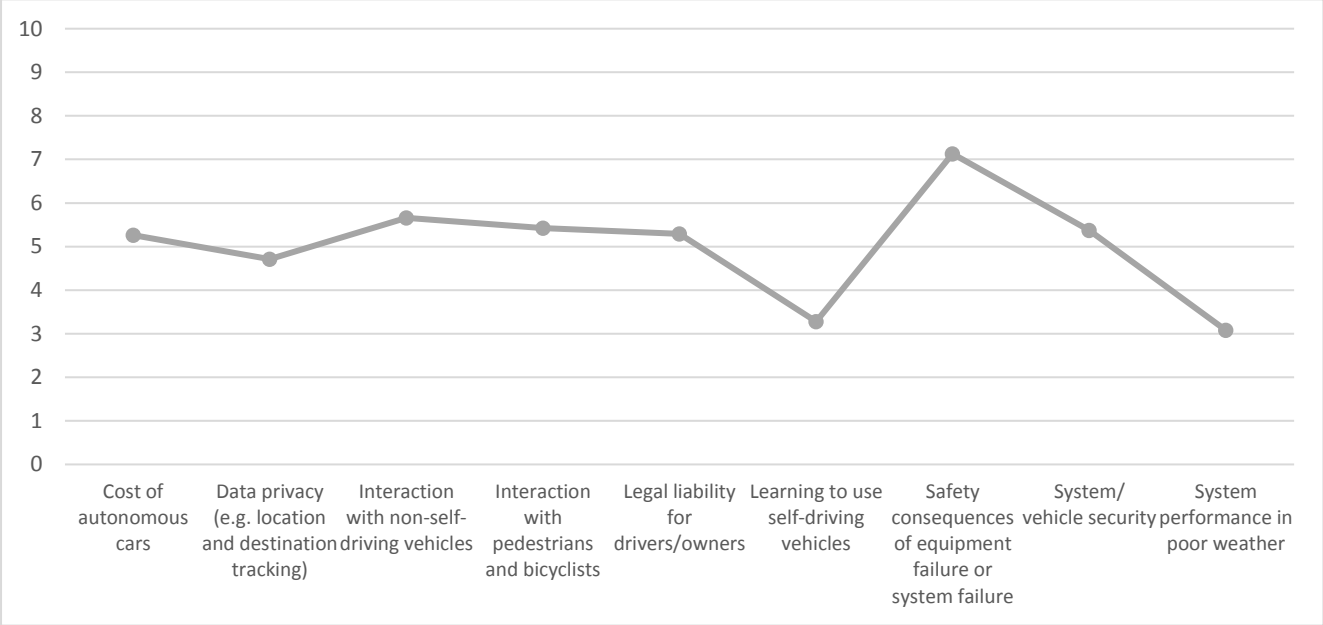

Figure 14: Perception of experts regarding the main concerns that the public considers when it comes to the use of autonomous cars

As shown in the 2 diagrams above, it is strongly evident that in both cases (regarding both benefits and concerns) protagonist is the parameter of safety, as has been also mentioned in the analysis of the other surveys in the previous sections. Getting a little bit deeper on this issue and the perception of main risks on behalf of the public, the experts have stated that the safety risk, which is argued more often by the public refer to the safety consequences related to technical performance and reliability of (i.e. in case of equipment or system failure how will the vehicle respond and how the operator will?), followed by the infrastructure readiness to host the autonomous cars and of course issues of cyber security and data privacy (Figure 15).

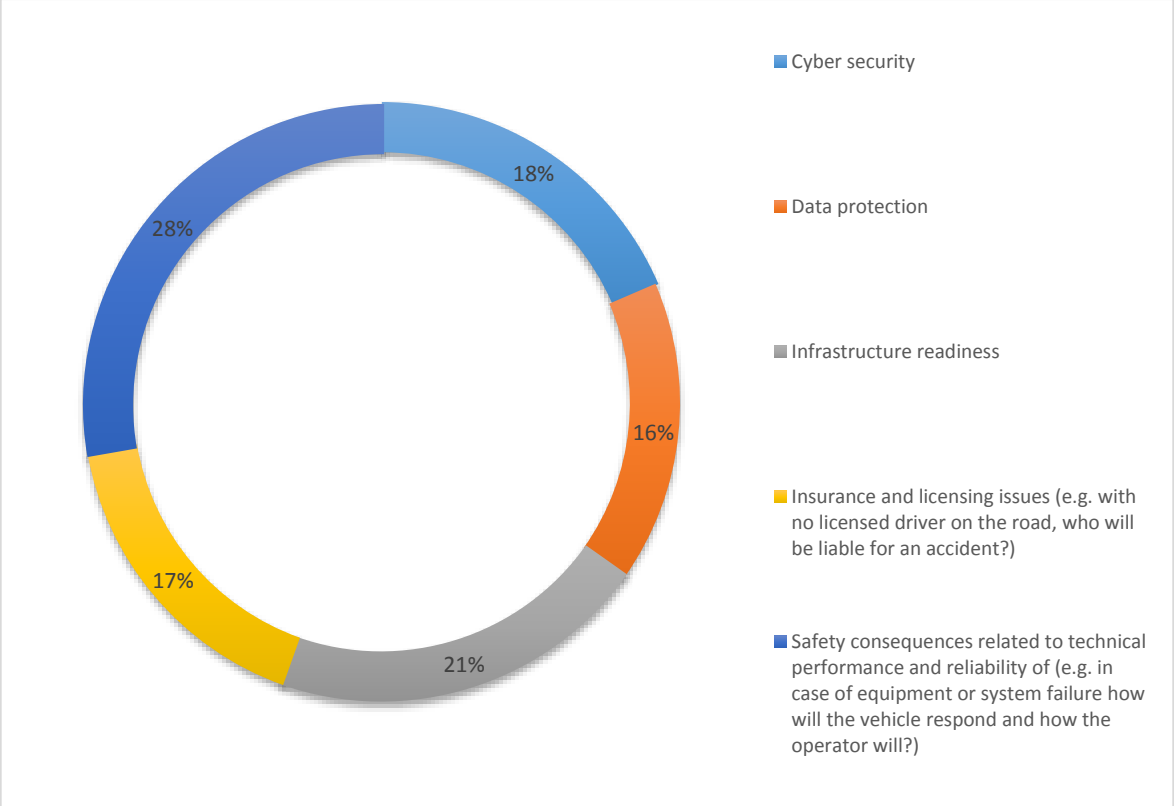

Figure 15: Perception of experts regarding the main risks that the public considers when it comes to the use of autonomous cars

Within the survey, experts have been also requested to comment on the users' concerns in relation to specific, scenarios where completely self-driving vehicles are included. The scenarios that were given to them as option are the following:

- Riding in a vehicle with no driver controls available
- Self-driving vehicles moving by themselves from one location to another while unoccupied
- Commercial vehicles such as heavy trucks or semi-trailer trucks that are completely self-driving
- Public transportation such as buses that are completely self-driving
- Taxis that are completely self-driving

The scenario that the experts reported as the one mostly causing the concern of the public is the one riding within a vehicle which has no driver controls, followed by the scenarios of completely self-driving commercial vehicles and taxis being into the road network. It's noteworthy though that the scenario with the self-driving public transport, being the one with the smallest rate of concern (Figure 16). This could, of course, be justified considering that in self-driving vehicles already exist on public transport, and for quite a few years, such as rail and metro vehicles or even self-driving buses, used mainly in piloting phases (i.e. in the city of Trikala in Greece, in the city of Sion in Switzerland, in the city of Stockholm, Sweden, etc.).

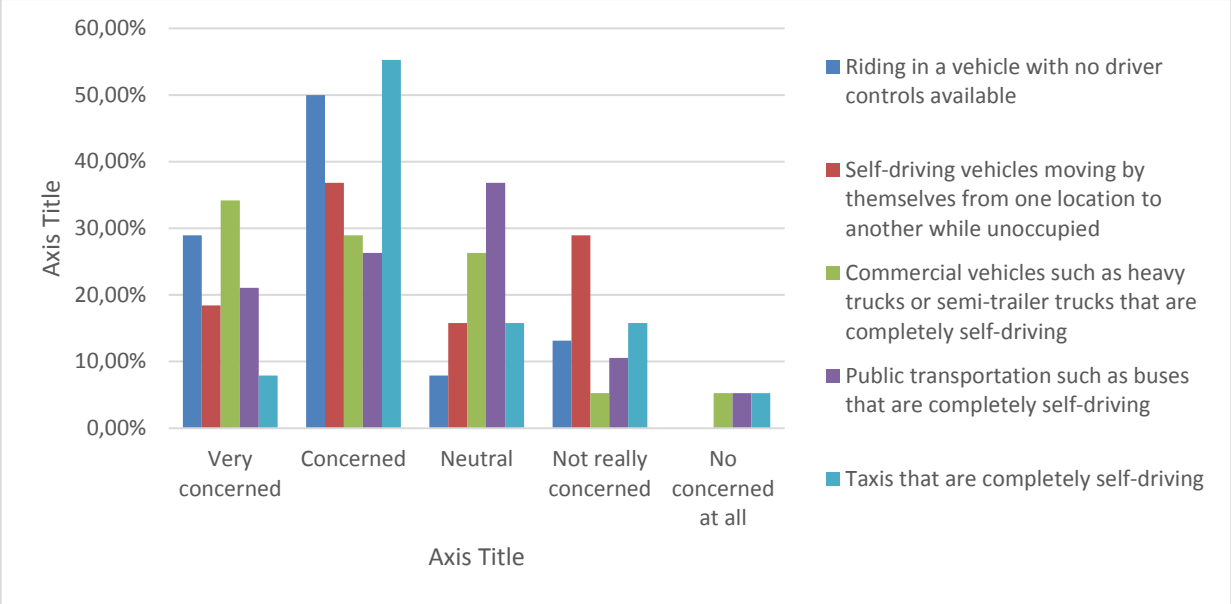

Figure 16: Rates of public's concern in relation to specific scenarios of AVs use

Furthermore, regarding the intention of the users to own and their willingness to pay for self-driving technology, experts' responses indicate that there is no a clear picture yet, as most of them responded neither positively or negatively in this question (Figure 17). As has been already mentioned above, this is too probably due to the fact that the public does not have a clear picture either of the very nature of the technologies but of the cost-benefit ratio.

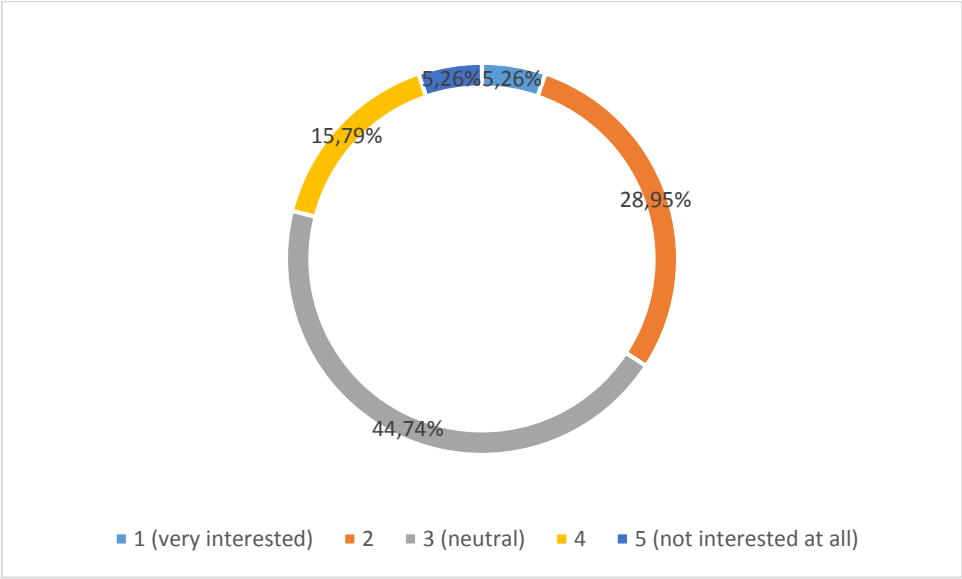

Figure 17: Level of interest of the public in owning and willing to pay for self-driving technology

Another important issue raised in this survey, concerns the types of users that is expected to be keener in embracing and using autonomous cars. The vast majority of the experts answered agreed that there are some specific types of users that will be more facilitated by the use of autonomous cars and, therefore, are expected to embrace more the development of relevant technologies and their market penetration (Figure 18).

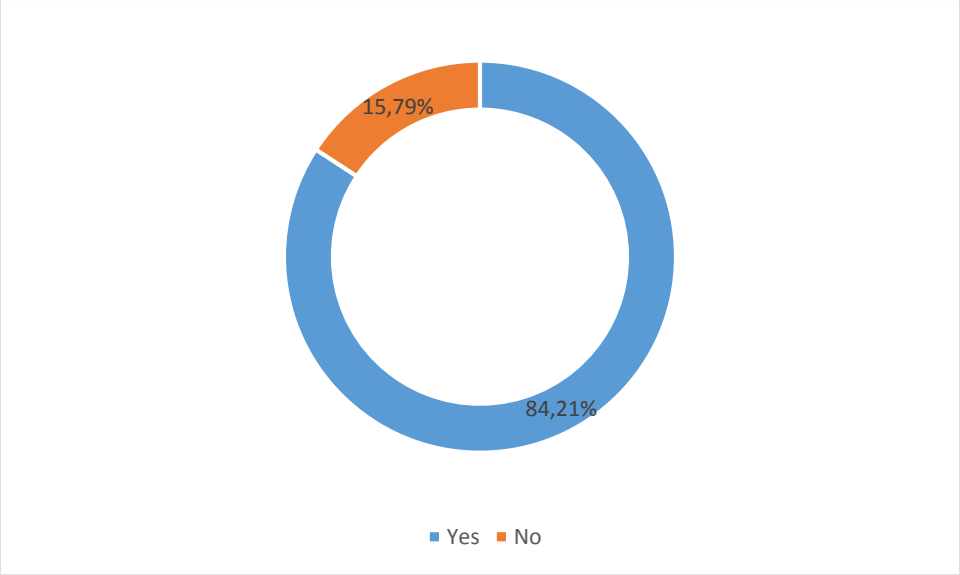

Figure 18: Rates of experts' opinion in regard to the existence of user types that would be keener in embracing and using autonomous cars

According to the feedback provided by the experts, persons with disabilities and elderly are the user types mostly expected to embrace and use autonomous cars, since this technology is foreseen to offer to them more independence in their mobility (Figure 19). Additionally, people more familiar to technology advancements, as well as younger people, are also included in this list, in fact being two categories that many experts have interrelated, mentioning that youngers are more technology oriented.

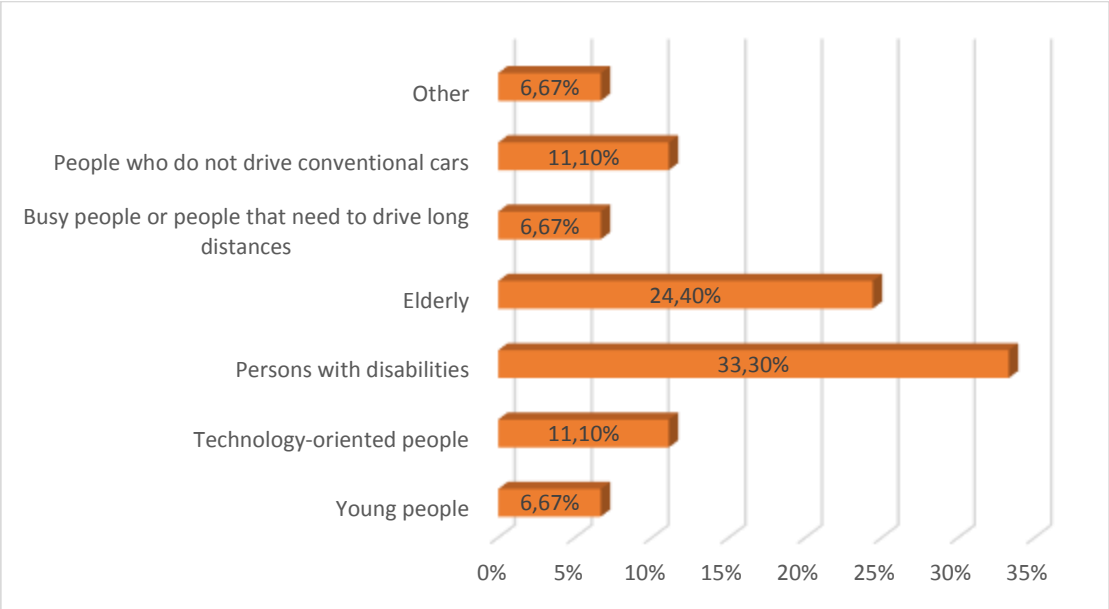

Figure 19: Types of users most likely expected to use autonomous cars

Following this, the factor of residence has been also taken under consideration, with the vast majority of experts agreeing that the users' place of residence plays a role in the degree of acceptance of AVs technologies (Figure 20).

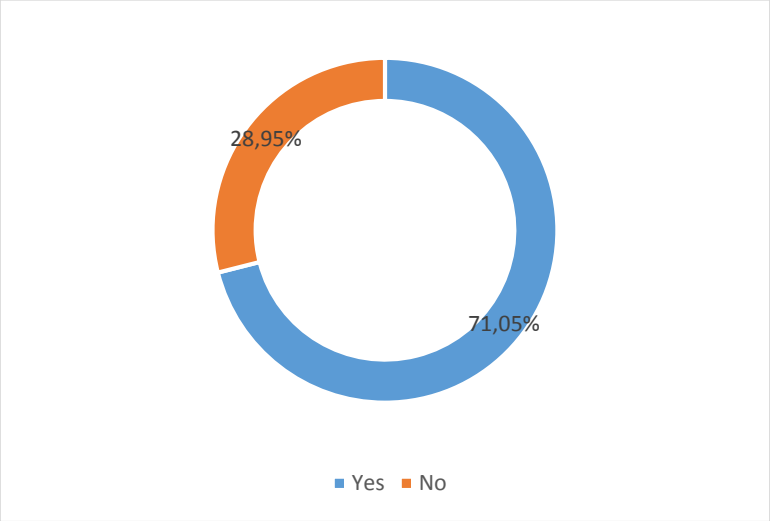

Figure 20: Rates of experts' opinion in regard to the role of users' place of residence in the degree of public acceptance of AVs technology

More specifically, it has been stated that public acceptance is expected to be greater in advanced and well-organised countries and cities, as the acceptance is much related to the geographical characteristics in terms of technology deployment in the city of residence (i.e. smart city planning and implementation) and on familiarisation of ICT usage per age (as an example Finnish people are much more familiar with ICT usage than Greek people, according to Eurostat). The residence factor is also highly interdependent to the public transport options that each area offers, according to the experts.

As has been mentioned above in different cases, public acceptance is highly related to the public participation during the development of the technology. Almost all experts that participated in this survey, pointed out the importance of public acceptance as a factor for the roll out of AVs in Europe, differing just in the degree of importance (**Error! Reference source ot found.**), while on the other hand their majority has found that public participation (i.e. sufficient information and interaction with users), in the development of the AVs technology could be more sufficient in most European countries (Figure 22), with the benefits and performance of AV being more clearly explained to potential users and society. However, it has been also reported that the current timing seems a little bit early to mass communication. According to the received feedback, public participation requires receiving feedback and providing input and it would be very useful to ask the user's on their particular preferences, which would enable a higher market penetration of the AVs. Moreover, a very important remark provided concerns the fact that there is a big gap between scientific/technically sound information and commercial propaganda and the real question is whether public opinion can be set according to "the benefit of all" (i.e. clever public transport, access and usage restrictions to overcome congestion, etc.) or just "own's comfort" (i.e. AVs as entertainment places or extended offices, etc.).

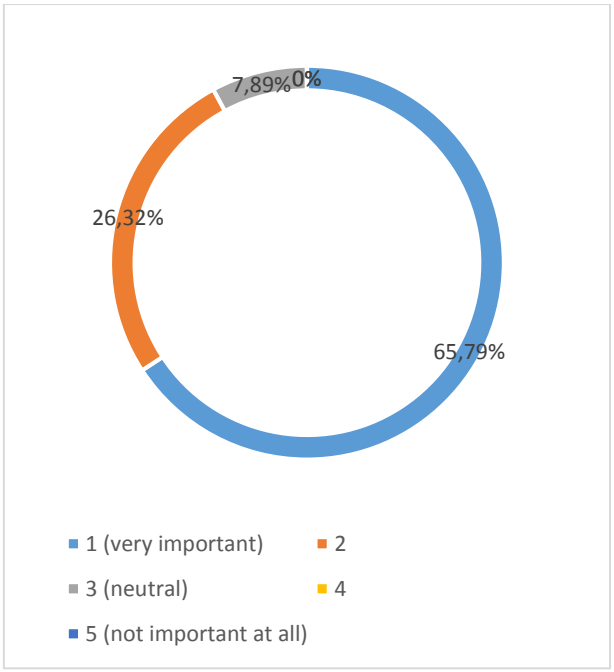

Figure 21: Percentages of experts opinion related to the importance of public acceptance as a factor for the roll out of AVs in Europe

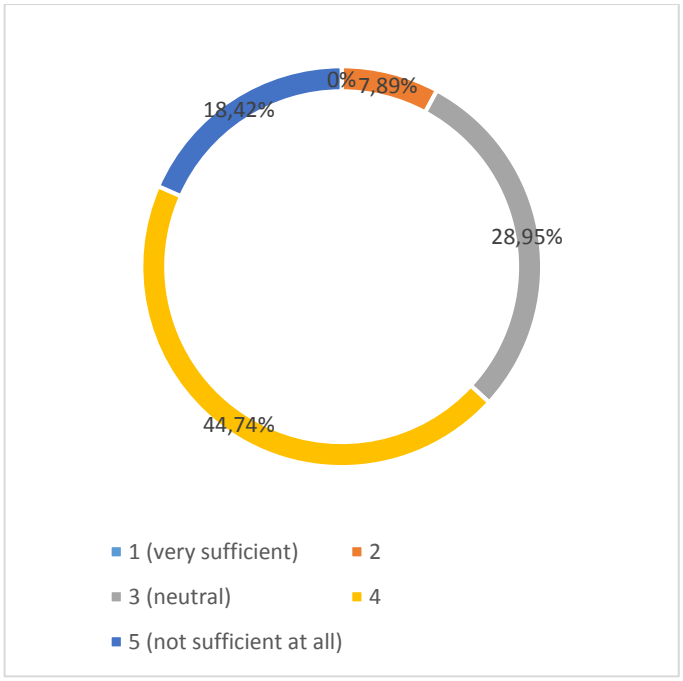

Figure 22: Percentages of experts opinion related to the sufficiency of public participation in the development of the AVs technology

Following the previous statements of the experts, they have also declared in their vast majority that public participation during the development of the AVs technology would offer some advantage(s) in its roll out in the European countries (Figure 23). Emphasis has been given by many experts to the fact that the technological advances must run in coordination with society needs and to the fact that awareness and familiarity should be enhanced.

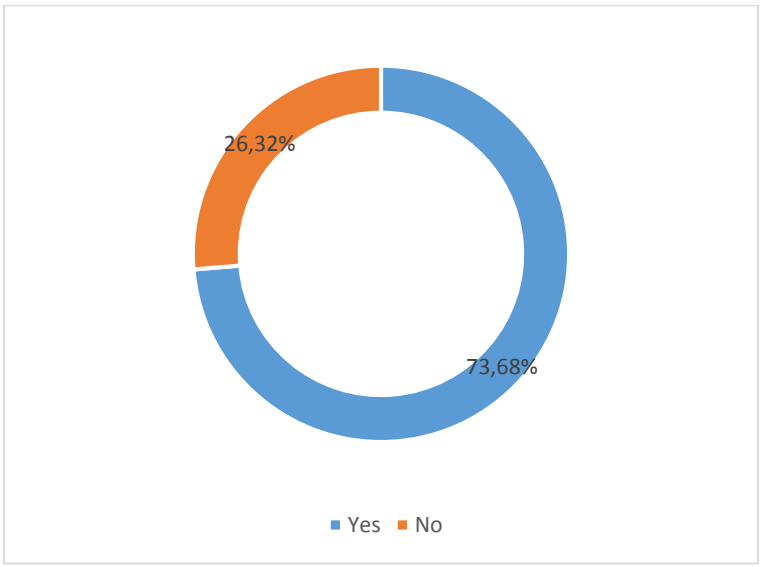

Figure 23: Percentages of experts opinion related to the importance of public participation during the development of the AVs technology in its roll out in Europe

The involvement of the public can provide the developers with valuable feedback already at the development phase, leading to more acceptable features and applications. That way, issues related to perception, safety, interaction with other road participants, human-machine interaction, meaningful services and transition modes, would be much more improved and much more safely and efficiently designed. Public participation leading to reliability will regulate the market. Finally, another important aspect that has been also stressed out by the participants is the fact that sometimes there are differences between to what the experts and the public think. And this is gap that can be shortened by sound information and public participation.

Considering the types of involvement that the experts suggested, in order for the public participation to be most appropriate and effective, the most popular of the suggestions is the users' engagement in demo vehicles, in order to be able to test the AV functions and the HMI designs during design and prototyping processes, in open roads with safety and security measures taken, or in specific city environments (i.e. e.g. test areas in cities such as the TAF-BW in Karlsruhe). Large-scale tests are suggested for this scope (+1.000 users), in order for useful data to be collected. The next most popular suggestion concerns the realisation of dissemination activities and information platforms and websites, while also the organisation of open events and demonstrations where public would be able to provide its feedback to the developers (Figure 24).

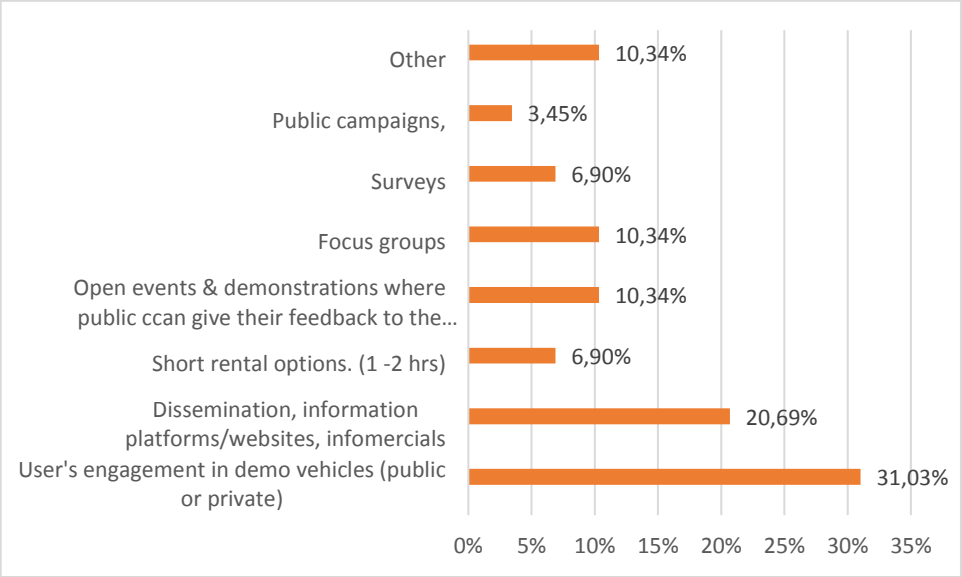

Figure 24: Types of public participation suggested by the survey's participants as the most appropriate and effective

Finally, in a comparison between Europe and USA for the public participation issue in the development of AVs, although most experts (55,26%) stated that there is no important differences in the development of the AVs technology between US and Europe, in terms of public participation, they have also reported that Europe is much more cautious in allowing wide testing of AVs in public roads, due to safety and security risks, as safety is one of the most important criteria for the EU, but also for the European car industry (EuroNCAP). On the other hand, US has a notably larger road infrastructure than Europe, allowing large-scale testing and kilometres driven in real-road environments of various types. In the US, autonomous vehicles

are brought to the public and in the market before being mature enough, which contains higher risk but potentially higher development speed and cost efficiency). This allows users to get in touch with the technologies earlier but there might be more casualties; this is supported by legislation. In Europe, the required testing (for high quality) is being done and the user acceptance is limited to scoped campaigns in this stage. This leads to higher development costs (until success) with higher quality and higher level of public safety. However, legislation would need to be evolved more appropriately and timely.

5.3 Interviewing Experts on Public Engagement

After the analysis of the survey's responses has been implemented, an interview structure has been developed (Annex 2), focusing on some more specific topics coming out of the survey's outcomes. For receiving more detailed information, regarding this more dedicated topics, 5 experts have been contacted and asked to provide some further clarifications. Some of them had answered the survey, while others had not.

The topics that have been selected form the survey to be further clarified, concern mainly the following:

1. The specific types of users that are foreseen to be keener in embracing and using autonomous cars and whether they are being involved in the development of AVs technologies**.**
2. The main concerns of the public related to the use of AVs that mostly regard safety and security issues and the factors that may cause these concerns.
3. The ways that public participation (or even co-design) of AVs could be realised and enhanced during the development of the AVs technology, in order to be more advantageous in its roll out in Europe (i.e. bigger market penetration, increase of acceptance, increase of reliability, etc.) and the barriers that prevent the participation of the public.

From the 5 experts, 3 have managed to provide us with the necessary input on time, covering though all the desired sectors of the autonomous cars field, namely research, policy and industry. It's interesting to point out that there are different opinions expressed from the representatives of the different sectors, for the issues described above, depicting the different priorities, needs and wants of each sector.

Starting the representative person of the policy sector, a project officer in the European Commission, who is dealing with projects also related to autonomous driving, he agreed that people with mobility restraints are very interested in the introduction and use of very high-capacity vehicles, that is to say, with the least possible involvement in driving and decision-making while driving. In addition to people with mobility difficulties, it is also interesting to have automated operations in vehicles from transport companies, logistics or heavy vehicle and truck manufacturers. The main reasons for this are safety and the reduction of fuel consumption. Another group interested in the introduction of such solutions are tourists or groups of people moving between important points of interest (i.e. from a train station to a stadium, from a Metro station to a Ski Centre, Airports etc.).

Currently, there are several applications for the use of such solutions on a research scale or on a small piloting scale, either at a national or European level. Various projects have been

implemented in the past, while at the moment the AVENUE project (http://h2020-avenue.eu/) is running pilots in 4 cities (Lyon, Copenhagen, Geneva, Luxembourg) and 3 more will take place next years, concerning the introduction and integration of autonomous small-scale passenger buses into an existing transport network. There is a call for follow-up of this project to achieve a larger-scale engagement of automakers that will start late 2019 or early 2020. Moreover, within the project ENSEMBLE (https://platooningensemble.eu/), regarding truck platooning with the participation of the 94% of the truck industry, attempts have been made to set up the bases for data exchange, in order to automate some operations on heavy vehicles.

As for the safety and security concerns of the public, he agreed that the end customer who is the ordinary citizen will only trust and buy the product if the safety and security are validated. Also when traveling in different environments (urban, suburban, etc.) or between Member States, the public wants to enjoy the services without interruption and without having to take any additional actions. It was pointed out that communication with citizens has not been done in the right way and new channels should be implemented. Issues such as employment should also be explained as automation is a potential threat to job losses.

The spread of accidents (fatal sometimes) where autonomous vehicles have been involved in a trial period is on breaking news without however explaining the reasons for the accident being reported and this increases the citizen's mistrust. Also issues such as the management of personal data and liability in the event of an accident have not been clarified.

Moving on, regarding the issue of public participation, he agreed with the citizens' involvement in a great scale, through information conferences, reports, test “drives', small-scale demo and analysis of major mobility needs. Industry and policy in this area should intensify the public’s engagement that is also the final customer.

This is probably not the case because there is a perception that the autonomous vehicles will have to meet all needs from the first moment whenever the requirements are particularly high, which also increases the cost. Moreover, considering that the issue of safety it is of first priority no one wants to take responsibility in the event of an accident. These factors are being used indicative to justify the fact that the users are not yet heavily involved in the AVs development. Also, the institutional/ legislative framework should be amended to allow greater engagement.

Similar opinions have been also expressed by the representative of the research sector, the director of a European research institute, focusing on transportation issues and with great experience in autonomous cars, confirming the survey’s results and giving emphasis on the benefits that the autonomous road vehicles would offer to persons with motor disabilities, as well as with mobility restrictions, including the elderly. These user groups, together with other persons that cannot drive conventional cars, are expected to benefit to a large extent from the use of such vehicles, ensuring much greater freedom and flexibility in their mobility.

The next two issues have been answered together by this second interviewee, since they were considered interrelated. The feeling of uncertainty and ignorance, which is caused by the non-information and involvement at the AVs development process, is mainly the factors causing the concerns about the safety and security features of the autonomous cars. This combined

to the incomplete and still unclear legislative framework, causes the biggest fears to the public that are being often enhanced by the media misleading information.

This current status, justifies the need for greater and deeper involvement of the public in autonomous driving development and design issues. It is a fact that this particular field of research is somewhat special, and the lack of a legislative framework makes it even more difficult for the public to participate in its formulation. However, there are different channels that could be used and option to be adopted, expert from the classic surveys and information websites. Emphasis has been given to the creation of relevant focus groups that could interact in great extend to stakeholders directly involved to the AVs R&D, receiving information and providing their feedback. Moreover, the most useful activity to be organised is the implementation of pilot testing is specially designed public or private areas, where users could participate and "drive" autonomous cars, while also take part in open demonstrations by experts. For example, a very interesting example that could be replicated and it also takes safety under great consideration, is the "Wizard of Oz" test vehicle (active orders managed by a professional driver without the driver realizing it), developed in France by VEDECOM, vehicle specially developed to analyze user interface and self-driving vehicle use and also to test the acceptability of the interfaces and diagnose robustness in open road driving conditions.

On the other hand, there is quite a different view on these issues from the interviewee representing the Industry sector, senior executive of one of the biggest European automotive associations. He has not agreed at all with the survey's result about the specific types of users that will benefit more from the autonomous cars technologies and therefore embrace it more. He stated that autonomous cars is a technology that is being designed for all people and by limiting it to specific users, the attention but also the responsibility is turned to them, which is neither fair nor true. Moreover, he pointed out the industry (especially nowadays) does not design a technology for a specific type of users, as their scope is to sell to everybody.

Regarding the public participation in the design and the development of autonomous driving technologies, he also clearly stated that the public has no idea about the functions behind such technologies and indeed needs to be explained to them what we are talking about. However, he has pointed out that since currently the vast majority of the public is not aware of these technologies and their functions (yet), they cannot effectively contribute. What can be the contribution of the public, compared to the many people that are already in the domain? What more can they offer?

Nevertheless, he stress out that awareness is fundamental, differentiating though in the fact that the information can reach the public after the product's development (even if it is not the final). And this is the stage where the public can provide its feedback, otherwise it's very difficult (if not impossible) for the public to contribute in the design (due mainly, as described above, of its ignorance).

Even regarding the main concerns of the public related to the use of AVs that mostly regard safety and security issues, the opinion expressed was that it's up to others (experts and more relevant stakeholders) to find and give any required solutions (i.e. industry, lawyers, reliability experts, safety experts etc.). The public cannot have an in-depth view its risks at this stage, let

alone propose solution about these risk, which will probably be superficial. On the other hand, there are experts dealing entirely with issues like these ones.

6. Conclusions

Automation has been integrated technologically, organizationally and socially in the public transport regimes. Road public transport has already initiated the introduction of automated vehicles, with several examples throughout Europe. The autonomous vehicles have been emerged as niche innovations to claim their position in the incumbent transport regimes. Their integration has been based on visions and expectations created by experts and stakeholders while depends on public perceptions about the technological future, the urban mobility, as well as the mobility of specific social relevant groups. The aim of the thesis is to provide information on the views and the attitudes of the public in relation to the autonomous cars, focusing on the experts' perception of them, in order to examine and understand any incentives of the experts to move on the involvement of the public in the development and design of this new technology. To achieve this aim the issues that were selected to be examined concern the a) experts' understanding of the public attitudes, including the risks and benefits of the AVs development and diffusion into the transportation system, b) the experts' priorities in relation to the public involvement in this technological transition and implementation of autonomous cars that is expected to change the road transportation system, c) the comparison of experts and public representation of the autonomous vehicles and d) challenges and open issues that need to be further researched.

The outcomes emerging from the 2 different analyses that have taken place in this thesis, the literature review based on surveys' results realised during the last 5 years and the input provided by the experts that answered our survey and participated in the interviews, coincide in the core, as both that public interest in autonomous driving has increased during the last years, as well as the public acceptance of this specific technology. However, there are still more to be achieved as the term "autonomous driving," is still not yet clearly defined in the public discourse, causing confusions and various concerns. These two analyses have shown more similarities than differences between the responses resulting from the analysis of the public's surveys and the survey addressed to the experts. The main similarities focus on the scepticism towards autonomous vehicles still exists although the acceptance of the citizens has is gradually increased but not to the level to be defining. Safety concerns are still expressed by the surveys participants, with the majority of them requiring the governments' regulation and approval of self-driving cars. On the other hand, a difference that has been presented is the degree of importance regarding the security risk. Although in the public's surveys has been identified as a major risk, the experts have ranked lower in the risks scale, under the readiness of infrastructure. Moreover, another issue that is not fully compatible between the two analyses concerns the age factor. Although the majority of the experts stated that the elderly are among the groups expected to embrace and use the autonomous cars technologies, some surveys of the public show that younger responders are more likely to use autonomous vehicles than those aged 55 or more.

The differences between the countries of Europe related to the acceptance and interest of the public to the autonomous cars has not been significant during the last years examined. Of course, there have been some differences between countries that could be characterized as more technology oriented and more receptive to changes (i.e. Netherlands, Sweden, etc.), in comparison to countries usually less flexible to technological changes, like Eastern countries

where technology transfer activities are important but neglected drivers of innovation along with non-R&D-based innovation activities, due to a confluence of socio-economic factors. [93] The biggest differences that have been observed are mostly time-related. As it has been specifically noticed, for example, the acceptance rate has gone from 45% to 72% in Germany and from 37% to 65% in France in just one year (from 2017 to 2018). This development is mainly related to the fact that the research on autonomous vehicles is intensifying, but also to the increased media exposure. However, experts have noted in several questions of the survey that this media exposure has, in several occasions, influenced negatively the public, especially when presenting autonomous cars related accidents, without though including the overall context.

What appears most prominent in the experts' opinions, as mostly expressed in our survey, is the barrier that exists in the direct involvement of the public in the development of this technology, mainly due to the lack of a solid policy and legislative framework that would allow it. And this is the main difference pointed out between the evolution of autonomous cars in Europe and USA, the fact that Europe is much more cautious in allowing wide testing of AVs in public roads in Europe, due to safety/security risks.

No significant surprises emerged by the analysis of the experts opinions, concerning to the level of public acceptance of autonomous vehicles, as well as the need for the involvement of the public in the technology's design and development. The vast majority of the participants pointed out the fact that that technology is gaining ground to the citizens' acceptance through the years, as research increasingly focuses on it but they have also stated that conservative attitude is still being noticed due to limited information available currently for the public. But can the future of the autonomous cars technology be determined by speculations and misinformation? Or should the public opinion be formulated based on research finding and own knowledge?

A particularly differentiated view, which mainly appearing in the interviews, is that of the industry, which opposes much more the involvement of the public to the development of this technology at this early stage, emphasizing the fact that the involvement of the various user groups only confusion can cause, while on the contrary there are groups of experts in the various relevant fields who know better the site, the subject, but also the problems that may arise and how they can be addressed. User engagement is welcome at a later stage where there is something to be presented and to which feedback can be given.

As a conclusion from this short survey conducted in the context of this thesis, can be drawn the fact that the main challenges faced in the area of autonomous cars and in the involvement of the public in the development of relevant technologies revolve mostly around the wider problem of appropriate communication of a complex and technical topic to the general public. The incomplete or, in some cases, incorrect information provided to the citizens, either by the experts themselves or by the media often causes a confusion and wrong impressions about the risks and benefits of the AVs. This is a common problem addressed in the development of technologies that the public is not familiar to, such as nanotechnologies[94] and CCS

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technologies[95]. As also mentioned in the study regarding carbon capture and storage[96], misinformation of public may cause challenges for constructive dialogue, while the existence of a healthy opposition of views, presents an opportunity for genuine understanding and fruitful dialogue and this is probably one of the priorities, together with the development of the policy and legislation framework, that the experts need to set in relation to the public engagement in the case of Autonomous cars.

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Annex 1

Autonomous Cars as Public Technology: Aspects and Approaches for their Social Acceptance and the Co-production

In the context of the thesis titled *"Autonomous Cars as Public Technology: Aspects and Approaches for the Social Acceptance and the Co-production"* the following questionnaire has been developed, which aims to explore the opinion of experts in the field of transport and autonomous vehicles (levels 3 to 5). In particular, expert feedback is expected to be collected on the public perception and acceptance rate this technology presents but also on whether and/or how public participation in the development of this technology could potentially improve the identified perception.

I. Personal Information

Nationality:

Age:

Gender: ❒ Male ❒ Female ❒ Other ❒ N/A

Field of experience/ expertise:

Years of relevant experience:

❒ 0-5

❒ 5-10

❒ 10-25

❒ More than 25

Home institution and/or other professional/institutional affiliation (optional):

Do you have any experience with issues related to public acceptance of and public engagement to autonomous cars?

❒ **Yes**

❒ **No**

If yes, please describe….

II. Public Acceptance of Autonomous Cars

1. **In your opinion, what is the public's and users' general opinion regarding autonomous and self-driving vehicles?**

   ❒ Positive

   ❒ Neutral

   ❒ Negative

Comments:

_____
_____
_____
_____

2. **Please choose one of the following sentences as more appropriate according to your perception with regard to the public's intention to use AVs:**

   ❒ Assuming AVs come into use, I intent to use them.

   ❒ Assuming AVs come into use, I intent to use them regularly.

   ❒ Assuming AVs come into use, I intent to recommend them to others to use.

   ❒ Assuming AVs come into use, I would like to buy one.

   ❒ Assuming AVs come into use, I don't think I am going to change my current transport mean

   ❒ Assuming AVs come into use, I'm definitely not going to use them.

Comments:

_____
_____
_____
_____

3. **According to your experience and expertise, which do you think are the main benefits the public takes into account when it comes to the use of autonomous cars in the transportation system?** *(Please rate the following benefits from the most important to the least one – Choices have been listed in alphabetical order)***.**

   ❒ Better fuel economy

   ❒ Fewer accidents / crashes

   ❒ Improved emergency response to accidents / crashes

   ❒ Less traffic congestion

   ❒ Lower insurance rates

   ❒ Lower vehicle emissions

   ❒ Reduced severity of accidents / crashes

   ❒ Shorter travel time

   ❒ Other (please specify……)

Comments:

_____
_____
_____
_____

4. **According to you experience and feedback received, which do you think are the main concerns of the public when it comes to the use of autonomous cars in the transportation system?** *(Please rate the following concerns form the most important to the least one – Choices have been listed in alphabetical order)*

   ❒ Cost of autonomous cars
   ❒ Data privacy (e.g. location and destination tracking)

   ❒ Impact on environment

   ❒ Interaction with non-self-driving vehicles

   ❒ Interaction with pedestrians and bicyclists

   ❒ Legal liability for drivers/owners

   ❒ Learning to use self-driving vehicles

   ❒ Safety consequences of equipment failure or system failure

   ❒ System security (from hackers)

   ❒ System performance in poor weather

   ❒ Vehicle security (from hackers)

   ❒ Other (please specify……)

Comments:

_____
_____
_____
_____

5. **Which do you think are the main risks (according to the public) related to the use of autonomous cars in the transportation system?** *(Please rate the following concerns form the most important to the least one – Choices have been listed in alphabetical order)*

❒ Cyber security

❒ Data protection

❒ Infrastructure readiness

❒ Insurance and licensing issues (i.e. with no licensed driver on the road, Who will be liable for an accident?)
❒ Proper and timely response to an emergency.

❒ Safety consequences related to technical performance and reliability of (i.e. in case of equipment or system failure how will the vehicle respond and how the operator will?)

❒ Other (please specify……)

Comments:

_____
_____
_____
_____

6. **How concerned do you think is the public in respect to the following scenarios where completely self-driving vehicles are included?**

   a. ***Riding in a vehicle with no driver controls being available***

❒ Very concerned ❒ Concerned ❒ Neutral ❒ Not really concerned ❒ No concerned at all

   b. ***Self-driving vehicles moving by themselves from one location to another while unoccupied***

❒ Very concerned ❒ Concerned ❒ Neutral ❒ Not really concerned ❒ No concerned at all

   c. ***Commercial vehicles, such as heavy trucks or semi-trailer trucks, that are completely self-driving***

❒ Very concerned ❒ Concerned ❒ Neutral ❒ Not really concerned ❒ No concerned at all

   d. ***Public transportation, such as buses, that are completely self-driving***

❒ Very concerned ❒ Concerned ❒ Neutral ❒ Not really concerned ❒ No concerned at all

   e. ***Taxis that are completely self-driving***

❒ Very concerned ❒ Concerned ❒ Neutral ❒ Not really concerned ❒ No concerned at all

Comments:

_____
_____
_____
_____

7. **In your opinion, how big is the overall interest of the public in owning and willing to pay for self-driving technology?**

   ❒ 1 (very big)

   ❒ 2

   ❒ 3 Neutral

   ❒ 4

   ❒ 5 (not big at all)

Comments:

_____
_____
_____
_____

8. **In your opinion, are there any types of users that would be keener in embracing and using autonomous cars (i.e. persons with disabilities, men vs women, etc.)**

   ❒ Yes

   ❒ No

7a. If yes, which one(s)?

_____
_____
_____
_____

9. **In your opinion, the users' place of residence plays a role in the degree of public acceptance of this technology?**

   ❒ Yes

   ❒ No

9a. If yes, please describe:

❒ Urban area residents are keener to accept it

❒ Rural area residents are keener to accept it

❒ Other (please specify……)

Comments:

_____
_____
_____
_____

III. Public Participation in the development of the Autonomous Cars technology

1. In your opinion, how important is public acceptance as a factor for the roll out of AVs in Europe?

❒ 1 (very important)

❒ 2

❒ 3 Neutral

❒ 4

❒ 5 (not important at all)

Comments:

_____
_____
_____
_____

2. According to research in the US, 87% of the public wants online consumer information on the safety features of driverless cars. In your opinion, has public participation (i.e. sufficient information and interaction with users), in the development of the AVs technology been sufficient?

❒ 1 (very sufficient)

❒ 2

❒ 3 Neutral

❒ 4

❒ 5 (not sufficient at all)

Comments:

_____
_____
_____
_____

3. **Do you think that public participation during the development of the AVs technology would offer some advantage(s) in its roll out in Europe?**

   ❒ Yes

   ❒ No

3a. If yes, what kind of advantage(s)?

_____
_____
_____
_____

3b: If yes, what kind of public participation activities you could suggest as the most appropriate and effective?

_____
_____
_____
_____

4. **In your opinion, are there any differences in the development of the AVs technology between US and Europe, in terms of public participation?**

   ❒ Yes

   ❒ No

4a. If yes, please describe

_____
_____
_____
_____

Annex 2

Autonomous Cars as Public Technology: Aspects and Approaches for their Social Acceptance and the Co-production

Interview Questions

(Guide)

1. **According to the experts feedback provided in the survey developed within this master thesis, there are some users that are expected to be keener in embracing and using autonomous cars (i.e. persons with disability, elderly, persons that do not drive conventional cars, etc.). Do you agree?**
    a. ***If yes, are there any more users; clusters that fall into this category?***
    b. ***Are there any activities made regarding the involvement of these users in the development of AVs technologies? Or prediction for such activities?***
    c. ***Is there any relevant research that you are aware of (i.e. research projects results, survey, etc.) confirming this?***

2. **According to the survey's results, public's and users' general opinion regarding autonomous and self-driving cars is considered to be positive, with some main concerns related mostly to safety and security issues. Do you agree?**
    a. ***If yes, what are, in your opinion, the factors that may cause users' mistrust to autonomous and self-driving cars?***
        i. *Factors, such as ignorance, lack of continuity, dilemmas about how it will affect it traffic congestion, etc. are considered to be critical for public acceptance?*

3. **According to the survey's results, public participation during the development of the AVs technology would offer some advantage(s) in its roll out in Europe, such as bigger market penetration, increase of acceptance, increase of reliability, etc.). Do you agree?**
    a. ***If yes, how could the public participation (or even co-design) of AVs be realised and enhanced?***
    b. ***The users' involvement is something that is desirable by all stakeholders (i.e. industry, research, policy)?***
    c. ***What are the main barriers that prevent the participation of the public in the AVs development?***