LIABILITY FOR HARM CAUSED BY THE DECISION-MAKING SYSTEM OF AUTONOMOUS VEHICLES CONSIDERING THE NEW EU PRODUCT LIABILITY DIRECTIVE

Ömer Batuhan Dogan*

Abstract

The development of artificial intelligence technologies impacts the transport sector, which has led to the emergence of the autonomous vehicle industry. As a consequence of the emergence of autonomous vehicles in dynamic traffic environments, the first incidents occurred. It is therefore notable that the damage caused by these accidents has led to the decision-making system of autonomous vehicles being given particular importance in the context of tort law. The new product liability directive has expanded the definition of products to include hardware and software that, functionally integrated, are capable of performing specific tasks. Consequently, autonomous vehicle-related software and hardware are now encompassed within the scope of the product. Regulation (EU) 2019/2144 and the Commission Implementing Regulation (EU) 2022/1426 of 2019/214, as well as the Commission Implementing Regulation (EU) 2026/481 of 3 March 2026, which is the most recent update to date, delineate the definition and functions of autonomous vehicles. As the vehicle is being developed, the established traffic road rules will be taken into consideration, and an evaluation will be made in collaboration with the new product liability. The objective of this article is to ascertain, within the paradigm of incorporating a software system within the product definition, the parameters under which a software defect would be addressed within the scope. This is important to establish the limits of the manufacturer's liability and to ensure a balanced relationship between the parties. Subsequently, the new product liability directive will provide clarification upon the determination of the source of the damage in order to establish a causal link with the manufacturer in the case of damages caused by autonomous vehicles integrated with many software systems. The establishment of liability rules for autonomous vehicles is significant for ensuring the proper functioning of the internal market and maintaining a high level of safety on traffic roads.

Keywords: product liability, autonomous vehicles, decision-making system, traffic roads, European Union

1. Introduction

The development of artificial intelligence has been in progress since the 1900s with the aim of making people's lives easier. The development of artificial intelligence in the United States has inspired projects in Europe. These European projects have contributed significantly to the current state of artificial intelligence.

* dr. jur. Ömer Batuhan Dogan, PhD student, second year, Deák Ferenc Doctoral School of Law, University of Miskolc, Department of Civil Law. E-mail: omer.batuhan.dogan@student.uni-miskolc.hu.

In the present time, with the continuous development of artificial technologies, the integration of AI in various fields has become important. One of these fields in which AI is being integrated is autonomous vehicles. These vehicles, equipped with software that incorporates artificial intelligence, are getting ready to enter a new transportation world. The concept of autonomous vehicles has historically been a technological dream, and their appearance in films and series has been a reference for the current time. Autonomous vehicles are regarded as a significant advancement, with the prevailing perspective that they will reduce the number of road accidents and help the environment by reducing carbon emissions.[1] Bob Luz, a former General Motors Vice Chairman stated: "The autonomous car doesn't drink, doesn't do drugs, doesn't text while driving, and doesn't get road rage. Autonomous cars don't race other autonomous cars, and they don't go to sleep."[2]

From the perspective of the user, the attractive aspect of this development is the fact that there is no need to control the vehicle when it is fully autonomous, and the idea of being able to do something else during this time. The integration of autonomous vehicles, equipped with advanced artificial intelligence capabilities, into our transportation systems is therefore no longer a fiction, but a reality. World-renowned manufacturers have increased their investment in the development and sustainability of autonomous vehicles on the road. The AV manufacturers "testing AVs on public roads are either from traditional vehicle manufacturers (i.e., Toyota, Nissan, and General Motors), or technology companies (i.e., Google, Uber, and Baidu)."[3] As the data shows, significant investment is being directed towards the AI sector by large companies. This indicates the necessity for the legal system to adapt in order to protect investments and ensure the technology can thrive in the future. Currently, SAE Level 3 Conditional Driving Automation is available for use on public roads in Europe. The introduction of SAE Level 4 vehicles on European roads has been significantly advanced by Commission Implementing Regulation (EU) 2022/1426. This development paves the way for the appearance of autonomous vehicles on European roads in the forthcoming years.

In Europe, relatively modern Directives have been initiated, which are Directive (EU) 2024/2853 of the European Parliament and of the Council of 23 October 2024 on liability for defective products and repealing Council Directive 85/374/EEC (Text with EEA relevance) and Commission Implementing Regulation (EU) 2022/1426 of 5 August 2022 laying down rules for the application of Regulation (EU) 2019/2144 of the European Parliament and of the Council as regards uniform procedures and technical specifications for the type-approval of the automated driving system (ADS) of fully automated vehicles. These Directives will provide the framework for the integration of autonomous vehicles into traffic scenarios while ensuring minimal disruption and encouraging new developments. In the context of tort law, the most significant directive is focused on the principle of compensation, and the causal link is formed by the Product Liability Directive.

The 1985 directive (85/374/EEC) has been deemed inadequate in addressing contemporary advancements in artificial intelligence and technology. Consequently, studies have been carried out in order to develop a new product liability directive that is appropriate for today's conditions.

[1] RUSTAD, M. L., Products liability for software defects in driverless cars, Southern California Interdisciplinary Law Journal, 2022, 32(1), 181.
[2] RUSTAD, op. cit. 183.
[3] RUSTAD, op. cit. 178.

The culmination of these studies and the outcome of the application assessment reports is the new Product Liability Directive 2024/2853, which is designed to address current requirements. The ongoing debate within legal doctrine concerning the new directive continues, with numerous ambiguities and unresolved issues remaining. However, the inclusion of AI-based systems within the scope of the directive is significant in itself, and the directive has made it possible for consumers to pursue legal remedies.

This directive has extended the scope of liability to software, which was not covered by the old directive, by classifying it as a product under the new Product Liability Directive. Consequently, in instances of damages arising from software defect, the injured party will be able to seek compensation under the Product Liability Directive. In comparison to the previous directive, the scope of liability has been expanded, encompassing additional parties. Consequently, the range of liability has been broadened, and it has become easier for the injured party to recover damages.

The primary reason for this is to ensure that the injured party can more easily identify the person who is responsible due to the fact that complex software is integrated with multiple software. Given that autonomous vehicles function in an integrated manner with numerous software systems, it has become a significant concern to ascertain which software is defective, or which software's failure affects the operation of other software.

Regulation (EU) 2019/2144, the Commission Implementing Regulation (EU) 2022/1426 of 2019/2144, and *Commission Implementing Regulation (EU) 2026/481 of 3 March 2026 amending Implementing Regulation (EU) 2022/1426 laying down rules for the application of Regulation (EU) 2019/2144 of the European Parliament and of the Council as regards uniform procedures and technical specifications for the type-approval of the automated driving system of fully automated vehicles* delineate the definition and functions of autonomous vehicles.

Consequently, Europe has recently enacted a directive for the purpose of establishing the necessary interconnection between them. In order to facilitate discussion of autonomous systems, it is first necessary to analyse the historical developments in the EU. This will facilitate a more detailed understanding of the expectations and requirements for autonomous vehicles, and the potential for their future impact.

2. Development of AI technology in the EU

In the 1900s, with the increase in production speed worldwide especially in the car industry, there has been a rise in manufacturing. However, with this expansion, the future of petrol cars has begun to be questioned due to their widespread use, pollution and carbon emissions. In this regard, States have begun to draw up environmental plans for the use of cars powered by energy other than petrol, in the name of a cleaner environment. This transition plan has taken into account the potential contributions of artificial intelligence systems in enhancing the experience of drivers and the environment. The development of relevant projects has been undertaken accordingly.

Key figures in the field had already pursued research initiatives and begun to conceptualise this significant step that would transform the future long before now. By the end of the 20th century, computers will emulate human intelligence in a way that makes it impossible to distinguish a machine from a human.[4] This vision has guided the sequence of developments that have been witnessed. From a historical perspective, the importance of examining these significant projects has been greatly emphasised by this historical statement.

Subsequently, the concept and planning of autonomous vehicles, which gained momentum especially after the 1950s, were put into practice.

The year 1987 may be considered a first milestone in the development of road vehicle guidance by machine vision.[5] The UBM test vehicle for autonomous mobility and computer vision VaMoRs demonstrated the capability of fully autonomous longitudinal and lateral vehicle guidance by computer vision on a free stretch of Autobahn over more than 20 km at speeds up to 96 km/h (limited only by engine power).[6]This project provided the initiative for the establishment of PROMETHEUS, which has had a major impact in Europe and has enhanced the work to a higher level. Additionally, the project has expanded beyond national boundaries, evolving into a comprehensive and technical initiative encompassing multiple countries.

One of Europe's important works is a project called PROMETHEUS. The concept of vision-based autonomous driving gained momentum with the EUREKA-PROGRAMME for a European Traffic of Highest Efficiency and Unprecedented Safety (PROMETHEUS) of the European Union (1987–1994).[7] On the one hand, research has been carried out and, on the other, test drives have been carried out to obtain data in the field. Given that the function of these autonomous systems is to solve problems by leveraging data obtained through learning in subsequent scenarios, the significance of traffic data is particularly important. In reaction, the UniBwM decided to demonstrate the capability of its VaMP in a fully autonomous long distance run from Neubiberg near Munich to Odense in Denmark. The car drove 95 % (1.678 km) of the trajectory autonomously in 1995.[8]

In 1997 an Italian group also did a long distance test drive ‘Mille Miglia in Automatico’ named after the famous race taking place every year in this country.[9] This study demonstrates that, alongside Germany – which is at the vanguard of this field – other European countries are also conducting studies to facilitate the deployment of autonomous vehicles on European roads. Despite the fact that these endeavours are being undertaken separately, the primary objective is becoming increasingly apparent: the presence on European roads of vehicles capable of autonomous driving within Europe. This leads us to address the role of European directives in achieving this common objective.

The role of driving support systems is of significant importance for the effective and correct operation of artificial intelligence systems. These support systems are imperative for the autonomous system to execute its driving functions, with the capacity to optimise driving by assessing road conditions, weather conditions, and traffic flow. Consequently, there has been a step-up in studies in Europe to verify that visual support systems are working correctly and that

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[4] CZECH, P., Artificial intelligence as a basic problem when implementing autonomous vehicle technology in everyday life, Scientific Journal of Silesian University of Technology. Series Transport. 2024, 122, 49-60.
[5] DICKMANNS, E.D., The development of machine vision for road vehicles in the last decade, *Intelligent Vehicle Symposium, 2002. IEEE*, vol.1, Versailles, France, 2002, 268-281.
[6] DICKMANNS, op.cit.
[7] KRÖGER, F. "Automated Driving in Its Social, Historical and Cultural Contexts." In *Autonomous Driving*, edited by Markus Maurer, J. Christian Gerdes, Barbara Lenz, and Hermann Winner, Springer, 2016, 144.
[8] KRÖGER, op. cit., 146.
[9] DICKMANNS, op. cit.

they can maintain their function over long distances. “In the following years, other projects continued to develop the visual approach: In the context of the ARGO-project, which followed after Prometheus, the University of Parma in Italy used 1998 a Lancia Thema to drive 2000 km in Italy only camera based. The success of all these projects accelerated the shift from automatic lanes to autonomous vehicles.”[10]

The European Union is taking important steps for the closer future by carrying out the necessary projects for the introduction of autonomous vehicles into traffic, while at the same time working on directives for autonomous vehicles. Currently, the European Union is supporting research on autonomous driving within its framework research support scheme, “Horizon 2020.”[11]

By the end of 2023, the SAE Level 4 autonomous driving test project, which is being conducted as part of Mercedes-Benz China's technology research programme[12], aims to develop the software and hardware of autonomous driving systems and to validate multi-sensor perception technologies and their integration under various conditions. To this end, two specially modified Mercedes-Benz S-Class test vehicles, equipped with LiDAR, radar and camera systems, are being used.

Consequently, in the future, it is expected that artificial intelligence systems will play an important role in our daily lives.

3. Autonomy and standards of activity

The term "automobile" is of Greek origin, deriving from “the Greek "autòs" (meaning "self, personal, or independent") and the Latin "mobilis" (meaning "mobile").”[13] The combination of these elements emphasises the notion of a self-moving machine. The following definition can be proposed: It is evident that from the very beginning, mankind's expectation of the automobile was the concept of a self-driving vehicle without human power.

Autonomy can be defined as “(self = Greek autos, see above) to stay within the bounds of simple laws' '(Greek nómos: "human order, laws made by people")' 'autonomy as "self-determination within a superordinate (moral) law".”[14] From this point of view, the concept of self-determination within the framework of certain legal norms can be illustrated by the fact that today's AI-based systems make their own optimal decisions by gaining experience through machine learning.

The machine learning system that is being used here has put on the spot the question of what kind of decision-making mechanism of artificial intelligence should be within a standard and how that standard should be determined. The establishment of a standard is necessary for the functioning of the Product Liability Directive, and it should be noted that without a certain

[10] KRÖGER, op. cit. 146.
[11] SCHREURS, M. A., Steuwer, S. D., "Autonomous Driving—Political, Legal, Social, and Sustainability Dimensions," in Markus Maurer et al. (eds.) *Autonomous Driving: Technical, Legal and Social Aspects*, Springer, 2016, p. 373.
[12] Mercedes-Benz Group AG. (2024, August 8). *Testing of Level 4 automated driving in Beijing*. https://group.mercedes-benz.com/technology/autonomous-driving/driving/level-4-beijing.html (Accessed 13 June 2026).
[13] MAURER, M, "Introduction," in Markus Maurer et al. (eds.) *Autonomous Driving: Technical, Legal and Social Aspects*, Springer, 2016, 25.
[14] MAURER, op. cit., 26.

technical usage standard which is firstly meeting the requirements of product safety and expected standards for determining the fault, it is not possible to talk about defective products.

For regulatory purposes, it is important to distinguish autonomy from automation: an automated system functions independently but follows pre-programmed instructions, while an autonomous system possesses its own decision- making capacity.[15]

The capabilities and reactions of the artificial intelligence of the autonomous vehicle in traffic and the human capabilities are more limited; whether the use of human or artificial intelligence should be taken as the standard for determining the standard in question has also been an important issue. While there is no inherent issue with traffic regulations, a significant distinction exists between the decision reflex in a technical sense and the ability to make a quick, accurate decision in a crisis. It is important that autonomous vehicles have multiple sensors and a more comprehensive knowledge of the event compared to a human driver with supporting systems such as LiDAR, radar sensors and cameras. "There are common misconceptions as to what constitutes a self-driving car as well."[16]In the contemporary era, a significant proportion of vehicles are equipped with driver-assistance features such as emergency braking and lane-detection systems. These functions are collectively referred to as driver-assistance features and bear a distinct relation to autonomous driving software or levels. This scenario serves to underscore the true essence of autonomous driving and underscores the paramount importance of technical expertise in the domain of driving experience.

The levels of driving automation for autonomous vehicles are determined by international standards set by the Society of Automotive (hereinafter referred to as SAE)[17]. These features are classified into 5 levels of autonomous vehicles. This will enable autonomous vehicles to be seen in traffic in stages. The categorisation of these levels is as follows:

Group I (non-autonomous vehicles for development purposes) consists of the SAE level 0 (non-automated) SAE level 1 (driver support system) and SAE level 2 (as partially automated vehicles with one or more driver support features).[18] Level 0 means that driving is the responsibility of the driver and no damage can be caused by a software error. Level 1 refers to the use of basic functions, such as a braking system, to assist the driver by allowing them to temporarily remove their foot from the pedal. Level 2, on the other hand, introduces functions that enable partial automation, allowing the driver to remove their hands from the steering wheel temporarily. "Avs usually incorporate an internal artificial intelligence ('Al') assistance technology, which is called the Advanced Driver Assistance Systems ('ADAS'). Thereby, ADAS may help to prevent accidents caused by errors and cognitive limitations of human drivers."[19]

The group II (autonomous vehicle for developing partially automated driving features) comprises SAE level 3 as conditional automatisation and level 4 as high-level automatisation (it

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[15] BUITEN, M., DE STREEL, A., PEITZ, M., The law and economics of AI liability. *Computer Law & Security Review,* 2023, 48, 105794.

[16] RZECZYCKA, H., KOVAC, M. Autonomous self-driving vehicles the advent of new legal era? *King's Student Law Review*, 2019, 10(1), 30-50.

[17] SAE International, *SAE Levels of Driving Automation™ Refined for Clarity and International Audience*.

[18] PUSZTAHELYI, R., Liability for Traffic Accidents Caused by Highly Automated and Autonomous Vehicles in Light of Hungarian Civil Law, in Pillet , G. (ed.) *Autonomous Vehicles and the Law.* Brill | Nijhoff, 2025, 242-288.

[19] YUQING, O., Driving into the Unknown: An Evaluation of Liability for Accidents Caused by Autonomous Vehicles under UK Law. *Manchester Review of Law, Crime and Ethics,* 2024, 12, 66-88.

does not require to driver to take over driving).[20] The concept of autonomy can be considered at level 3. Whereas the previous levels were systems that supported the driver's driving, this level allows the driver to temporarily take his eyes off the road. A notable feature of this function is that the driver, whose focus is not on the road, is alerting the warning system to drive again. Level 4, on the other hand, signifies a driver who does not need to pay attention to the road, and when certain conditions are met, fully autonomous driving takes place. This driving mode diverges from Level 3 in that it incorporates a system that waits for the right moment when the driver wants to take control.

And group III (autonomous vehicle for developing fully automated driving features) for SAE level 5 (full automatisation: feature can drive everywhere for all conditions).[21] In accordance with these standards, the potential issues that may arise when the driver assumes control of the steering wheel at levels 3 and above during the transition to and from autonomous mode have been a subject of debate. The potential issues that have been identified are as follows:

The probability of accidents resulting from drivers' lack of attention to the road when driving autonomously, and their inability to regain attention immediately in situations where they need to take control?

The central issue under consideration is whether the operator is issued with a warning instructing them to take control of the vehicle during periods of autonomous driving. If the driver is issued a warning to take control but does not comply, they will be held liable. However, while the marketing of autonomous vehicles often suggests that the driver can focus on other tasks or even sleep, it is unreasonable to expect the driver to monitor the road with full attention during autonomous driving. Furthermore, it is imperative to ascertain whether the issuance of a takeover warning was attributable to a system error.

In the context of driving at Levels 4 and above of automation, if the driver were to attempt to take control in an incident, would it be the driver's fault or the fault of the software?

The fundamental issue is to consider whether the probability of an error is reduced when the driver is in control as opposed to when the autonomous system is in control. Research has indicated that the error rate of autonomous systems is lower than that of human drivers. In this situation, it is necessary to evaluate whether the driver's decision to take over control when conditions permit autonomous driving falls under the scope of liability, and whether the system's inability to respond constitutes an error.

Furthermore, if the driver were to take control, by what standard would the system determine that the road is suitable for control?

In the event of an autonomous system assuming control, it is incumbent upon the system to ensure that the road conditions are suitable and that the necessary conditions for the takeover are met. Should these conditions not be met, the autonomous system that transfers control to the driver may be considered a system failure.

What are the problems caused by minor differences between the reaction of the system and the car when taking over control?

Should an error occur during the brief period when control is transferred during the journey, it can be assumed that the system is faulty. Despite the technical guidelines recommending an

[20] PUSZTAHELYI, op. cit.
[21] PUSZTAHELYI, op. cit.

approach in which control is transferred only after the vehicle has come to a stop, this approach may not be the most efficient.

Furthermore, as autonomous systems are progressively integrated into road traffic, how will drivers of conventional vehicles adapt to the movements of autonomous vehicles? "The "driver" of the autonomous vehicle is looking outside and makes incidental eye contact with the other road user. In that case the eye contact with non-autonomous road user can lead to an inaccurate understanding of the situation and thus cause a conflict."[22]

Will the differences in autonomous systems from different brands have an impact on autonomous driving?

It is evident that a variety of automobile marques are capable of providing a range of customised experiences. However, should these autonomous systems be customised by brand, challenges pertaining to liability and fault determination may ensue. Furthermore, there is a possibility that the interactions between systems from two different brands will vary. It is the contention of the present study that the autonomous driving system should be standardised for all users, whilst other user experience services should be customised.

"Google and Volvo have concluded that the safest route is to bypass levels 2 and 3 DAS altogether in favor of fully autonomous vehicles (levels 4 and 5) that by definition do not rely on DAS and instead eliminate any chance for human driving error. Other manufacturers are trying to reduce these errors by incorporating fault-tolerant planning into levels 2 and 3 DAS."[23] This approach by companies could help prevent drivers from causing accidents due to the "out-of-the-loop" problem. The section of the European Type Approval Directive pertaining to the transition to autonomous driving and the handover of control has proven to be problematic. The fact that the vehicle stops and transitions to autonomous driving at an appropriate location, which could have a negative impact on the driving experience, supports the companies' view. However, under typical operating conditions, assuming control during operation of the vehicle could potentially result in system errors. Consequently, utilising vehicles that are exclusively authorised for autonomous operation may be advantageous. Consequently, with regard to the licensing of drivers, it would be feasible to issue a licence for autonomous driving alone. It is further possible that lower standards for the autonomous driving licence may also be applicable.

This safety issue arose in an accident that occurred in May 2016 when Joshua Brown was killed while behind the wheel of a Tesla Model S electric sedan in self-driving mode (level 2)—the first known fatal accident involving a self-driving car.[24] This incident serves to underscore the pivotal role that drivers' behaviour and attentiveness play in ensuring safe driving conditions. It is imperative for drivers to acknowledge their responsibility and to place unwavering trust in the capabilities of autonomous driving systems. In order to address this issue, it may be more appropriate for drivers to use autonomous driving only in scenarios that are clearly defined. "Volvo Cars, Google and Daimler AG's Mercedes-Benz have all pledged to accept liability if their

[22] FÄRBER, B.,"Communication and Communication Problems Between Autonomous Vehicles and Human Drivers," in Markus Maurer et al. (eds.) *Autonomous Driving: Technical, Legal and Social Aspects*, Springer, 2016, 311.
[23] GEISTFELD, M. A., A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation. *California Law Review*, 2017, 105(6), 1611–1694.
[24] See VLASIC, B., BOUDETTE, N. E., *Self-Driving Tesla Was Involved in Fatal Crash, U.S. Says*, N.Y. TIMES (June 30, 2016) https://www.nytimes.com/2016/07/01/business/self-driving-tesla-fatal-crash-investigation.html (Accessed 13 June 2026).

vehicles cause an accident."[25] This has had the effect of incentivising users to purchase and use these autonomous vehicles, even in circumstances where such use is not strictly legal.

4. Software as a product

In accordance with the provisions of the recently enacted Product Liability Directive, a number of technological innovations have been incorporated into the existing product category. These include software, artificial intelligence (AI)-based products, autonomous systems, smart products, machine learning systems and cloud systems. Moreover, the manufacturer's control, product updates, and the significant expansion of economic operators – such as authorised representatives, service providers, platform services, digital services, and application operators – have created numerous options for consumers to seek redress. This initiative is driven by the recognition of consumers' vulnerability in identifying issues with complex and technically sophisticated products, a situation that is further exacerbated by the challenges faced by consumers in comprehending such information.

Moreover, the €500 limit, which has long been the subject of debate and deemed unnecessary, has been removed. While this may appear negligible on an individual basis, it is important to note that companies have previously exploited this limit to increase their profits, even when hundreds of consumers suffered losses due to the same error.

In general, there have been endeavours to align the legislation with contemporary standards. However, it should be noted that as the transposition period extends until December 2026, a thorough review will be required in order to clearly assess its effects.

In order to address the term decision making system, it is first necessary to determine the legal status of the software that is the source of this system. A fully autonomous and connected vehicle is a highly complex product that combines both hardware and software.[26] The recent directive 2024/2853 on product liability in the European Union has clarified this controversial issue by including software and artificial intelligence within the scope of products.

Article 4(1) of the directive in which a definition of the product is given: 'product' means all movables, even if integrated into, or inter-connected with, another movable or an immovable; it includes electricity, digital manufacturing files, raw materials and software;

Autonomous systems and supporting software are included in the scope of the product, and the software that is the source of autonomous vehicles is evaluated within the scope of the product. However, it is challenging to identify which of this software is defective, as many systems continue to function in an integrated manner. New generation vehicles are composed of five or more domains, together comprising hundreds of functional components in the car and in the cloud that cover.[27]

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[25] *Volvo Cars Responsible for the Actions of its Self-Driving Cars*, VOLVO CARS (Oct. 20, 2015), http://www.volvocars.com/intl/About/Our- Innovation-Brands/IntelliSafe/IntelliSafe-Autopilot/News/Volvo-Cars-responsible-for-the-actions-of- its-self-driving-cars ("Volvo Cars will accept full liability for the actions of its autonomous cars when in Autopilot mode, making it one of the first manufacturers to take this vital step forward in the development of self-driving cars.").

[26] LIIVAK, T. Liability of manufacturer of fully autonomous and connected vehicles under the product liability directive. *International Comparative Jurisprudence*, 2018, 4(2), 178-189.

[27] RUSTAD, op. cit., 183.

These systems are evaluated on the basis of their software and hardware components, with support provided by cloud-based infrastructure. While the identification of errors and the establishment of causality in cases, even under the previous directive and when products were simpler, proved challenging, the burden of proof has been somewhat alleviated—and a presumption deemed sufficient—given that the identification of such a complex structure would be even more difficult. "The very term "software" has developed in opposition to "hardware", i.e. corporeal artefacts. Software itself is non-corporeal, but a major part of its function is to operate hardware in space and time. As these products tend to be connected to each other and to cloud-based servers, they establish what has come to be called the "Internet of Things" (IoT)."[28]

The pivotal observation is that AI software does not constitute a singular programme; rather, it is an amalgamation of multiple programmes and third-party software. Consequently, a debate has emerged within the domain of legal doctrine concerning this matter, as the law does not specify who should be held liable and how in the event of an error occurring within the scope of the interactions between these software programmes. Should such an error be identified, it is highly probable that the software responsible for the error can be determined; in the event that this is not possible, all economic operators may be held liable. AI systems can fail if there are problems with its inputs, such as the data or the sensor hardware, if the processing logic is deficient in some way, or if the repertoire of actions available to the AI system is inadequate, resulting in an inappropriate output.[29]

Furthermore, as related services are also covered by the product's scope of indemnity, the data utilised by artificial intelligence spans a wide range, including applications such as navigation systems and standalone software used by doctors for diagnosis. In the legal proceedings under consideration, it is imperative that these concepts be defined, and that the product be classified and its risk level determined. "By extending product liability to related services, their providers will be incentivised to optimise their activities in delivering digital services that have functionality implications."[30] If the producer or any other party that is responsible for product safety and post-market surveillance in lieu of the producer under product safety legislation (such as the Market Surveillance Regulation) were the party that assumes strict liability for emerging technologies such as AI, this would ensure that safety and liability is treated in a parallel manner.[31]

For software defects, we can specify software defects that require service and can be fixed by an update. It is imperative that the system is capable of detecting the defective component and subsequently preventing the autonomous system from switching to it. These latent defects in software can be fixed by updates but must be discovered before passengers are injured or killed.[32] Regarding the update, we can consider what kind of responsibility we will talk about when a new update comes while driving and an accident occurs in a situation where the update cannot be done

[28] WAGNER, G., Software as a Product, in Lohsse, S., Schulze, R., Staudenmayer, D. (eds.) *Smart Products.* Münster Colloquia on EU Law and the Digital Economy VI, Nomos, 2022, 157.
[29] CHANDA, S. S., BANERJEE, D. N., Omission and commission errors underlying AI failures. *AI & Society*, 2022, 39, 937–960.
[30] LI, S., FAURE, M., The Revised Product Liability Directive: A Law and Economics Analysis. *Journal of European Tort Law*, 2024, 15(2), 140-171
[31] WENDEHORST, C., Strict Liability for AI and other Emerging Technologies. *Journal of European Tort Law*, 2020, 11(2), 150-180
[32] RUSTAD, op. cit. 197.

at that moment. According to UN Regulation No. 156[33], over-the-air (OTA) software updates during driving are permitted only if the manufacturer has demonstrated, through appropriate processes and procedures, that such updates will not adversely affect vehicle safety. Conversely, in instances where execution of an update cannot be conducted safely while the vehicle is in motion, the manufacturer is obligated to ensure that the vehicle cannot be driven during the update and that the driver is unable to access functionalities that could compromise either vehicle safety or the successful execution of the software update. The discussion will encompass the liability of the driver, particularly in instances where updates to the supporting systems, as opposed to the primary autonomous system, have not been implemented and consequently result in an accident. To this end, it would be appropriate to provide a warning that the update is either a mandatory update that affects autonomous driving or a minor update that improves driving on the road.

On the other hand, the correct performance of the update obligation is itself part of conformity.[34]There is thus a non-conformity if the trader does not supply an update although this is provided in the contract itself or is necessary for the objective conformity with the contract.[35] A fundamental question pertains to the role of user preference in determining the necessity of an update. In traditional usages, updates are typically user-preference-based. However, it is the contention of the present study that it is not appropriate for systems involving high-risk activities – such as autonomous vehicles – to leave the decision to the user. It is important to note that users who do not install the update should be unable to use the autonomous system's functions. However, it is also important to consider the classification of updates in this context. In the context of updates intended to enhance the driving experience, the conventional approach of empowering users to make personalised decisions may be deemed sufficient. However, the critical point to consider here is that in scenarios where an update is not performed, these integrated systems – which appear to be responding to a simple update request – could potentially malfunction. Consequently, it is considered more prudent for these systems to incorporate a mechanism for continuous remote monitoring and for updates to be authorised and tracked by official organisations.

The categorisation of updates as major or minor would then be instrumental in determining the level of driver responsibility. "An example of a minor modification would be a software update that does not change the level of automation of the vehicle, does not change the ODD, and does not significantly alter the safe operation of the AV. In contrast, when the ADSE desires to make a significant modification, it must self-certify to the in-service regulator by proving that the modification meets the safety standards declared during the first-supply process."[36]

When there is no software malfunction in fully autonomous driving, it will not be possible to talk about human liability. As long as algorithms implemented in the vehicles act as simple executors of human will, one should establish a normative attribution to the human being in

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[33] United Nations Economic Commission for Europe (UNECE), *UN Regulation No. 156 – Uniform Provisions Concerning the Approval of Vehicles with Regards to Software Update and Software Updates Management System*, Official Journal of the European Union, L 82, 2021.

[34] LOHSSE, S., SCHULZE, R., STAUDENMAYER, D., "Smart Products – A Focal Point for Legal Developments in the Digital Economy, in Lohsse, S., Schulze, R., Staudenmayer, D. (eds.) Smart Products: Münster Colloquia on EU Law and the Digital Economy VI, Nomos, 2022, 16.

[35] Ibid.

[36] EASTMAN, B. et al., Comparative Look at Various Countries' Legal Regimes Governing Automated Vehicles. *Journal of Law and Mobility*, 2023, 1-79.

question.[37]Furthermore, the Product Liability Directive (EU) 2024/2853 stipulates that producers are subject to a strict liability regime for damage caused by defective autonomous vehicles and their software. In order to address the evidentiary challenges posed by complex technologies, the Directive establishes rebuttable presumptions of defectiveness and causation under specified conditions, while preserving the producer's right to rebut those presumptions.

5. Decision making system

The software of autonomous vehicles is not only in the form of coding. It encompasses a more specific form of software in that it improves the quality of driving according to the experience gained from the data collected by the deep learning system during the journey about road conditions, driving technique and other conditions. Deep learning is a common type of machine learning that is used for computer vision and object classification.[38] It gives the technical systems based on it the opportunity to observe the environment, deal with what they observe, and solve tasks to achieve the intended goal.[39] With deep learning, the gathering of data in pilot phases has reached a certain point, and it is seen that this system will be more useful by gathering the movements of drivers and pedestrians in flowing traffic. Finally, an algorithm needs a "learning curve," during which the algorithm obtains increasing amounts of data, shares information with other vehicles, and runs alternative scenarios.[40] In this context, the term "learning curve" should be recognised as a description of the progressive improvement in the algorithm's performance through continuous training, data acquisition, and exposure to diverse operational scenarios. Autonomous cars rely on machine learning to continuously improve their performance across perception, prediction, and control tasks. Learning doesn't stop at initial deployment — fleets on the road are constantly gathering new data, which is then used to retrain or fine-tune models.[41]

In the context of a system that has only recently initiated data collection, a distinct challenge emerges concerning the reliability of the autonomous system's decision-making process and its adherence to a defined responsibility. When establishing the standard for the autonomous vehicle, it is necessary to determine whether the deep learning systems should be regarded as the initial version or the enhanced version with the data obtained subsequently. It is important to determine whether the decision-making mechanism is based on the maximum attention that a human would take, or on what an artificial intelligence can do. If motor vehicles are to be truly autonomous and able to operate responsibly on our roads, they will need to replicate—or do better than—the human decision-making process.[42]

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[37] SWIERCZYNSKI, M., ZARNOWIEC, L., Law applicable to liability for damages due to traffic accidents involving autonomous vehicles. *Masaryk University Journal of Law and Technology*, 2020, 14(2), 177-200.
[38] HANEY, B. S., The optimal agent: the future of autonomous vehicles & liability theory. *Albany Law Journal of Science & Technology*, 2020, 30(1), 1-35.
[39] CZECH, op. cit.
[40] COWGER, A. R. Jr., Liability considerations when autonomous vehicles choose the accident victim. *Journal of High Technology Law*, 2018, 19(1), 1-60.
[41] MASSOBRIO, A., *Self-Driving Car Machine Learning Fully Explained*, Neural Concept, February 5, 2026, https://www.neuralconcept.com/post/self-driving-car-machine-learning-fully-explained (Accessed 13 June 2026).
[42] LIN, P., Why Ethics Matters for Autonomous Cars, in Maurer, M. et al.(eds.) *Autonomous Driving: Technical, Legal and Social Aspects*, Springer, 2016, 167.

The fundamental issue under discussion here is the determination of error occurrence and the establishment of the criteria for such determination. In this study, the hypothesis is put forward that it would be more logical to use artificial intelligence as the benchmark and to examine their average performance. "Courts can compare a product's risks with comparable risks. In the case of AI-based products striving for human-like "intelligence", it seems plausible to compare their safety with the safety ensured by a human performing the same task as the product."[43]

The integration of artificial intelligence as a core component of autonomous vehicles, which are expected to coexist with conventional vehicles on the road, is likely to require conventional drivers to adapt their driving behaviour to mixed traffic environments. Working together, these systems allow the vehicle to change speed, direction, and route, and navigate the road environment with minimal input from their human occupants.[44] The significance of the safety benchmark is derived from the product liability directive, which defines the concept of a defect as a product that is above or below the standard set for determining whether a product is defective.

The Safety Assessment would cover the following areas: Data Recording and Sharing, Privacy, System Safety, Vehicle Cybersecurity, Human Machine Interface, Crashworthiness, Consumer Education and Training, Registration and Certification, Post-Crash Behavior, Federal, State and Local Laws, Ethical Considerations, Operational Design Domain, Object and Event Detection and Response, Fall Back (Minimal Risk Condition) and, Validation Methods.[45]

The notion of a defect proved problematic in the preceding directive, and it is this that primarily complicates the identification of defects. In the contemporary context, given the autonomous and efficient operation of artificial intelligence, enabled by machine learning, there is an ongoing debate within legal doctrine concerning the objective determination of such defects. Moreover, given the complexity and technical nature of the product, consumers face significant challenges in identifying defects. Consequently, a simplified method of identification has been proposed for consumers, representing an advancement from previous approaches. The doctrine employs three distinct approaches as auxiliary methods for establishing standards: technical standards, Infrahuman performance, and suprahuman performance. "Technical standards; As scholars have suggested, defectiveness should generally be defined by comparison with technical standards governing specific industry branches. Infrahuman performance; If the model does not, on average, perform as well as humans in a given task, this should trigger a rebuttable presumption of defectiveness. Suprahuman performance; in turn, should not be considered a carte blanche for economic operators to assume non-defectiveness. Rather, incentives for innovation and improvement need to be set in this domain as well. This cannot mean, however, that only the industry leader is considered free of defects and any competitors not quite meeting its performance rate are deemed defective."[46]

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[43] MAYRHOFER, A.-K., Product liability in the age of AI: Proposal for a "two track" solution. *Revista Electrónica de Direito*, 2024, 33(1), 105–127

[44] PEARL, T. H., The fourth amendment in the age of autonomous vehicles. *George Mason Law Review*, 2022, 30(1), 179-226.

[45] National Highway Traffic Safety Administration, *Federal automated vehicles policy: Accelerating the next revolution in roadway safety*. U.S. Department of Transportation, 2016. www.transportation.gov/sites/dot.gov/files/docs/DOT_AV_Policy.pdf (Accessed 13 June 2026).

[46] HACKER, P., The European AI liability directives: Critique of a half-hearted approach and lessons for the future. *Computer Law & Security Review*, 2023, 51, 105871.

In our opinion, the initial focus should be on an examination of industrial safety standards, with a subsequent assessment of the average performance of the same product in other applications. To illustrate this point, if the product in question generally operates at 60% efficiency, it could be assessed as having a 40% margin of error. Alternatively, a specific percentage could be designated as the efficiency benchmark, and any performance below this threshold could be considered a fault. In establishing these limits, it is imperative to consider deviations arising from user utilisation.

Moreover, the capacity to obtain information on the time of the accident is a significant innovation. The black-box system facilitates the analysis of accident-related data, thereby enabling more straightforward determination of causality within this very complex system. Most machine learning systems are a "black box" in which the decision-making process of the machine is usually impermeable to human understanding, although Al developers are devoting substantial resources to trying to make their systems more transparent.[47]

The pivotal element in this context pertains to the integration of the notion of 'damage', encompassing phenomena such as data loss or data corruption, in conjunction with the preceding directive. This development signifies a substantial advancement in the domain of product liability. The utilisation and accumulation of user and environmental data by numerous AI-based products is facilitated by digital services and cloud systems. Consequently, consumers have been granted the right to compensation for loss or damage to their personal data. This demonstrates that, whereas the previous directive only covered financial losses, the new directive introduces a new feature. This is an important move, as digital assets are recognised as private property deserving the same protection against harm – destruction or corruption – as the destruction of or damage to tangible items of property that were the exclusive focus of art 9 (b) PLD 1985.[48]

The technical and complex nature of new technologies poses a significant problem for individuals who, in the absence of this factor – a key element in tort law – face the risk of being unable to claim compensation for their losses. As previously stated, the process of establishing the existence of damage is relatively straightforward; it is sufficient for the user to have suffered concrete damage. However, the establishment of a causal link between the damage and the manufacturer – the most crucial aspect in such cases – presents a significant challenge for both the consumer and the judge. A significant shortcoming of the new directive is its failure to provide adequate guidance on the drafting of this section, with the result that consumers are not sufficiently informed.

6. The future of traffic roads with autonomous vehicles

In order for autonomous vehicles on the roads, European directives have regulated the system descriptions of autonomous vehicles as type approval requirements, thereby enabling autonomous vehicles on the roads. The definition and technical functions of autonomous vehicles within the European Union are primarily governed by Regulation (EU) 2019/2144, as supplemented by Commission Implementing Regulations (EU) 2022/1426 and (EU) 2026/481, which establish

[47] MARCHANT, G., BAZZI, R., Autonomous vehicles and liability: what will juries do?. *Boston University Journal of Science and Technology Law*, 2020, 26(1), 67-119.
[48] WAGNER, G., Next Generation EU Product Liability – For Digital and Other Products. *Journal of European Tort Law*, 2024, 15(2), pp. 172-224.

uniform procedures and technical specifications for the type approval of automated driving systems in fully automated vehicles. The important autonomous system terms defined in this directive, such as 'Automated Driving System' (ADS), 'Dynamic Driving Task' (DDT), 'Operational Design Domain' (ODD), have been prepared for possible accidents.

The Automated Driving System (ADS) is the core technical concept of autonomous driving, as it is the system responsible for performing the Dynamic Driving Task (DDT) within a defined Operational Design Domain (ODD). Accordingly, Regulation (EU) 2019/2144 and its implementing regulations define ADS as the central element of automated driving, while further specifying related concepts, including DDT and ODD, which determine the functional scope and operational limits of the system.

Article 8 of the Vienna Convention states that every moving vehicle (or combination of vehicles) shall have a driver. A further general condition is that every driver shall possess the necessary physical and mental ability and be in a fit physical and mental condition to drive.[49] In accordance with the aforementioned definition, it is evident that, despite the fact that the driver may ostensibly be regarded as a passenger within the paradigm of autonomous driving, their presence remains indispensable and their liability persists. This will facilitate the establishment of a more predictable approach regarding liability and insurance.

Statistics have shown that about 95% of road traffic accidents in EU are related to human errors.[50] This demonstrates that the integration of autonomous driving technology into everyday life is inevitable, and that autonomous vehicles must incorporate these features in order to prevent driver errors.

With the autonomous systems in levels, it will be more appropriate for them to drive in a certain order, as they will slowly appear on the roads. Given that the autonomous vehicles in question are equipped with a speed limit as part of their software, and that other vehicles do not have this feature, it would be incorrect for them to utilise the same lane as non-autonomous vehicles. Furthermore, it is conceivable that lower speed limits may be designated for autonomous vehicles on the roads. The 01 Series of Amendments to UN Regulation No. 157[51] constituted a significant development in the regulation of automated driving by extending the maximum permitted operating speed of ALKS from 60 km/h to 130 km/h. However, the Regulation continues to require the system to determine its maximum operational speed according to the prevailing environmental conditions and the capability of its sensing system. This ensures that operation remains risk-based rather than solely speed-based. Nevertheless, unlike strict product liability, this traffic liability regime is not harmonised at the EU level but respectively determined by domestic traffic liability laws.[52]

In order to perform these functions, autonomous vehicles will not always be able to use the road in fully autonomous mode, as road conditions and the location must be suitable. Furthermore,

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[49] JUHÁSZ, Á., PUSZTAHELYI, R., "Legal Questions on the Appearance of Self-driving Cars in the Road Traffic with Special Regard on the Civil Law Liability*European Integration Studies* 2016, p. 10, 19.

[50] European Parliament, *Road death statistics in the EU*, last updated: 20-10-2025, https://www.europarl.europa.eu/topics/en/article/20190410STO36615/road-death-statistics-in-the-eu-infographic (Accessed 13 June 2026).

[51] UNECE, *Addendum 156 – UN Regulation No. 157 Rev.1 – 01 Series of Amendments*.

[52] LI, S., FAURE, M., Motor liability insurance in a world with autonomous vehicles. In Jovanovic, S., Marano, P., (eds.) *Insurance and legal-economic environment – Wider and narrower framework: Proceedings, vol. 23* , Association for Insurance Law of Serbia (AIDA Serbia), 2022, pp. 108–119.

certain areas may be subject to restrictions, and there may be instances where autonomous functions will be inactive. The bottom line is that drivers are normally subject to fault-based rules (despite the presumption of fault of the driver in some jurisdiction).[53]

In addition, it is also important for manufacturers to ensure the safety of their systems when manufacturing autonomous vehicles. The manufacturer of autonomous motor vehicles, in turn, must ensure that the passenger, who was once the driver, cannot exert any influence on the system's operation.[54] With this issue, people who were previously drivers have become operators in fully autonomous driving. In some countries, the owner of the vehicle is subject to strict liability, even though the damage was actually caused by a technical failure related to the manufacturing or the (mis)behaviour of drivers.[55]

This demonstrates that it would be beneficial for countries with differing domestic legal systems to find common ground regarding traffic rules and technical regulations; otherwise, it appears that resolving legal conflicts will become more difficult. Moreover, the Product Liability Directive and the Road Traffic Act are subject to technically distinct dynamics. In light of the potential for product liability issues to emerge from the decision-making processes of autonomous systems, a pan-European level of protection could be attained by mandating compulsory insurance that incorporates a product liability insurance element.

Consequently, from a legal perspective, their responsibility as an operator will also be different. The risk of liability is placed upon the custodian of the defective object irrespective of whether he has committed any fault (for example, negligently performing the custody) and even if he was not aware or could not have been aware of the defect.[56] The driver, who becomes the operator, is now responsible for checking the autonomous vehicle's system for errors and problems.

7. Liable persons

The recent amendments to the Product Liability Directive have resulted in a notable expansion in the scope of liability. In this instance, the legislator has introduced a provision that facilitates the identification of the party responsible for damages caused by products that are increasingly complex in nature. The concept of strict liability, which enables direct recourse to the manufacturer, assumes particular significance in the context of compensation for damages. "As noted by H. Koziol, strict liability means liability for dangerousness. In Europe, the application of strict liability in case of damage caused by a motor vehicle is widespread."[57]

The integration of autonomous vehicles with machine learning systems and multiple software has led to a significant increase in the complexity of error detection and causality analysis. It may be very difficult, if not impossible, for the injured person to prove the existence of the defectiveness and causal link in complex situations, for example, when the damage is caused by

[53] PATTI, F. P. The European road to autonomous vehicles, *Fordham International Law Journal*, 2019, 43, 125.
[54] WAGNER, G., Liability Rules for the Digital Age – Aiming for the Brussels Effect. *Journal of European Tort Law*, 2022, 13(3), 191-243.
[55] SLIMMEN, M., VAN BOOM, W. H., Road traffic liability in the Netherlands, 2017. Available at SSRN: http://dx.doi.org/10.2139/ssrn.2975796 (Accessed 13 June 2026).
[56] DE BRUYNE, J., TANGHE, J., Liability for damage caused by autonomous vehicles: Belgian perspective. *Journal of European Tort Law*, 2017, 8(3), 324-371.
[57] KOZIOL, H., *Basic Questions of Tort Law from a Germanic Perspective*. Jan Sramek Verlag, 2012, p. 234.

pharmaceutical products, or products based on machine learning and artificial intelligence, or products with a digital component in general.[58]

The Directive has been interpreted as extending strict liability beyond the manufacturer of a defective product to other economic operators in specific circumstances. These include the manufacturer of a defective component, a person who substantially modifies a product outside the manufacturer's control, a distributor where the manufacturer or importer cannot be identified, and, under the conditions laid down by the Directive, a provider of an online platform.

In the instance that the product is manufactured outside of the European Union; (i) the importer of the defective product or component; (ii) the authorised representative of the manufacturer; and (iii) where there is no importer established within the Union or authorised representative, the fulfilment service provider.

As demonstrated here, the responsibility of economic operators within and outside the Union has been expanded, and users have been assured that they can use the products with confidence. The establishment of explicit regulations has also encouraged producers to make investments by defining their limits at the time of investment.

A pivotal issue in this context pertains to the identification and accountability of service providers who, due to the integration of internet platforms and artificial intelligence systems within the purview of liability, have effectively assumed the role of manufacturers. The question of how these service providers will be identified and held liable for damages when they occur is of paramount importance. This is due to the fact that it is almost impossible to reach these internet service providers, who are located outside of Europe, and secure compensation for damages. The question of how compensation will be provided to a producer who engages with customers online without the obligation to maintain an office or an authorised representative in Europe remains unresolved. This obligation is currently in place for other producers.

8. Liability insurance

Although it is predicted that the number of accidents will decrease significantly with the appearance of autonomous vehicles on the road, it is inevitable that accidents will occur. Furthermore, the scope of insurance should be expanded to encompass repairs due to system failures. In the European Union, motor vehicle liability insurance is compulsory, and this should be updated to encompass developments such as other directives, including those relating to autonomous systems. This system is financed and, to a certain extent, also organized by the motor vehicle liability insurers, whose involvement is mandatory in Europe.[59]

This insurance, which is obligatory within the European Union, facilitates the submission of claims for damages in the event of accidents occurring in the context of cross-border transportation, as stipulated by the Rome II regulation. Directive 2009/103/EC requires that each Member State take all appropriate measures to ensure that civil liability in respect of the use of

[58] MIRIC, M. K., Product liability reform in the EU. *EU and Comparative Law Issues and Challenges Series*, 2023, 7(1), 383-413.
[59] WAGNER, G., Liability for Artificial Intelligence: A Proposal of the European Parliament, *Working Paper No. 9 des Forschungsinstituts für Recht und digitale Transformation*, 2021.

vehicles normally based in its territory is covered by insurance, e.g. all motor vehicles in the EU must be covered by the Motor Third Party Liability insurance (hereinafter "MTPL insurance")..[60]

The importance of the black box in autonomous vehicles has increased in determining the fault of insurance companies in these accidents. The absence of a black box in such systems can result in a longer and more difficult investigation. The proposal for insurers to define premiums is through pay-as-you-drive systems and black boxes.[61]

Furthermore, it may be appropriate to change product liability insurance for autonomous vehicles to product liability insurance and integrate it with the Product Liability Directive by considering autonomous systems as products. The AVs may lead to new problems in the course of subrogation. Under the current insurance framework, owners are obliged to purchase mandatory liability insurance.[62]The aforementioned change would be in line with the proposed alteration of the concept of 'driver' in vehicle insurance to 'operator' with the introduction of fully autonomous driving, which could in turn contribute to a shift in the current framework of product liability insurance. This is necessary to show that a reasonable and adequate ultimate allocation of liability costs is indeed also of practical importance, as it determines whether insurance premiums could shift from motor insurance to product liability insurance.[63]

9. Conclusion

Since the Greek period, mankind's expectation and dream of a self-driving vehicle has been working towards what it is today since the 1900s. The commitment of nations to environmental sustainability, as evidenced by initiatives to mitigate carbon emissions and address the challenges posed by global warming, has led to the initiation of research into the development of autonomous vehicles.

The most significant source of autonomous vehicles is constituted by artificial intelligence-based systems, which have become a reality in every aspect of our lives and have begun to make people's lives easier. The prevailing legal directives against artificial intelligence systems have become inadequate to address current and future challenges. Consequently, there is an increasing need to define their legal status in order to limit the damage and investment caused by artificial intelligence systems. In 2020, the European Union initiated the issuance of directives, and by 2024, it had revised the product liability directive to align with contemporary requirements. This directive has classified artificial intelligence-based systems as products, thereby expanding the scope of liability for those responsible.

The vehicle has been designed to progress continuously, with the machine learning system integrated into autonomous vehicles with artificial intelligence-based systems. With the determination and international recognition of the levels of autonomous vehicles, it is more clearly

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[60] PRIMORAC, Ž., Normal function of a vehicle as a means of transport or a machine for carrying out work in motor third-party liability insurance with special regard to the latest rulings of the Court of Justice of the European Union. *EU and Comparative Law Issues and Challenges Series* (ECLIC), 2018, 2, 235–251.

[61] SEVER, T., CONTISSA, G., Automated driving regulations – where are we now? *Transportation Research Interdisciplinary Perspectives*, 2024, Volume 24, 101033.

[62] LI, FAURE, op. cit.

[63] PUTZ, F., MURPHY, F., MULLINS, M., MAIER, K., FRIEL, R., ROHLFS, T., Reasonable, adequate and efficient allocation of liability costs for automated vehicles: case study of the German liability and insurance framework. *European Journal of Risk Regulation (EJRR),* 2018, 9(3), 548-563.

defined how the vehicle will exhibit autonomous functions. The complexity of autonomous vehicles necessitated the definition of the key system functions of the vehicle, and these functions were defined in the guidelines for compensation and insurance in the event of an accident.

Regarding the standard that should be set in the decision-making mechanism of autonomous vehicles, the driver should control the journey as an operator and the journey should be realised. In the event of full authority being granted to the artificial intelligence within the decision-making mechanism, there will be significant benefits to be gained from driving on a specific road series in conjunction with conventional vehicles. In scenarios where drivers employ vehicles below level 3 before transitioning to autonomous driving, it would be more rational for passengers to utilise conventional roads. Conversely, when the drivers switch to autonomous driving, it would be more logical for passengers to switch to a special series to avoid disturbing the driving attention of the drivers.

The appearance of fully autonomous vehicles on the roads of Europe will be seen in the near future. This development will provide valuable insights into the practical management of accidents involving autonomous vehicles.