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Towards the Future of Mobility: Ethical and Legal Challenges of Autonomous Vehicles in Europe*

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Abstract

Autonomous vehicles (AVs) are expected to revolutionize mobility, integrating advanced technology with urban development and promising increased safety, efficiency and sustainability. This article examines the normative aspects connected to autonomous mobility, investigating the ethical dilemmas and the legal regulatory challenges stemming from the implementation of AVs. A focal point in the analysis is represented by the German approach, a leading example within the fragmented European landscape. The research highlights the necessity of a harmonized approach in the EU to ensure a safe and responsible integration of AVs into society.

Verso il futuro della mobilità: sfide etiche e giuridiche delle auto a guida autonoma in Europa.

I veicoli a guida autonoma detengono un potenziale rivoluzionario nel campo della mobilità, promettendo maggiore sicurezza, efficienza e sostenibilità grazie all'integrazione di tecnologie avanzate nel contesto urbano. L'articolo esamina i profili normativi connessi alla mobilità autonoma, ne indaga i dilemmi etici e le sfide regolatorie, e sottolinea la necessità di adottare un approccio armonizzato per garantire una sicura integrazione dei veicoli senza conducente. Punto focale dell'analisi è rappresentato dall'iniziativa di legislazione tedesca, considerata un esempio di riferimento all'interno del frammentato panorama europeo.

* Sottoposto a referaggio.

Keywords: Autonomous vehicles, autonomous mobility, trolley problem, legislative challenges, German legislation.

Parole chiave: Auto a guida autonoma, mobilità autonoma, dilemma del carrello ferroviario, sfide legislative, regolamentazione tedesca.

1. Introduction

Autonomous vehicles (AVs), i.e. automobiles equipped with a self-driving mode designed to perform some or all driving tasks without human intervention, represent a significant innovation in the automotive industry, as they constitute a great example of the intersection between technology and urban environment, potentially transforming the way people perceive mobility. Their first appearance can be traced back to the United States in the first half of the 1900s, when traffic accidents were an alarming social issue due to their fatality rates.[1] Even though cities worldwide are currently experiencing rapid innovation in autonomous transportation, we are still far away from witnessing a state of total independence in mobility. In this regard, the Society of Automotive Engineers (SAE) defined six levels of automation in vehicles, ranging from no autonomy to a complete one, where each step is characterized by specific elements that outline the system's minimum capabilities.[2] A fundamental distinction arises between level 2, where a portion of the driving act is still in the hands of humans, and level 3, where the AV is required to automatically perform every "dynamic driving task".[3] First introduced in 2014 and later updated in 2016 and 2021, this classification quickly became an industry standard, and it is today frequently referred to in academic literature.

1. This datum was due to a specific circumstance: in the US the mass adoption of automobiles started three decades earlier with respect to Europe, and the primary cause of the accidents was attributed to driver errors. P. D. NORTON, *Fighting Traffic: The Dawn of the Motor Age in the American City*, MIT Press, 2011.
2. SAE International, *SAE Levels of Driving Automation™ Refined for Clarity and International Audience*, 2021.
3. *"The term* dynamic driving *task includes the operational (steering, braking, accelerating, monitoring the vehicle and roadway) and tactical (responding to events, determining when to change lanes, turn, use signals, etc.) aspects of the driving task, but not the strategic (determining destinations and waypoints) aspect of the driving task"*. V. ILKOVÁ, A. ILKA, *Legal aspects of autonomous vehicles – An overview, 21st International Conference on Process Control (PC)*, 2017, p. 428-433.

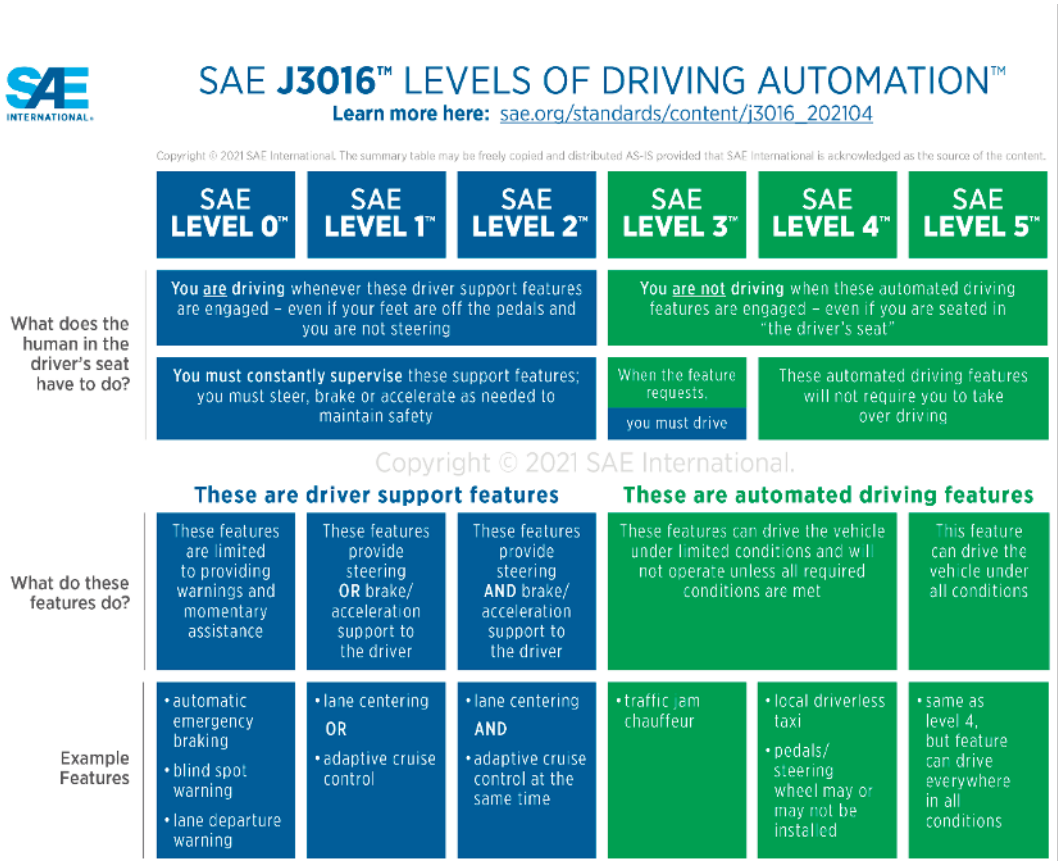

Figure 1 – SAE levels of driving automation[4]

Among the potential benefits that could follow the implementation of this technology, AVs' revolutionary power is first believed to lie in the ability to solve the most recent challenges of urbanization, such as climate change, congestion and greenhouse gas (GHG) emissions;[5] hence, smart urban mobility technology[6] has emerged as a crucial component of modern civic policy agendas, aimed at mitigating the adverse impacts of contemporary travelling. Moreover, the employment

4. SAE International, *SAE Levels of Driving Automation*, cit.
5. According to Kamruzzaman, around a quarter to one-third of GHG emissions can be attributed to transportation, an essential element of the city itself. M. KAMRUZZAMAN, J. HINE, T. YIGITCANLAR, *Investigating the link between carbon dioxide emissions and transport related social exclusion in rural Northern Ireland*, in *International Journal of Environmental Science and Technology*, 2015.
6. Smart urban mobility is defined by the convergence of intelligent vehicle technologies and sustainable transportation systems, facilitated by cooperative Intelligent Transport Systems (ITS). Therefore, the development of autonomous vehicles, which combines a vast range of ITS tools, is among the cutting-edge applications of this new perspective. K. EMORY, F. DOUMA, J. CAO, *Autonomous vehicle policies with equity implications: Patterns and gaps*, in *Transportation Research Interdisciplinary Perspectives*, 2022.

of driverless cars may offer several other advantages, such as increased mobility, reduced resource consumption, lower emissions, decreased need for parking spaces, and improved traffic safety.[7] Furthermore, by enhancing transportation access, AVs hold the potential to create a more equitable future, particularly for marginalized groups, and could therefore improve the quality of life of many disadvantaged people.[8] As autonomous vehicles progressively diminish the role of human drivers, the exploration of research questions concerning their normative oversight becomes increasingly vital. As a result, the article will first address the ethical considerations related to the widespread adoption of AVs, highlighting the importance of conducting effective moral reasoning vis-à-vis autonomous mobility. Then, recognizing the challenging need to create new effective regulations, as well as to adapt and update existing laws and their enforcement, it will be conducted an analysis of the European legislative framework, investigating liability concerns and stressing the importance of the German national framework.

2. Normative reasonings in AVs: ethics and the law

The introduction of AVs will represent a significant milestone in society since, for the first time in history, artificially intelligent systems will interact with humans in real-world settings, travelling at high speeds and on a large scale, thus generating dilemmas in the field of ethics. Current literature on this matter primarily focuses on crash scenarios involving some kind of unavoidable damage, where an autonomous vehicle must take decisions about how to distribute such a harm. When faced with an imminent collision, indeed, the system may be forced to solve controversies, about which the *trolley problem* can be considered one of the most emblematic thought-experiments. Specifically, trolley cases are idealized scenarios where an individual, in the guise of an autonomous vehicle, is confronted with a choice between two evils, which will result in different distributions of unavoidable harm. The trolley problem was first introduced by the English philosopher Philippa Foot in 1967,[9] and later modified in 1976 by the American scholar Judith Jarvis Thompson with the "switch" and "bridge" versions.[10] The significance of these types of dilemmas[11]

7. K. EMORY, F. DOUMA, J. CAO, *Autonomous vehicle policies with equity implications: Patterns and gaps*, in *Transportation Research Interdisciplinary Perspectives*, 2022.
8. *Ibid*.
9. Foot presents the following hypothetical situation: *"The driver of a runaway tram can only steer from one narrow track on to another; five men are working on one track and one man on the other; anyone on the track he enters is bound to be killed. [...] The question is why we should say, without hesitation, that the driver should steer for the less occupied track."* P. FOOT, *The Problem of Abortion and the Doctrine of the Double Effect*, in *Oxford Review*, 1967.
10. J. J. THOMSON, *The trolley problem*, in *Yale Law Journal*, 1985, vol. 94(6), p. 1395-1415.
11. Despite Foot's original problem and Thomson's standard one being the most read and discussed versions of trolley cases, academics and scholars proposed through time a list of variations to these interesting experiments – such as the "loop" version –, with the aim of analysing ethical principles on the basis of individuals' intuitive responses.

does not lie in equating autonomous vehicles with real-world trolleys, but rather in highlighting the challenging ethical decisions that AVs will have to face once introduced in society. Indeed, unlike humans who rely on instinct, driverless cars are programmable and therefore will require explicit instructions on how to act in such cases.[12]

Among further moral implications arising from the introduction of driverless cars, the questions posed by social norms and the law are fundamental. Following the reasoning of Pagallo,[13] the normative challenges of AVs recommend taking into consideration their *politics*. The term encompasses both a broad and narrow meaning, although they can be viewed as complementary. The narrow meaning of politics regards activities related to a country's governance and international relations; in the context of driverless cars, this includes the modification to already existing traffic laws with the aim of accommodating the adoption of this technology in driveways. The broader sense of the term, instead, can be drawn from the idea of Aristotle, according to whom politics has to do with the concepts of "practical science" and "practical reason", including ethics and the law, social customs and economics. On this basis, it is possible to identify several main issues related to autonomous vehicles that require attention.[14] The first concerns the ethics of AVs: it is indeed crucial to examine whether the existing declarations and guidelines should oppose current legislation, adopting therefore a hard ethics approach, or if it is only necessary to improve current norms in accordance with a soft ethics approach.[15] In most Western political systems, the institutional debate about driverless cars regards primarily the soft side of ethics, a tendency that can be attributed to various factors. Among the main reasons, there exists a long-lasting tradition of adherence to international provisions, such as the European Convention on Human Rights and the EU Charter of Fundamental Rights. Ongoing initiatives concerning ethics in autonomous mobility commonly held this latter view.[16]

12. Even though the trolley problem often serves as an effective explanation for the need of ethics when programming AVs, nevertheless its application has faced considerable criticism by scholars; to this regard, it is essential to acknowledge that real-world situations faced by AVs will be significantly more intricate, involving multiple actors, uncertain information, and various external factors; thus, this theoretical question is not able to solve alone the complex issue of AVs programming. However, the purpose of the trolley problem is precisely the one it has served: to force people to acknowledge, and then choose a position on, an important moral feature that is subject to disagreement. N. G. EVANS, *Ethics and risk distribution for autonomous vehicles*, in R. JENKINS, D. ČERNÝ, T. HŘÍBEK (Edited by), *Autonomous Vehicle Ethics: The Trolley Problem and Beyond*, Oxford University Press, 2022.
13. U. PAGALLO, *The Politics of Self-driving cars – Soft ethics, hard law, big business, social norms*, in R. JENKINS, D. ČERNÝ, T. HŘÍBEK (Edited by), *Autonomous Vehicle Ethics*, cit.
14. *Ibid*.
15. To clarify this distinction: in hard ethics the emphasis lies on determining actions that ought to be taken to align with current laws or go against them, while in soft ethics the concern is about enhancing and reinforcing existing regulations. See L. FLORIDI, *Soft ethics and the governance of the digital*, in *Philosophy and Technology*, 2018, 31(1), p. 1-8.
16. U. PAGALLO, *The Politics of Self-driving cars*, cit.

Both in the EU and in the US, the current regulatory landscape surrounding AVs is very fragmented: in this realm, each State has its own set of laws, either federal or regional; although most of these norms are expected to undergo revisions soon. Whereas autonomous vehicles have the potential to enhance public safety, promote better health outcomes, alleviate traffic congestion and revolutionize mobility systems, their widespread adoption might face a significant obstacle: public distrust. In fact, social barriers hindering the acceptance of AVs often appear to revolve around human perception: when public opinions diverge on the benefits and drawbacks of autonomous vehicles, it becomes increasingly difficult to rely on social norms that effectively address the challenges associated with technological innovation. Therefore, considering the broader sense of politics, it becomes fundamental to strike a balance between ethical, political, economic and societal issues in the governance of driverless cars.[17]
From a normative point of view, there can be three approaches to reach this ambitious goal: the reliance on traditional forms of hard law, co-regulation or self-regulation.[18] Pagallo, in this regard, notes a limited room for both the first and the third option in the realm of autonomous vehicles; in fact, with the advancement of technology, the suitability of traditional, rigid legal frameworks diminishes. However, it remains crucial to manage social norms and market forces through the robust tools provided by the law. Therefore, the search for co-regulatory solutions becomes fruitful. By combining elements of both legal regulation and collaborative approaches, co-regulation offers a promising avenue to effectively govern AVs and strike a balance between innovation and accountability, taking also into account the ethical and societal aspects of the field.[19]

3. Liability concerns

It was previously discussed how autonomous vehicles could potentially reduce fatalities on the road by fostering a safer mobility; nonetheless, if legal and societal obstacles will not be torn down in the near future, then manufacturers would be discouraged from developing and commercializing AVs.[20] Philosophers, such as Foot and Thomson, have proposed thought experiments, e.g., the trolley problem, to shed light on how ethics might guide the moral issues posed by self-driving cars: such a guide can be useful to developers in deciding which conduct could be the best to "teach" to the AV in difficult situations, for example, when an accident is unavoidable. However, it is fair to admit that a solid and detailed legal background is still needed. Consequently, especially

17. *Ibid*.
18. Like any other bottom-up approach with limited legal framing.
19. U. PAGALLO, P. CASANOVAS, R. MADELIN, *The middle-out approach: assessing models of legal governance in data protection, artificial intelligence, and the web of data*, in *The Theory and Practice of Legislation*, 2019, 7(1), p. 1-25.
20. S. S. WU, *Autonomous vehicles, trolley problems, and the law*, in *Ethics and Information Technology* Vol. 22, 2020, p. 1-13.

within the European context, the exploration of research questions concerning the normative oversight of autonomous vehicles is becoming increasingly vital.[21]

Current main legal barriers can be organized into three categories: issues of compliance arising from the introduction of AVs into the mass market, information governance,[22] and responsibility. Liability concerns related to driverless vehicles, in particular, pose the most significant challenges,[23] having received extensive attention by scholars both in civil and criminal law.[24] Indeed, in the context of conventional vehicles, the driver is typically held responsible in the event of a crash; instead, with the approaching changes in transportation, this practice will unavoidably face shortcomings to adequately address the emerging mobility landscape. Concerning agency issues in AVs, scholars have identified several stakeholders, such as automobile and insurance companies, manufacturers, developers and owners.[25] In the event of an accident involving an autonomous vehicle, the allocation of liability among these parties remains uncertain, and it raises questions about the potential responsibility of drivers if there were manual intervention options available to prevent the crash.[26] As regards civil liability, the most prominent solutions include operator liability, product liability, strict liability and no-fault compensation. The first approach could offer a straightforward path for victims to seek recourse after an accident, absolving however the manufacturer of its duty to exercise caution. Product liability would place on victims the significant burden of proving a system flaw or a defect: without any technical expertise, this process could be daunting for individuals. Strict liability might be able to mitigate this latter challenge, but its adoption could result in delaying the implementation of an innovative technology. Finally, no-fault compensation might provide an efficient means for victims to obtain reimbursement, while also ensuring easy financial management for manufacturers: in case of harm caused by an autonomous vehicle, reparation – subject to the parameters outlined in the governing legislation – would be provided to the victims and individuals involved. In this case, the insurer would assume responsibility and therefore dispense the reimbursement[27]. A no-fault compensation scheme

21. V. ILKOVÁ, A. ILKA, *Legal aspects of autonomous vehicles*, cit., p. 428-433.
22. Examples of compliance issues may regard the kind of license that should be required to operate AVs, while examples of information governance issues may pertain to the protection and management of data generated by AVs.
23. According to attorney Stephen Wu, here are some of the questions that are still unanswered in terms of accountability: "what happens when an AV has an accident? Who is responsible? Will manufacturers face such crushing liability that it could cause them to exit the market or deter them from developing and marketing AVs in the first place?" S. S. WU, *Autonomous vehicles*, cit., p. 1–13.
24. M. ALAWADHI, J. ALMAZROUIE, M. KAMIL, et al., *Review and analysis of the importance of autonomous vehicles liability: a systematic literature review*, in *International Journal of System Assurance Engineering and Management*, Vol. 11, 2020, p. 1227-1249.
25. *Ibid*.
26. *Ibid*.
27. Remarkably, this form of compensation would be granted irrespective of any product defects, manufacturer faults, operator negligence, or the involvement of any other party in providing the mobility service. S. VAN UYT-

could take various forms, since the insurance taker could be the vehicle user or the manufacturer, and contributions to the victim compensation fund could originate from a broader array of sources, including tax revenue. Given the adaptable nature of no-fault compensation, drafting an accurate and thoughtful law outlining the specificities of this approach could help strike a balance between safeguarding victims and supporting innovation.[28]

In the criminal law field, the focus is on the principle of legality, according to which no crime exists without a specific norm. Since autonomous vehicles – and in general technological innovations – will trigger new circumstances, it then becomes necessary to insert additional provisions to address new crimes. Typically, criminal laws require two elements: *actus reus* and *mens rea*. Yet, in the realm of automobile-related crimes, road regulations present different mens rea standards: for example, in the case of more severe offenses committed by a driver, demonstrating recklessness or a deliberate and flagrant disregard for the safety of individuals or property becomes imperative.[29] However, even though certain norms require both elements, a significant portion of traffic regulations only requires the actus reus: this single requirement implies that the majority of road criminal violations will fall under strict liability offences, which pertain to "crimes that authorize liability no matter what the evidence would show about the actor's fault with regard to a particular material element of the offense".[30] Therefore, road regulations may often provide for scenarios where the individual's fault has no relevance, and the only necessary step is to verify the occurrence of an actus reus; because of this peculiarity, strict liability offences could present benefits and advantages in most criminal cases, even considering the involvement of autonomous vehicles.[31]

4. The European regulatory framework

It is important, within the mobility sector, that tech companies and automobile producers can drive innovation in vehicle systems together, providing developers with the right support and collaboration to deploy new technologies. In order to facilitate effective communication between different stakeholders and public authorities, i.e. legal and political actors, it is fundamental to develop a standardized terminology and a normative framework delineating advanced mobility,

SEL, D. V. VARGAS, *Autonomous Vehicles – Business, Technology and Law*, in *Perspectives in Law, Business and Innovation*, Springer, 2021.

28. *Ibid*.

29. J. GURNEY, *Driving Into the Unknown: Examining the Crossroads of Criminal Law and Autonomous Vehicles*, in 5 *Wake Forest J.L. & Pol'y* 393, 2015.

30. A. C. MICHAELS, *Constitutional Innocence*, in H*arvard Law Review*, Vol. 112(4), 1999, p. 828–902.

31. According to Michaels, there are at least four types of criminal laws that must be considered when discussing AVs: general traffic laws, driving under the influence (DUI) laws, reckless driving and due care laws and vehicular manslaughter. A. C. MICHAELS, *Constitutional Innocence*, cit.

so that the path towards road safety can be more easily travelled. Considering in particular how national jurisdictions may slow down the progress in this field, a unified approach within the EU seems fundamental: if not adopted, non-harmonized norms could eventually undermine the competitiveness of the Union.[32] In this regard, technical requirements and international traffic regulations have already been established on a global scale at the United Nations level[33], and they are now being developed through the delineation of AVs standards by working groups in which the European Union, along with its Member States, is actively participating.[34]

Globally, the field of mobility includes several international documents and treaties, which hold great importance to their contracting parties and the global community. In particular, the *Geneva Convention on Road Traffic*, approved in Geneva in 1949 and entered into force on 26 March 1952, is particularly relevant for promoting the development and safety of international transportation.[36] As regards the European Union, although presenting a comprehensive set of regulations governing traffic in today's technological context, it lacks specific provisions addressing the definition of "driver" and "driving". To date, the EU has not established a normative framework for autonomous vehicles, even though substantial efforts have been made in this regard within the High-Level Group GEAR 2030 initiative[36]. In October 2017, after an eighteen-months investigation, the High Level Group on the competitiveness and sustainable growth of the automotive industry in the European Union published its final report,[37] addressing how mobility industries could act in order to tackle technological changes and adapt to current trends. The document highlighted two pivotal areas in which the EU should advance to maintain global competitiveness:

32. *Ibid*.

33. In the realm of international governance on this topic, the United Nations Economic Commission for Europe plays a fundamental role. The UNECE stands as one of the five regional Commissions under the administration of the UN Economic and Social Council, comprising a total of 56 countries and operating as a platform for fostering economic collaboration. Within this body, the Inland Transport Committee serves as a forum for international cooperation and dialogue in the matter of inland movement, both of persons and goods, and over the years it resulted in more than 50 international agreements and conventions, successfully establishing a legal framework for the improvement of international roads and rails. Part of the ITC are two permanent subsidiary bodies, whose work is significantly shaping the implementation of driverless cars technologies: the Working Party on Road Traffic Safety (WP.1) and the World Forum for Harmonization of Vehicle Regulations (WP.29).

34. At the core of the discussion, together with the aim of implementing and integrating autonomous vehicles, it lays the objective of addressing how data protection and cybersecurity can be fortified in this realm, as well as finding comprehensive answers to liability concerns. European Parliament, *Automated vehicles in the EU*, 2016.

35. United Nations, *Convention on Road Traffic*, 1949.

36. The European High-Level Groups are tripartite and independent bodies that temporarily work on specific policy sectors or strategic issues, and they are composed of members coming from national governments, corporations, universities and associations. Each HLG eventually issues a final report, agreed by consensus, with recommendations on the analysed topic.

37. European Commission, *High Level Group GEAR 2030 report on automotive competitiveness and sustainability is published*, 2017.

zero-emissions vehicles and autonomous driving. With regard to the latter, notably, the sixth section of the report states the following:

> Automated and Connected vehicles in particular bring new challenges for regulators and policy makers concerning e.g. road safety, environmental, societal and ethical issues, cybersecurity protection of personal data, competitiveness and jobs, etc. which need to be addressed. The big question is how to develop a new coherent legal framework for some vehicles that have not yet been built. These challenges need to be tackled by both Member States and the Commission.[38]

Experts in the HLG advocated for the importance of research and funding initiatives at both the European and the national level, calling for additional support in terms of policies and regulatory measures concerning AVs. The report analysed the ways in which Europe could effectively regulate the use of driverless cars, highlighting again the need to divide responsibilities between Member States and the EU, and underlining the importance of implementing "policy initiatives and regulatory initiatives to ensure the best framework for the development of these fast evolving technologies while at the same time being able to cope with the associated challenges".[39] Moreover, potential legislative actions involving autonomous cars were analysed in terms of road safety, liability and data protection. The report stressed how the advent of AVs will result in a blurring of conventional boundaries between regulations targeting drivers and those focusing on vehicles; consequently, it advised to consider future adjustments to both vehicles and traffic rules in order to prevent conflicts.[40]

Another crucial initiative on driverless cars is represented by the document, issued in 2018 by the European Commission, 'On the road to automated mobility: An EU strategy for mobility of the future'.[41] The text set the objective of ensuring policies able to support the proper development of AVs, outlining the proposal for "a comprehensive EU approach towards connected and automated mobility, setting out a clear, forward looking and ambitious European agenda".[42] Moreover, the difficulties in establishing liability in the event of crashes or accidents, when higher levels of automation will be reached, are once again stressed in the document. Hence, the Commission proposed to "regulate data recorders for automated vehicles as part of the revision of the General

38. European Commission, GEAR 2030. *High Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union. Final report*, 2017.
39. *Ibid*.
40. "Automated vehicles will blur the traditional distinction between rules applying to drivers (mainly national traffic rules) and rules applying to vehicles (mainly harmonized EU vehicle approval legislation). It is therefore essential that adaptation on vehicles and on traffic rules follow a coherent path". *Ibid*.
41. European Commission, *On the road to automated mobility: An EU strategy for mobility of the future*, 2018.
42. *Ibid*.

Safety Regulation for motor vehicles to clarify who was driving (the vehicle or the driver) during an accident",[43] while continuing monitoring the need for further EU policies as innovation continues to advance. The document concluded with a thought: "how to anticipate the effects of autonomous cars on society and economy?"[44] In fact, due to the ongoing testing phase of AVs, their long-term impact on mobility, economy, environment and society remains uncertain; it is therefore crucial to promptly evaluate these issues, in order to foresee and prevent any potential negative consequence. Additionally, the Commission highlighted the need to analyse and focus on the ethical aspects of driverless cars, in order to rapidly address and solve emerging moral dilemmas and guarantee that this innovation will be developed in accordance with European values.[45] As part of this strategy, in February 2019, the Commission issued guidelines[46] to establish a harmonized normative approach to autonomous vehicles, thus striving to harmonize legislation across all Member States.

Across the world, several regulatory frameworks and standards concerning AVs have either been established or are in the making, reflecting the rapid advancements in the technology itself. In the United States, self-driving vehicles have undergone public road testing for years, and the National Highway Traffic Safety Administration (NHTSA) has issued comprehensive guidelines for their evaluation and deployment. However, much of the legislation concerning the use of autonomous vehicles on public roads falls under the jurisdiction of single states[47], thus resulting in a fragmented regulatory environment, in which states such as California, Nevada, and Arizona are pioneers in testing and implementing the technologies in controlled settings.[48] The lack of uniformity across US state regulations highlights the need for a comprehensive federal legislation, to ensure consistency and to establish nationwide safety standards.[49]

43. *Ibid*.
44. *Ibid*.
45. *Ibid*.
46. Supported by the Technical Committee on Motor Vehicles, the Guidelines concerns: driver/operator/passenger interaction, transition of the driving task, installation of event data recorders, cybersecurity, safety assessment and tests and information provision to automated vehicle users. European Commission, *Guidelines on the exemption procedure for the EU approval of automated vehicles*, 2019.
47. Currently, about half of US states have enacted laws regulating vehicles with varying levels of autonomous technology, from basic driver-assist systems to future fully autonomous models. E. S. POVICH, "Self-driving cars aren't here yet, but states are getting the rules ready", *West Virginia Watch*, 2024.
48. Autonomous ride-hailing services from Waymo – formerly Google's self-driving car project – are already operating in designated areas of Los Angeles, Phoenix, San Francisco and Austin, and they are soon to be implemented in Atalanta and Miami. https://waymo.com/.
49. D. SUHARIYANTO, *Autonomous Vehicles: From Technology to Law and Regulation*, in *ESL*, Vol. 3, No. 02, 2024, p. 62–67.

5. The German national framework

German car manufacturers are currently actively competing for a leading position in the field of autonomous mobility, therefore, during the last years several measures have been implemented in this realm.[50] In Germany, the first relevant political involvement in autonomous driving can be traced back to 2013, when the Round Table on Automated Driving (*Runder Tisch Automatisiertes Fahren*) was issued by the Federal Ministry of Transport and Digital Infrastructure, establishing an advisory body aimed at facilitating a productive exchange of ideas and experiences on the topic, bringing together stakeholders from various sectors, including industries and associations.[51] Later, in 2016, the Ministry of Transport established the Ethics Commission on Automated and Connected Driving, which the following year presented its Ethical Guidelines,[52] a document that played a significant role in shaping the Autonomous Driving Act, later issued in 2021. The Ethics committee consisted of 14 members, including law, ethics and engineering professors, in addition to representatives from automobile companies and associations of consumers. The commission was divided into five working groups, which discussed unavoidable accident situations, data security and data economics, human-machine interface, responsibility for software and infrastructure, and ethical context beyond traffic.[53] Their report, published in 2017, addressed important aspects in the AVs field, including the moral dilemmas related to different values based on personal characteristics. Wider safety concerns, inquiries into data utilization, and the delineation of responsibilities were also discussed, encompassing principles of human dignity, non-discrimination and equality before the law.[54] Eventually, in 2021, Germany revised the Road Traffic Act with the introduction of the Autonomous Driving Act, establishing a legal framework for driverless systems operating within defined areas, specifically addressing vehicles at SAE level 4. The Autonomous Driving Act took effect on July 28, 2021, tackling manifold ethical challenges posed by driverless cars and engaging with constitutionally protected principles, such as human dignity, or the right to life and the right to non-discrimination.
The Act firstly proposes the very definition of 'autonomous driving', then establishes a general division of responsibilities and a set of measures to be taken in order to prevent accidents.[55] Accordingly,

50. M. EBERS, *Civil Liability for Autonomous Vehicles in Germany*, 2022, available at SSRN (https://ssrn.com/abstract=4027594).
51. Federal Ministry for Digital and Transport, *Automated and Connected Driving*, 2020.
52. Federal Ministry of Transport and Digital Infrastructure Ethics Commission, *Automated and Connected Driving. Report*, 2017.
53. C. LÜTGE, *The German Ethics Code for Automated and Connected Driving*, in *Philosophy and Technology*, Vol. 30, 2017, p. 547-558.
54. A. KRIEBITZ, R. MAX, C. LÜTGE, *The German Act on Autonomous Driving: Why Ethics Still Matters*, in *Philosophy and Technology*, 2022, p. 35, 29.
55. A. KRIEBITZ, R. MAX, C. LÜTGE, *The German Act on Autonomous Driving*, cit.

driverless cars are defined as means which "can perform the driving task independently within a specified operating range without a person driving the vehicle".[56] The Act provides the technical specifications which are needed to qualify a vehicle as autonomous, such as possessing a software system capable of functioning without continuous monitoring by the driver.[57] Moreover, the text analyses the different dynamics among the key players in autonomous driving, introducing relevant new roles as the category of "technical oversight".[58] As defined by the Act, such a specific status concerns individuals who possess the authority to deactivate the AV and authorize specific operations, closely resembling a remote-control function. With this amendment, the German framework aimed to establishing a steady connection between driverless cars and their effective supervision, where both the car owner and the producer bear responsibility in updates, maintenance and risk assessments.[59] Furthermore, the Act pursues the aim of reducing fatalities on the road, and therefore introduces the concept of "risk-minimized state". The latter notion is expressed in the first article of the legislative text as follows:

> For the purposes of this Act, a risk-minimized state is a state in which the motor vehicle with autonomous driving function, at its own instigation or at the instigation of the technical supervisor, comes to a standstill in the safest possible place and activates the hazard warning lights in order to ensure the greatest possible safety for the vehicle occupants, other road users and third parties, taking due account of the traffic situation.[60]

It can be appreciated how, in the Act, major importance is given to the concept of risk-minimized state in terms of accident prevention; indeed, this provision aims to ensuring that the vehicle, whenever a technical problem occurs, has the ability to securely stop, prioritizing the safety of passengers and individuals. Additionally, the Act outlines three guiding standards for autonomous vehicles. Such standards establish the fundamental norms upon which AVs shall safeguard the core objective of diminishing road fatalities, aligning with the previously introduced idea of risk-minimized state. Specifically, the AV should be designed to prevent and decrease damage, to preserve human life in the event of unavoidable danger, and to refrain from choosing and prioritizing human lives on the basis of personal attributes,[61] in accordance with the principle of non-discrimination. Therefore, several aspects are taken into account by this amendment, including moral implications and liability concerns related to the introduction of autonomous vehicles in

56. Bundesgesetzblatt, *Gesetz zum autonomen Fahren*, 2021.
57. J. GESLEY, *Germany: Road Traffic Act Amendment Allows Driverless Vehicles on Public Roads*, in *Library of Congress*, 2021.
58. A. KRIEBITZ, R. MAX, C. LÜTGE, *The German Act on Autonomous Driving*, cit.
59. *Ibid*.
60. Bundesgesetzblatt, *Gesetz zum autonomen Fahren*, cit.
61. *Ibid*.

the market. In addition, the Act recognizes the importance of core concepts such as data protection and non-discrimination, as well as consumer protection; the goal of the risk-minimized approach is in a nutshell to diminish and prevent accidents on the road.[62]
It must be noted how the German legislation primarily focuses on corporate and public utilization of AVs, rather than the private sector: this suggests that the current law, even the most advanced on this topic, still needs significant adjustments in order to be effectively applicable also to individual mobility; consequently, it should not be understood as the definitive legislation for autonomous driving, but rather, "a first and cautious move to allow the technology to be used in specifically designated areas and by fewer users".[63] Those unaddressed gaps in the normative field, together with other issues related to ethics, economics and public acceptance, will require the attention of many stakeholders, such as companies and AV-developers: these parties shall abide by the Autonomous Driving Act taking into account also other relevant normative sources, including EU data protection law and anti-discrimination frameworks.[64] Therefore, even though it may just represent an initial stride in an extensive journey, the importance of the German Autonomous Driving Act can hardly be overvalued: Germany's laws on high-level driverless car provides a model for other nations and will probably lead the way in the future, possibly helping to create a collaborative environment where legislation will transcend national boundaries.[65]
Indeed, while Germany has become the first State in Europe to issue a normative framework for Level 4 vehicles, many European countries currently present differing norms with respect to autonomous mobility, mainly ranging between Level 3 and 4. Switzerland is actively participating in several funding initiatives for autonomous driving on a European scale, and on March 2025, it introduced a comprehensive regulatory framework for AVs through the Swiss Federal Ordinance on Automated Driving (OAD), establishing the legal foundation for operating and overseeing automated driving systems.[66] On the contrary, Italy currently permits vehicles up to Level 2 to operate on public roads, presenting however no established legal framework regulating high-level AVs. Still, the adoption of law no. 205/2017, followed by the 2018 Ministerial Decree on smart road,[67] allows road testing of connected driving systems, possibly serving as a foundational framework for future legislative developments in this area.[68] The United Kingdom, significantly, has been

62. A. KRIEBITZ, R. MAX, C. LÜTGE, *The German Act on Autonomous Driving*, cit., p. 35, 29.
63. *Ibid*.
64. *Ibid*.
65. T. PLASS, *Navigating the future: Germany's Autonomous Driving Act*, in *Israel Public Policy Institute (IPPI)*, 2023.
66. The OAD builds on the 2023 amendment to the Swiss Road Traffic Act (RTA), which empowered the Federal Council to regulate three specific autonomous driving use cases. L. DORIGO, F. MARTENS, *Self-Driving Cars: The New Reality in Switzerland?*, *Pestalozzi*, 2025.
67. Ministero delle Infrastrutture e dei Trasporti, Decree of 28 February 2018, on the implementation methods and operational tools of road testing of Smart Road solutions and connected and automatic driving.
68. H. WESTERMARK, M. C. GAETA, J. CURRAN, R. POLANCO LAZO, *Legal opinion on the Regulation of certain aspects of Automated Driving*, *E-Avis ISDC*, 2022.

developing a domestic strategy for implementing automated and connected mobility on the roads since 2018, when it approved the Automated and Electric Vehicle Act, providing norms on civil liability for damages caused by autonomous vehicles of Level 4 and 5. In May 2024 the UK Automated Vehicles Act received Royal Assent and was thus enacted, establishing a legal framework that aims to support the safe integration of autonomous vehicles through new regulatory structures and concepts[69]. The goal is to eliminate legal uncertainties and clear the way for the introduction of AVs on British roads, expected in 2026[70].

6. Conclusion

This article has discussed how implementing autonomous vehicles could potentially bring several positive aspects to society, improving health, equality and non-discrimination, or facilitating the access to mobility by persons with disabilities. The introduction of AVs is expected to prevent car crashes by diminishing the risk of human errors in driving, to bring environmental benefits by reducing traffic congestion and decreasing fuel emissions and consumption, and to provide better accessibility and social inclusion; overall, if well-exploited, autonomous vehicles will improve societal cost-savings.[71] At the same time, however, driverless cars might create a series of adverse outcomes that, if not well addressed, could negatively affect human societies. Specifically, ethical dilemmas and security issues could become challenging, together with the complex procedure of establishing liability in civil or criminal domains. Thought experiments like Foot's Trolley Problem are useful in investigating the moral consequences of such an introduction in the market, whereas a robust legal framework will soon be needed to effectively regulate the technology, preventing fragmentation among States all around the world.

To pave the way for its widespread integration on European roads, the EU will need to take several key steps: to cultivate research and development in this sector; to review existent regulations and to create new ones; to harmonize infrastructures making them suitable for autonomous driving and, lastly, to provide education to the general public and to future passengers and drivers of AVs.[72] Indeed, in order to positively affect society, every technological advancement always needs to go hand-in-hand with the needs and acceptance of the community. Currently, among EU Member

69. It defines key terms and clarifies critical aspects related to risk and insurance, such as the concept of an Authorised Self-Driving Entity (ASDE), licensed operators, the future role of the regulator, incident reporting and investigation, authority holders within AV operations, self-driving marketing, and key liability positions. S. TILTMAN, *The Automated Vehicles Bill: Future of self-driving vehicles in the UK*, Marsh, 2024.

70. J. CARFRAE, *Hands off: Assessing the Automated Vehicles Act*, *BusinessCar*, 2025.

71. The reduction in car crash-related costs, reduced strain on the healthcare system, more efficient transportation, better fuel savings, and more can all contribute to the overall societal cost-savings.

72. European Automobile Manufacturers Association, Automated Driving. *Roadmap for the deployment of automated driving in the European Union*, 2019.

States, Germany has taken the most steps forward, clearing a path for regulating driverless cars on higher levels of automation and serving as a model for other nations; however, Member States alone do not have the means to effectively legislate such a complex topic, and the intervention of the European Union will soon be necessary. Advanced and fostered mobility among European countries has always been a key principle of the Union, but with the advent of autonomous vehicles it will become essential to harmonize laws on this topic among the Member States, which are nowadays focused on the regulation of different levels of automation, ranging from SAE Level 2 to Level 4. Next-generation norms, in accordance with international standards, will need first to address security in the communication between the vehicle and its digital infrastructures, to establish accurate ways to address liability when automated decision-making processes are involved, and to effectively keep up with Artificial Intelligence innovations, with the aim of shaping tomorrow's mobility and transport.