

ARTICLE

THE EUROPEAN ROAD TO AUTONOMOUS
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ABSTRACT

The present contribution intends to outline a European regulatory strategy to address technological and legal challenges posed by autonomous vehicles. Starting with a recent communication of the European Commission, this Article provides a critical analysis of EU policies on the legal issues of liability related to autonomous vehicles. The ongoing discussions within national jurisdictions demonstrate that a comprehensive plan to tackle the aforementioned problems is missing. The efforts made by national legislators and scholars reveal a patchwork of solutions, whereby everyone tries to find their own way to balance innovation with the need to protect the interested persons. It is however clear that the possible evolutions in the automotive sector will mainly affect three branches of private law: traffic accident liability, product liability, and insurance law. It is thus necessary to understand whether private law needs to adapt its paradigms to the technological developments under examination. In this respect, this contribution tries to examine the main problematic aspects of the actual legal framework at the national and European level. It goes then further in presenting, through a two-steps approach, what traffic liability may look like in the future, both in the short and in the long term. The main findings of this Article are that in the near future no dramatic changes are required, but just some minor amendments to adapt the product liability regime to the technological changes; in the more distant future, when users will demand autonomous vehicles through their devices, there will be the need to fashion a new system of traffic liability with compulsory insurance on manufactures, which will become a prerequisite for the vehicle being in motion. Finally, this Article advances some conclusions about the need to foster comparative research on the examined issues.

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I. A SOFT APPROACH TO AN ENORMOUS CHALLENGE

The problems of tortious liability related to accidents involving autonomous vehicles (“AVs”) have gained increasing attention in the global context. Apart from economic and technological challenges, the resolution of tort law and insurance law issues is of great importance to provide certainty with respect to the economic consequences of accidents. In this sense, the very central question when dealing with

AVs before their launch in the market is: Who is liable for crashes?¹ This issue entails the resolution of other problematic aspects, such as who should cover the risks, what the modalities for liability are, and which interests have to be protected.

The European institutions seem to be aware that reasonable answers to these questions are of dramatic importance for the future of AVs.² In fact, it is widely acknowledged that autonomous driving will bring benefits to society.³ According to predictions, new technologies should dramatically diminish the number of road accidents through the elimination of human errors.⁴ Moreover, they will improve traffic

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1. See Jack Boeglin, *The Costs of Self-Driving Cars: Reconciling Freedom and Privacy with Tort Liability in Autonomous Vehicle Regulation*, 17 YALE J.L. & TECH. 171, 174 (2015) (“Though manufacturers, insurers, news outlets, and academics have all posed this question, they have not found easy answers”). See also Jessica S. Brodsky, *Autonomous Vehicle Regulation: How an Uncertain Legal Landscape May Hit The Brakes on Self-Driving Cars*, 31 BERKELEY TECH. L.J. 851, 853 (2016) (“Scholars have speculated about how exactly the law should and will handle the introduction of autonomous vehicles, reaching differing and often contradictory conclusions and suggestions”).

2. See *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions “On the road to automated mobility: An EU strategy for mobility of the future”*, COM (2018) 283 final 11 (May 17, 2018) [hereinafter *EU Strategy for Mobility*].

3. Frank Douma, Adeel Lari & Kory Andersen, *The Legal Obligations, Obstacles, and Opportunities for Automated and Connected Vehicles to Improve Mobility and Access for People Unable to Drive*, MICH. ST. L. REV. 75, 92–96 (2017); Jeremy A. Carp, *Autonomous Vehicles: Problems and Principles for Future Regulation*, 4 U. PA. J.L. & PUB. AFF. 81, 87–92 [iv] (2018). See also David Levinson, *Climbing Mount Next: The Effects of Autonomous Vehicles on Society*, 16 MINN. J.L. SCI. & TECH. 787, 794–806 (2015). For a different view, see Gregory H. Shill, *Should Law Subsidize Driving?*, 95 N.Y.U. L. REV. (forthcoming 2020) (manuscript at 5) <http://dx.doi.org/10.2139/ssrn.3345366> [<https://perma.cc/AYP5-VP6X>] (arguing that automobile’s social costs are in part encouraged by the law and that AVs “may reduce collisions but likely won’t mitigate the other costs”).

4. According to data provided by the World Health Organization, every year over 1.2 million people die as a result of car accidents. It is stated that 90% of accidents each year are caused by human error. The figure is at 95% according to the *Report from the Commission to the European Parliament and the Council Saving Lives: Boosting Car Safety in the EU Reporting on the monitoring and assessment of advanced vehicle safety features, their cost effectiveness and feasibility for the review of the regulations on general vehicle safety and on the protection of pedestrians and other vulnerable road users*, COM (2016) 787 final 4 (Dec. 12, 2016).

flows, provide for social inclusion in rural areas and cities, and act in favor of aging and disabled persons. The automation of vehicles could eventually produce additional positive changes if linked to the sharing economy and the decarbonization of transport in pursuit of a zero-emission society.

The European Commission intervened in the Declaration of Amsterdam of 2016 and agreed with some Member States and part of the industry on joint goals and actions to facilitate the introduction of connected and automated driving.⁵ The indications on the future legal framework are rather generic. The document states only that “the legal framework should offer sufficient flexibility to accommodate innovation, facilitate the introduction of connected and automated vehicles on the market and enable their cross-border use.”⁶ In drafting an agenda to plan the steps to be taken in view of automated mobility, the European Commission assumes a clearer position in declaring that “no changes are necessary as regards autonomous vehicles.”⁷ Apparently, the Commission believes that the still existent Motor Insurance Directive,⁸ as well as interpretative guidance concerning the Product Liability Directive,⁹ are sufficient tools to tackle the evolutions in the transport sector.

The launch of AVs will mainly affect three different branches of private law: traffic accident liability, product liability, and insurance law. The aim of the present contribution is to evaluate whether the soft approach laid down by the European Commission is appropriate. In what follows, the prevailing paradigms of regulations will be analyzed. European and some national rules will be scrutinized to assess if it is necessary to work on a normative framework at a European and national level, one adequate to face the future challenges in the area of AV accident liability.

5. *Declaration of Amsterdam of 14-5 April 2016 “Cooperation in the field of connected and automated driving.”*

6. *Id.* II a.

7. *EU Strategy for Mobility, supra* note 2.

8. Directive 2009/103, of the European Parliament and of the Council of Sept. 16, 2009 Relating to Insurance Against Civil Liability in Respect of the Use of Motor Vehicles, and the Enforcement of the Obligation to Insure Against such Liability, 2009 O.J. (L 263) 11 (EC).

9. Council Directive 85/374 of July 25, 1985, on the Approximation of the Laws, Regulations and Administrative Provisions of the Member States Concerning Liability for Defective Products, 1985 O.J. (L 210) 29 (EEC).

*II. THE MOTOR INSURANCE DIRECTIVE: A SHADOW TORT
LAW REGIME?*

The statements of the European Commission cannot be understood without a quick analysis of the Motor Insurance Directive, which provides for the compulsory insurance of vehicles within the European Union and a direct claim of the victim against the insurer covering the liable person.¹⁰ Pursuant to the Directive, each EU Member State is to act appropriately to ensure that civil liability in respect of the use of vehicles normally based in its territory is covered by insurance. In accordance with the law in force in other Member States, such insurance is to cover any loss or injury which is caused in the territory of those States. The compulsory insurance covers both damage to property and personal injuries. Moreover, the Directive indicates minimum amounts that should be covered by the compulsory insurance,¹¹ and it obliges the Member States to set up a body having the task of providing compensation for damage caused by an unidentified vehicle or a vehicle for which the insurance obligation has not been satisfied.¹²

In the interest of the victims, the Motor Insurance Directive obliges the Member States to set up a compensation procedure, according to which the insurance undertaking of the person who caused the accident or its claims representative is required to make an offer of compensation where the liability is not contested and the damages have been quantified. Conversely, if liability is denied or has not been clearly determined or the damages have not been fully quantified, the insurance undertaking to whom the claim for compensation has been addressed is required to provide a reasoned reply to the points made in the claim.

The systems based on compulsory insurance, even if operating with private law instruments, have gained a bureaucratic character.¹³ The frequent occurrence of accidents makes it inefficient to treat cases involving accident liability on an individual basis. Often liability issues concerning motor cars are resolved directly by insurance companies

10. Directive 2009/103, art. 5, 2009 O.J. (L 263) 11, 17 (EC).

11. *Id.* art. 9.

12. *Id.* art. 10.

13. Wolfgang Ernst, *General Introduction: Legal Change? Railway and car accidents and How the Law Coped with Them*, in *THE DEVELOPMENT OF TRAFFIC LIABILITY* 1, 7 (Wolfgang Ernst ed., 2010).

through a schematic standard procedure.¹⁴ This bureaucratization based on the insurance industry is a common future within Europe; nonetheless, from a formal and technical point of view in matters of tort law, relevant distinctions between legal systems are still existent and are resistant to change.¹⁵ Compulsory insurance does not transform a system based on the liability of the driver or the keeper into a no-fault system independent of any basis for attribution;¹⁶ the insurer simply replaces the insured party in any tort claim that may arise. Nevertheless, all around Europe, compulsory insurance is seen as a tool to protect victims of road traffic accidents, rather than an instrument to protect the keeper.¹⁷ Such an understanding of compulsory insurance creates hybrid systems based on tort law and insurance law, which of course influence the outcome of the cases, making it arduous to escape from liability.¹⁸

It is possible to assume that details of tort liability in the different EU Member States do not significantly affect the overall functioning of the compensation procedures, which have proven to be efficient due to the regulation of insurance. In this sense, it has been claimed that the Motor Insurance Directive represents a “shadow tort regime.”¹⁹ Notwithstanding the risks of moral hazard, through the minimum coverages and the spreading of losses in the community of drivers, the described mechanism solves the problem of undercompensation.²⁰ It also permits an internalization of the risks through the payment of the insurance premium. Insurers can play an important role in seeing that

14. See Simon Halliday et al., *Street-Level Tort Law: The Bureaucratic Justice of Liability Decision-Making*, 75 *MODERN L. REV.* 347, 355-56 (2012).

15. Ernst, *supra* note 13, at 10–11. See also *infra* Part III.

16. See e.g., for comparative remarks, VALENTINA V. CUOCCI, DALL’ASSICURAZIONE OBBLIGATORIA R.C. AUTO ALLA NO-FAULT INSURANCE 119–94 (2013) (Ita.).

17. On the aims of compulsory liability insurance, see Michael Faure, *Compulsory Liability Insurance: Economic Perspectives*, in *COMPULSORY LIABILITY INSURANCE FROM A EUROPEAN PERSPECTIVE* 319, 320–22 (Attila Fenyves et al. eds., 2016).

18. Cf. Gerhard Wagner, *Tort Liability and Insurance: Comparative Report and Final Conclusions*, in *TORT LAW AND LIABILITY INSURANCE* 307, 317 (2005).

19. James Davey, *A Compulsory Diet of Chickens and Eggs: The EU Motor Insurance Directives as a Shadow Tort Regime*, in *RESEARCH HANDBOOK ON EU TORT LAW* 239, 240–243 (Paula Gilker ed., 2017). For the assumption that the understanding of a tort law system requires an analysis of the practice of insurance companies, see Mauro Bussani & Marta Infantino, *Tort Law and Legal Cultures*, 63 *A.J. COMP. L.* 77, 80–83 (2015). Specific differences between European legal systems in the area of traffic liability are indicated by CHRISTOPH OERTEL, *OBJEKTIVE HAFTUNG IN EUROPA* 103–06 (2010) (Ger.).

20. Faure, *supra* note 17, at 320.

proper care is taken so as to avoid accidents by imposing contractual conditions that discourage wrongful and potentially injurious behavior. Such influences of insurance law on tort law may also be explained in the light of social advantages and economic efficiency.²¹

Given the profound modifications in the automotive sector, it is questionable whether the described shadow tort regime is sufficient to assure certainty and equal treatment of injured persons in Europe. With AVs, the keeper/owner becomes a potential victim of her own car. In addition, competition between internal market manufacturers will be impacted by a significant new element: nowadays there is little if any relation between manufacturers and cases involving car accidents,²² but in the future things may change since the software embedded in the vehicles means the driving task will be under their responsibility. With a new main character on the scene, the manufacturer, it seems uncertain whether the Motor Insurance Directive can provide for a clear and correct allocation of the risks and boost competition within the internal market. If the Member states do not adopt a harmonized system of liability for AVs, damages claims against manufactures will be assessed through different criteria depending on the applicable national law.

III. SUBSTANTIVE TORT LIABILITY RULES

To understand how the legal landscape of AVs might appear, one has to consider how national legal systems currently deal with accident liability where a motor car is involved and how they plan to adapt the law to the new technologies. Due to the differences, the focus here will be put on examples from civil law and common law that adopt different grounds of liability. The discussions, proposals and enactment of new laws by some national legal systems demonstrate that AVs necessarily will influence substantive tort law.

21. Cf. Willem H. van Boom, *Insurance Law and Economics: an Empirical Perspective*, in *ESSAYS IN THE LAW AND ECONOMICS OF REGULATION. IN HONOUR OF ANTHONY OGUS* 253, 254–59 (Michael Faure & Frank H. Stephens eds., 2008); Tom Baker & Peter Siegelman, *The Law and Economics of Liability Insurance: A Theoretical and Empirical Review*, in *RESEARCH HANDBOOK ON THE ECONOMICS OF TORT* 169, 183–85 (Jennifer H. Arlen ed., 2013); Ina Ebert, *Tort Law and Insurance*, in *COMPARATIVE TORT LAW. GLOBAL PERSPECTIVES* 144–50 (Mauro Bussani & Anthony J. Sebok eds., 2015).

22. See, for relevant data, Lennart S. Lutz, *Autonome Fahrzeuge als rechtliche Herausforderung*, *NEUE JURISTISCHE WOCHENSCHRIFT* [NJW] 119 (2015) (Ger.).

A. Divergent Rules across Europe

Due to its inherent risks, driving a car exposes people to the possibility of becoming a tortfeasor. The industrial revolution and the rise of the automobile industry demanded legislative intervention. Evolutions in the law were not fast, and it took time for legal systems to provide a response to societal needs.²³ In the nineteenth and twentieth centuries, European legal systems followed different paradigms,²⁴ and nowadays within the non-harmonized area of law, there are similarities and divergences between the Member States.²⁵

This is understandable because the earlier role of EU law and comparative research was of course not the same as today. The actual standpoint is different than the one which existed when the rules on car accident liability were first enacted. Even if not comparable to the work done in the area of contract law,²⁶ scholars long ago began to discuss specific issues of tort liability within international groups and drafted the Principles of European Tort Law.²⁷ Nevertheless, with respect to the great challenges of the AVs that affect the economy of the continent, many scholars and institutions are currently engaged in isolated national discourse.

B. The French and the German System: Strict Liability of the Keeper

The first reference when dealing with accident liability in the French legal system is law no. 85-677 of 5 July 1985, the so-called “*loi*

23. Ernst, *supra* note 15, at 5–11.

24. See REINHARD ZIMMERMANN, *THE LAW OF OBLIGATIONS: ROMAN FOUNDATIONS OF THE CIVILIAN TRADITION* at 1017–30 (Oxford Univ. Press 1996) (1990); Gerhard Wagner, *Comparative Tort Law*, in *THE OXFORD HANDBOOK OF COMPARATIVE LAW* 994, 998–1001 (Mathias Reimann & Reinhard Zimmermann eds., 2d ed. 2019).

25. Compare Hein Kötz, *Liability for Motor-Vehicle Accidents in Europe: Recent Reforms and Reform Proposals* in 2 *STUDI IN MEMORIA DI GINO GORLA* 1441, 1455–58 (A. Giuffrè ed., 1994); CEES VAN DAM, *EUROPEAN TORT LAW* 408–17 (2d ed. 2013); Ernst Karner, *A Comparative Analysis of Traffic Accident Systems*, 53 *WAKE FOREST L. REV.* 365, 368–72 (2018).

26. See REINHARD ZIMMERMANN, *The Present State of European Private Law*, 57 *A.J. COMP. L.* 479, 494–96 (2009); PIETRO SIRENA, *Die Rolle wissenschaftlicher Entwürfe im europäischen Privatrecht*, *ZEITSCHRIFT FÜR EUROPÄISCHES PRIVATRECHT [ZEU]* 838, 847 (2018) (Ger.).

27. See Bernhard A. Koch, *The “European Group on Tort Law” and its “Principles of European Tort Law”*, 53 *A.J. COMP. L.* 189, 189 (2005). See also Marta Infantino, *Making European Tort Law: The Game and Its Players*, 18 *CARDOZO J. INT’L & COMP. L.* 45, 60–65 (2010).

Badinter,” devoted especially to “victims of a traffic accident in which a motor vehicle is implicated.”²⁸ The primary rule of the regulation is that the victim of the accident in which a motor vehicle is involved is entitled to sue the driver and the keeper for compensation, whereby it is not necessary to demonstrate that the vehicle caused the accident.²⁹ According to the aforementioned statute, the driver and the keeper can be exonerated from liability only if they demonstrate that the victim intentionally sought (*recherché*) the suffered damage or that the victim’s *faute inexcusable* was the sole cause of the accident.³⁰ For the driver of a motor vehicle who suffers damage from a road traffic accident, the amount of compensation is reduced if she has committed a *faute*.³¹

A study group of scholars has recently proposed a window dressing of the aforementioned regime.³² With respect to the *loi Badinter*, a new definition of driver should be adopted: the one who initiates the operating system of an AV.³³ In addition, the rule on contributory negligence should not apply to a “driver” of an AV.³⁴

28. See FRANÇOIS CHABAS, *LE DROIT DES ACCIDENTS DE LA CIRCULATION APRES LA REFORME DU 5 JUILLET 1985* 1–52 (2d ed. 1988); GENEVIEVE VINEY, *L’INDEMNISATION DES VICTIMES D’ACCIDENTS DE LA CIRCULATION* 1–36 (1992); from a comparative perspective, Ruth Redmond-Cooper, *The Relevance of Fault in Determining Liability for Road Accidents: The French Experience*, 38 INT’L & COMP. L.Q. 502, 508–20 (1989).

29. See Jean-Sébastien Borghetti, *Extra-Strict Liability for Traffic Accidents in France*, 53 WAKE FOREST L. REV. 265, 276–77 (2018).

30. Law 85-677 of July 5, art. 3(1) (1985).

31. *Id.* art. 4.

32. See generally LIONEL ANDREU et al., *DES VOITURES AUTONOMES. UNE OFFRE DE LOI* (2018).

33. *Id.* at 184: “Ajouter un alinéa 2 à l’article 2 de la loi du 5 juillet 1985: « Les victimes, y compris les conducteurs, ne peuvent se voir opposer la force majeure ou le fait d’un tiers par le conducteur ou le gardien d’un véhicule mentionné à l’article 1^{er}. Est réputé conducteur celui qui active le système de conduite autonome d’un véhicule terrestre à moteur »” (Adding a 2d sentence to article 2 of Law July 5, 1985: “It is prohibited for the driver or the keeper of a vehicle mentioned in article 1, to oppose to the harmed persons, included the drivers, the force majeure or the fact of a third. The persons who starts the driverless system of a motor vehicle is considered the driver”).

34. *Id.*: “Ajouter un alinéa 2 à l’article 4 de la loi du 5 juillet 1985: « La faute commise par le conducteur du véhicule terrestre à moteur a pour effet de limiter ou d’exclure l’indemnisation des dommages qu’il a subis. L’alinéa précédent n’est pas applicable au conducteur d’une voiture autonome qui, au moment de l’accident, était autorisé à ne pas contrôler le comportement du véhicule »” (Adding a 2d sentence to article 4 of Law July 5, 1985: “The fault committed by the driver of a motor vehicle limits or excludes the recovery of the damage that he or she has suffered. The precedent paragraph is not applicable to a driver of an

German law provides for a similar regulation in the Road Traffic Act (*Straßenverkehrsgesetz*, “StVG”), enacted in 1952.³⁵ The StVG states that the keeper of a motor vehicle is liable for damages caused in the course of its operation (*Betriebsgefahr*) unless she can prove an external cause.³⁶ The driver is jointly liable with the keeper, but she can escape from liability by proving that she did not cause the damage intentionally or negligently. The differences between the German and the French regime are not significant, and also the Italian Civil code contains similar rules.³⁷ Legal scholars are of the view that the system of liability will be able to work properly also with AVs. As it will be seen,³⁸ the insurance company may ultimately sue the manufacturer for relief if the damage was caused by its defective product. Such liability systems may have the advantage of permitting a coexistence with conventional vehicles, for which the behavior of the driver will still remain of importance. Whereas the liability of the driver will no longer be of relevance in assessing liability issues concerning AVs, the keeper will continue to bear the risks that must be covered through compulsory insurance.

C. United Kingdom: From the Duty of Care to the Automated and Electric Vehicles Act 2018

A divergent system of liability was adopted in England and Wales, where the strict liability doctrine was rejected in favor of a system based on the duty of care of the driver.³⁹ In the presence of a

autonomous vehicle, who, at the moment of the accident, was authorized not to control the behavior of the vehicle”).

35. The above-mentioned Act has replaced the Motor Vehicle Act of 1909 (*Kraftfahrzeuggesetz*). See Sebastian Lohsse, *Development of Traffic Liability in Germany*, in *THE DEVELOPMENT OF TRAFFIC LIABILITY*, 75, 93 (2010).

36. § 7 (1) StVG. According to § 7(2) StVG, the duty to compensate is excluded if “the accident was caused by an unavoidable event which is not due to a defect in the construction of a vehicle or to the failure of its mechanism.” See BASIL S. MARKESINIS ET AL., *MARKESINIS’S GERMAN LAW OF TORTS* 167-69 (5th ed. 2019).

37. See C.c., art. 2054. Cf. CESARE M. BIANCA, *DIRITTO CIVILE*, 5, *LA RESPONSABILITÀ* (2d ed. 2012) 354–56; PIETRO TRIMARCHI, *LA RESPONSABILITÀ CIVILE: ATTI ILLECITI, RISCHIO, DANNO* 397-98 (2d ed. 2019).

38. See *infra* Part IV.A.

39. Wolfgang Ernst, *General Introduction: Legal Change? Railway and car accidents and How the Law Coped with Them*, in *THE DEVELOPMENT OF TRAFFIC LIABILITY* 1, 7 (Wolfgang Ernst ed., 2010). From a comparative perspective, cf. 2 CHRISTIAN VON BAR, *THE COMMON EUROPEAN LAW OF TORTS* at 405 (2000) (describing the regime as a result of “One of the unfortunate developments of the English law”). Cf. also the case of Israel: Ronen Perry, *From*

compulsory insurance regime, the differences with the continental systems (at least from a practical point of view) seem not significant, because third party motor insurance highly influences the outcome of cases.⁴⁰ Nevertheless, a fault-based system which relies on drivers' standards of care is obviously inapt for AVs.⁴¹ In addition, negligence liability requires evidence of how the accident occurred, which often depends on witnesses and technicalities, and the burden of proof is on the victim.⁴²

Unsurprisingly, the legislature intervened with the Automated and Electric Vehicles Act 2018 of 19 July 2018. Through a re-conceptualization of road traffic liability, the recent Act places liability on the insurer "where an accident is caused by an automated vehicle when driving itself on a road or other public place in Great Britain."⁴³ When the vehicle is not insured, the owner is liable for the damage.⁴⁴ The amount of liability is reduced in cases of contributory negligence.⁴⁵ Special rules are devoted to accidents resulting from unauthorized software alterations or a failure to update

Fault-Based to Strict Liability: A Case Study of an Overpraised Reform, 53 WAKE FOREST L. REV. 383, 394–98 (2018).

40. See e.g. Lord Denning in *Morris v. Ford Motor Co. Ltd* [1973] Q.B. 792, at 798: "The damages are expected to be borne by the insurers. The courts recognize this every day. They would not find negligence so readily – or award sums of such increasing magnitude – except on the footing that the damages are to be borne, not by the man himself, but by an insurance company." For an overall assessment, cf. John R. Spencer, *Motor-cars and the Rule in Rylands v. Fletcher: A Chapter of Accidents in the History of Law and Motoring*, 42 CAMBRIDGE L.J. 65, 80 (1983).

41. Cf. Ernst Karner & Lukas Schellerer, *Non-Contractual Liability for Railways, Buses and Aeroplanes*, 9 J. EUR. TORT L. 143, 151 (2018) (arguing that in the field of self-driving vehicles the English fault liability system "leads to serious gaps in protection").

42. See, on liability issues related to AVs, Andrew D. Selbst, *Negligence and AI's Human Users*, 100 B.U. L. REV. (forthcoming 2020) (manuscript at 9) (on file with author). See generally, on the burden of proof in English common law of negligence, RICHARD A. BUCKLEY, *THE LAW OF NEGLIGENCE AND NUISANCE* 2.21 (6th ed., 2017). For comparative remarks and on the possibility of reversals of the burden of proof in presence of defective products, see generally Helmut Koziol, *Comparative conclusions*, in *BASIC QUESTIONS OF TORT LAW FROM A COMPARATIVE PERSPECTIVE* 685, 801–02 (Helmut Koziol ed., 2015). On the immanence of corrective justice in negligence liability and the impact of reversals of the burden of proof, see ERNEST J., WEINRIB, *THE IDEA OF PRIVATE LAW* 154–55 (2012).

43. Automated and Electric Vehicles Act 2018, c. 18, § 2(1), <http://www.legislation.gov.uk/ukpga/2018/18/contents/enacted>. [<https://perma.cc/MS3Z-DTNY>].

44. *Id.* § 2(2).

45. *Id.* § 3.

“safety-critical” software.⁴⁶ Finally, the insurer and the owner of the vehicle may file a claim against any other person liable to the injured party in respect of the accident.⁴⁷ Through this Act, the British law adopts a strict liability system which, with respect to the general ground for liability, does not differ so much from the continental systems based on the strict liability of the keeper. It should be noted that behind the insurer, mentioned by the Act of 2018, lies a policy-holder, who usually is the vehicle’s keeper. Compared to the French and the German models, the advantage here is that in the event of an accident also the owner/keeper can technically be considered a victim for which the insurer is liable. Moreover, it should be welcomed that the position of the driver is no longer taken into consideration in the legal framework. The Automated and Electric Vehicles Act avoids creating a “fictitious” or “artificial” driver, as is the case in a recent proposal of French scholars.⁴⁸ Where an operating system autonomously executes the task of driving, there can no longer be a human driver.

IV. THE PRODUCT LIABILITY REGIME

The point of reference in Europe is, of course, the Product Liability Directive of 1985. As is well known under the Directive, a product is defective when it does not provide the safety which a person is entitled to expect, taking all circumstances into account, this including the presentation of the product, the reasonable use of the product, and the time when the product was put on the market.⁴⁹ The victim bears the burden of proof with respect to the actual damage, a defect in the product and a causal link between the damage and the defect. Even though there is not an onus to prove the manufacturer’s negligence or fault, it could be hard for the victim to fulfill the aforementioned requirements.

In general terms, it is questionable whether the European product liability regime could be a useful tool to regulate AVs’ accident liability. Moreover, at an institutional level, it is currently discussed whether the more than three-decade regime needs to be updated

46. *Id.* § 4.

47. *Id.* § 5.

48. See ANDREU et al., *supra* note 32, at 86–92. The text of the relevant provision proposed by the French group of scholars is reported *supra* note 33.

49. Council Directive 85/374, art. 6, 1985 O.J. (L 210) 29, 31 (EEC).

through a new legislative instrument that is capable of facing the more recent technological developments.⁵⁰

A. The Manufacturer not at the Forefront

The absence of a driver is the most evident distinction between AVs and conventional vehicles. This leads one immediately to think that in cases of accidents involving AVs the manufacturer of the vehicle will be the liable party. In the European context, the product liability regime is at the moment being analyzed in order to understand whether it could eventually cope with the rise of self-driving technologies and provide convincing solutions.⁵¹ It is assumed that product liability will gain much more importance than in the current situation.⁵² Nevertheless, within countries that impose strict liability on the owner/keeper—because of the onus of proving a defect in the product and the other elements of civil liability—it would be foolish for victims to bring a claim against the manufacturer and not against the owner/keeper.⁵³ In addition, compulsory insurance guarantees that damage suffered by the victim is covered.⁵⁴ In such legal systems, product liability could have a pivotal role only for the insurance company when it comes to seeking relief from the manufacturer.⁵⁵

50. The Commission has set up an expert group on liability and new technologies (*see* <http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3592>) [<https://perma.cc/536C-75S4>]. The group has 2 formations. The “product liability formation” will assist the Commission in drawing up guidance on the Directive. The “new technologies formation” will assess the implications of emerging digital technologies for the wider liability frameworks at EU and national level.

51. *Cf.* Christian Gomille, *Herstellerhaftung für automatisierte Fahrzeuge*, 71 JURISTENZEITUNG [JZ] 76, 77–80 (2016) (Ger.); Gerhard Wagner, *Produkthaftung für autonome Systeme*, 217 ARCHIV FÜR DIE CIVILISTISCHE PRAXIS (ACP) 708, 724 (2017) (Ger.). For a broader perspective, *see also* Marta Infantino & Weiwei Wang, *Algorithmic Torts: A Prospective Comparative Overview*, 29 TRANSNAT’L L. & CONTEMP. PROBS. (forthcoming 2019) (unpublished manuscript at 21–24) (on file with authors).

52. *See* Martin Ebers, *Autonomes Fahren: Produkt und Produzentenhaftung*, in AUTONOMES FAHREN. RECHTSFOLGEN, RECHTSPROBLEME, TECHNISCHE GRUNDLAGEN 93, 96 (Bernd H. Oppermann & Jutta Stender-Vorwachs eds., 2017) (Ger.). For the U.S., *see* Kyle Colonna, *Autonomous Cars and Tort Liability*, 4 CASE W. RES. J.L. TECH. & INTERNET 81, 114–16 (2012); Bryant Walker Smith, *Automated Driving and Product Liability*, MICH. ST. L. REV. 1, 30–32 (2017); Madeline Roe, *Who’s Driving That Car: An Analysis of Regulatory and Potential Liability Frameworks for Driverless Cars*, 60 B.C. L. REV. 317, 327–34 (2019).

53. Wagner, *supra* note 51, at 760.

54. *Id.*

55. *See*, especially in German literature, Christian Armbrüster, *Verantwortungsverlagerungen und Versicherungsschutz – Das Beispiel des automatisierten*

It is true that a complete shift in liability towards the manufacturer may disincentivize investing in new technologies,⁵⁶ but allowing the latter to easily exempt liability may considerably impact on AVs' social desirability. People need to trust in manufacturers and in the fact that they are ready to cover the unavoidable losses that will arise because of the vehicles. At any rate, it appears correct to affirm that the actual state of the art regarding product liability on a European level does not require a reduction of AV manufacturers' liability to boost innovation. On the other hand, it also appears correct to affirm that the already existing product liability regime could serve an important preventive effect with respect to AV manufacturers and induce them to take reasonable care in order to avoid defects.⁵⁷ Taking all this into consideration, when dealing with AVs in the European context, the issue related to the Product Liability Directive should be somewhat reversed. It is not a matter of deciding whether to exempt manufacturers from liability, but to verify if the protection granted by the Directive is adequate,⁵⁸ and if it provides for satisfactory incentives.⁵⁹

B. An Ancient Piece of Legislation

The Product Liability Directive of 1985 took into consideration the “increasing technicality” and the need for “a fair apportionment of the risks inherent in modern technological production.”⁶⁰ Nevertheless, after more than thirty years, evolutions in technology make the

Fahrens, in *INTELLIGENTE AGENTEN UND DAS RECHT* 205, 216–17 (Sabine Gless & Kurt Seelmann eds., 2016); Gomille, *supra* note 51, at 81; Wagner, *supra* note 51, at 758, 760–61; Ebers, *supra* note 52, at 98.

56. Melinda F. Lohmann, *Liability Issues Concerning Self-Driving Vehicles*, 7 EUR. J. RISK REG. 335, 338 (2016).

57. Wagner, *supra* note 51, at 762. See also Horst Eidenmüller, *The Rise of Robots and the Law of Humans*, *ZEITSCHRIFT FÜR EUROPÄISCHES PRIVATRECHT [ZEuP]* 766, 771–72 (2017) (declaring that without liability the manufacturers “would have the wrong incentives”). Compare this opinion with the opinion expressed in Colonna, *supra* note 52, at 118.

58. See VON BAR, *supra* note 39, at 412–14 (explaining that a possible lack of protection affects the passengers of the vehicle. As they participate in the risk of using a motor vehicle, legal systems traditionally put them in a less advantageous position than the third parties involved in accidents).

59. See Erica Palmerini & Andrea Bertolini, *Liability and Risk Management in Robotics*, in *DIGITAL REVOLUTION: CHALLENGES FOR CONTRACT LAW IN PRACTICE* 225, 253–54 (Reiner Schulze & Dirk Staudenmayer eds., 2016).

60. Council Directive 85/374, 2d recital, 1985 O.J. (L 210) 29, 29 (EEC).

Directive an outdated construction incapable of tackling the fundamental problems that could arise from software embedded in AVs that operate independently in the public space.⁶¹ As it was stated several times among legal scholars, placing the onus of proof on the victim could hinder the effectiveness of the Directive.⁶² Some of the issues may be solved through very strict safety requirements that necessarily will be enacted in order to assure an appropriate level of safety. In addition, compulsory insurance would avoid the possibility of undercompensation.⁶³ At any rate, the Product Liability Directive does not comprise an effective measure to protect injured people in the sector of AVs.⁶⁴

Unlike other branches where the “internet of things” is involved, there is not inadequate protection of victims due to the presence of the traffic liability regime and mandatory insurance.⁶⁵ Nevertheless, some rules contained in the Product Liability Directive pose serious concerns

61. Tom M. Gasser, *Fundamental and Special Questions for Autonomous Vehicles*, in *AUTONOMOUS DRIVING: TECHNICAL, LEGAL AND SOCIAL ASPECTS* 523, 525 (Markus Maurer et al. eds., 2016). See also Antonio Davola & Roberto Pardolesi, *In viaggio col robot: verso nuovi orizzonti della r.c. auto (driverless)?*, *DANNO E RESPONSABILITÀ [DANNO E RESP.]* 616, 627–29 (2017) (Ita.); MARIA C. GAETA, *LIABILITY RULES AND SELF-DRIVING CARS: THE EVOLUTION OF TORT LAW IN THE LIGHT OF NEW TECHNOLOGIES* 140–41 (Editoriale Scienifica ed. 2019). Decades of legal scholarship discuss the applicability of the Product Liability Directive to software and artificial intelligence: see Simon Whittaker, *European Product Liability and Intellectual Products*, 105 *L.Q. REV.* 125 (1989); K. Alheit, *The Applicability of the EU Product Liability Directive to Software*, 34 *COMP. & INT'L L.J. SOUTHERN AFR.* 188 (2001); Andrea Bertolini, *Robots as Products: The Case for a Realistic Analysis of Robotic Applications and Liability Rules*, 5 *LAW INNOVATION & TECH.* 214, 235–42 (2013).

62. See *Report from the Commission to the European Parliament, the Council and the European Economic and Social Committee on the Application of the Council Directive on the approximation of the laws, regulations, and administrative provisions of the Member States concerning liability for defective products (85/374/EEC)*, at 6, COM (2018) 246 final 6 (May 7, 2018) (stating that “[o]verall, the Directive can be considered to contribute to a reasonable balance between protecting those who suffer injury and ensuring fair competition on the single market. However, some of the Directive’s concepts require guidance and/or clarification as they hamper the effectiveness of the Directive. In particular, a better common understanding of what is meant by “product”, “damage” and “defect” as well as clarifications on the burden of proof would render the Directive’s application more effective.”)

63. See *supra* Part II.

64. See e.g., *ENFORCEMENT AND EFFECTIVENESS OF CONSUMER LAW* (Hans-Wolfgang Micklitz & Geneviève Saumier eds., 2018) (providing a comparative law perspective).

65. Gunther Teubner, *Digitale Rechtssubjekte? Zum privatrechtlichen Status autonomer Softwareagenten*, 218 *ARCHIV FÜR DIE CIVILISTISCHE PRAXIS [AcP]* 155, 159 (2018) (Ger.). On the same issue, see also Christiane Wendehorst, *Consumer Contracts and the Internet of Things*, in *DIGITAL REVOLUTION: CHALLENGES FOR CONTRACT LAW IN PRACTICE*, *supra* note 59, at 189, 195–96 (referring to a “dispersion of responsibility”).

with respect to the protection of injured parties.⁶⁶ First of all, it appears difficult to accept that, given the possibility of updating the software, a product cannot be considered defective for the sole reason that a better product is subsequently put into circulation.⁶⁷ In addition, it seems quite easy for the manufacturer to escape liability by proving that, “having regard to the circumstances, it is probable that the defect which caused the damage did not exist at the time when the product was put into circulation by him or that this defect came into being afterwards,”⁶⁸ or that “the state of scientific and technical knowledge at the time when he put the product into circulation was not such as to enable the existence of the defect to be discovered.”⁶⁹

In the long run, a modification or a clarification of the rules will be needed in order to assess with a higher degree of certainty when the manufacturer is liable.⁷⁰ A detailed analysis of all the issues related to product liability would be beyond the scope of the present contribution. It nevertheless seems of interest to analyze some of the issues that recently were discussed with respect to the liability of AV manufacturers.

C. Some Issues to be Resolved

In the following sections, three examples of possible interventions on a European level will be presented in respect of AV liability issues: first, a case in which there is a need to eliminate a provision; second, a case in which a consistent interpretation of an existing provision is needed; and third, a case in which it is necessary to add a provision.

66. Roeland de Bruin, *Autonomous Intelligent Cars on the European Intersection of Liability and Privacy. Regulatory Challenges and the Road Ahead*, 7 EUR. J. RISK. REG. 485, 491 (2016) (observing that “the current framework on product liability does not provide an easy toolkit for consumers to hold AIC manufacturers liable for defects in their products”).

67. Council Directive 85/374, art. 6(2), 1985 O.J. (L 210) 29, 31 (EEC).

68. *Id.*, art. 7(b), 1985 O.J. (L 210) 29, 31. See Gert Straetmans & Dimitri Verhoeven, *Product Liability Directive*, in EUROPEAN PRODUCT LIABILITY. AN ANALYSIS OF THE STATE OF THE ART IN THE ERA OF NEW TECHNOLOGIES 40, 60–61 (Piotr Machnikowski ed., 2016).

69. Directive 85/374, art. 7(e), 1985 O.J. (L 210) 29, 31 (EEC).

70. See Simon Whittaker, *Introduction to Fault in Product Liability*, in THE DEVELOPMENT OF PRODUCT LIABILITY 1, 27 (Simon Whittaker ed., 2010) (stating that “there are number of issues on which the Directive is not clear and, in particular, where it leaves concepts undefined or only partially defined”).

1. Eliminating the Development Risk Defence

Through what has been termed the “development risk defen[s]e,”⁷¹ the Product Liability Directive provides that a producer is exonerated from liability if the state a producer bears no liability if the state of scientific and technical knowledge at the time in which the product was put into circulation was insufficient to uncover the defect.⁷²

The presence of the provision inspired significant disagreement among Member States during the procedure that led to the enactment of the Directive.⁷³ The difficulties in finding an agreement led to the possibility of omitting the rule in implementing the Directive.⁷⁴ The aim of the exoneration ground is clear: manufacturers should not be deterred from investing in new products and technological innovation. Nevertheless, the final wording of the provision adopted by the EU lawmakers raised some doubts. In fact, commentators had to tackle the unsolved issue of whether the exoneration applied only for absolute undiscoverability or also for a mere undiscoverability by reasonable means. The latter interpretation is problematic because it substantially resembles the fault requirement that, in theory, was abandoned by the Directive. The ECJ⁷⁵ could not definitively solve the issue but expressly declared that the rule refers to the “objective state of scientific and technical knowledge, including the most advanced level of such knowledge, without any restriction as to the industrial sector concerned.”⁷⁵ Apart from the different opinions that may exist on its interpretation, it is indisputable that the practical significance of the

71. Piotr Machnikowski, *Product Liability Directive*, in EUROPEAN PRODUCT LIABILITY. AN ANALYSIS OF THE STATE OF THE ART IN THE ERA OF NEW TECHNOLOGIES, *supra* note 68, 62, 77–79.

72. Directive 85/374, art. 7(e), 1985 O.J. (L 210) 29, 31 (EEC).

73. Mark Mildred, *The development risks defence*, in PRODUCT LIABILITY IN COMPARATIVE PERSPECTIVE 167 (Duncan Fairgrieve ed., 2005); Hans-W. Micklitz, *Liability for Defective Products and Services*, in NORBERT REICH, HANS-W. MICKLITZ, PETER ROTT, KLAUS TONNER, EUROPEAN CONSUMER LAW 239, 263–64 (2d ed., 2014).

74. Directive 85/374, art. 15 (1)(b) 1985 O.J. (L 210) 29, 33 (EEC): “Each Member State may: . . . (b) by way of derogation from article 7 (e), maintain or, subject to the procedure set out in paragraph 2 of this article, provide in this legislation that the producer shall be liable even if he proves that the state of scientific and technical knowledge at the time when he put the product into circulation was not such as to enable the existence of a defect to be discovered.”

75. Case C-300/95, *Commission v. United Kingdom*, 1997, E.C.R. I-2649, paras 26–29. For a very in-depth analysis of the judgment, see SIMON WHITTAKER, LIABILITY FOR PRODUCTS. ENGLISH LAW, FRENCH LAW, AND EUROPEAN HARMONISATION 495–502 (2005).

rule is to shift the risk of injury caused by a new technology onto the victim and not onto the manufacturer “who reaps the benefits of distributing the product.”⁷⁶

There is poor case law on the legal meaning of the defense,⁷⁷ but its practical significance could dramatically increase due to the development of technology. Autonomous systems that rely on choices determined by algorithms pose serious concerns as regards the ground of exemption. The systems adopt autonomous decisions that could be wrong and cause harm also if the manufacturer has fulfilled the required safety duties.⁷⁸ It is questionable whether in the future it would be a suitable solution to wholly eliminate the development risk defense for AV accident liability. AV manufacturers should at any rate not escape liability if the state of scientific and technical knowledge at the time when the AV was put into circulation was not yet advanced enough to allow for the delegation of the behavior at issue to algorithmic decisions. Every decision taken by the software that amounts to a defect, i.e. that does not entail the safety which a person is entitled to expect,⁷⁹ should trigger strict liability. As it is, single Member States, due to the option provided by the Product Liability Directive, could adopt such a measure with reference to AV manufactures.⁸⁰ However, especially to assure competition in the single market and a high level of protection for the victims, it seems preferable to exclude the development risk defense by means of European legislative intervention.

2. Discovering a Defect in the Design

The more important difference between conventional vehicles and AVs is that crashes involving the latter could be caused by the hardware and software components of the operating system.⁸¹ In tackling the problems of AVs, it is useful to adopt the Anglo-American distinction

76. Machnikowski, *supra* note 71, at 78.

77. Cf. Mildred, *supra* note 73, at 170–72; Micklitz, *supra* note 73, at 265–66.

78. Teubner, *supra* note 65 at 190. See also the critics of Antonio Davola, *A Model for Tort Liability in a World of Driverless Cars: Establishing a Framework for the Upcoming Technology*, 54 *IDAHO L. REV.* 591, 600 (2018).

79. See *infra* Part IV.C.2.

80. ANDREU et al., *supra* note 32, at 108–09.

81. Mark A. Geistfeld, *The Regulatory Sweet Spot for Autonomous Vehicles*, 53 *WAKE FOREST L. REV.* 337, 354–57 (2018).

between different types of defects, namely “manufacturing defects” and “design defects.”⁸²

In its recent communication, the Commission has proposed that AVs be fitted with data recorders in order to clarify who was driving during an accident, namely the software or the driver.⁸³ Additionally, the EU Parliament has indicated the need for clear legislation obligating the installation of event data recorders “in order to clarify and enable the tackling, as soon as possible, of issues of liability.”⁸⁴ The importance of data recording must be stressed because such recording would make it possible to understand *ex post* what events actually caused the damage, which is a decisive issue for the attribution of liability. Where a full automation level has been engaged,⁸⁵ it can be assumed that passengers do not devote attention to what happens on the road, and in the event of an accident they would not be able to reconstruct the events that led to the damage.⁸⁶

Assuming that by means of track recording it will be possible to demonstrate the events that led to an accident, an additional important issue remains: was the accident caused by a defect? In this respect, difficult questions arise with regard to the qualification of a design defect in cases in which the AVs operating system is fully functioning. How can one assess the existence of a defect in the design? Is an incorrect decision made by the software that drives the vehicle enough to consider the AV defective? Can a crash be considered proof of defective design?

On these issues, an article recently published by author Mark Geistfeld attempted to apply settled product liability doctrines to AVs

82. Jane Stapleton, *Bugs in Anglo-American products liability*, in *PRODUCT LIABILITY IN COMPARATIVE PERSPECTIVE*, *supra* note 73, at 295, 300–02; Lauren Sterret, *Product Liability: Advancements in European Union Product Liability Law and Comparison between the EU and the U.S. Regime*, 23 *MICH. ST. INT’L L. REV.* 885, 893–903 (2015); Michael D. Green & Jonathan Cardi, *United States of America*, in *EUROPEAN PRODUCT LIABILITY. AN ANALYSIS OF THE STATE OF THE ART IN THE ERA OF NEW TECHNOLOGIES*, *supra* note 68, at 575, 585–89.

83. *EU Strategy for Mobility*, *supra* note 2, at 10.

84. EUR. PARL. 2014-2019 Committee on Transport and Tourism, 2018/2089(INI) “on autonomous driving in European transport” (July 20, 2018).

85. Reference is made to the criteria provided by the Society of Automotive Engineers (SAE): Level 5 describes a System that “can cope with all situations automatically during the entire journey. No driver required” (*see* https://www.sae.org/standards/content/j3016_201401/) [<https://perma.cc/W89U-PTRV>].

86. LENNART S. LUTZ, *AUTOMATISIERTES FAHREN, DASHCAMS UND DIE SPEICHERUNG BEWEISRELEVANTER DATEN* 29 (2017).

in order to outline a roadmap for future regulation.⁸⁷ The starting point of the examination is the fact that “AVs will transform the individualized behavior of human drivers into a collective, systematized form of driving.”⁸⁸ A single driver, the software, will have the capacity to drive an entire fleet of AVs and determine their movements. Another important assumption of the analyzed study is that the AV’s operating system will be designed in a manner that is not completely safe.⁸⁹ Users will also have to accept a certain risk when deciding to be transported by an AV and, of course, they must be warned by the manufacturers about the inherent safety risks related to AVs.

In this future scenario, premarket testing plays an important role and permits detection of whether an AV fulfills the required safety expectation. In particular, it is proposed that the manufacturer would be providing a safe design if the aggregate premarket testing data shows that the fleet of fully functioning autonomous vehicles performs at least twice as safe as conventional vehicles.⁹⁰ To avoid liability for AV crashes, a manufacturer who respects the indicated safety benchmark must only adequately warn consumers about this inherent risk.⁹¹ In Geistfeld’s contribution, Waymo was chosen as a reliable premarket testing example.⁹² AV operating systems are learning machines that

87. Mark A. Geistfeld, *A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation*, 105 CALIF. L. REV. 1611, 1621–24 (2017).

88. *Id.* at 1632–34.

89. *Id.* at 1635. See also Karni A. Chagal-Feferkorn, *Am I an Algorithm or a Product? When Products Liability Should Apply to Algorithmic Decision-Makers*, 30 STAN. L. & POL’Y REV. 61, 84 (2019) (“sophisticated systems, in particular self-learning algorithms, rely on probability-based predictions, and probabilities by nature inevitably “get it wrong” some of the time”).

90. Geistfeld, *supra* note 87, at 1651–52. The above-mentioned parameter is based on a risk-utility test. *Contra* Kenneth S. Abraham & Robert L. Rabin, *Automated Vehicles and Manufacturer Responsibility for Accidents: A New Legal Regime for a New Era*, 105 VA. L. REV. 127, 142–45 (2019).

91. Geistfeld, *supra* note 87, at 1654–56. The author further explains that on the basis of this data, auto insurers can establish the risk-adjusted annual premium for insuring the vehicle. Through the disclosure of such a premium to the consumers, the manufacturer would satisfy its obligation to warn of the inherent risk of crash, “eliminating this final source of manufacturer liability for crashes caused by a fully functioning autonomous vehicle.”

92. For an explanation of the premarket testing techniques currently used by Waymo, see Andrew J. Hawkins, *Inside Waymo’s strategy to grow the best brains for self-driving cars. The Google spinoff has a head start in AI, but can they maintain the lead?*, THE VERGE (May 9,

through testing acquire experience in order to prevent accidents. It is further argued that AV crashes are substantially different than those caused by humans.⁹³ An AV could encounter difficulties in what is termed “corner cases,” very peculiar scenarios that were not addressed during the premarket testing.⁹⁴

Taking into consideration all the listed features of AVs, it is contended that in order to ascertain the presence of a design defect in an AV which has been involved in a crash caused by the AV’s fully functioning operating system, an overall assessment of the systemized driving should be made through performance data for the fleet, regardless of the particular circumstances of the crash.⁹⁵ In other words, one has to consider whether the fleet fulfills the safety requirements independent of what happened in the particular case because AVs do not act like humans and their behavior depends on an operating system that is embedded in an entire fleet of vehicles. This means that respecting the safety rate previously specified (i.e. half the accidents of conventional vehicles) would permit escape from liability (if the consumer was properly informed of the product’s inherent risks) no matter what the circumstances of the accident were.

It is clear that the liability test depends on the way in which courts will formulate the expectation of how a fully functioning operating system should execute the dynamic driving task. The above discourse has a strong impact on the standards that have to be taken into consideration in evaluating the safety expectations of the users. According to the described view, it is wrong to compare the behavior of a single AV with that of a hypothetical reasonable human driver facing the same traffic situation (referred to as the “anthropocentric standard”).⁹⁶ The safety expectation must be assessed with the overall data concerning the fleet (i.e. the total number of crashes over a certain period of time).

2018), <https://www.theverge.com/2018/5/9/17307156/google-waymo-driverless-cars-deep-learning-neural-net-interview> [<https://perma.cc/7X5V-7XF3>].

93. Geistfeld, *supra* note 87, at 1651.

94. HOD LIPSON & MELBA KURMAN, DRIVERLESS: INTELLIGENT CARS AND THE ROAD AHEAD 4–5 (2016).

95. *Id.*

96. Teubner, *supra* note 65, at 164–65.

In the absence of clear rules concerning the safety expectations in product liability,⁹⁷ the theory has gained approving support by a European scholar.⁹⁸ Nevertheless, it does not seem to be acceptable, at least in the near future when AVs are going to operate together with conventional vehicles.⁹⁹ Not focusing on the circumstances of the crash means accepting the possibility that an AV's manufacturer will elude liability even if in the individual circumstances the vehicle causes a crash that a human could easily avoid. For instance, in the case that involved a Tesla in Florida, the operating system confused a tractor-trailer with a lit sky and failed to apply the brakes.¹⁰⁰ It is indisputable that a human concentrating on the driving task would have had the capacity to prevent the crash. Rejecting the manufacturer's liability in such a case would be an unacceptable outcome, even if the operating system's data shows that the accident's rate respects the aforementioned level of safety. Here, the software replaces human behavior and, therefore, reasonable human behavior is the first reference to be taken into consideration as a minimum safety standard that must be fulfilled by the operating system.¹⁰¹ It does not mean that statistics are not a viable way to assess the safety expectations, but account should be given to data only if it is demonstrated that a reasonable human driver could not have avoided the crash. In reality, the suggested assessment of liability based on accident rates similarly entails a comparison between human behavior, expressed by the

97. Cf. Council Directive 85/374 of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member states concerning liability for defective products, art. 6(1), 1985 O.J. (L 210) ("A product is defective when it does not provide the safety which a person is entitled to expect, taking all circumstances into account, including: (a) the presentation of the product; (b) the use to which it could reasonably be expected that the product would be put; (c) the time when the product was put into circulation.")

98. Wagner, *supra* note 51, 733–36.

99. See *infra* Part V.A.

100. Tesla declared that "the vehicle was on a divided highway with Autopilot engaged when a tractor trailer drove across the highway perpendicular to the Model S. Neither Autopilot nor the driver noticed the white side of the tractor trailer against a brightly lit sky, so the brake was not applied": The Tesla Team, *A Tragic Loss* (June 30, 2016), <https://www.tesla.com/blog/tragic-loss> [<https://perma.cc/VNP7-YL8Y>]. For further analysis, cf. HANNAH YEEFEN LIM, *AUTONOMOUS VEHICLES AND THE LAW. TECHNOLOGY, ALGORITHMS AND ETHICS* 33–50 (2018).

101. Teubner, *supra* note 65, at 194: ("Anfangs wird sich das Rechtswidrigkeitsurteil an den Fähigkeiten menschlicher Akteure orientieren. Das aber ist nur der Minimalstandard, der stets einzuhalten ist") (At the beginning, the assessment of unlawfulness will be oriented on human capabilities. However, it represents just a minimum standard that must be fulfilled in any case).

accident rate of a group of drivers, and the AVs' fleet behavior, expressed by a different accident rate. The distinction does not have a qualitative nature, but only a quantitative nature. In a period in which it is certain that AVs and conventional vehicles are going to be subject to the same traffic rules, it does not, therefore, seem appropriate to omit a focus on the specific accident and a comparison of the individual AV's response with that of a hypothetical human driver. This is particularly important for reasons of deterrence. Liability could more strongly induce manufacturers to learn from their mistakes and to improve or update their systems.

The indicated minimum standard of the reasonable human will not remain applicable forever. In the future, in a context where only linked AVs will circulate on the roads,¹⁰² traffic will look completely different than it is now. For instance, it can be expected that traffic lights will disappear, given that all the vehicles will be able to calculate the movements of other vehicles and decelerate or accelerate as needed in road intersections.¹⁰³ In such a future scenario, the hypothetical behavior of a human driver will only be a historical artifact useless for resolving issues of liability. Instead, the benchmark in order to assess the presence of a defect could predominantly be based on data related to the performances of different AV operating systems.¹⁰⁴

3. A Duty to Observe the Product

The type of product under examination makes it difficult to accept the applicability of the rule contained in the Product Liability Directive, according to which a product is not to be considered defective for the

102. See *infra* Part V.A.

103. Chris Smith, *MIT Thinks it Can Create a World Without Traffic Lights*, BGR, March 18, 2016, <https://bgr.com/2016/03/18/mit-smArt.-intersection-traffic-lights/> [<https://perma.cc/FQ95-V5X4>]. With respect to smart traffic, engineers are currently working on new solutions built upon slot-based systems similar to those commonly used in aerial traffic: see in particular Remi Tachet et al., *Revisiting Street Intersections Using Slot-Based Systems*, 11(3) PLOS ONE 2016, <https://doi.org/10.1371/journal.pone.0149607> [<https://perma.cc/U4E3-SSNQ>].

104. See Wagner, *supra* note 51, at 735–37, 764–65. See also Karni Chagal-Feferkorn, *The Reasonable Algorithm*, 1 U. ILL. J.L. TECH. & POL'Y 111, 116–17 (2018) (trying to develop a “reasonable algorithm” standard applicable to non-human decision makers); Eric Tjong Tjin Tai, *Liability for (semi)autonomous systems: robots and algorithms*, in RESEARCH HANDBOOK ON DATA SCIENCE AND LAW 55, at 72 (Vanessa Mak, Eric Tjong Tjin Tai & Anna Berlee eds., 2018) (discussing the development of the criterion of a “reasonable robot” or “reasonable algorithm”).

sole reason that a better product is subsequently put into circulation.¹⁰⁵ Beginning with the ways to assess the defectiveness of the product, the Directive focuses on the moment when the product is put into circulation as the relevant point in time.¹⁰⁶ This characteristic does not fit with a deep learning operating system such as the one embedded in AVs. Such technology is able to learn from mistakes and to ameliorate its performances through experience. It is possible that shortcomings in the functioning of the AVs could come to light only after the product is put into circulation. If this were the case, it would be advisable for manufacturers to react in order to fix the previously unknown problem with respect to the entire fleet of AVs. In other words, where it is possible to align a product with the safety level of products subsequently put into circulation through a mere update of the software, it must be done.

It is arguable that in cases of risks for passengers and bystanders, the manufacturers' policy would be to recall the AVs and fix the problem anyways. However, due to the inherent risks, it would be better to provide for a specific observation duty extended to the entire fleet of autonomous vehicles. Observation duties on products are known to some legal systems,¹⁰⁷ as for instance in Germany, where pursuant to rulings of the Federal Court manufacturers have a duty towards the community to observe their products and detect potential damaging features and inform themselves of risks deriving from usage.¹⁰⁸ It is observed that the AVs' manufacturers will easily have the opportunity to control the functioning of their connected operating systems and that the duty to observe will, therefore, be strictly evaluated.¹⁰⁹ The problem is to understand what exactly the manufacturers' duties are when a situation of risk is detected. Should they merely warn the users about the risks, or is a positive action

105. Council Art Directive 85/374 of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member states concerning liability for defective products, art. 6(2), 1985 O.J. L 210 art. 6(2), 1985 O.J. L 210 (EEC).

106. On the notion of defect, *see also Id.* art. 6(1).

107. *See*, with regard to U.S., German and French Law, JEAN-SEBASTIAN BORGHETTI, LA RESPONSABILITE DU FAIT DES PRODUITS. ÉTUDE DE DROIT COMPARE 79–80, 132–34, 331–33 (2004). On Council Directive 85/374, art. 13, 1985 O.J. (L 210) 29, 32 (EEC) and the relationship between national and European harmonized rules, *see Whittaker, supra* note 70, at 24–26.

108. On the so-called “Produktbeobachtungspflichten”, *see Gomille, supra* note 51, at 79–80; Wagner, *supra* note 51, at 750–51; Ebers, *supra* note 52, at 112–13.

109. Gomille, *supra* note 51, at 80; Wagner, *supra* note 51, at 750.

required? The German Federal Court has been reluctant in imposing more than a duty to warn.¹¹⁰ This is predominantly due to the high costs associated with the recall of products and modification of their design. Things may be different with AVs, given that very good results could be achieved through simple updates of the software.¹¹¹ It seems that an observation duty should be regulated at a European level in order to avoid inconsistencies between Member States' laws that could impair competition in the single market and yield imbalances in the level of protection.

The observation duty would be of special importance also to avoid effects that could be detrimental to the development of technology. As is well known, the ECJ has ruled that “where it is found that products belonging to the same group or forming part of the same production series, such as pacemakers and implantable cardioverter defibrillators, have a potential defect, such a product may be classified as defective without there being any need to establish that that product has such a defect.”¹¹² Even if AVs could entail great risks for the personal safety of the involved people, it seems wrong to automatically extend the assessment of defectiveness to an entire fleet. The ECJ judgment scrutinized a very peculiar product that is difficult to inspect, and therefore one has to be careful in extending the reasoning to other products.¹¹³ At any rate, to avoid any uncertainty on the issue it seems worthwhile to clarify that the occurrence of a single accident, caused by a design defect, does not necessarily imply the defectiveness of the entire fleet which has embedded the same operating system. In these cases, the fulfillment of the observation duty and, potentially, an update of the software could be sufficient to protect against liability.

V. TOMORROW'S TRAFFIC LIABILITY

In trying to determine if there is a need to change the actual regulatory framework, one has to consider that the rules on tort are

110. Wagner, *supra* note 51, at 754–55.

111. *Id.*

112. Boston Scientific Medizintechnik GmbH v. AOK Sachsen-Anhalt. Die Gesundheitskasse, Betriebskrankenkasse, Joined Cases 503/13 & 504/13, [2015], E.C.R. I (delivered March 5, 2015).

113. Cf. André Janssen, *Die Produkthaftungsrichtlinie von der Wiederbelebung?*, ZEITSCHRIFT FÜR DAS PRIVATRECHT DER EUROPÄISCHEN UNION [GPR] 236, 237 (2015) (Ger.); Straetmans & Verhoeven, *supra* note 68, at 56.

mainly based on the rationale that the liable person is the one who has created a risk that materializes in some manner of damage.¹¹⁴ Following this paradigm, it is therefore appropriate that the owner or keeper of the vehicle has to internalize the risk through insurance. The indicated persons usually have control of the motor car.¹¹⁵ They decide when and where to use it, how to use it and who can use it. The accident probabilities are strictly related to those choices and, to a certain extent, reflected in the price of insurance. The AVs' behavior, by contrast, depends on choices made by an algorithm and on the capacity of machine vision software to "read" certain situations.¹¹⁶

Due to the complete automation, it is obvious that the liability of the driver will disappear with AVs operating at Level 5.¹¹⁷ If the behavior of the vehicle no longer depends on the conduct of the driver, there is no way to make her liable for an accident. However, the position of the keeper of an AV is less evident. The keeper decides when and where to use the vehicle, but she is not responsible in terms of how the vehicle behaves. In using the AV, she has made only a choice about the vehicle company and the embodied software. Is this enough to maintain the liability scheme as it currently stands in many jurisdictions—namely, to impose strict liability on the keeper and to require compulsory insurance?

A. From the Keeper to the Manufacturer

The question of who has to cover the risk has gained attention at various levels. An ethics commission established by the German Ministry for Transport and Digital Infrastructure—and charged with addressing the ethical and legal problems related to autonomous

114. See Stephen Perry, *Torts, Rights and Risks*, in *PHILOSOPHICAL FOUNDATIONS OF THE LAW OF TORTS* 38, 45 (John Oberdiek ed., 2014) ("The basic idea is that risk itself is a form of harm, and we are duty-bound not to subject others to (unreasonable) levels of risk because to do so is to harm them"); Matthew Dyson, *What does Risk-Reasoning Do in Tort Law?*, in *REGULATING RISK THROUGH PRIVATE LAW* 455, 511 (Matthew Dyson ed., 2018). See also GERT BRÜGGEMEIER, *COMMON PRINCIPLES OF TORT LAW: A PRE-STATEMENT OF LAW* 82–92 (2004).

115. VON BAR, *supra* note 39, at 409 ("So long and in so far as one recognizes the risk theory as the basis of strict liability, liability for road vehicles must lie with the keeper").

116. Alberto Broggi et al., *Intelligent Vehicles*, in *SPRINGER HANDBOOK OF ROBOTICS* 1627–56 (Bruno Siciliano & Oussama Khatib eds., 2d ed. 2016).

117. See criteria provided by the Society of Automotive Engineers, reported *supra* note 85.

driving—has asserted that new rules for AVs should take into consideration the fact that responsibility for the vehicle’s behavior will shift from the driver to the manufacturer and the different subjects who have the power to take decisions with respect to the regulation of traffic and the maintenance of the relevant infrastructure.¹¹⁸ Scholars have reacted in different ways. It is argued that the liability of the keeper will continue to dominate the setting and that product liability will be of importance only in cases of regress by the insurance company or where the liability of the keeper does not cover the loss.¹¹⁹ According to a divergent view, it is argued that manufacturers must be held strictly liable for crashes of AVs operating at the highest level of automation.¹²⁰ The indicated reason is that manufacturers are, with their exhaustive knowledge of the software, better positioned “to control the risks and balance the benefits and costs of the technologies that are “driving” fully autonomous cars.”¹²¹

The latter conclusion cannot be disputed, but a reliable assessment must necessarily take into consideration also the impact on the vehicles’ prices. It seems convincing to state that making the vehicle companies strictly liable would probably result in the cost of insurance being shifted from the keeper to the manufacturer. In any event, product liability will have the effect of making vehicles more expensive given that manufacturers have to spread the costs of liability among its customers.¹²² Assuming that the overall risk of accidents depends on the volume of use of the vehicles, this could lead to an unsatisfactory situation where customers who do not frequently use the vehicles

118. BUNDESMINISTERIUM FÜR VERKEHR UND DIGITALE INFRASTRUKTUR *Ethik-Kommission* [FED. MINISTRY OF TRANSP. AND DIG. INFRASTRUCTURE ETHICS-COMM’NETHIC-Commission], *Automatisiertes und Vernetztes Fahren* [ETHIC-COMMISSION FOR AUTONOMOUS AND CONNECTED DRIVING REPORT] § III(10), https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/bericht-der-ethik-kommission.pdf?__blob=publicationFile [<https://perma.cc/W9ZT-KVQR>].

119. Wagner, *supra* note 51, at 759–61.

120. Eidenmüller, *supra* note 57, at 772–73. *See also*, with reference to the United States, Adam Rosenberg, *Strict Liability: Imagining a Legal Framework for Autonomous Vehicles*, 20 TUL. J. TECH. & INTELL. PROP. 208, 218–22 (2017) (advocating for AVs the application of the strict liability framework of early aviation); David Goldstein, *Autonomous Vehicles Will Drive Themselves - But They Won’t Regulate Themselves*, 13 HASTINGS BUS. L.J. 241, 254–56 (2017).

121. Eidenmüller, *supra* note 57, at 772.

122. Wagner, *supra* note 51, at 763.

subsidize customers who do make significant use of them.¹²³ It is posited that such problems also affect the liability of the keeper in cases where the amount of the insurance premium is not based on the use of the vehicle.¹²⁴ This is certainly true, but there are also other important tariff criteria related to the keeper that do not fit neatly with a fleet of fully autonomous vehicles. For instance, in establishing a premium for third party insurance, the following elements are taken into consideration in evaluating the risk: age, years as licensed driver, educational level and of course the ability of the keeper in managing the risks, all controlled through the “bonus-malus” system that adjusts the premiums paid by a customer based on her individual claim history.¹²⁵

It is evident that pricing and insurance play an important role in creating the right incentives for manufacturers and in influencing the choices of customers. In the present contribution, the issue will be addressed under two different scenarios: a near future where AVs will coexist with conventional vehicles and a more distant future in which roads will be populated exclusively by AVs.

B. The Near Future: A Competition between New and Old

In the near future, compulsory insurance law could play an important role in supporting the use of AVs during the time in which the latter is going to be on the road together with conventional vehicles. If we assume that the legal system should work to maximize the benefits derived from technology and deter the use of conventional vehicles, or at least nudge people towards abandoning them, placing liability on the keeper/owner (or the insurer) and requiring compulsory insurance on the part of the owner could generate a beneficial

123. *Id.* Nevertheless, it should be noted that in leasing contracts and other types of long term leases, which are becoming a widespread way to join vehicles, a maximum annual mileage is normally foreseen and it influences the amount of the lease.

124. *Id.*

125. For an overall assessment, see Ulrich Meyer, *Motor Liability Insurance in Europe. Comparative Study of the Economic-Statistical Situation*, in *PANEUROPÄISCHE TARIFSTRUKTUR IN DER KFZ-HAFTPFLICHTVERSICHERUNG* 35, 43–48 (Jürgen Basedow et al. eds., 2005). For the more recent developments on the “pay-as-you-drive” schemes related to data processing, see Jan Lüttringhaus, *Mehr Freiheit wagen im Versicherungsrecht durch daten- und risikoadjustierte Versicherungstarife*, in “MEHR FREIHEIT WAGEN.” *BEITRÄGE ZUR EMERITIERUNG VON JÜRGEN BASEDOW* 55, 58 (Anatol Dutta & Christian Heinze eds., 2018).

competition between the new (AVs) and the old (conventional vehicles).

Even after the launch of AVs, there will be people who prefer to drive rather than be transported by a computer program that decides on the destiny of passengers, be it motivated by fear, the pleasure of driving, or economic reasons.¹²⁶ The point in time at which a formal ban of conventional vehicles will be enacted seems to be still far off.¹²⁷ The acceptance of the new technology and the willingness to definitively prohibit conventional vehicles will probably require a degree of generational change.¹²⁸ Several elements are going to accompany this evolution, and transformation still began, at least in the Western countries. There is a significant trend to abandon private vehicle ownership in favor of the shared automobiles which increasingly transport people around in urban settings.¹²⁹ Public measures such as banning private motor cars from city centers because of pollution will additionally prompt a change in habits. In this context, an important tool for increasing awareness – among all stakeholders – about the advantages of AVs could be a regime of strict liability imposed on the owner/keeper (or the British regulation which formally places the liability on the insurer)¹³⁰ as it nowadays exists in several legal systems; also of value is a requirement of compulsory insurance.

As discussed earlier, the European Commission¹³¹ does not perceive a need to change the compulsory insurance scheme provided by the Motor Insurance Directive. The reasons for this choice are basically related to the position of the harmed individuals who must

126. On the issues related to societal acceptance see the empirical study of Eva Fraedrich & Barbara Lenz, *Societal and Individual Acceptance of Autonomous Driving*, in AUTONOMOUS DRIVING: TECHNICAL, LEGAL AND SOCIAL ASPECTS, *supra* note 61, at 622-40.

127. See John Naughton, *The Crucial Flaw of Self-driving Cars? They Will Always Need Human Involvement*, THE GUARDIAN, (July 15, 2018), <https://www.theguardian.com/commentisfree/2018/jul/15/crucial-flaw-of-self-driving-cars-always-need-human-involvement> [<https://perma.cc/Q52J-F7YS>].

128. Cf. the empirical evidence provided by Ingo Wolf, *The Interaction Between Humans and Autonomous Agents*, in AUTONOMOUS DRIVING: TECHNICAL, LEGAL AND SOCIAL ASPECTS, *supra* note 61, at 103, 110–18.

129. Wagner, *supra* note 51, at 764. With respect to the United States, compare Nora F. Engstrom, *When Cars Crash: The Automobile's Tort Law Legacy*, 53 WAKE FOREST L. REV. 293, 295–96 (2018).

130. Also with respect to the Automated and Electric Vehicles Act 2018, it seems that the risk is covered by the owner through the compulsory insurance regulation. See *supra* Section III.C.

131. See *supra* Parts I and II.

continue to rely on a system capable of granting full compensation in cases of accidents.¹³² The situation of a driverless vehicle which hits a different driverless vehicle could easily be resolved by holding, in accord with the current legal framework of many countries, the keeper of the first AV strictly liable.¹³³ Her insurance will then cover the inflicted damage.

Such a paradigm could not be considered optimal in the long run because it does not saddle liability onto the “cheapest cost avoider,” which in our case is undoubtedly the manufacturer who has control over the functioning of the technology and the capacity to assess the causation of an accident.¹³⁴ An advantage of this regime is the fact that through insurance market mechanisms the desirability of AVs could prevail over conventional vehicles. It can be predicted that insurance for AVs will ultimately be significantly cheaper than insurance for conventional vehicles. As has often been discussed, AVs will be allowed on the road once it has been demonstrated that they are able to systematically drive in a reasonably safe manner with at least half the incidence of crashes relative to conventional vehicles.¹³⁵ This means that the lower risk of accidents will surely reduce the costs of insurance policies.¹³⁶ Additional reductions may derive from the fact that AVs are always trackable. This could prevent manipulations by the policyholders and simplify the ascertainment of what brought about accidents¹³⁷, and sophisticated smart contracts might be structured.¹³⁸

132. Wagner, *supra* note 51, at 760.

133. See *supra* Part III. See also, with reference to French law, ANDREU et al., *supra* note 34, at 92–93.

134. See *infra* Section V.C.

135. Geistfeld, *supra* note 87, at 1651 *et seq.*; Wagner, *supra* note 51, at 734–35.

136. With respect to the tariff criteria adopted by insurance companies, see Meyer, *supra* note 125, at 40 *et seq.* But see JEFFREY W. STEMPEL & ERIK S. KNUTSEN, STEMPEL AND KNUTSEN ON INSURANCE COVERAGE 38–39 (4th ed., 2019) (“the claims amount at stake in the aggregate may not dissipate as one would expect, as class actions could potentially obviate the launching of suits against manufacturers on behalf of owners of entire lines of vehicles”). It has to be noted that, differently than in the U.S., in Europe tort class actions are traditionally unknown: see for comparative remarks on algorithmic torts, Infantino & Wang, *supra* note 51, at 33–34 (arguing that in European jurisdictions, in which new class action regimes have been implemented, there has been relatively little use of the procedure to date).

137. See Ina Ebert, *Automatisiertes Fahren aus Sicht der Versicherer*, in AUTONOME SYSTEME UND NEUE MOBILITÄT 65, 68–69 (Eric Hilgendorf ed., 2017) (referring to ongoing studies of insurance companies on the impact that AV technology may have on insurance premiums).

138. See Angelo Borselli, *Smart Contracts in Insurance: A Law and Futurology Perspective*, in DEMYSTIFYING INSURTECH (forthcoming)

The cheaper premiums will represent an important development especially for car-sharing companies which have the possibility to extend the reduced cost of insurance onto an entire fleet of vehicles. Such an implementation of new mobility concepts could have a pivotal role in familiarizing people with the new technology and making them aware of the benefits related to AVs. All these elements could give a competitive advantage to new technology and expose the shortcomings of conventional vehicles. On the other hand, the cost of insurance for conventional vehicles could increase. One can presume that repair costs for AVs' will, due to the used technology (sensors, cameras, etc.), be higher than those associated with conventional vehicles. Consequently, where a human driver crashes into and damages an AV, her insurance company will have to pay higher amounts, which in turn will augment the insurance premiums and create an additional competitive advantage for AVs.¹³⁹

It should also be noted that, from a legislative point of view, the choice not to modify the compulsory insurance regime and the basic features of liability does not result in a fragmentation of the legal system. One regime will cover both situations and influence the choices of the customers. Such a solution seems particularly appropriate when considering current driverless technologies permit an occupant of the vehicle to take over control. In addition, such a regulatory framework could also encourage technological development because usually it would not put manufacturers in the front line of a liability claim.¹⁴⁰ Further, in the majority of cases, the dispute over financial responsibility would be exclusively between professional players, insurance companies and manufacturers,¹⁴¹ and the absence of lay parties—already satisfied by insurance companies—would probably lead to an increase in extrajudicial settlements. Finally, people involved in accidents will continue to rely on the same proceedings to secure

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3318883 [https://perma.cc/7WWC-ZFSN] (arguing that “a sophisticated smart contract might be structured, envisioning a future where, with the advent of driverless cars, the smart contract might even direct the car itself to an accredited garage for its repairment”).

139. Cf. Jan Eichelberger, *Autonomes Fahren und Privatversicherungsrecht*, in AUTONOMES FAHREN. RECHTSFOLGEN, RECHTSPROBLEME, TECHNISCHE GRUNDLAGEN, *supra* note 52, at 127, 129.

140. See *supra* Part IV.A.

141. Wagner, *supra* note 51, at 761.

compensation, and this will additionally help to enhance the level of confidence in new technologies.

C. A More Distant Future: Only Autonomous Vehicles on the Road

The preference for private vehicles is less prevalent than in the past. Car-sharing fleets are invading cities all across Europe and are offering high flexibility to their customers. Vehicles are available at any time and for any duration, without the need to book them or to plan the journey in advance. It is argued that, with AVs, it is possible to significantly extend the existing mobility concepts.¹⁴² A time will come when users will no longer go to vehicles located by their smartphone apps; they will instead simply demand them through their devices. This technology could eliminate the issue of physical distance between humans and vehicles and help people with impaired mobility.

In the near future, this transformation of custom will impact the insurance market and alter accident liability, making the assessment and the compensation of damages caused by vehicles a question to be resolved between large enterprises. How should the legal system react to these changes? There is no need to dramatically modify the liability scheme or the compulsory insurance regime. Compared to the “no-fault” schemes adopted by some legal systems, especially in North America and New Zealand,¹⁴³ the current European legal framework seems to provide a valuable mechanism for ensuring the proper incentives and avoiding the risks of undercompensation.¹⁴⁴

142. Barbara Lenz & Eva Fraedrich, *New Mobility Concepts and Autonomous Driving: The Potential for Change*, in *AUTONOMOUS DRIVING: TECHNICAL, LEGAL AND SOCIAL ASPECTS*, *supra* note 61, at 174.

143. For a general assessment of the common law experience, see Ken Oliphant, *Landmarks of No-Fault in the Common Law*, in *SHIFTS IN COMPENSATION BETWEEN PRIVATE AND PUBLIC SYSTEMS* 43, 56–60 (Willem H. van Boom & Michael Faure eds., 2007).

144. Kötz, *supra* note 25, at 1455–58. See also Shill, *supra* note 3, at 71–72. Completely “no-fault” schemes could eventually be taken into consideration in a final stage of technological development, where the accident rate will be close to zero and deterrence will no longer be an issue. Compare Kevin Funkhouser, *Note, Paving the Road Ahead: Autonomous Vehicles, Products Liability, and the Need for a New Approach*, 2013 UTAH L. REV. 437, 458–59 (2013); David C. Vladeck, *Machines Without Principals: Liability Rules and Artificial Intelligence*, 89 WASH. L. REV. 117, 146–47 (2014); Maurice Schellekens, *No-Fault Compensation Schemes for Self-Driving Vehicles*, 10 LAW INNOVATION & TECH. 314–33 (2018); Abraham & Rabin, *supra* note 90, at 145–71 (framing a Manufacturer Enterprise Liability, “MER”, able to substitute tort law); Davola, *supra* note 78, at 609–12 (arguing the possibility to provide a system based on compensation paid by a fund created through taxes and payments of manufacturers, where for every crash an authority would – nevertheless – check the existence of negligence); Richard

Nevertheless, the need to enhance the preventive effects of accident liability requires, at least, a *prima facie* shift in the party who has to fulfill the duty to insure the vehicle.¹⁴⁵ Specifically, the burden will no longer fall on the owners/keepers, who definitely lost control of the vehicle, but on the manufacturers. The insurance cost will thus become a component of the market price of the vehicles or an additional service offered by the manufacturers. The costs of insurance will therefore presumably still fall on the owners/keepers, but the insurance tariffs will not be influenced by the behavior of the latter. In order to promote this new paradigm, AV manufacturers have to demonstrate that their products do not pose an unreasonable risk.¹⁴⁶ To create confidence in the market, in the near future it is therefore very important to continue placing liability on the keeper, as was indicated above.¹⁴⁷

The described change in the law would have the benefit of placing liability on the “cheapest cost avoider,”¹⁴⁸ the figure able to control the sources of risk and internalize the costs and the level of the activity.¹⁴⁹ At this stage, the competition would only be between manufacturers of AVs, and the insurance costs, reflected in the price, would represent an important factor apt to drive market choices in a satisfactory way. The price will also be related to the risk of accidents and, therefore, to the level of safety that the specific AV can guarantee. Not having the

LoRiccio, *Autonomous Vehicles: Why We Need Them, but Are Unprepared for Their Arrival*, 36 QUINNIPIAC L. REV. 297, 321–24 (2018). On the shift from tort law to a social welfare system, see Bussani & Infantino, *supra* note 19, at 81.

145. On the preventive effect of tort law in car accident liability, cf. NILS JANSEN, *DIE STRUKTUR DES HAFTUNGSRECHT* 173–78 (2003) (Ger.). For a general assessment, also with regard to the Principles of European Tort Law, see LA FUNZIONE DETERRENTE DELLA RESPONSABILITÀ CIVILE ALLA LUCE DELLE RIFORME STRANIERE E DEI *PRINCIPLES OF EUROPEAN TORT LAW* (Pietro Sirena ed., 2011) (Ita.).

146. Bryant Walker Smith, *Regulation and the Risk of Inaction*, in *AUTONOMOUS DRIVING: TECHNICAL, LEGAL AND SOCIAL ASPECTS*, *supra* note 61, at 571, 576. (Markus Maurer et al. eds., 2016).

147. See *supra* Part V.A.

148. Cf. Ronald Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 3 (1960); Guido Calabresi & Jon T. Hirschoff, *Toward a Test for Strict Liability in Torts*, 81 YALE L.J. 1055, 1060–84 (1972).

149. WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF TORT LAW* 66–67 (1987). But see Steven Shavell, *On the Redesign of Accident Liability for the World of Autonomous Vehicles* (August 19, 2019), Harvard Law School John M. Olin Center Discussion Paper No. 1014, <https://ssrn.com/abstract=3437474> (proposing a complete different form of strict liability, than the one described in the text, in which damages would be paid to the state in order to induce an adequate safety level and a not excessive mileage level by users of autonomous vehicles).

keeper be involved in liability issues carries the advantage of simplifying the assessment of liability and creating certainty as to which party has to be held liable for the damage. Victims would be protected through the permissibility of direct actions against the insurers as they currently are under EU law. Accidents would subsequently influence the contractual relationships between manufacturers and insurers and provide for an adaptation of the applied tariffs consistent with the risks generated by the particular fleet of AVs. A simplified legal regime eliminates the possible overlap of different liability schemes that might otherwise create a significant obstacle to efficient risk management by the players involved.

In this context, an element that could help the manufacturers who have to bear the costs of risk management is limiting the duration of risk.¹⁵⁰ Updates, end-user license agreements, and leasing arrangements could, for instance, enable manufacturers to update or retire systems that become obsolete.¹⁵¹ Such concepts would follow current trends in the market, where leasing and fixed-term contracts are replacing the model of ordinary sale and induce consumers to change cars more often than in the past.¹⁵² These changes are also driven by technology because as it occurs with smartphones, customers increasingly look to the latest technology. It is arguable that the use of AVs will become a kind of service offered on the market by different providers and that vehicle ownership by individual customers will no longer play a role.¹⁵³

D. A Different Product Liability Regime or a New Paradigm of Traffic Liability?

In light of the problematic issues related to the Product Liability Directive, it seems clear that in the long run a suitable legal framework cannot be reached through a mere evolutionary interpretation of the existing law. After the launch of AVs, the Directive could in the near

150. Smith, *supra* note 146, at 580.

151. *Id.*

152. In the U.S., see, e.g., Aaron M. Kessler, *Auto Leasing Gains Popularity Among American Consumers*, N.Y. TIMES, (Jan. 8, 2015), <https://www.nytimes.com/2015/01/09/business/auto-leasing-gains-popularity-among-american-consumers.html> [<https://perma.cc/5W29-LVGD>].

153. See Wagner, *supra* note 51, at 764-65 (describing the future perspective as follows: “Von der Eigentümer- zur Dienstleistungsmobilität”, which translates to [“From an owners-mobility to a services-mobility”]).

future also remain as it presently stands,¹⁵⁴ and some adjustments may be provided through the proposed interpretation of the notion of defect.¹⁵⁵ The development risk defen[s]e could eventually be inapplicable with respect to algorithms, and a duty to observe the product should be established.

When AVs become an accepted technology in society, more significant amendments to the law will certainly be needed. In cases of accidents, in order to avoid insurmountable difficulties related to evidence, the injured person will need to identify one single actor that must be held strictly liable in accord with the law. It seems that the manufacturer is in the best position to deal with the situation of an accident, particularly in order to evaluate its liability with respect to the crash. For instance, in cases of multiple tortfeasors where it is difficult to ascertain the responsibility for a crash,¹⁵⁶ after having recovered the damage, the manufacturer or its insurance will eventually file a claim for relief against the real tortfeasor (e.g. the custodian of the road or an external hacker).¹⁵⁷ It seems proper to let the manufacturer escape from liability in cases of force majeure or where the accident was caused by the negligent behavior of the injured party, as it nowadays happens in many jurisdictions under the rules on traffic liability.

When trying to imagine what the liability of car manufacturers will look like in the future, it could be asked whether it would be adequate to refer to a general product liability regulation or to a new special traffic liability regime that should affect car manufacturers. The first option would hinder legal fragmentation, but due to the profound differences between the technologies and the different interests that have to be protected within the several sectors of private law, it is difficult to conceive of a “one-size-fits-all solution” apt to solve in a

154. *See supra* Part V.A.

155. *See supra* Part IV.C.

156. For a comparative overview, see UNIFICATION OF TORT LAW. MULTIPLE TORTFEASORS *passim* (W.V. Horton Rogers & Willem H. van Boom eds., 2004); SANDY STEEL, PROOF OF CAUSATION IN TORT LAW 139–60 (2015); Marta Infantino & Eleni Zervogianni, *Summary and Survey of the Results*, in CAUSATION IN EUROPEAN TORT LAW 587, 646–47 (Marta Infantino & Eleni Zervogianni eds., 2017). On the foundations of collective liability, *see generally* ARIEL PORAT & ALEX STEIN, TORT LIABILITY UNDER UNCERTAINTY 130–159 (2001).

157. *See also* Deirdre K. Mulligan & Kenneth A. Bamberger, *Public Values, Private Infrastructure and the Internet of Things: The Case of Automobiles*, 9 J.L. & ECON. REG. 7, 7 (2016) (discussing cybersecurity problems related to AVs).

reasonable way the challenges related to the new technologies.¹⁵⁸ Therefore, it seems beneficial to fashion a new concept of traffic liability with compulsory insurance which will become a prerequisite for the vehicle being in motion. As was indicated above, in the distant future insurance should become a matter for vehicle manufacturers as they will also compete in the market in terms of the amount paid for insurance premiums, with the latter corresponding to the level of safety that the AV fleet will be able to assure.

VI. CONCLUSION

AVs entail a disruptive technology that will grossly impact the behavior of market actors. At this stage, the task of tort law and insurance law is to provide the right incentives in order to balance the aim of promoting innovation alongside the need to protect people from injuries.¹⁵⁹ Immediate and radical changes in the legal framework would provoke a substantial limitation on individual motorized mobility. This field calls for a step-by-step approach. People need to gradually change their habits and acquire confidence in the new technology. The task of tort law and insurance law is to foster—and not hinder—technological evolutions that could be beneficial to society while at the same time avoiding undercompensation.

Some traffic liability schemes adopted in European jurisdictions seem to offer a valuable solution for the near future, but a comparative discussion on the issue is missing. By imposing strict liability on the keeper and by requiring compulsory insurance, they protect victims and spread the loss among the users of vehicles. The same is true for the British “Automated and Electric Vehicles Act 2018,” which, as a matter of principle, places liability directly on the insurer.¹⁶⁰ Such approaches could also promote innovation if it were demonstrated that, compared to conventional vehicles, AVs significantly reduce the accident rate. In this regard, tariff schemes adopted by insurance

158. See generally Jean-Sébastien Borghetti, *How can Artificial Intelligence be Defective?*, in *LIABILITY FOR ARTIFICIAL INTELLIGENCE AND THE INTERNET OF THINGS* 63, 72 (Sebastian Lohsse, Reiner Schulze, Dirk Staudenmayer eds., 2019) (considering a sector-by-sector approach more appropriate to face liability issues of IoT and AI). Cf. Chagal-Feferkorn, *supra* note 89, at 87–107 (exposing different features to distinguish between products and thinking algorithms).

159. On market regulation through tort law, see Jan von Hein, *Marktregulierung durch Deliktsrecht – Zukunftsperspektiven der Rechtsvergleichung*, in *ZUKUNFTPERSPEKTIVEN DER RECHTSVERGLEICHUNG* 223, 234–37 (Reinhard Zimmermann ed., 2016) (Ger.).

160. See *supra* Part III.C.

companies could play a pivotal role in creating the right incentives in the market and exercise a deterrent effect.

In the more distant future, if and when exclusively AVs populate the roads, a shift of liability from the keeper to the manufacturer is needed. The latter will be in the best position to insure the produced vehicles. The paid insurance premiums based on the accident rate of the AV fleet will be reflected in the price of the vehicles and contribute to fair and beneficial competition between the market actors.

Against this background, the Product Liability Directive should also be amended in order to provide adequate solutions in accordance with technological changes. It is clear that there is not a need to change the rules in order to boost innovation. The Directive contains provisions that could easily let the manufacturers elude liability. This has the positive effect of not hindering innovation, but some minor adjustments are needed in order to produce a sufficient level of deterrence. A specific interpretation of the design defect must be elaborated in advance in order to know with certainty just when an AV with a fully functioning operating system can be considered defective in the event the AV causes a crash. Undeniably, accidents will not disappear; subsequent to the launch of AVs it seems correct to refer to the behavior of a reasonable driver as a kind of minimum standard of expected safety when attempting to ascertain a design defect. A comparison between the accident rate of conventional vehicles and the accident rate of a particular fleet of AVs could be used as an additional parameter in cases where the minimum standard is fulfilled. In the more distant future, the manufacturers' liability should become stricter, as has happened in some jurisdictions with respect to traffic liability. At that stage, it would be advisable to create a new set of rules establishing strict car manufacturer liability for the circulation of AVs.

In conclusion, many issues arise in trying to trace a European road to autonomous vehicles. The difficult challenges of the new technologies seem insufficiently tackled by the soft approach adopted by European institutions. The existing EU law represents only the starting point, namely a set of rules that grant full compensation and do not prevent technological development. Discussions held within national jurisdictions show that the establishment of a consistent system of liability for AVs at a European level is far from being reached. Only comparative and interdisciplinary research by European scholars may provide for the construction of a complete legal framework capable of competing in the global context.

