Automated driving safety data protocol - Ethical and legal considerations of continual monitoring

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Automated driving safety data protocol – Ethical and legal considerations of continual monitoring

Technical Report ITU-T FGAI4AD-02

Technical Report ITU-T
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Summary

This Technical Report addresses several ethical and legal considerations of continual monitoring. It introduces the Molly problem. The Molly problem raises the question of what information should be recorded of a scenario in which a young girl called Molly is crossing the road alone and is hit by an unoccupied self-driving vehicle in absence of eye-witnesses. In a survey, this question was posed to the public. The survey results are discussed in this Technical Report. In addition, ethical considerations concerning continual monitoring and automated driving safety are discussed, while legal considerations concerning liability are addressed from a US and EU perspective. An overview of relevant regulations and standards is provided.

Keywords

Automated driving, continual monitoring, data, data recording, ethics, safety legal framework, Molly problem.

Note

This is an informative ITU-T publication. Mandatory provisions, such as those found in ITU-T Recommendations, are outside the scope of this publication. This publication should only be referenced bibliographically in ITU-T Recommendations.

Change Log

This document contains the final version of the ITU-T Technical Report on *"Automated driving safety data protocol – Ethical and legal considerations of continual monitoring"* approved at the ITU-T Focus Group on 8th meeting held online, 01-02 December 2021.

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Nynke Vellinga (University of Groningen) served as the main editor of this Technical Report. Stefano Polidori (Advisor, ITU) and Mythili Menon (Project Officer, ITU) served as FG-AI4AD Secretariat.

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1 Scope

The scope of this Technical Report will cover ethical and legal considerations of continual monitoring. It will describe the public's justified expectations of performance of these systems and the impact of the public's justified expectations in the context of product liability.

2 References

A bibliography is included at the end of this report.

3 Definitions

3.1 Terms defined elsewhere

This Technical Report uses the following terms defined elsewhere:

None.

3.2 Terms defined in this Technical Report

This Technical Report defines the following terms:

None.

4 Abbreviations and acronyms

This Technical Report uses the following abbreviations and acronyms:

ABS	Antilock Braking System
ADAS	Advanced Driver Assistance Systems
ADS	Automated Driving System
AEB	Autonomous Emergency Braking
AI	Artificial Intelligence
Art.	Article
AV	Automated Vehicle
CAV	Connected and Automated Vehicle
DPIA	Data Protection Impact Assessment
DSSAD	Data Storage System for Automated Driving
EDR	Event Data Recorder
EU	European Union
ESP	Electronic Stability Program
GDPR	General Data Protection Regulation
ODD	Operational Design Domain

PLD	EU Product Liability Directive 85/374/EEC of 25 July 1985
SAE	Society of Automotive Engineers
UN	United Nations
UNECE	United Nations Economic Commission for Europe
WP.1	Global Forum for Road Traffic Safety (Working Party 1) of the United Nations Economic Commission for Europe Inland Transport Committee
WP.29	World Forum for Harmonization of Vehicle Regulations (Working Party 29) of the United Nations Economic Commission for Europe Inland Transport Committee

5 Conventions

None.

6 The Molly problem

The Molly problem: a young girl called Molly is crossing the road alone and is hit by an unoccupied self-driving vehicle. There are no eye-witnesses. What data on this incident does the public expect to be recorded?

With the help of a survey, we investigated people's views on automated vehicles (AVs) post-collision behaviour.[1] Based on Article 31 of the 1968 Convention on Road Traffic, we examined the following three behaviours of AVs in the event of an accident: (i) calling the police, (ii) stopping at the accident site, and (iii) recording the accident scene. We found that people care strongly about all three types of post-collision behaviours. Appropriate post-collision behaviour appears to have a moral value in and of itself. People therefore stated that AVs should have the capabilities for these behaviours, and they also think that AVs will have these capabilities. People expressed pronounced preferences for appropriate post-collision behaviour and even indicated a certain willingness to pay for the required technological devices. If people's ethical preferences are taken seriously, accidents involving AVs should always be detected and recorded, if possible. Otherwise, pre-accident behaviour would have to account for potential detection and recording loopholes

Although post-collision behaviour (i.e., what a human driver should do in case of an accident) is an essential aspect of road traffic, this issue is almost never contemplated regarding AVs. The interests of many vulnerable road users, such as pedestrians and cyclists, might be completely neglected if AVs' equipment is left entirely to the manufacturers' discretion. Specifically, it is unclear whether people expect AVs to behave as human drivers if this behaviour has no bearing on the accident's direct consequences. For instance, do certain behaviours—such as stopping at the accident site, calling the police, or helping determine responsibilities—have value in and of themselves? How important would appropriate AV capabilities be to the public? Would people be willing to pay for them? What if the necessary technology for accident registration delays the introduction of AVs altogether?

Following a bottom-up approach, we surveyed people's expectations regarding AVs' post-collision behaviour from various angles. We investigated whether appropriate post-collision behaviour enters the moral evaluation of a crash scenario, what people's normative and empirical expectations about AVs' post-collision behaviour are and whether people would be willing to pay for the required technology.

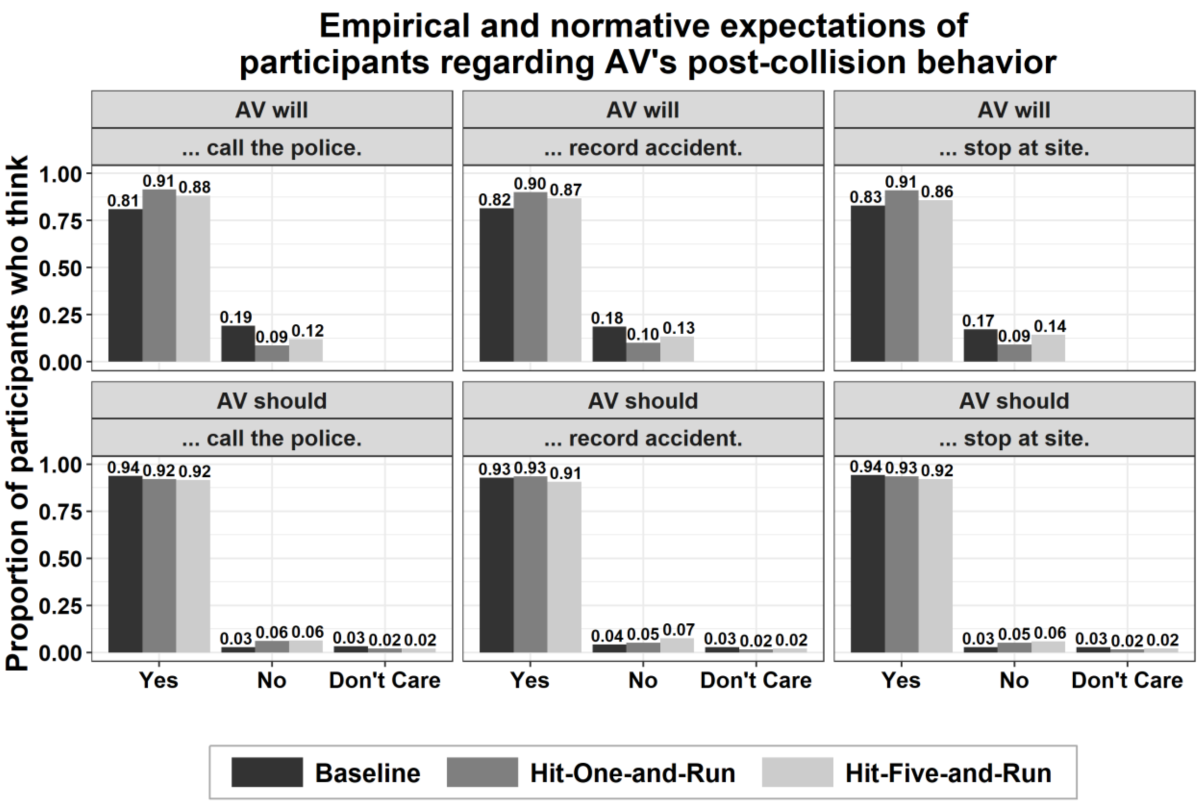
[1] Krügel, S., Uhl, M. & Balcombe, B. (2021), *Automated vehicles and the morality of post-collision behavior*, Ethics Inf Technol (2021). https://doi.org/10.1007/s10676-021-09607-w.

All in all, our study's results suggest that people care strongly about AVs' post-collision behaviour. Post-collision behaviour as defined in Article 31 of the 1968 Convention on Road Traffic appears to have moral value in and of itself. Accidents involving AVs without appropriate post-accident behaviour are significantly devalued morally compared to accidents involving AVs capable of such behaviour, even if this has no bearing on the accident victims themselves. Furthermore, people have strong empirical expectations that AVs will be capable of post-accident behaviour as suggested by the 1968 Convention on Road Traffic (see upper row in Table 1). The great majority of our surveyed people think that AVs will call the police, record the accident, and stop at the site. This is particularly noteworthy considering the current reality of a regulatory gap concerning AVs' post-collision behaviour. Apparently, our participants did not know that AVs currently do not fully have, and may not be required to have, these capabilities.

People's empirical beliefs that AVs will engage in certain post-collision behaviours (that are not actually provided) are backed by their normative preferences that decisively express the opinion that this should be the case (see lower row in Table 1). Our participants even expressed a substantial, though abstract, willingness to pay for the technological features that enable such post-collision behaviours. Nonetheless, it should be noted that their stated willingness to pay for this technology was significantly lower than their stated preference to use AVs with the corresponding capabilities. This gap between people's willingness to pay and their preferences for those devices might be an indication that the market alone would not lead to the socially desired outcome and that regulations might be needed to achieve the latter.

Our finding that people attach significant value to AVs' post-collision behaviour underlines the importance of detecting accidents as completely as possible. Otherwise, AVs would be required to reflect people's ethical preferences in their pre-collision decisions if people's preferences are taken seriously. Specifically, the AV's algorithm would then be expected to penalize manoeuvres with a higher risk of failing to detect an accident.

Table 1 – Empirical and normative expectations of participants regarding AV's post-collision behaviour



7 Opinions of ethics expert groups

7. Recommendations EC independent expert group on ethics of connected and automated vehicles

7.1.1 Introduction

The topic of ethics has never been far from discussions around the development and implementation of automated vehicles (AVs). The publication of Awad et al. (2018) paper, *The moral machine experiment*, attracted the attention of a global audience. Based on dilemmas and situations that echoed the so-called 'trolley problem' (Foot, 1967), their study explored participants' attitudes and expectations towards the behaviour of AVs in relation to potential collision partners.

However, the intuitive appeal of such dilemmas has potentially detracted from discussions around the technical challenges associated with the practical implementation of AVs and broader ethical questions associated with their development and deployment. As a counterpoint to trolley problems, the Autonomous Driving Alliance (ADA) and TU-Munich created the 'Molly problem'. This scenario is summarized as follows:

> *"A young girl called Molly is crossing the road alone and is hit by an unoccupied self-driving vehicle. There are no eye-witnesses. What should happen next?"*

The limited detail provided about how the incident occurred was deliberate and invites respondents to think carefully about the many different circumstances in which such an event might have taken place, and the associated ethical implications. In a survey format, a series of questions explored respondents' views on how the AV should behave in response to the incident and what information it should be capable of providing to investigators. This scenario is highly likely to occur as AVs become more prevalent. Indeed, the tragic death of Elaine Herzberg when struck by an Uber test vehicle under the control of a developmental automated driving system (ADS) [b-NTSB] has echoes of the scenario, reinforcing the importance of addressing the ethical issues evoked by the Molly problem.

Following a review of the potential socioeconomic impacts of automated vehicles [b-Zmud] and supporting broader work on the ethics of artificial intelligence, the European Commission initiated an expert group to deliver recommendations on the ethical implications of connected and automated vehicles (CAVs). Grounded in the fundamental ethical and legal principles laid down in EU Treaties and in the EU Charter of Fundamental Rights, the group produced twenty recommendations [b-Bonnefon] on the topics of road safety, privacy, fairness, explainability, and responsibility. In this paper, each of the twenty recommendations are listed and a commentary on their relevance to the Molly problem is provided.

7.1.2 Recommendation 1: Ensure that CAVs reduce physical harm to persons.

> To prove that CAVs achieve the anticipated road safety improvements, it will be vital to establish an objective baseline and coherent metrics of road safety that enable a fair assessment of CAVs' performance relative to non-CAVs. New methods for continuously monitoring CAV safety and for improving their safety performance where possible.

Implications of Recommendation 1 for the Molly problem:

A critical aspect of the Molly problem is the ability of a CAV to detect that an incident has occurred. When collisions involving CAVs occur (especially those involving humans), it is essential that these are identified and recorded to understand the relative safety performance of CAVs. This would be improved if standardized data about the how and why of the incident were recorded and improved further still if near collisions and crash relevant conflicts were also captured. Statistical analysis would depend on CAV developers / operators being willing to share such data, for which there may be some resistance due to commercial sensitivity.

An issue here is that comparisons with human driving performance are fraught with challenges. Reducing physical harm suggests that CAVs must perform at least a little better than an average driver, and it is unclear whether that will be societally acceptable, even if there is a reduction in injury and fatalities. Further, even if CAVs reduce overall harm, new categories of collision may emerge as a result of automated driving that society deems unacceptable. It seems that progress here must be based on reliable data on where, why, how and how often CAVs are having collisions, and data from collisions like those involving Molly will be vital.

7.1.3 Recommendation 2: Prevent unsafe use by inherently safe design.

In line with the idea of a human-centric artificial intelligence (AI), the user perspective should be put centre-stage in the design of CAVs. It is vital that the design of interfaces and user experiences in CAVs takes account of known patterns of use by CAV users, including deliberate or inadvertent misuse, as well as tendencies toward inattention, fatigue and cognitive over/under-load.

Implications of Recommendation 2 for the Molly problem:

Recommendation 2 has limited application to the Molly problem since the Molly scenario suggests that the CAV is unoccupied, so interfaces and user experiences for vehicle occupants are not relevant. If the Molly scenario were to occur with a sleeping (or otherwise inattentive) occupant of a CAV operating in automated mode, the process by which the occupant is alerted to the incident and the post-collision behaviour of the vehicle should be understood and clear to the user.

7.1.4 Recommendation 3: Define clear standards for responsible open road testing.

In line with the principles of non-maleficence, dignity and justice, the life of road users should not be put in danger in the process of experimenting with new technologies. New facilities and stepwise testing methods should be devised to promote innovation without putting road users' safety at risk.

Implications of Recommendation 3 for the Molly problem:

Recommendation 3 is relevant if the vehicle involved in the Molly collision were part of a CAV testing programme. This was the case for the Uber vehicle involved in the collision that killed Elaine Herzberg [b-NTSB], where the vehicle was driving as part of the automated driving system development. The safety driver in the Uber vehicle did not observe Ms. Herzberg until the collision was unavoidable. If the collision had been less severe, it is quite possible the safety driver would not have noticed, producing a Molly-like scenario. The implications of the recommendation are that organizations planning to operate CAVs on public roads need to ensure that their testing protocols reasonably take account of the performance and limitations of their automated driving systems and that of the humans involved in the safety case (whether within the vehicle or remote observers / operators). If a Molly-like collision were to occur, the responsible developer must be prepared to recognize that a collision had taken place and to take the actions necessary in follow-up (such as stopping the vehicle, ensuring the data is captured, authorities are notified, etc.). Indeed, the BSI PAS (publicly available specification) 1881:2020 describes how the processes for incident (and near miss) reporting should be included in the safety case for CAV testing.

7.4.5 Recommendation 4: Consider revision of traffic rules to promote safety of CAVs and investigate exceptions to non-compliance with existing rules by CAVs.

Traffic rules are a means to road safety, not an end in themselves. Accordingly, the introduction of CAVs requires a careful consideration of the circumstances under which: (a) traffic rules should be changed; (b) CAVs should be allowed to not comply with a traffic rule; or (c) CAVs should hand over control so that a human can make the decision to not comply with a traffic rule.

Implications of Recommendation 4 for the Molly problem:

Without a deeper understanding of why the collision with Molly took place, it is hard to determine whether there might be a requirement for traffic rules to be changed to enhance CAV safety. That understanding would need to be data driven, highlighting the requirement for the CAV developers to provide the contextual information that would allow potential changes to traffic rules for CAVs in the interests of safety to be considered. Note that the recommendation also mentions the possibility for CAVs to handover to humans in situations of uncertainty. There is therefore a question in the Molly problem as to whether the CAV, under conditions of uncertainty, could or should have stopped and handed control to a remote operator rather than take the risks that resulted in the Molly collision.

7.1.6 Recommendation 5: Redress inequalities in vulnerability among road users.

In line with the principle of justice, in order to address current and historic inequalities of road safety, CAVs may be required to behave differently around some categories of road users, e.g., pedestrians or cyclists, so as to grant them the same level of protection as other road users. CAVs should, among other things, adapt their behaviour around vulnerable road users instead of expecting these users to adapt to the (new) dangers of the road.

Implications of Recommendation 5 for the Molly problem:

This recommendation suggests that developers must take reasonable account of the vulnerability of pedestrians and cyclists in determining CAV driving behaviour in their presence. For example, it means that in passing between a parked car and a pedestrian (and assuming no other road users are present), a CAV should not aim to pass with an equal gap on either side but should offer more space to the pedestrian because of their greater vulnerability in the event of a collision. In response to the Molly problem, a CAV developer would need to demonstrate how they determined the driving behaviour of the CAV in the presence of pedestrians and, assuming it detected Molly as a human pedestrian, how was her vulnerability considered in relation to other aspects of the driving environment and why the CAV failed to avoid the collision.

7.1.7 Recommendation 6: Manage dilemmas by principles of risk distribution and shared ethical principles.

While it may be impossible to regulate the exact behaviour of CAVs in unavoidable crash situations, CAV behaviour may be considered ethical in these situations provided it emerges organically from a continuous statistical distribution of risk by the CAV in the pursuit of improved road safety and equality between categories of road users.

Implications of Recommendation 6 for the Molly problem:

This recommendation was intended to address 'trolley problems' or at least offer some guidance on how situations involving multiple risks might be safely and ethically managed. For Molly, the developer would need to show how the CAV was managing risk in the run up to the collision and identify if / when Molly was observed; if / when Molly was classified as a pedestrian; how was Molly's behaviour predicted (and how accurate were those predictions); why the CAV's behaviour resulted in a collision with Molly and what other risks and objects was the CAV tracking that might have influenced this behaviour. If the developer can offer robust evidence to show that the CAV had correctly perceived all relevant hazards, accurately predicted their behaviour and acted in a timely manner to distribute risk according to shared ethical principles, it may be possible for the developer to demonstrate that the Molly collision was essentially the best outcome that could be achieved in the circumstances. This should not prevent efforts being made to understand why the collision occurred and prevent similar incidents happening in future.

7.1.8 Recommendation 7: Safeguard informational privacy and informed consent.

CAV operations presuppose the collection and processing of great volumes and varied combinations of static and dynamic data relating to the vehicle, its users, and the surrounding environments. New policies, research, and industry practices are needed to safeguard the moral and legal right to informational privacy in the context of CAVs.

7.1.9 Recommendation 8: Enable user choice, seek informed consent options and develop related best practice industry standards.

There should be more nuanced and alternative approaches to consent-based user agreements for CAV services. The formulation of such alternative approaches should: (a) go beyond "take-it-or-leave-it" models of consent, to include agile and continuous consent options; (b) leverage competition and consumer protection law to enable consumer choice; and (c) develop industry standards that offer high protection without relying solely on consent.

7.1.10 Recommendation 9: Develop measures to foster protection of individuals at group level.

CAVs can collect data about multiple individuals at the same time. Policymakers, with assistance from researchers, should develop legal guidelines that protect individuals' rights at group levels (e.g., driver, pedestrian, passenger or other drivers' rights) and should outline strategies to resolve possible conflicts between data subjects that have claims over the same data (e.g., location data, computer vision data), or disputes between data subjects, data controllers and other parties (e.g., insurance companies).

Implications of Recommendation 7, 8 and 9 for the Molly problem:

To understand why the Molly collision occurred, it is essential that the CAV collects data relevant to the collision. This would include the CAV position, speed, control inputs, sensor outputs and so on. However, these recommendations recognize that the position regarding the aggregation and analysis of such data in the context of CAVs is not mature and that work is required to establish best practices, especially how to balance data collected in the interests of safety and law enforcement against the requirement to inform data subjects about the predefined purposes for which their data are collected. This may necessitate new forms of consent, enabling subjects to manage how their data is used and ways to manage the consequences if that consent is not given – especially challenging in the Molly problem where, as a child, this would need to be via Molly's legal guardian(s).

7.1.11 Recommendation 10: Develop transparency strategies to inform users and pedestrians about data collection and associated rights.

CAVs move through and/or near public and private spaces where non-consensual monitoring and the collection of traffic-related data and its later use for research, development or other measures can occur. Consequently, meaningful transparency strategies are needed to inform road users and pedestrians of data collection in a CAV operating area that may, directly or indirectly, pose risks to their privacy.

Implications of Recommendation 10 for the Molly problem:

Data collected by CAVs operating in the vicinity of pedestrians unable to give their consent has similar issues to those raised by images collected by CCTV and dashcams. It seems that investigation of the causes of the Molly collision would be lawful basis for processing personal data from the CAV involved. The UK Information Commissioner's Office (ICO) offers the following guidelines for organizations managing data related to children:

- Comply with all the requirements of the UK general data protection regulation (GDPR), not just those specifically relating to children.
- Design data processing with children in mind from the outset, and use a data protection by design and by default approach.
- Make sure that processing is fair and complies with the data protection principles.
- As a matter of good practice, use data protection impact assessments (DPIAs) to help assess and mitigate the risks to children.
- If processing is likely to result in a high risk to the rights and freedom of children then always do a DPIA.

- As a matter of good practice, take children's views into account when designing processing.

(ICO, 2021)

Even though Molly may not have been identified by the CAV as a child (as opposed to a small adult), once that distinction is clarified, it seems that policies should apply that help to manage data associated with the Molly collision appropriately.

7.1.12 Recommendation 11: Prevent discriminatory differential service provision.

CAVs should be designed and operated in ways that neither discriminate against individuals or groups of users, nor create or reinforce large-scale social inequalities among users. They should also be designed in a way that takes proactive measures for promoting inclusivity.

Implications of Recommendation 11 for the Molly problem:

The key element of recommendation 11 is that a CAV should not discriminate. Molly is a child and therefore presumably somewhat smaller than a typical adult pedestrian. She is commensurately harder for the CAV sensors to detect than a larger adult human. However, she should be at no additional risk of being struck by the CAV than any other human. In fact, under recommendation 5, it may be the case that, due to the greater unpredictability of their behaviour, a CAV may act more cautiously in the presence of a child than it would for adults but the case for a CAV developer to do this would need to be evidence-led.

7.1.13 Recommendation 12: Audit CAV algorithms.

Investments in developing algorithmic auditing tools and resources specifically adapted to and targeting the detection of unwanted consequences of algorithmic system designs and operations of CAVs are recommended. This will include development of CAV specific means and methods of field experiments, tests and evaluations, the results of which should be used for formulating longer-term best practices and standards for CAV design, operation and use, and for directly counteracting any existing or emerging ethically and/or legally unwanted applications.

Implications of Recommendation 12 for the Molly problem:

The contribution of the CAV's algorithms in causing the Molly collision would need to be understood. This may involve auditing of those algorithms using the tools suggested in recommendation 12 to test the behaviour of the CAV in the Molly situation and variants of it. This may confirm whether the CAV behaved as expected in the Molly collision or whether other unexpected issues affected the CAV's performance. If the algorithms are found to be deficient, the auditing tools may be helpful in understanding why, how such deficiencies may be resolved and testing to ensure the updates to the algorithms do not produce unwanted side effects in other situations.

7.1.14 Recommendation 13: Identify and protect CAV relevant high-value datasets as public and open infrastructural resources.

Particularly useful and valuable data for CAV design, operation and use, such as geographical data, orthographic data, satellite data, weather data, and data on crash or near-crash situations should be identified and kept free and open, insofar as they can be likened to infrastructural resources that support free innovation, competition and fair market conditions in CAV related sectors.

Implications of Recommendation 13 for the Molly problem:

It is presumed that the CAV owner / operator would comply with any data sharing practices regulated under recommendation 13. However, the tension between utilitarian CAV data use in the interests of safety and achieving acceptable privacy has been recognized e.g., [b-Fagnant]. The aviation model is often referenced when discussing the possibilities for sharing CAV data to advance safety whereby aircraft manufacturers and operators share de-identified, non-attributable data from incidents to promote safety improvements that benefit both the industry and passengers. It would certainly seem that allowing other developers to learn from collisions like the one involving Molly would be beneficial for the industry.

7.1.15 Recommendation 14: Reduce opacity in algorithmic decisions.

User-centred methods and interfaces for the explainability of AI-based forms of CAV decision-making should be developed. The methods and vocabulary used to explain the functioning of CAV technology should be transparent and cognitively accessible, the capabilities and purposes of CAV systems should be openly communicated, and the outcomes should be traceable.

Implications of Recommendation 14 for the Molly problem:

The actions of the CAV that resulted in the collision with Molly need to be understood in order to determine why it happened. To achieve that, it would be necessary to interrogate data recorded by the automated driving systems to understand what it perceived, what it understood about its status (location, sensor / actuator functionality, operational design domain (ODD), presence of other road users, predicted behaviour of other road users, etc.). Whilst representations of these data may be held in abstract digital forms when being processed by the vehicle in real-time, it should be possible for that information to be (re-)assembled into an interpretable format to determine why the collision occurred, where responsibility for the collision rests and if / how systems need to be improved to avoid such incidents in future.

7.1.16 Recommendation 15: Promote data, algorithmics, AI literacy and public participation.

Individuals and the general public need to be adequately informed and equipped with the necessary tools to exercise their rights, such as the right to privacy, and to actively and independently scrutinize, question, refrain from using, or negotiate CAV modes of use and services.

Implications of Recommendation 15 for the Molly problem:

With the implication that Molly is a 'young girl', the requirement to give adequate information to public road users is particularly topical. Molly is a road user with no lesser right to safety and privacy than any other individual. In this setting, the onus may be on CAV developers / operators to inform the public about any specific safety issues associated with CAV operation, highlighting that parents / guardians must appropriately cascade this information to their dependents. This could be combined with educational programmes aimed at schools to highlight any specific issues associated with CAV operation. At the same time, it is important to recognize that CAV developers cannot assume that all road users have received such education and understand exactly how CAVs behave. The responsibility remains with CAV developers to ensure that their vehicles behave appropriately in the presence of other road users, recognizing all the unpredictability associated with that.

7.1.17 Recommendation 16: Identify the obligations of different agents involved in CAVs.

Given the large and complex network of human individuals and organizations involved in their creation, deployment and use, it may sometimes become unclear who is responsible for ensuring that CAVs and their users comply with ethical and legal norms and standards. To address this problem every person and organization should know who is required to do what and how. This can be done by creating a shared map of different actors' obligations towards the ethical design, deployment and use of CAVs.

Implications of Recommendation 16 for the Molly problem:

This recommendation recognizes that an organization or individual responsible for a CAV should be able to trace the relevant norms and standards that apply and where responsibility for compliance against them sits. Note that this mapping is not about assigning blame but making sure that responsibilities are assigned appropriately. For example, it might be possible to trace the reasons for the Molly collision to the actions of an individual coder but overall responsibility for safe operation of CAVs must sit at a higher level and encompass all of the processes that led to approval of the vehicle for use in the public environment.

7.1.18 Recommendation 17: Promote a culture of responsibility with respect to the obligations associated with CAVs.

Knowing your obligations does not amount to being able and willing to discharge them. Similar to what happened, for instance, in aviation in relation to the creation of a culture of safety or in the medical profession in relation to the creation of a culture of care, a new culture of responsibility should be fostered in relation to the design and use of CAVs.

Implications of Recommendation 17 for the Molly problem:

Recommendation 17 recognizes that in fast moving and innovation-led businesses, there can be powerful incentives for individuals or groups not to disclose safety issues that may have been identified. This might be associated with needing to meet particular delivery deadlines for a manager or customer, to hit specific targets associated with fundraising or something as simple as not wanting to disappoint one's boss even when any such actions might be contrary to official company policy. The recommendation seeks to promote working environments where safety issues are treated with the appropriate respect and where an individual reporting concerns suffers no negative consequences for reporting justified concerns even if this causes deadlines or targets to be missed. The intention is to ensure that, if an employee of the CAV developer or operator of the vehicle involved in the Molly collision could have prevented the incident by reporting a specific safety issue that they had identified, then they would feel entirely comfortable in doing so and that their opinion was valued, respected and welcomed in the pursuit of safety, regardless of any wider implications for their employer.

7.1.19 Recommendation 18: Ensure accountability for the behaviour of CAVs (duty to explain).

"Accountability" is here defined as a specific form of responsibility arising from the obligation to explain something that has happened and one's role in that happening. A fair system of accountability requires that: (a) formal and informal fora and mechanisms of accountability are created with respect to CAVs; (b) different actors are sufficiently aware of and able to discharge their duty to justify the operation of the system to the relevant fora; (c) and the system of which CAVs are a part is not too complex, opaque, or unpredictable.

Implications of Recommendation 18 for the Molly problem:

This builds on recommendation 14, reinforcing, not only their need to have clarity over how CAV algorithms operate to enable traceability of outcomes but that mechanisms are in place that allow individuals and organizations involved in the operation of the CAV to determine where accountability sits. For the Molly collision, this means that the CAV developer, when alerted to the occurrence of the incident, should readily be able to enact a process that enables the factors surrounding the incident to be explained and accountability (and not blame) to be appropriately allocated. For example, if the Molly collision were determined to be caused by a faulty sensor, the CAV manufacturer needs to be able to determine if it was the specific behaviour of the sensor or their use of it; if it was the behaviour of the sensor, they need share information with the sensor supplier, who needs to the determine whether the issue relates to a manufacturing process, software issue, lower tier supplier, etc. The organization responsible for operation of the CAV must also know (and enact) the process by which they report the behaviour of the CAV to the relevant authorities.

7.1.20 Recommendation 19: Promote a fair system for the attribution of moral and legal culpability for the behaviour of CAVs.

The development of fair criteria for culpability attribution is key to reasonable moral and social practices of blame and punishment, e.g., social pressure or public shaming on the agents responsible for avoidable collisions involving CAVs, as well as fair and effective mechanisms of attribution of legal liability for crashes involving CAVs. In line with the principles of fairness and responsibility, we should prevent both impunity for avoidable harm and scapegoating.

Implications of Recommendation 19 for the Molly problem:

This recommendation highlights that it would not be ethical to hold, for example, an individual software engineer employed by the CAV developer as being responsible for the Molly collision, even if it were possible to identify that it was their specific code that resulted in the collision (unless their actions were malicious). Instead, it should be for organizations to recognize how their culture and processes allowed the fault to reach the production level.

A topical example of this has been the two crashes of the Boeing 737 MAX 8 aircraft resulting in 346 deaths and all such aircraft being grounded for an extended period while its safety was under review. Boeing paid $2.5bn to settle criminal charges after the U.S. Department of Justice charged the company with conspiracy to defraud the Federal Aviation Administration's (FAA) Aircraft Evaluation Group in connection with the evaluation of the aircraft (Department of Justice, 2021). The House Committee on Transportation & Infrastructure (2020) report into the crashes highlighted five central themes that contributed to the failings of the aircraft:

- **Production pressures** – cutting costs and attempting to maintain the program schedule in the face of competition from other manufacturers;
- **Faulty design and performance assumptions** – failing to understand the characteristics of the manoeuvring characteristics augmentation system (MCAS) and pilots' responses to it;
- **Culture of concealment** – information withheld from the FAA in relation to key control systems, including MCAS;
- **Conflicted representation** – Boeing employees with permission to represent the interests of the FAA failed to disclose important safety information that contributed to the crashes;
- **Boeing's influence over the FAA's oversight structure** – examples where Boeing influenced FAA management to overrule findings of FAA technical experts.

The report concludes that the design and development of the aircraft was:

> *"marred by technical design failures, lack of transparency with both regulators and customers, and efforts to downplay or disregard concerns about the operation of the aircraft."*

The House Committee on Transportation & Infrastructure (2020)

By contrast, in reaching the settlement with the U.S. Department of Justice, Boeing released a statement noting that the agreement was:

> *"…based on the conduct of two former Boeing employees and their intentional failure to inform the FAA Aircraft Evaluation Group Event…about changes to MCAS." As a result of their conduct, the FAA AEG "was not fully informed about MCAS's expanded operating range" which impacted the way the FAA set out pilot training requirements for airlines using the MAX."*

Boeing (2021)

In concentrating on the actions of two former employees, it is notable that the statement does not capture any of the wider issues noted by the House Committee on Transportation & Infrastructure in the many processes by which the aircraft was approved for use. Whilst Boeing will undoubtedly be exploring all avenues to improve safety and restore confidence in its aircraft, the focus on two former employees in this way could be misinterpreted as an indication that removing the employees resolves all the issues that resulted in the two fatal crashes. This example provides salutary lessons for CAV developers and operators in ensuring that they develop a culture that promotes openness and proactive responsibility for safety, with responsibility for safe operation of vehicles allocated appropriately across the organization.

7.1.21 Recommendation 20: Create fair and effective mechanisms for granting compensation to victims of crashes or other accidents involving CAVs.

Clear and fair legal rules for assigning liability in the event that something goes wrong with CAVs should be created. This could include the creation of new insurance systems. These rules should balance the need for corrective justice, i.e., giving fair compensation to victims, with the desire to encourage innovation. They should also ensure a fair distribution of the costs of compensation. These systems of legal liability may sometimes work in the absence of culpability attributions, e.g., through "no fault" liability schemes.

Implications of Recommendation 20 for the Molly problem:

In the UK, the Government has passed legislation that simplifies the route to compensation for those injured in collision involving CAVs. The Automated & Electric Vehicles Act (2018) gives a route to compensation through an insurance process rather than having to make a product liability claim against the CAV manufacturer. This applies to third parties injured by the CAV and any occupants of the CAV, when not involved in driving the vehicle. While this legislation does not help to determine who is ultimately responsible for injury in the event of a Molly collision (which may be subject to a further investigation and trial), it does provide reassurance to the public that fair compensation can be claimed for any injury proven to be caused by the automated actions of a CAV.

7.1.22 Conclusion

The [b-Bonnefon] recommendations on the ethics of CAVs, published by the European Commission offer a powerful lens through which to explore the Molly problem and issues upstream and downstream of the collision. They emphasize how, in order to be considered ethical, CAV developers and operators will need to prepare carefully for potential Molly collisions, fully understanding their responsibilities in deploying technologies that have the potential to threaten life. Similarly, the Molly problem offers a useful test of the [b-Bonnefon] recommendations and, whilst the authors recognize that they do not cover all the ethical issues associated with CAVs, the applicability of the recommendations to the Molly problem suggests that they cover important ethical aspects of the scenario.

Perhaps the most significant outcome of this analysis is to reinforce that CAV developers and operators must be prepared to justify the actions of their vehicles clearly and comprehensively when under automated control. In the event of a collision, a transparent process to determine objectively why the incident occurred and to attribute accountability fairly across relevant parties should be enacted. Where appropriate, data on the behaviour of the vehicle should be shared to help investigators understand the incident and a sign of maturity in the industry would be for CAV developers / operators to share relevant de-identified data through an appropriate body to help the industry learn from such occurrences. As such, the application of the ethical recommendations in interesting and relevant CAV thought experiments such as the Molly problem may help to prevent future Molly collisions and safely accelerate access to the anticipated benefits of CAVs.

7.2 The opinion of the Data Ethics Commission

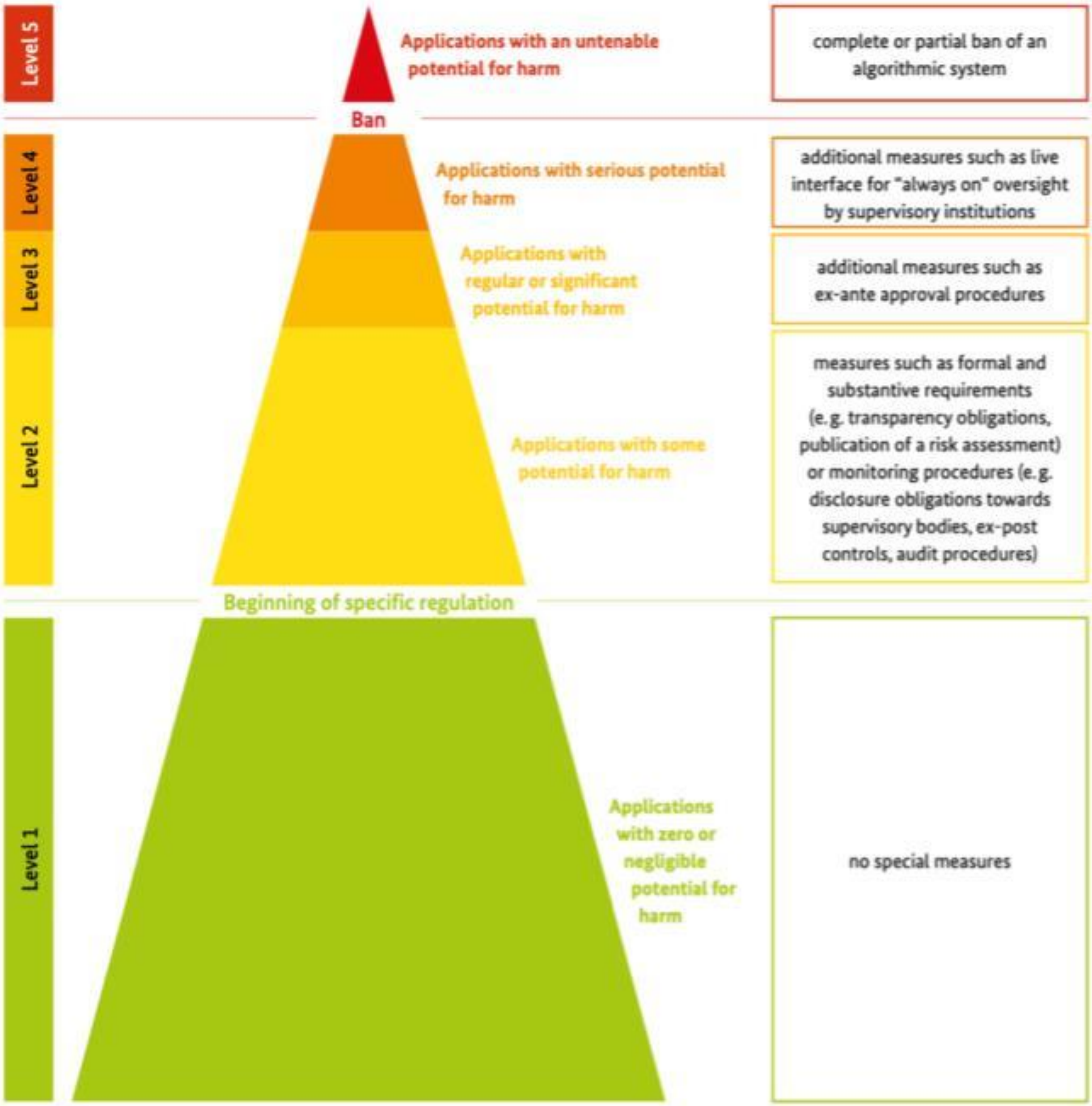
7.2.1 Background

The Data Ethics Commission (DEK)[2] recommends consistently determining the degree of criticality of algorithmic systems using an overarching model. The degree of criticality should guide legislators

[2] Data Ethics Commission (2019), *Opinion of the Data Ethics Commission*, Berlin, Data Ethics Commission of the Federal Government.

and society when seeking suitable regulatory thresholds and instruments, but can also provide developers and operators with guidance for assessing their products and systems themselves and finally also be used in basic, advanced and further training to educate and increase awareness amongst various stakeholders.

To that extent, with regard to the potential of algorithmic systems to cause harm, the Data Ethics Commission differentiates, both for private and for state operators, between five levels of criticality, as shown in Figure 1:[3]



Source: Data Ethics Commission (2019), *Opinion of the Data Ethics Commission*, Berlin, Data Ethics Commission of the Federal Government, p. 177.

Figure 1 – Data Ethics Commission criticality pyramid (2019).

3 https://www.bmjv.de/DE/Themen/FokusThemen/Datenethikkommission/Datenethikkommission_EN_node.html

Germany's Federal Government Data Ethics Commission (DEK) defines an algorithmic system's "criticality" as the "potential for harm" based upon the "likelihood that harm will occur" and "the severity of that harm".

7.2.2 Severity of harm

The severity of harm that could potentially result, for example from a faulty decision, depends among other things on:

1. The significance of the legally protected rights and interests affected in particular, for example;
   - The right to determine the use of one's personal data
   - Freedom of expression
   - The fundamental right to life and physical integrity
   - as well as to equal treatment)
2. The extent of the potential harm resulting from an infringement

Furthermore, the assessment of the severity of the potential harm must take into account:

1. The specific sensitivity of the data used
   - Not healthcare data
2. The level of potential harm for individuals or groups (including non-material harm or loss of utility that are hard to calculate in monetary terms)
3. The number of individuals affected
4. The total figure for the potential damage and
5. The harm to society as a whole, which may go well beyond a straightforward summation of the harm suffered by individuals

The consequences of using an algorithmic system should, based on its area of application, be considered in terms of its;

- ecological,
- social,
- psychological,
- cultural,
- economic
- and legal dimensions.

7.2.3 Likelihood that harm will occur

The likelihood that harm will occur is also influenced by the following system properties, and factors:

1. The role of algorithmic calculations in the decision-making process (from the mere inspiration of humans without any claim to accuracy up to algorithm-determined decisions, see section 1;
2. The complexity of the decision to be made (from a simple deterministic depiction of reality or a probabilistic appraisal of reality up to the multifactorial and non-determinate prediction of a future reality);
3. The effects of the decision (from a purely abstractly conceivable context of action or a specific context of action up to direct implementation); and
4. The reversibility of the effects (from full reversibility up to irreversibility).

7.2.4 Likelihood that harm will occur in the context of automated driving algorithms

1 Role

- Society of Automotive Engineers (SAE) Level 3/4/5 involves algorithmic-determined decisions
- For advanced driver assistance systems (ADAS) features it may fall below this level but above "mere inspiration".• Amber warning wing mirrors are "advisory".
- Antilock braking system (ABS) and electronic stability program (ESP) are reactionary responses to a human decision error.
- Autonomous emergency braking (AEB) is an intervention due to the lack of human decision making.

2 Complexity

- SAE Level 4/5 for instance "open road" would involve a multifactorial and non-determinate prediction of a future reality.
- SAE Level 4 for instance the "highly constrained Heathrow Pod ODD" would be more "deterministic" as this transport system is restricted to longitudinal movement only.
- SAE Level 4 for instance an "open footpath" would involve a multifactorial and non-determinate prediction of a future reality however the dynamics are much lower.

3 Effects

- SAE Level 4 would be a direct implementation of action through the control of the vehicle
- An ADAS system that provides enhanced situational awareness to the human driver, such as a head up display, or audible/visual indicators and alarms

4 Reversibility

- effects from automated driving algorithms are irreversible as they result in physical actions in time and space.

7.2.5 Discussion

Should the DEK "Levels of Critically" supersede SAE "Levels of Driving Automation" when considering "how safe is safe enough?" What "potential for harm" level do you feel automated vehicles pose?

Germany's Federal Government Data Ethics Commission (DEK) defines an algorithmic system's "criticality" as the "potential for harm" based upon the "likelihood that harm will occur" and "the severity of that harm". For example; Level 1 (zero/negligible) being a Netflix recommendation engine and Level 5 (untenable) being an autonomous weapon system. Where would you place automated driving algorithms?

For road mobility the current measures of "severity" are 1.35 million global road fatalities per year and 50 million serious injuries per year and where "driving" related traffic injuries are now the leading cause of death for children and young adults between 5-29 years old (higher than malaria, tuberculosis and HIV). This is the background context in which automated "driving" algorithms are being developed and deployed. An environment where harm not only applies to vehicle occupants but to the millions of vulnerable road users that surround them. So the question is, should automated "driving" algorithms sit at DEK Level 4 of criticality; "applications with serious potential for harm"?

8 Legal framework

The Molly Problem provides insights on the public's expectations regarding the data that are recorded in the case of an incident. In this clause, expectations concerning the behaviour of the automated vehicle in a legal context are explored.

8.1 Interpretation art. 34bis 1968 Convention on road traffic

Working Party 1 (WP.1) has accepted the Amendment Proposal to the 1968 Convention on road traffic submitted by Belgium, Finland, France, Luxembourg, Portugal, Russian Federation, Sweden and Switzerland during WP.1's eighty-first session (21-25 September 2020). This proposal will, together with its Explanatory Memorandum, be communicated by the Secretary-General to all Contracting Parties to the Convention. The Contracting Parties can, within a period of twelve months, notify the Secretary-General if they "(a) accept the amendment; or (b) reject the amendment; or (c) wish that a conference be convened to consider the amendment." If less than one-third of the Contracting Parties objects to the amendment proposal, the amendment will enter into force six months after the expiry of the period of twelve months.

The accepted proposal contains the insertion of two new definitions in article 1. These definitions read:

> "(ab) "Automated driving system" refers to a vehicle system that uses both hardware and software to exercise dynamic control of a vehicle on a sustained basis.
>
> (ac) "Dynamic control" refers to carrying out all the real-time operational and tactical functions required to move the vehicle. This includes controlling the vehicle's lateral and longitudinal motion, monitoring the road, responding to events in the road traffic, and planning and signalling for manoeuvres."

The accepted proposal also includes a new art. 34bis, which relates to automated driving systems and the requirement of art. 8 (1) of the Convention that every moving vehicle shall have a driver:

> "The requirement that every moving vehicle or combination of vehicles shall have a driver is deemed to be satisfied while the vehicle is using an automated driving system which complies with:
>
> (a) domestic technical regulations, and any applicable international legal instrument, concerning wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles, and
>
> (b) domestic legislation governing operation.
>
> The effect of this article is limited to the territory of the contracting party where the relevant domestic technical regulations and legislation governing operation apply."

As will be argued in this document, this new art. 34bis could lead to undesirable outcomes and influences the expectations one might have concerning automated vehicles.

Article 34bis states that the requirement of art. 8(1) is "deemed to be satisfied" when an automated driving system is being used. This can be interpreted in two ways:

1. The automated driving system should be considered to be the driver of the vehicle; or
2. The requirement of art. 8(1) is satisfied, but the automated driving system is not the driver of the vehicle.

Option 1 appears to be an incorrect interpretation of the phrase "deemed to be satisfied" as this contradicts the definition of "driver" given in art. 1 (v): "Driver" means any person who drives a motor vehicle or other vehicle (including a bicycle),…". Other wording would be more suitable for interpretation-option 1.

Therefore, option 2 seems to be the correct interpretation of art. 34bis.

Given art. 34bis, all traffic rules from the 1968 Convention directed at a driver (such as art. 11 on overtaking) would not apply to automated driving systems, as a vehicle with engaged automated driving system does not have a driver. Art. 34bis will thereby leave legislation governing the operation of vehicles with an automated driving system to the domestic legislator, as is explicitly stated in art. 34bis under b. Effectively, this limits the vehicle's ODD. As the parties state in the Explanatory Memorandum to the accepted proposal, art. 34bis ensures "that no party is obliged to accept, or to take action to prevent, the use of automated driving systems in its territory merely because another party allows them."

This risks the creation of a patchwork of legislation throughout the countries that are party to the Convention, as art. 34bis gives them free range to set their own rules on the deployment vehicles equipped with an automated driving system. This contradicts not only the consistent approach which parties have aimed for as mentioned in the Explanatory Memorandum of the accepted proposal, but it also contradicts the objectives of the Convention. These objectives concern the desire to facilitate international road traffic and to increase road safety through the adoption of uniform traffic rules. This is undermined by art. 34bis, which could lead to less uniformity as it opens the door for each country that is party to the Convention to draft their own legislation on automated driving systems. As a consequence, this could hinder cross-border traffic by having different legal frameworks on the use of automated driving systems.

The harmonization of rules governing automated driving systems is, with the introduction of art. 34bis, removed from the scope of the 1968 Convention on Road Traffic. On an international level, what is left is the harmonization through technical requirements, such as through the work of Working Party 29 (WP. 29).

This accepted proposal has implications for the expectations of automated vehicles. Whereas, in the current state of the Convention, traffic rules shape what one can expect from the behaviour of an automated vehicle, under the new art. 34bis the domestic legislation will influence those expectations. Consequently, the behavioural expectations of a vehicle with engaged automated driving system driving in Country A can differ from the behavioural expectations of a vehicle with engaged automated driving system driving in Country B. Thus, the behavioural expectations derived from traffic regulations are no longer set on an international level, but on a national level. On an international level, after the coming into force of art. 34bis, behavioural expectations can only be set through technical regulations. These developments in WP.1 thereby influence the work done within FG-AI4AD for TR02: "Automated driving safety data protocol – Public safety benefits of continual monitoring".

Another consequence of the accepted proposal is that countries that are in a position where they have less leverage or less negotiating power, can become less resistant to pressure from commercial parties, such as vehicle manufacturers, to draft legislation that is beneficial to these commercial parties. This, however, is not necessarily beneficial from a road safety perspective.

8.2 The US legal framework and justified expectations

8.2.1 Introduction

If an unoccupied, fully autonomous vehicle operating on a road in the United States were to hit a pedestrian, as described in the Molly Problem, the manufacturer of the vehicle can expect a lawsuit to be filed against it seeking to hold it civilly liable.[4] While there are no reported decisions addressing this specific situation, and product liability law varies from state to state, the following is an overview of how a product liability lawsuit brought against the manufacturer of the fully autonomous vehicle, on behalf of Molly, the injured bystander, could be expected to proceed, based on the general product

[4] We do not address potential theories of criminal liability that might be asserted against the manufacturer of the fully autonomous vehicle. Although the facts differ from those in the Molly Problem, it is notable that Rafaela Vasquez, the test vehicle operator who was behind the wheel of the self-driving vehicle that was being tested by Uber in Arizona and struck and killed pedestrian Elaine Herzberg in 2018, has been criminally charged with negligent homicide, a Class 4 felony, for which she could spend 4-8 years in prison if she is convicted. No criminal charges have been brought against Uber in connection with Herzberg's death.

liability concepts that are incorporated in the laws of most states, and some of the issues that might arise during the course of the litigation.

8.2.2 The state of U.S. autonomous vehicle law

The United States does not have a federal law governing autonomous vehicles. While there have been attempts to pass federal legislation to regulate autonomous vehicles, none of those legislative efforts have been successful.[5] The debate continues as to whether autonomous vehicles should be regulated at the federal level and whether any federal autonomous vehicles law should preempt state autonomous vehicles laws. At present, the United States has a patchwork of different, and often inconsistent, state laws that govern the testing and operation of highly automated vehicles on public roads and the obligations and responsibilities of the companies who manufacture and test these vehicles.[6]

The National Highway Traffic Safety Administration (NHTSA)[7] has issued voluntary, non-binding guidance relating to autonomous vehicle technologies. In one of those publications, *Automated Driving Systems 2.0: A Vision for Safety*, issued in 2017, NHTSA expressed its view that determining liability for accidents involving autonomous vehicles is the responsibility of the states, rather than NHTSA's responsibility. See *Automated Driving Systems 2.0: A Vision for Safety* at 20, 24 (suggesting best practices for states including beginning to "consider how to allocate liability among [vehicle] owners, operators, passengers, manufacturers, and other entities when a crash occurs" and "rules and laws allocating tort liability[8]").

8.2.3 The civil lawsuit: Molly v. Manufacturer

Following the incident, unless Molly's legal representative[9] (the "plaintiff") reaches an out-of-court financial settlement with the manufacturer, plaintiff will almost certainly file a product liability lawsuit against the manufacturer of the autonomous vehicle, seeking an award of monetary damages.[10] The United States does not have a uniform federal product liability law. Product liability law is determined at the state level, and is primarily judge-made common law. It varies across states,

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5 See, e.g., Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act (SELF DRIVE Act), https://docs.house.gov/meetings/IF/IF00/20170727/106347/BILLS-115-HR3388-L000566-Amdt-9.pdf; American Vision for Safer Transportation Through Advancement of Revolutionary Technologies (AV START Act), https://www.commerce.senate.gov/services/files/1fb8fa36-331b-4f0b-907a-6dededda4d31 .

6 See National Conference of State Legislatures, *Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation*, https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx#table

7 NHTSA is part of the U.S. Department of Transportation, a federal administrative agency. NHTSA's functions include setting motor vehicle safety standards, identifying safety defects and managing recalls, and facilitating the testing and deployment of highly automated vehicles.

8 *Automated Driving Systems 2.0: A Vision for Safety*, https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf

9 Since Molly is a minor, the lawsuit would be filed by her parents or legal representative or by her estate in the event that she did not survive being hit by the vehicle.

10 If the vehicle was owned or operated by a rideshare company or as part of a government or corporate fleet, that entity would likely also be named as a defendant and could assert claims against the vehicle manufacturer.

with each state adopting its choice of definitions, tests, and requirements for imposing liability for harm caused by defective products.[11]

8.2.4 The parties to the lawsuit

In the product liability lawsuit, plaintiff will be able to sue all the companies in the autonomous vehicle supply chain, the theory being that one or more of those companies may have supplied a component part that was defective and caused her injuries.[12] At the time plaintiff files the lawsuit, he may not know the identity of the suppliers who provided the potentially defective parts that went into the autonomous vehicle. Once the discovery phase of the litigation begins, plaintiff will be entitled to serve interrogatories and requests for production of documents on the manufacturer to obtain information from the manufacturer about the companies in the supply chain. Plaintiff may then seek to add those companies as defendants in the lawsuit. If plaintiff chooses not to name some or all of the companies in the supply chain as defendants in the lawsuit against the vehicle manufacturer, the manufacturer can file a motion to bring those companies into the case and, once they are added to the case, assert claims against them.[13]

8.2.5 Strict liability cause of action

One of the legal theories the plaintiff can rely on to state a claim against the manufacturer of the allegedly defective vehicle is strict liability, also known as liability without fault. With strict liability, "a defendant is liable when the plaintiff proves that the product is defective, regardless of the

[11] Courts have generally held that computer software is not a product and, therefore, is not subject to product liability law and strict liability. This is a hotly debated issue, with numerous legal scholars disagreeing with this analysis. See Zollers, F.E., McMullin, A., Hurd, S.N. and Shears, P. (2004), *No More Soft Landings for Software: Liability for Defects in an Industry That Has Come of Age*, 21 Santa Clara High Tech. L.J. 745 (2004), https://digitalcommons.law.scu.edu/cgi/viewcontent.cgi?article=1390&context=chtlj; Kim, S. (2018), *Crashed Software: Assessing Product Liability for Software Defects in Automated Vehicles*, 16 Duke Law & Technology Review 300-317, https://scholarship.law.duke.edu/dltr/vol16/iss1/9; Reutiman, J.L. (2012), *Defective Information: Should Information Be a Product Subject to Products Liability Claims*, Cornell Journal of Law and Public Policy: Vol. 22: Iss. 1, Article 5, http://scholarship.law.cornell.edu/cjlpp/vol22/iss1/5. While an individual who claims to have been injured as a result of a defect in the software that operates a fully autonomous vehicle will not be able to bring a strict products liability cause of action against the software manufacturer, he will be able to bring a strict liability cause of action against the manufacturer of the autonomous vehicle that utilized the allegedly defective software.

[12] Molly is entitled to sue multiple members of the supply chain based on multiple legal theories but she can recover only once for the injuries she incurred as a result of this incident.

[13] If the manufacturer is found liable for Molly's injuries, the indemnification provisions in its contracts with the companies in the supply chain that provided component parts for the autonomous vehicle may enable it to obtain reimbursement from those companies if their products were defective or contributed to Molly's injuries.

defendant's intent. It is irrelevant whether the manufacturer or supplier exercised great care; if there is a defect in the product that causes harm, he or she will be liable for it.[14]"

Many states have modelled their strict products liability laws on Section 402A of the Second Restatement of Torts.[15] While some states have modified the Restatement test and there are some variations in how it is applied, generally, the elements of a cause of action for strict products liability, which plaintiff must prove by a preponderance of the evidence[16] in order to prevail at trial are that:

- The defendant sold the product at issue;
- The defendant is in the business of selling this kind of product;
- The product was defective and unreasonably dangerous at the time it left the defendant's hands;
- The product is expected to reach, and reached, the user or consumer without substantial change in the condition in which it was sold; and
- The defective product was the proximate cause of the plaintiff's injuries.[17]

8.2.5.1 Defective and unreasonably dangerous

To establish the third element of the strict liability cause of action, plaintiff will try to prove that the fully autonomous vehicle that hit Molly had a design defect or a manufacturing defect.[18]

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[14] Cornell Law School, Legal Information Institute, https://www.law.cornell.edu/wex/products_liability. See also *Adams v. Buffalo Forge Co.*, 443 A.2d 932 (Me. 1992) ("Strict liability has been adopted, either by judicial development of the common law, or by legislation, as a result of policy considerations that manufacturers, sellers and suppliers have a duty not to place defective, unreasonably dangerous products into the stream of commerce and that those who do so should be held responsible for injuries which thereafter occur as a result.").[15] Restatements of the Law, such as the Restatement of Torts, are treatises that articulate the principles or rules for a specific area of law. They are secondary sources of law written and published by the American Law Institute (ALI), a nongovernmental organization made up of judges, legal scholars, and attorneys, to clarify the law by restating existing case law and statutes from different jurisdictions. Restatements are not law, but are sources of persuasive authority, as is the case with Section 402A of the Restatement (Second) of Torts, which is frequently cited by courts and has been influential in the development of state product liability law. See Cornell Law School, Legal Information Institute, https://www.law.cornell.edu/wex/restatement_of_the_law .

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[16] Proving an element of a cause of action by a "preponderance of the evidence" means proving that something is more likely than not. Under this evidentiary standard, a litigant satisfies his burden of proof when he convinces the fact finder, which is the jury in a jury trial or the judge in a bench trial, that there is a greater than 50% chance that his claim is true.

[17] Restatement (Second) of Torts § 402A (1965) (stating this rule and explaining that it applies even though the seller of the product "has exercised all possible care in the preparation and sale of his product, and the user or consumer has not bought the product from or entered into any contractual relation with the seller").

[18] Under product liability law, a third way to establish the "unreasonably dangerous" element is to prove that the defendant failed to provide adequate warnings to the consumer or user of the autonomous vehicle. This legal theory might be applicable in case involving an allegedly defective SAE Level 3 vehicle, but is likely not applicable to the Molly Problem, where a bystander, who the manufacturer would not have been expected to warn, is hit by an unoccupied fully autonomous (SAE Level 5) vehicle.

Design defects

To prevail on a design defect claim, the plaintiff must prove that the autonomous vehicle, performing as specified, created unreasonable risks. Different states apply different standards to determine if a product has a design defect. The most frequently used tests are the "risk-utility" test and the "consumer expectation" test.[19]

Risk-utility test: The risk-utility test weighs the risks in the product against the ability of the manufacturer to reduce the risks. If the risks of the product outweigh its benefits to consumers, the product will be found to be unreasonably dangerous. Generally, plaintiff will be required to prove that at the time the product was sold, a reasonable alternative design was available that would have reduced the risk of the product without proportionally reducing its usefulness. Under this test, a manufacturer is not liable for a design defect if the evidence proves the utility of the product outweighs the risk of harm inherent in it. [20]

Consumer expectation test: The consumer expectations test determines whether a product is defective by looking at whether the design of the product makes it dangerous in a way that an ordinary consumer would not expect. This test focuses on whether a reasonable consumer would find the product to be defective when he used it in a reasonable manner. Under this test, a manufacturer will not be liable if a reasonable consumer would not find the product to be defective when he used it in a reasonable manner, even if the plaintiff was injured as a result of the design flaw in the product.[21]

Manufacturing defects

A manufacturing defect exists when a product fails to meet the manufacturer's specifications for it, which results in the product being unreasonably dangerous. Generally, to prove that a product is unreasonably dangerous due to a manufacturing defect, the plaintiff must show that the product was dangerous in a way that a reasonable consumer would not expect it to be. A manufacturer will not be able to avoid liability for injuries from the allegedly defective product by introducing evidence that its quality control department tested and inspected the product, because fault is not relevant in a strict liability cause of action.[22]

8.2.6 Negligence cause of action

Another legal theory that plaintiff can use to state a claim against the manufacturer of the allegedly defective autonomous vehicle that hit Molly is negligence. "Negligence is a fault-based theory: in order to recover for negligence, a plaintiff must prove that a defendant owed a "duty" to the plaintiff a minimum standard of conduct recognized by the law as well as the defendant's "breach" of that duty. The plaintiff must then show that the breach of duty actually and proximately caused his or her

[19] Most states use the risk-utility test for strict liability design defect claims. See *Branham v. Ford Motor Co.*, 390 S.C. 203, n. 11 (S.C. 2010) ("By our count 35 of the 46 states that recognize strict products liability utilize some form of risk-utility analysis in their approach to determine whether a product is defectively designed."); *Cavanaugh v. Stryker Corp.*, 2020 WL 5937405 (Fla. 4th DCA Oct. 7, 2020) (affirming defence verdict in favour of medical device manufacturer in case where jury instructions used the risk-utility test rather than the consumer expectations test); 50 State Survey of Design Defect Requirements (as of 3/13/19), https://protesolutio.com/2019/03/13/50-state-survey-of-design-defect-requirements/ .

[20] Charles H. Moellenberg, Jr. (editor), Product Law Worldview, Product Liability Law in the United States ("Jones Day") at 2, https://www.jonesday.com/files/Publication/9cff4d38-4120-4128-a23b-20f343945201/Presentation/PublicationAttachment/c18dbcae-8cfa-4bb4-b977-212a2a249356/Product%20Law%20Worldview.pdf; Cornell Law School, Legal Information Institute, https://www.law.cornell.edu/wex/products_liability .

[21] Jones Day at 2; Cornell Law School, Legal Information Institute, https://www.law.cornell.edu/wex/products_liability.

[22] Jones Day at 2.

injury."[23] Under a negligence theory, the plaintiff must show that defendant's conduct failed to meet the standard of care that a reasonable person would expect. Plaintiff can argue that the defendant was negligent in the design of the product, in the way it manufactured the product, or because it failed to give appropriate warnings or instructions.

To prevail on a negligence theory, the plaintiff must prove, by a preponderance of the evidence, that:

- The defendant owed a duty of care to provide a reasonably safe product or to warn of dangerous defects;
- The defendant breached that duty of care by failing to meet the required standard of conduct; and
- The defendant's conduct was the actual and proximate cause of the plaintiff's injury.

8.2.7 Establishing causation

Causation is a critical factor in product liability case. In order to prove causation under a strict liability or negligence theory of product liability, plaintiff must prove that the defective autonomous vehicle was the actual and proximate cause of Molly's injuries.

Actual Causation: To prove actual causation, plaintiff must show that defective product was the "but for" cause of the harm, meaning that but for the defective autonomous vehicle, Molly would not have been injured.

Proximate causation: The plaintiff can establish proximate causation by proving that there is a reasonably close nexus between the defective autonomous vehicle and Molly's injuries, such that the defective product was a sufficiently direct cause of the harm. If the defective product is too remote from the harm, meaning that the causal chain between the defective autonomous vehicle and Molly's injuries is too long, the defective product may not be considered the proximate cause of Molly's injuries, even if it was the "but for" cause of those injuries. If an intervening or superseding cause that was not reasonably foreseeable to the manufacturer breaks the causal chain between the defective product and the harm, plaintiff will not be able to prove causation element required to state a claim for relief.[24]

Manufacturer's potential defence strategies

The manufacturer of the autonomous vehicle can be expected to defend itself against plaintiff's product liability claims by asserting defences and introducing evidence to show that plaintiff has not, and cannot, establish the elements of the causes of action.

8.2.8.1 Strict liability

In response to a strict liability cause of action, the manufacturer may introduce evidence to show that the plaintiff cannot prove that the vehicle was defective, which is one of the required elements of the cause of action. The manufacturer may argue that:

- The autonomous vehicle was not defectively designed or manufactured.
- The autonomous vehicle was not defective at the time it left the manufacturer's hands, and was subsequently materially altered by the individual or company that purchased it and caused it to be on the road at the time it hit Molly.
- The autonomous vehicle was not defective at the time it left the manufacturer's hands, and was subsequently misused by the individual or company that purchased it and caused it to be on the road at the time it hit Molly.

[23] Jones Day at 3.

[24] Jones Day at 3.

- Even if the autonomous vehicle was defective, the defect was not the proximate cause of Molly's injuries.

Similarly, the manufacturer may take the position that the plaintiff cannot establish the required element of causation because intervening or superseding events broke the causal chain and, therefore, any alleged defect in the autonomous vehicle was not the proximate cause of Molly's injuries. The manufacturer may argue that:

- The individual or company that purchased the autonomous vehicle and caused it to be on the road at the time it hit Molly failed to properly maintain the vehicle, interfered with the proper operation of the sensors or other components in the vehicle or materially altered the vehicle by adding aftermarket parts or other devices, and these actions by the third party caused the autonomous vehicle to hit Molly and injure her.
- The crash and Molly's injuries were caused by the state or local government's failure to properly maintain the roadway where the crash occurred and, therefore, any alleged defect in the vehicle was not the proximate cause of Molly's injuries.[25]

8.2.8.2 Negligence

In response to a negligence cause of action, the manufacturer may introduce evidence to show that the plaintiff cannot prove that the manufacturer breached its duty of care, which is a required element of the cause of action. The manufacturer may argue that:

- The manufacturer satisfied its duty of care and the vehicle was reasonably safe. To demonstrate this, it may offer testimony from engineers who were involved in designing and manufacturing the vehicle as well as members of its quality control team who reviewed the design and manufacturing processes and inspected the vehicle before it was sold. The manufacturer may seek to introduce quality control records and other documents it maintains that support the testimony of these witnesses.
- The manufacturer may also call expert witnesses to explain to the jury how the autonomous vehicle was designed and operates and why the manufacturer's actions were reasonable and sufficient to ensure that the vehicle was reasonably safe when it left the manufacturer's control.

As with the strict liability cause of action, the manufacturer will defend itself against the negligence cause of action by attempting to show that plaintiff cannot prove the element of causation because Molly's injuries were caused by something else or someone else that broke the causal chain between the allegedly defective autonomous vehicle and the harm to Molly.

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[25] Government entities were named as defendants in two lawsuits filed in 2019 by the estates of individuals who died in automated vehicle technology-related crashes. While the facts in these cases differ from the facts in the Molly Problem, as they did not involve unoccupied fully autonomous vehicles, the legal theories asserted against the government entities are instructive.

In *Huang v. Tesla Inc., the State of California, et al.*, No. 19CV346663, Cal. Super. Ct., Santa Clara Cty, plaintiffs allege that the State of California is liable for negligently creating a dangerous condition on the highway where Walter Huang's Tesla Model X, which was in "autopilot mode," struck a median, and that the dangerous and defective condition created by the State was a substantial factor in Huang's death.

Similarly, in *Wood v. State of Arizona and City of Tempe*, No. CV 2019-090948, Ariz. Super. Ct., Maricopa Cty, representatives of the estate of Elaine Herzberg contend that the State of Arizona and City of Tempe had a duty to keep their roadways reasonably safe for travel, and negligently failed to properly oversee vehicles that were testing autonomous vehicle technology on Arizona roads, like the Uber that struck Herzberg. They also allege that the harm suffered by Herzberg was a direct result of the City of Tempe's negligent design of the median located near the spot where the accident took place, which made the median unreasonably dangerous.

In negligence cases, defendants often attempt to reduce or eliminate their potential liability by arguing that the plaintiff was contributorily negligent, meaning that the negligent conduct of the plaintiff contributed to the harm suffered by the plaintiff. In the context of the Molly Problem, the argument would be that Molly was negligent, possibly because she was crossing the street against a red light at the time she was hit by the autonomous vehicle, or was improperly standing in the crosswalk, or ran towards the autonomous vehicle while it was moving and her conduct was a contributing cause of her injuries.

This argument is problematic in the case of an unoccupied autonomous vehicle (as opposed to in a typical negligence case). Plaintiff's response is likely to be that the fact that the vehicle was not able to anticipate these kinds of foreseeable situations and that the manufacturer did not design the vehicle to be able address them without hitting Molly proves that the vehicle was unsafe and that the manufacturer breached its duty of care to ensure that the vehicle was safe at the time it sold it.

8.2.8.3 Cybersecurity

Under certain circumstances, the manufacturer may argue that Molly's injuries were not caused by a defect in its autonomous vehicle or by negligence, but by a cyberattack or hacking incident caused by (a) infrastructure operated by the state or local government, such as a road sign, traffic light, or sensor in the road that connected to the autonomous vehicle, and/or (b) malware introduced into the autonomous vehicle by the owner who altered the vehicle by adding aftermarket parts, telematics systems, or other devices.

In the context of the Molly Problem, the manufacturer could take the position that the vehicle was not defective and that the manufacturer did not breach its duty of care because the crash was due to the conduct of others that occurred after the vehicle left the manufacturer's hands. The manufacturer could also argue that the cyberattack was an intervening event that broke the causal chain between the manufacturer and Molly's injuries, and therefore, plaintiff cannot prove that the vehicle was the proximate cause of Molly's injuries and the manufacturer cannot be held liable under either a strict liability or negligence theory.

Plaintiff can be expected to take the position that the fact that the vehicle was hacked is evidence of a design defect for purposes of the strict liability cause of action, and that the manufacturer had a duty to ensure that the vehicle was protected from cyberattacks and therefore breached its duty of care and is liable for negligence. Plaintiff will argue that the manufacturer failed to take reasonable steps to ensure that the vehicle was safe and to prevent it from being hacked, which was foreseeable, and that the manufacturer was in the best position to secure the vehicle. Expert testimony will play a key role in both parties' arguments.

The United States does not have a federal cybersecurity law and state cybersecurity-related laws vary. NHTSA takes the position that "while cybersecurity is a critical issue for NHTSA, the emphasis for addressing cybersecurity ultimately must be with the industry, which must be the primary mover and leader in this field." [26] In its recently issued publication, *Ensuring American Leadership in Automated Vehicle Technologies, Automated Vehicles 4.0*, it states that "the agency has taken several other concrete steps to prepare for the eventuality of an automotive cyber incident that affects safety" and references the non-binding best practices it issued in 2016[27] as well as the best practices issued by

[26] NHTSA (2020), *Ensuring American Leadership in Automated Vehicle Technologies, Automated Vehicles 4.0* at 22, https://www.transportation.gov/sites/dot.gov/files/2020-02/EnsuringAmericanLeadershipAVTech4.pdf .

[27] HTSA (2016), Cybersecurity Best Practices for Modern Vehicles, https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/812333_cybersecurityformodernvehicles.pdf .

the Automotive Information Sharing and Analysis Centre (Auto-ISAC), the auto industry led clearinghouse to share cybersecurity information.[28]

8.2.9 Proprietary data and expert witnesses

Two important considerations for the autonomous vehicle manufacturer in the Molly Problem will be the treatment of the proprietary data it is required to provide to plaintiff during the discovery phase of the litigation and the retention of expert witnesses.

8.2.9.1 Proprietary data

During the discovery portion of the case, the plaintiff will serve interrogatories[29] and requests for production of documents[30] on the manufacturer asking the manufacturer to provide information relating to the claims and defences in the case. This will include information and documents that the manufacturer considers proprietary, confidential or trade secrets, such as information about the algorithms used to operate the vehicle; the manufacturer's design processes, engineering processes, and quality control and inspection processes for its autonomous vehicles; and details of its contractual relationships with its suppliers.

The scope of discovery is broad. Generally, parties "may obtain discovery regarding any nonprivileged matter that is relevant to any party's claim or defence and proportional to the needs of the case."[31] The manufacturer can file a motion with the court objecting to the plaintiff's discovery requests as overly broad. The judge will decide that motion if the parties are unable to resolve the dispute themselves. While the manufacturer may be able to limit the scope of the plaintiff's discovery requests through a successful motion, it will still be required to provide the plaintiff with proprietary information that is relevant to the claims and defences in the case.

To protect its proprietary information, the manufacturer will want to negotiate a protective order[32] with the plaintiff and have it approved by the court. Generally, protective orders include provisions placing limits on how the plaintiff can use the manufacturer's proprietary information, to whom the plaintiff can give access to the information, whether the data can be copied, and the steps the plaintiff must take to secure the information. Protective orders also, generally, require the plaintiff to return

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[28] Auto-ISAC, Best Practices, https://automotiveisac.com/best-practices/ .

[29] "In a civil action, an interrogatory is a list of questions one party sends to another as part of the discovery process. The recipient must answer the questions under oath and according to the case's schedule." Cornell Law School, Legal Information Institute, https://www.law.cornell.edu/wex/interrogatory .

[30] "Documents" is defined broadly and includes electronic information such as emails, text messages, audio and video recordings and social media posts.

[31] Federal Rules of Civil Procedure, Rule 26(b)(1) ("Unless otherwise limited by court order, the scope of discovery is as follows: Parties may obtain discovery regarding any nonprivileged matter that is relevant to any party's claim or defence and proportional to the needs of the case, considering the importance of the issues at stake in the action, the amount in controversy, the parties' relative access to relevant information, the parties' resources, the importance of the discovery in resolving the issues, and whether the burden or expense of the proposed discovery outweighs its likely benefit.").[32] *See, e.g.*, Federal Rules of Civil Procedure, Rule 26(c) ("The court may, for good cause, issue an order to protect a party or person from annoyance, embarrassment, oppression, or undue burden or expense, including . . . (G) requiring that a trade secret or other confidential research, development, or commercial information not be revealed or be revealed only in a specified way.").

[32] *See, e.g.*, Federal Rules of Civil Procedure, Rule 26(c) ("The court may, for good cause, issue an order to protect a party or person from annoyance, embarrassment, oppression, or undue burden or expense, including . . . (G) requiring that a trade secret or other confidential research, development, or commercial information not be revealed or be revealed only in a specified way.").

the information to the manufacturer after the litigation is finally resolved and set out penalties for violations of the agreement.[33]

8.2.9.2 Expert witnesses

The manufacturer will need to offer expert witness testimony to explain technical issues in the case to the jury and to rebut the testimony of the plaintiff's expert witnesses. Those issues could include whether a design defect or manufacturing defect existed, what the appropriate standard of care is, and whether road conditions or other factors were the cause of Molly's injuries.

Expert witness testimony is permitted when the witness, who is qualified as an expert, has specialized knowledge that will help the jury to understand the evidence in the case or to determine a fact that is in issue. Unlike other witnesses, expert witnesses are permitted to testify in the form of opinions.[34] Generally, in product liability cases, both the plaintiff and the manufacturer introduce testimony from expert witnesses. This increases the cost of litigation and can result in a case becoming a "battle of the experts," where jurors must decide which expert opinion to believe.

8.3 The EU legal framework and justified expectations

8.3.1 Introduction

This contribution explores the justified expectations under the EU Product Liability Directive (PLD)[35] and its relation with the work of UNECE Working Party 1, Working Party 29 and therefore its relationship with the 1949 Geneva Convention on Road Traffic, the 1968 Vienna Convention on Road Traffic, and the UN vehicle Regulations (Addenda to the 1958 Agreement) on vehicles. [36]

8.3.2 Legal landscape

The Product Liability Directive is part of an intricate legal framework. The Directive concerns one specific type of non-contractual liability, so liability not derived from the breach of a contract. There are, however, many more types of non-contractual liability. For instance, the liability for damage caused by an animal, the liability of the keeper or owner of an immovable (such as a house), the liability of a person who is 'to blame' for the damage caused. These are often, other than the EU Product Liability Directive, matters of national law. Therefore, who is liable for damage caused in a motor vehicle accident can differ per jurisdiction. A requirement for liability could be that the driver of the vehicle was at fault, or it might be enough to establish liability if a known risk has materialized. This is the difference between fault liability and strict liability: fault liability requires the liable party to be at fault, whereas for strict liability the liable party is liable (briefly stated) because a risk he could control has materialized.

Apart from non-contractual liability, liability can also result from a breach of contract. If a contract is not performed as agreed, this can, depending on national law, result in the liability of the contracting party that has not performed the contract (correctly). Although this is largely a matter of national law, the EU does have several legal instruments governing some parts of contract law in order to offer

[33] Court records are generally publicly available. Absent a protective order, a party that receives information from an opposing party in response to a discovery request is entitled to disseminate that information. Trials are also presumptively public.

[34] Federal Rules of Evidence, Rule 702, https://www.law.cornell.edu/rules/fre/rule_702.

[35] Council Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (Directive 85/374/EEC) [1985] OJ L210/29.

[36] Geneva Convention on Road Traffic (adopted 19 September 1949, entered into force 26 March 1952) 125 UNTS 3 (Geneva Convention), Vienna Convention on Road Traffic (adopted 8 November 1968, entered into force 21 May 1977) 1042 UNTS 17 (Vienna Convention).

consumer protection. In the context of automated driving, two recent Directives are of specific interest: EU Directive 2019/770[37] and EU Directive 2019/771.[38] Directive 2019/770 sees to contracts for the supply of digital content and digital services to consumers, whereas Directive 2019/771 concerns contracts for the sale of goods to consumers.[39] Both Directives require the trader or seller to ensure that the consumer is informed of and supplied with updates, including security updates and safety updates, during a particular period (art. 7, 8 Directive 2019/770; art. 6, 7 Directive 2019/771). If the trader or seller does not do this, the content, service or good is deemed not in conformity with the contract. A seller of an automated vehicle, sold for private use, (which falls within the definition of 'goods' within the meaning of art. 2 Directive 2019/771) will therefore have to supply software-updates for the vehicle (art. 6, 7 Directive 2019/771). If he does not do so, he might face a claim for non-conformity from the consumer he sold the vehicle to.

Also relevant for liability issues concerning motor vehicles is the European mandatory motor vehicle insurance. EU Directive 2009/103/EC (Motor Insurance Directive)[40] requires Member States to take appropriate measures to ensure that civil liability in respect of the use of vehicles of every motor vehicle normally based within the territory of a Member State is covered by insurance (art. 3). The insurance has to cover (at least) "liability for personal injuries to all passengers, other than the driver, arising out of the use of a vehicle" (art. 12 Motor Insurance Directive). The insurance does not have to cover personal injuries of the driver of the vehicle. The insurance company that pays damages to the injured party, can subsequently seek redress from the party that has caused the accident, for instance the driver of the vehicle that caused the accident, or the producer of the vehicle in case the vehicle was defective.

In the context of automated driving, this means that an injured party has several routes to get his damage compensated. The routes that are open also depend on the type of injured party. In Figure 2 and Figure 3, the routes of two possible injured parties are explored. Figure 2 concerns the occupant of an automated vehicle used in the performance of a taxi service, in Figure 3 the injured party is another road user (such as a pedestrian). The Figures 2 and 3 also indicate from which parties the insurance company may seek redress.

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[37] Directive (EU) 2019/770 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the supply of digital content and digital services [2019] OJ L 136/1.

[38] Directive (EU) 2019/771 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the sale of goods, amending Regulation (EU) 2017/2394 and Directive 2009/22/EC, and repealing Directive 1999/44/EC [2019] OJ L 136/28.

[39] Both Directives define consumer as "any natural person who, in relation to contracts covered by this Directive, is acting for purposes which are outside that person's trade, business, craft or profession" (art. 2 (6) Directive 2019/770, art. 2 (2) Directive 2019/771).

[40] Directive 2009/103/EC of the European Parliament and of the Council of 16 September 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] OJ L 263/11.

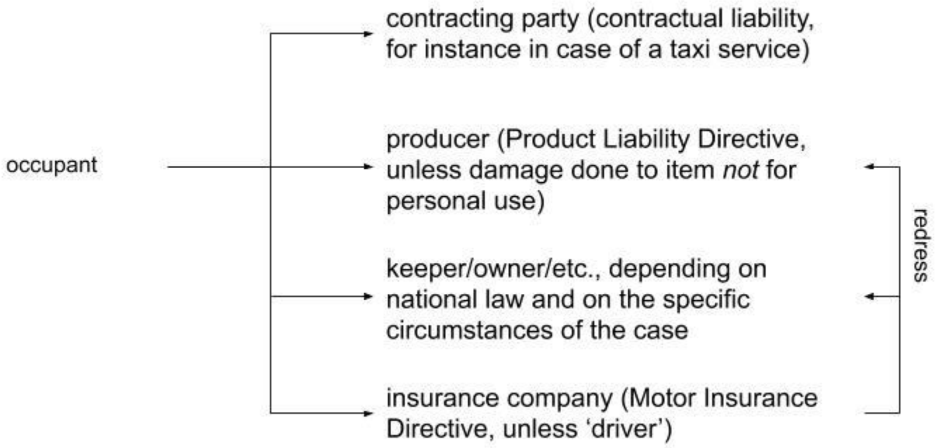

Figure 2 – Compensation of damage to user of taxi service

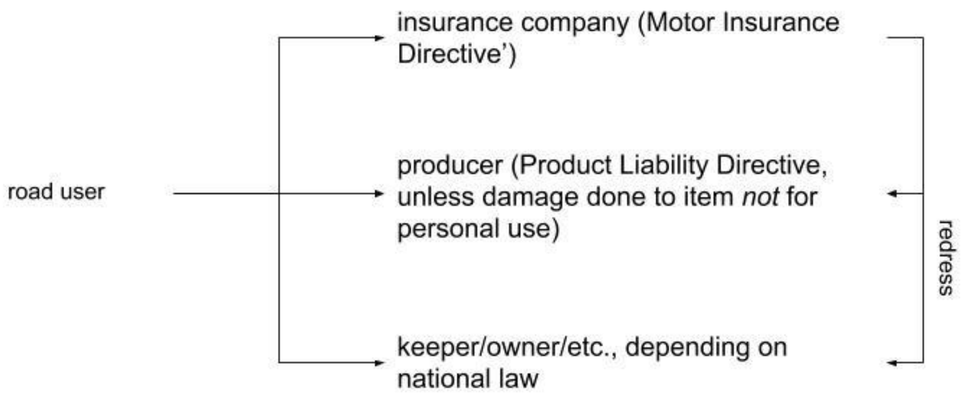

Figure 3 – Compensation of damage to road user

8.3.3 European Product Liability Directive

The European Product Liability Directive stems from 1985. The Directive is a response to, among other things, the tragedies caused by Thalidomide in the 1960s. Across Europe, people were confronted with the devastating effects of the drug. This laid bare the lack of a harmonized product liability regime across the European Union (EU). As a consequence, the level of consumer protection could vary from Member State to Member State. In the context of a single European market, this was deemed undesirable. Therefore, the EU Product Liability Directive was drafted. The Directive came into effect in 1985. The Product Liability Directive, as are EU Directives in general, is binding, but leaves to the national authorities the choice of form and methods (art. 288 Treaty of the Functioning of the European Union). In the Netherlands, for instance, the Product Liability Directive was converted into national law as part of the Dutch Civil Code (art. 6:185-193 Burgerlijk Wetboek)[41],

[41] As of 1 January 1992.

whereas in Germany the Product Liability Directive led to the Produkthaftungsgesetz.[42] As a result, some differences can still occur between Member States.

8.3.3.1 Producer

Under the Product Liability Directive, a producer is liable for damage caused by a defect in his product (art. 1 PLD) unless he is able to successfully invoke one of the six defences listed in art. 7 PLD.[43] A producer is not only the (legal) person that has manufactured the product:

> " 'Producer' means the manufacturer of a finished product, the producer of any raw material or the manufacturer of a component part and any person who, by putting his name, trade mark or other distinguishing feature on the product presents himself as its producer." (art. 3 (1) PLD)

So, if someone puts his name on the automated vehicle he might be considered to be its producer under the Directive. This, however, does not mean that if someone puts the name of his own business on his vehicle, he becomes the producer of the vehicle. That will only be the case if he actually presents himself as the producer. So, if a company offering a taxi service puts their company name on the vehicle with a telephone number through which the taxi can be ordered, this company does not present itself as the producer and is therefore not the producer within the meaning of the Product Liability Directive. If he does present himself as the producer, by for instance putting his logo on specific parts of the vehicle, he could be deemed to be the producer of the vehicle within the meaning of the Directive, even though he was not involved in the manufacturing process. In addition, the party importing a product into the EU and the supplier of the product can, under specific circumstances, also be deemed producer within the meaning of the Product Liability Directive (art. 3 (2) and (3) PLD).

It should be pointed out that in case where multiple producers are involved in the production of an automated vehicle, they are jointly and severally liable (art. 5 PLD). This means that, even when an automated vehicle has perhaps 8 different producers, the consumer can claim damages from just one of them. This producer would have to compensate the consumer for all the damage suffered, even if the damage is unrelated to the part this producer has produced. Subsequently, the producer can seek redress from the other producers involved. The consumer does not have to investigate which producer was responsible for the defect or defective part of the vehicle. Thereby, the aim of consumer protection is served.

8.3.3.2 Damage

If the producer is found to be liable for the damage caused, he will have to indemnify the injured party. There is a limitation to what damage falls within the scope of the Product Liability Directive:

> "For the purpose of Article 1, 'damage' means:
> (a) damage caused by death or by personal injuries;
> (b) damage to, or destruction of, any item of property other than the defective product itself, with a lower threshold of 500 ECU, provided that the item of property:
>
> (i) is of a type ordinarily intended for private use or consumption, and
>
> (ii) was used by the injured person mainly for his own private use or consumption.
>
> This Article shall be without prejudice to national provisions relating to non-material damage." (art. 9 PLD)

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[42] Gesetz über die Haftung für fehlerhafte Produkte (Produkthaftungsgesetz – ProdHaftG) vom 15. Dezember 1989.

[43] See more extensive on the defences of the producer: Vellinga, N.E. (2020), *Legal Aspects of Automated Driving: On Drivers, Producers, and Public Authorities*, dissertation, University of Groningen, Chapter 5.

With this limitation to damage to an item of property intended for private use or consumption, the Product Liability Directive is demarcated to consumer protection. Damage of an item of property intended for commercial use falls outside of the scope of the Directive.

> A person uses his automated vehicle to drive him to and from work. During the time he spends at work, he allows for the car to be used as part of an automated vehicle taxi service. So, whilst he is at work, other people can use his vehicle for a trip. The vehicle could incur damage during a trip made as part of its taxi service, for instance by another automated vehicle that is defective because of defective sensors. The damaged automated vehicle was both used for private purposes – the commute to work – as well as commercial purposes. It will be up to the judge to decide whether the damaged automated vehicle was used mainly for private use. An element that could be important in this respect is the time the vehicle was used for private use and the time the vehicle was in use for commercial purposes, as well as the number of trips made with the vehicle for private purposes and for commercial purposes.[44]

8.3.3.3 Burden of proof

The injured party will have to prove the damage, the defect and the causal relationship between the two (art. 4 PLD). This burden of proof for the consumer will mean that the consumer will want to have, for instance, access to data collect by an event data recorder. How to obtain access, and whether access will be granted, are matters of national procedural law. Depending on the circumstances, the burden of proof from art. 4 of the Directive could be a too excessive burden for the consumer. National procedural law can offer ways for a judge to alleviate this burden. For instance, the judge could decide to reverse the burden of proof, meaning that the burden comes to rest with the producer to proof that his product was not defective or did not cause the damage. Which possibilities the judge has to alleviate the burden of proof of the consumer depends on national procedural law.

8.3.3.4 Product within the meaning of the PLD

What constitutes a defect within the Product Liability Directive is the main focus of this paper. For this, it is important to also get a greater understanding of what actually is a product under the Directive. Art. 2 of the Product Liability Directive states:

> "For the purpose of this Directive 'product' means all movables, with the exception of primary agricultural products and game, even though incorporated into another movable or into an immovable. 'Primary agricultural products' means the products of the soil, of stock-farming and of fisheries, excluding products which have undergone initial processing. 'Product' includes electricity."

An automated vehicle is a movable, therefore, as follows from this provision, an automated vehicle as a whole is a product. However, the situation is not so clear when it comes to software.[45] The status of software has been debated in literature since the late 1980s. Figure 4 shows the four main opinions that have been expressed in literature.[46]

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[44] In this context Case C-464/01 Gruber/Bay Wa AG [2005] ECR I-00439, in which the European Court of Justice decides that in order to qualify as 'consumer' within the Brussels Convention (on jurisdiction and the enforcement of judgments in civil and commercial matters) the trade or professional purpose should be "so limited as to be negligible in the overall context of the supply", could be of importance.

[45] See also European Commission (2018), *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)*, COM (2018) 246 final.

[46] See more extensive: Vellinga, N.E. (2020), *Legal Aspects of Automated Driving: On Drivers, Producers, and Public Authorities*, dissertation, University of Groningen, Chapter 5.

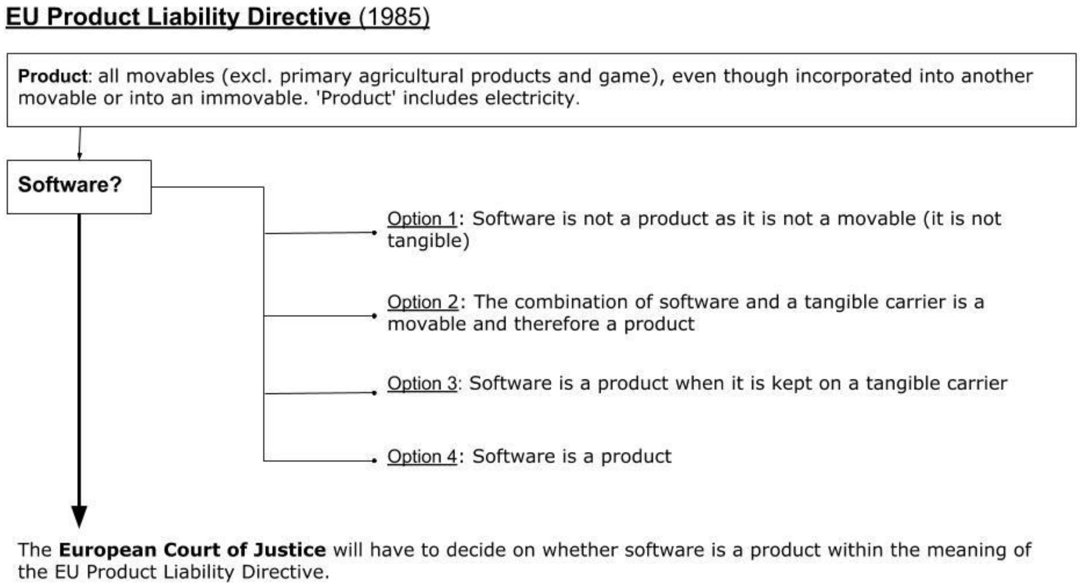

Figure 4 – Software and the Product Liability Directive

If software is not deemed a product within the Product Liability Directive, this could mean that a software producer avoids liability for damage caused by his software. National laws might have a framework in place correcting for this outcome. This outcome is nevertheless not in line with the aim of consumer protection by the Product Liability Directive. As it concerns the interpretation of an EU Directive, the European Court of Justice will have the final say in how to interpret the notion of product and whether this includes software. With regard to automated vehicles the status of software is not of relevance when the automated vehicle was already equipped with the software when the vehicle was put into circulation. In that case, the automated vehicle in its entirety, so including the software, qualifies as a product. If it is defective and causes damage, the producer of that vehicle can be held liable.

Given the undecided status of software, the status of software-updates is also unclear. There is, furthermore, an extra dimension to software-updates compared to software as such or software installed before an automated vehicle was put into circulation. This is because it can be argued that if the software-update is substantial and changes core characteristics of an existing product, a new product is formed. This product will have to live up to the justified expectations of the moment it is put into circulation.

> The changing of the tires of a vehicle does not turn the vehicle into a new product. The alteration that has taken place is too limited, it does not change the core characteristics of the vehicle. A software-update to the in-vehicle entertainment system is not drastic enough to bring a new product into being. If, however, a software-update is so extensive that, for instance, it brings a vehicle from SAE Level 2 to SAE Level 4, it can well be argued that a new product has come into existence. There is, however, not a clear line that distinguishes between when a product has just changed (substantially), and when it has become an entirely new product. Ultimately, this will need to be decide by a judge.

8.3.4 Defect: justified expectations

Under the Product Liability Directive, a product is defective when it does not provide the safety which a person is entitled to expect (art. 6 PLD). All circumstances need to be taken 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." Here, it concerns the justified expectations at the moment the product was put into circulation, not the moment the product causes damage. These justified expectations are not the expectations of the injured person, but of the public at large.[47] Many aspects are factored in when establishing the justified expectations of a product, for instance the price of the product, warnings and instructions given to its user, time the product was put into circulation, etc. The risk of harm and the severity of the possible harm are also elements to take into account. The influence of this risk of harm and of the severity of harm on the justified expectations within the Product Liability Directive are illustrated in Figure 5, using the 'criticality pyramid' of the German Data Ethics Commission.[48]

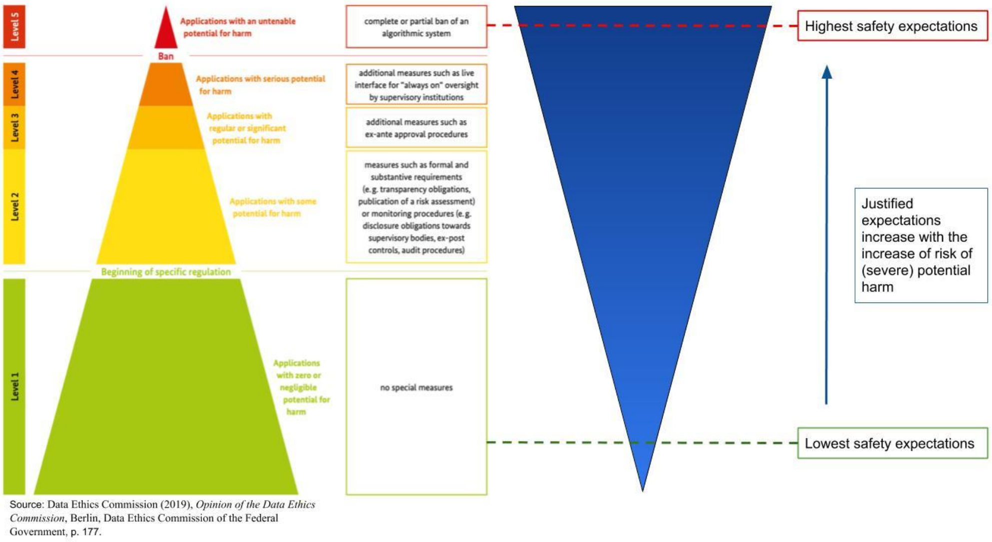

Figure 5 – The 'criticality pyramid' and justified expectations

As Figure 5 shows, the higher the risks to legally protected rights and interests, such as the right to life and physical integrity, at stake, the higher the safety expectations will be.[49] Take for example a circular saw: the saw poses a high risk to the hands of the person using it. Because of the high risk that is at stake, one is allowed to expect better safety measures, such as a blade guard on the circular saw. Applied to the automated vehicle, this means that given the substantial risks to human life for occupants and other road users and road safety, the justified safety expectations will be very high. Consequently, the producer will have to take more safety measures as to avoid liability. This approach is supported by the German Data Ethics Commission, which recommends adoption of a risk-adapted regulatory approach regarding algorithmic systems: "It follows the principle that the greater the potential of algorithmic systems to cause harm, the more stringent the requirements and the more far-

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[47] Preamble Product Liability Directive. See also Wuyts, D. (2014), *The product liability directive: more than two decades of defective products in Europe*, Journal of European Tort Law, Vol. 5, No. 1, April, pp. 1-34, 8ff.

[48] Data Ethics Commission (2019), *Opinion of the Data Ethics Commission*, Berlin, Data Ethics Commission of the Federal Government, p. 177.

[49] See also Schrader, P.T. (2016), *Haftungsfragen für Schäden beim Einsatz automatisierter Fahrzeuge im Straßenverkehr*, Deutsches Autorecht (DAR), Vol. 86, No. 5, pp. 242-245, p. 242, 243; Gomille, C. (2016), *Herstellerhaftung für automatisierte Fahrzeuge*, JuristenZeitung (JZ), Vol. 71, No. 2, pp. 76-82, p. 76, 77.

reaching the intervention by means of regulatory instruments."[50] So, a greater risk justifies greater legal intervention. Translated to the automated vehicle, this would mean that there would be no legal intervention for a failing in-vehicle entertainment system given the low (safety) risks involved. However, a legal requirement for a fail-safe in case a sensor fails would be justified following the risk-adapted regulatory approach.

It is important to note, though, that under the EU Product Liability Directive, the producer cannot avoid liability by stating that his product is in conformity with mandatory regulations. In other words, a product that is in conformity with mandatory regulations does not necessarily meet the justified expectations of the public. However, if the defect is due to the product being in compliance with mandatory regulations, the producer does avoid liability (art. 7 (d) PLD). So, if a design restriction in relevant mandatory regulations causes the product to be defective (i.e., not meeting the justified expectations), the producer can avoid liability under the Product Liability Directive.

In addition, it is important to note that a dangerous product it not necessarily a defective product: a knife is sharp, but that does not mean that it falls short of the justified expectations of the general public. The same goes for an automated vehicle: although it is a potentially life-threatening product, that characteristic in itself does not make it a defective product. It is all a matter of striking a balance between the risks and the severity of the possible harm on the one side, and the safety measures on the other. If a right balance is struck, a product is not defective simple because the risks have materialized.

In legal literature, there is a discussion on the justified expectations of automated vehicles unfolding. The discussion evolves around the so-called 'human driver test'.[51] Under this test, an automated vehicle does not live up to the public's justified expectations, and is therefore deemed defective, if the vehicle does not drive (as safe) as a human-driven car. The disadvantage of the human-driver test is that how safe the automated vehicle drives compared to a conventional, human-driven car will be difficult to establish. This gives rise to several questions. For instance, should an automated vehicle be statistically safer than a human driver in general or in a specific situation? And should the automated vehicle be compared to the best human driver, or to the average driver? Moreover, this test even seems to accept that the shortcomings of a human – distraction, reaction speed, intoxication – could be present in an automated vehicle, whilst risks (almost) only associated with automated vehicles such as risk of hacking, or software failure, are not weighed in the test. The human-driver test, therefore, does not seem the perfect test for automated vehicles. More discussion is needed.

In addition to the existing elements weighed in the establishment of the justified expectations, the development of automated vehicles introduces two new elements (type-approval, traffic rules) to take

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[50] Data Ethics Commission (2019), *Opinion of the Data Ethics Commission*, Berlin, Data Ethics Commission of the Federal Government, p. 173.[51] Schellekens, MHM (2015), *Self-driving cars and the chilling effect of liability law,* Computer Law and Security Review, Vol. 31, No. 4, pp. 506-517, p. 510-12; Tjong Tjin Tai, T.F.E. and Boesten, S. (2016), *Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten*, Nederlands Juristenblad, Vol. 91, No. 10, March, pp. 656-664, p. 660-661; Wagner, G. (2018), *Robot Liability,* https://ssrn.com/abstract=3198764, p. 12. See also Gomille, C. (2016), *Herstellerhaftung für automatisierte Fahrzeuge*, JuristenZeitung (JZ), Vol. 71, No. 2, pp. 76-82, p. 77-78; Ebers, M. (2017), *Autonomes Fahren: Produkt- und Produzenthaftung*, in Oppermann, BH and Stender-Vorwachs, J. (eds), *Autonomes Fahren. Rechtsfolgen, Rechtsprobleme, technische Grundlagen*, CH Beck, p. 110.

[51] Schellekens, MHM (2015), *Self-driving cars and the chilling effect of liability law,* Computer Law and Security Review, Vol. 31, No. 4, pp. 506-517, p. 510-12; Tjong Tjin Tai, T.F.E. and Boesten, S. (2016), *Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten*, Nederlands Juristenblad, Vol. 91, No. 10, March, pp. 656-664, p. 660-661; Wagner, G. (2018), *Robot Liability,* https://ssrn.com/abstract=3198764, p. 12. See also Gomille, C. (2016), *Herstellerhaftung für automatisierte Fahrzeuge*, JuristenZeitung (JZ), Vol. 71, No. 2, pp. 76-82, p. 77-78; Ebers, M. (2017), *Autonomes Fahren: Produkt- und Produzenthaftung*, in Oppermann, BH and Stender-Vorwachs, J. (eds), *Autonomes Fahren. Rechtsfolgen, Rechtsprobleme, technische Grundlagen*, CH Beck, p. 110.

into account when establishing the justified expectations of the public. These new elements are closely tied to the work of Working Party 1 and Working Party 29.

8.3.5 Vehicle regulations and justified expectations under the PLD

The UN Regulations (Addenda to the 1958 Agreement) concerning the technical specifications of vehicles form part of the EU type-approval process (art. 34 Directive 2007/46/EC). This type-approval process is governed by Directive 2007/46/EC.[52] For a vehicle to be allowed on the public roads within the EU, it needs to be (type-)approved. Type-approval concerns the approval of a specific type of vehicle. Once a type of vehicle has been granted type-approval by an approval authority in one Member State, all vehicles of its type are allowed on public roads within the EU (Directive 2007/46/EC). With the development of automated vehicles, the type-approval will in the future likely also contain (technical) requirements that (indirectly) concern the behaviour of the automated vehicle.[53] Thereby, a user of an automated vehicle will not only have expectations of the technical features of the vehicle (such as the safety of the doors and chairs, the brake, etc.) based on the awarded type-approval, but also on the non-human driver's behaviour. The (type-)approval of an automated vehicle will give the user the impression that it is safe to use the vehicle under the conditions mentioned in the approval. This expectation will therefore also see to the driving behaviour of the vehicle (e.g. that the vehicle will stop for a red traffic light). If, for instance, the (type-)approval does not limit the use of the automated vehicle to sunny conditions, the user will have the justified expectations the vehicle can safely operate during rain. If the automated vehicle does not live up to this expectation, it is defective within the meaning of the Product Liability Directive. So, the type-approval becomes an element that weighs in when establishing whether an automated vehicle is defective in that it sets the general public's justified expectations. Thereby, the influence of Working Party 29 is felt by the producer of the automated vehicle.

Steps can be made to keep this development at bay, in case that is desired. Through the design of the vehicle, matters of liability can be influenced. For example, taking the example from above, the producer could have chosen for a design where the vehicle comes to a save stop (minimal risk condition) if its sensors detect rain. Thereby, he avoids the situation in which the vehicle keeps on driving despite not being suitable for use during rain. Working Party 29 can also assume a role in this: the Working Party can formulate new provisions, demanding the vehicle to return to a minimal risk condition if it comes across a situation which it is not designed for. In addition, automated vehicles could be required to only be equipped with controls (such as a steering wheel, brake pedal etc.) necessary given the level of automation of the vehicle, so as to provide more clarity on the roles and liability risks of the parties involved. For instance, if an SAE Level 4 vehicle is equipped with all the controls of a conventional vehicle, the question arises if the user should have interfered in a particular situation and if, by not interfering, the user should be liable for subsequent damage. By not equipping an SAE Level 4 vehicle with conventional controls, this liability question does not rise. Working Party 29 could, therefore, have substantial influence on the liability questions arising from automated driving. Through the vehicle regulations, a sort of 'liability by design' could be developed.[54]

The influence of Working Party 29, through the type-approval process, on the liability of the producer of an automated vehicle is a new element in product liability under the Product Liability Directive introduced by the development of automated vehicles. However, it is not only Working Party 29 that

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[52] Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles [2007] OJ L263/1.

[53] Which would be justified under the risk-adapted regulatory approach of the Data Ethics Commission.

[54] See further on 'liability by design': Vellinga, N.E. (2020), *Legal Aspects of Automated Driving: On Drivers, Producers, and Public Authorities*, dissertation, University of Groningen, p. 183ff.

can influence matters of product liability. Working Party 1 could also influence the justified expectations of the general public of automated vehicles and thereby influence the question of the liability of the producer of an automated vehicle under the Product Liability Directive.

8.3.6 Geneva Convention, Vienna Convention, and justified expectations under the PLD

Both the Geneva Convention and the Vienna Convention contain rules of the road (Chapter II of both Conventions), traffic rules addressed to the driver of a vehicle. One could argue that the Conventions thereby set expectations of other road users for the behaviour of this driver. Road users will have an expectation that other road users, such as the driver of a vehicle, in principle behave in conformity with the applicable rules of the road. These are the expected behaviours. This reasoning could be extended to the driving behaviour of an automated vehicle.

In doing so, it should be noted that there is an ongoing discussion in Working Party 1 and legal literature on whether an automated vehicle has a driver within the meaning of the Geneva Convention and the Vienna Convention.[55] This matter is therefore still undecided. For the purpose of this paper, however, it is assumed that in one way or the other the Conventions or a successive convention on road traffic will contain traffic rules for all road users including both human and non-human drivers, in the form of rules of the road. For reasons of brevity and for the assumption that the traffic rules for an automated vehicle will be similar to those for human drivers, they will hereafter be referred to as rules of the road.

As described above, rules of the road raise expectations regarding the traffic behaviour of a road user with other road users. The same reasoning applies to rules of the road for automated vehicles: they give rise to the expectation of, for instance, a pedestrian that the automated vehicle will let the pedestrian cross the road at a pedestrian crossing. The rules of the road for automated vehicles, however, will not only give rise to expectations of road users, but also of the user of the automated vehicle. The user of an automated vehicle will have the expectation that the vehicle will drive safely by driving in conformity with the applicable rules of the road. The user will, for instance, expect the automated vehicle to stop for a red traffic light. This expectation can be qualified as a justified expectation within the meaning of art. 6 of the Product Liability Directive (unless there are additional circumstances, such as a warning, that would make it unjustified of a user to expect this behaviour). So, if an automated vehicle does not stop for the red traffic light as expected and causes damage (art. 9 PLD), it not only violates a traffic rule, but the vehicle is also defective within the meaning of the Product Liability Directive. In that case, the producer is exposed to liability under the Directive. This way, the effect of the rules of the road in the Geneva Convention and the Vienna Convention extends to the EU Product Liability Directive. As a consequence, there is an incentive (extra, next to the incentive from the type-approval) to only put vehicles into circulation that are capable of driving in conformity with the rules of the road of the Conventions on road traffic. From the perspective of consumer protection, this is a positive development.

Figure 6 summarizes the new elements that contribute to the justified expectations regarding automated vehicles of consumers. Alongside these new elements, the other elements will still weigh

[55] See for instance Smith, B.W. (2014), *Automated Vehicles Are Probably Legal in the United States*, Texas A&M Law Review, Vol. 1, No. 3, pp. 411-521; Von Bodungen, B. and Hoffmann, M. (2016), *Das Wienerübereinkommen über den Straßenverkehr und die Fahrzeugautomatisierung (Teil 1). Wege Aus dem Zulassungsdilemma*, Straßenverkehrsrecht, Vol. 16, No. 2, pp. 41-46; Von Bodungen, B. and Hoffmann, M. (2016), *Das Wienerübereinkommen über den Straßenverkehr und die Fahrzeugautomatisierung (Teil 2). Wege Aus dem Zulassungsdilemma*, Straßenverkehrsrecht, Vol. 16, No. 3, pp. 93-97; Van Wees, K.A.P.C. (2015), *Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse*, Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam; Vellinga, N.E. (2019), *Automated driving and its challenges to international traffic law: which way to go?*, Law, Innovation and Technology, Vol. 11, No. 2, September, pp. 257-278.

in. The new elements do not replace the elements known for conventional vehicles, they are simply new elements to factor in.

Figure 6 – Elements influencing the justified expectations

8.3.7 Automated vehicle: Divided into two products with separate justified expectations?

The question might arise whether the automated vehicle for the purpose of the Product Liability Directive can be 'split' into two different products: the vehicle's body and the 'driver', aka the software. From the perspective of the Product Liability Directive, there is no hierarchy between these products. In the case of such a split, each of these products could have its own set of justified expectations. For instance, a justified expectation to have of the vehicle's body is that the bonnet will not open whilst the vehicle is driving. A justified expectation regarding the automated vehicle's 'driver' could be that it behaves in conformity with the applicable rules of the road. From the perspective of Working Party 1 and Working Party 29, this split would be evident as it correlates with the work fields of both Working Parties. However, from the perspective of the Product Liability Directive this split is less evident.

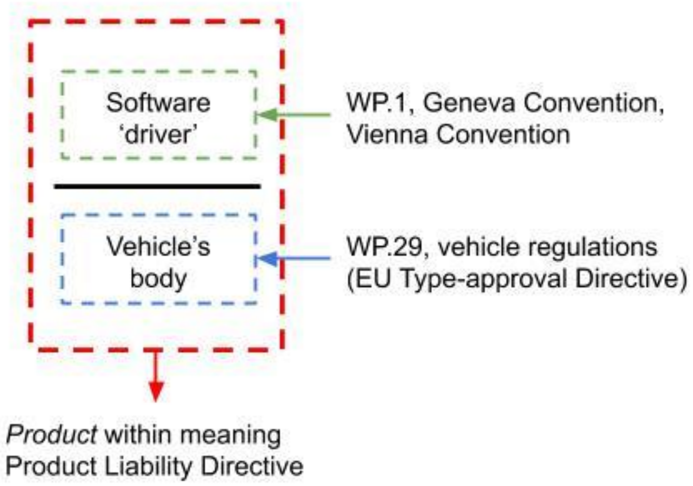

Figure 7 – Product within the meaning of the PLD and the influence of WP.1 and WP.29

One of the most important aims of the Directive is consumer protection. With the discussed divide between the vehicle's body and the (software) 'driver' this aim is put under pressure. Such a split, as shown in Figure 7, would require the injured party to investigate which of the two products, the body or the 'driver' has caused the damage, something which is otherwise left to the producers ("they shall be liable jointly and severally", art. 5 PLD). Because the injured party will have to investigate which product has caused the defect, this burden goes beyond the current duty of the injured party to prove the damage, the defect and the causal relationship between the two (art. 4 PLD). Instead, if this separation is not made and the automated vehicle as a whole qualifies as a product, the injured party will only have to show that the vehicle as a whole is defective and has therefore caused the damage he has suffered. So, for example, he will have to prove that despite the justified expectation that the automated vehicle would stop for a red traffic light, the vehicle ran the red traffic light and thereby caused damage to the injured party (e.g. through a collision, the injured party being the occupant of the vehicle, or another road user). If the split into the two products is made, the injured party would have to investigate whether the vehicle ran the red light because of a broken brake (vehicle's body) or because it interpreted the image incorrectly (software, 'driver').[56] Once he has established this, he would have to prove that the specific product, so either the vehicle's body or its software, is defective and that this defect has caused the injured party the damage he has suffered. The split-approach would therefore make it more difficult for the injured party to get indemnification, see Figure 8.

[56] Not incorporated in this example is the possibility of the system warning the occupant to take over the performance of the dynamic driving task. If the systems alerts the occupant and requests a takeover, which is ignored by the occupant, and subsequently causes damage because of the ignoring of the requested takeover, the occupant might be held liable for the damage caused. However, if the request was issued too late, in an insufficient manner or damage was caused because of the absence of a fail-safe, the producer could also be held liable for the damage caused.

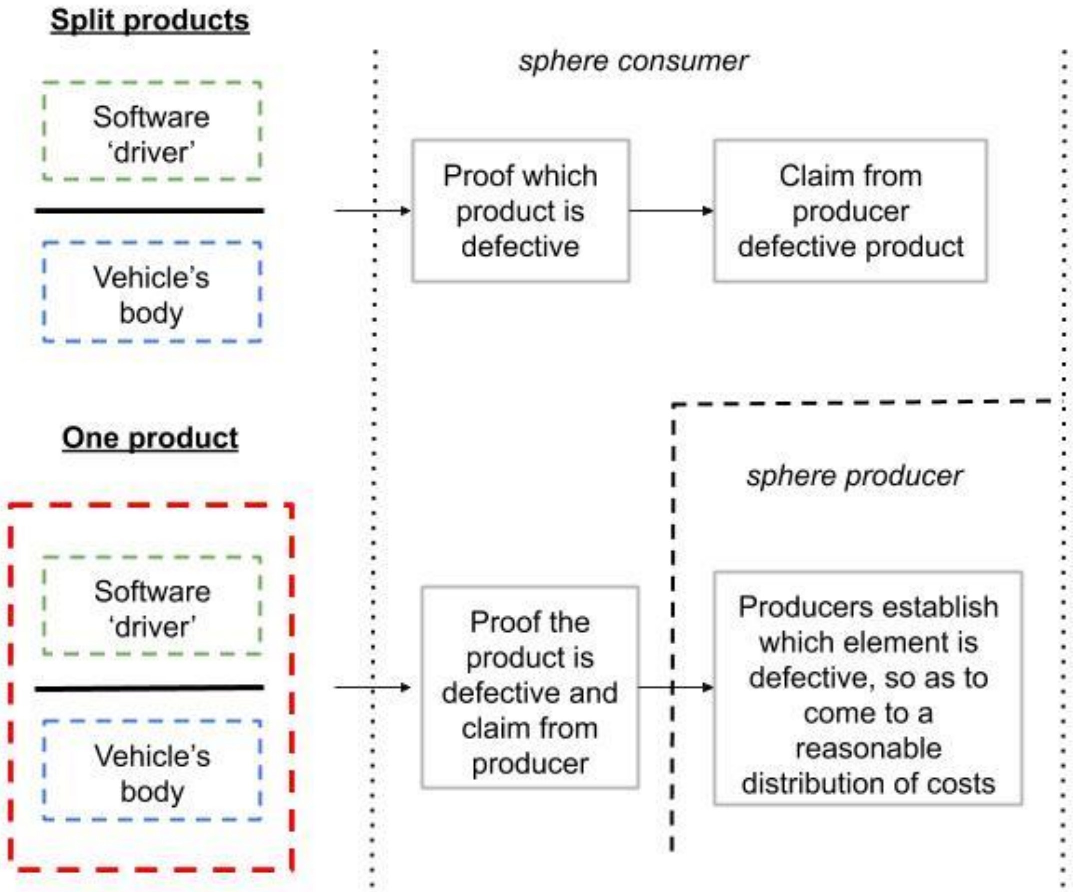

Figure 8 – Split products and one product, consequences for compensation

It would be even more difficult if the defect lies in the miscommunication between an element of the vehicle's body and the software (for instance between a sensor and the software). These difficulties would be in conflict with the aim of consumer protection of the Product Liability Directive, as it would put parties injured by an automated vehicle at a disadvantage compared to those injured by a conventional vehicle. From the perspective of the Directive, this approach would therefore be undesirable.

It should be noted that even though the defect of the automated vehicle as a whole is caused by the software 'driver', that is separately developed by a producer other than the producer of the rest of the vehicle, the producer of the entire vehicle can be held liable for the damage caused (art. 3, 5 PLD). In the context of the Product Liability Directive, there is no hierarchy between the different producers that have contributed to the product. The producer that is held liable can seek redress from the producer of the defective element (art. 5 PLD).

If software is deemed to be a product within the meaning of the Product Liability Directive (see section 3), the software producer can also be held liable for a defective automated vehicle. The software producer can then seek redress from the producer of the defective element (art. 5 PLD).

> An automated driving system (ADS) of producer A is retrofitted to a vehicle of producer B. This combination of products causes damage to a road user. A product (the ADS) is still a product within the meaning of the Product Liability Directive if it has been incorporated into another product (the vehicle). So, the road user could hold producer A liable for the damage done by his product. However, the automated vehicle as a whole could also qualify as a (new) product, in which case the road user could also hold producer B liable for damage suffered as a result of a defect in the ADS. Producer B could subsequently seek redress from producer A.

8.3.8 Justified expectations and software-updates

Above, it was argued that there are no separate expectations concerning just the software, the 'driver', of an automated vehicle. This changes if (software and) software-updates are deemed to be products by the European Court of Justice. This would have consequences in a specific situation, namely that the software-based driver of the automated vehicle is put into circulation after the vehicle itself has been put into circulation. In other words: a conventional vehicle is put into circulation at a certain time and a software-update that provides the vehicle with self-driving capabilities is available after the vehicle was put into circulation. In that specific case and if software-updates can be qualified as products within the meaning of the Product Liability Directive, separate expectations can be formed concerning the software-update and concerning the vehicle. The justified expectations regarding the software-update, the 'driver' of the vehicle, will be influenced by the rules of the road from, for instance, the Geneva Convention and the Vienna Convention and therefore the work of Working Party 1, whereas the justified expectations concerning the vehicle will be influenced by the work of Working Party 29 and the vehicle regulations.

However, it can also be argued that, due to the software-update, a new product (i.e., an automated vehicle) has been formed. That would mean that there is one product, the automated vehicle, and therefore just the expectations of the automated vehicle as a whole. Those expectations of the automated vehicle as a whole will also be influenced by the work of Working Party 1 and Working Party 29, as discussed above. It will depend on the specific circumstances of a case whether or not the conclusion can be reached that a new product was formed.

8.3.9 Defences

The producer of a defective product has six defences to avoid liability, all listed in art. 7 of the Directive:

> "The producer shall not be liable as a result of this Directive if he proves;
>
> (a) that he did not put the product into circulation; or
>
> (b) 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; or
>
> (c) that the product was neither manufactured by him for sale or any form of distribution for economic purpose nor manufactured or distributed by him in the course of his business; or
>
> (d) that the defect is due to compliance of the product with mandatory regulations issued by the public authorities; or
>
> (e) 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; or
>
> (f) in the case of a manufacturer of a component, that the defect is attributable to the design of the product in which the component has been fitted or to the instructions given by the manufacturer of the product."

In the context of automated driving, several defences are of relevance. The defence of art. 7(b) of the Product Liability Directive is of particular importance when an existing vehicle is being retrofitted with, for instance, new sensors or a new software-update. In addition, the defence of art. 7 (f) of the Directive is relevant in, for instance, cases in which a vehicle is retrofitted with an ADS. The defence of article 7(e) of the Directive, the so-called development risk defence, will be explored further below.

8.3.9.1 The development risk defence of art. 7(e) PLD

The development risk defence (sometimes referred to as state-of-the-art defence)[57] provides a certain degree of protection for the producer: he is not confronted with the development risk. This is the risk involved in developing a new product, such as the yet unknown side effects of newly developed medication or the unknown effects of an algorithm. The development risk defence sees to defects that were impossible to discover, given the state of scientific and technical knowledge at the time the product was put into circulation. So, it is about "whether the risk could be known, not whether it could have been avoided."[58] This scientific and technical knowledge must have been accessible at the time the product was put into circulation.[59] It is unclear whether a publication in a lesser known language is indeed 'accessible'.[60] So, summarizing, the defect already existed when the product was brought onto the market, but it was, given the scientific and technical knowledge back then, impossible to discover it at that time.

This way, innovation is being encouraged. As a consequence, and depending on national tort law, the injured party is burdened with the development risk and will bear "the cost of scientifically unknown risks."[61] One could argue that this defence negatively impacts the balance of the interests of the consumer and the interests of the producer. This defence has because of this always been quite controversial. Therefore, the option for Member States to derogate from the development risk defence was laid down in art. 15 of the Product Liability Directive. This gives Member States the option to derogate entirely from the defence (Luxembourg and Finland)[62], or only in respect of certain products (such as medication; Germany[63]).[64] With the development of AI, the development risk defence has again come under scrutiny.[65]

8.3.10 Final remarks

This paper has focused on the EU Product Liability Directive, more specifically on the question of when an automated vehicle is to be deemed defective by not meeting the justified expectations of the

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[57] The state of the art within the Product Liability Directive actually does not relate to the development risk defence. The state of the art sees to the question of whether a product is defective: was the product, when it was put into circulation, state of the art in the sense that it offered the safety that the public justifiably expected?

[58] Van Dam, C.C. (2013), *European Tort Law*, 2nd edn., Oxford University Press, p. 435. See also BGH 9 May 1995, BGHZ 129, 353.

[59] Case C-300/95 Commission v UK [1997] ECR I-02649.

[60] Van Dam, C.C. (2013), *European Tort Law*, 2nd edn., Oxford University Press, p. 435.

[61] Evas, T. (2017), *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles*, EPRS - European Union, p. 42; Engelhard, E.F.D. and De Bruin, R. (2017), *Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles*, in Evas, T. (2017), *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles*, EPRS - European Union, p. 61.

[62] Engelhard, E.F.D. and De Bruin, R. (2017), *Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles*, in Evas, T. (2017), *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles*, EPRS - European Union, p. 66; Van Dam, C.C. (2013), *European Tort Law*, 2nd edn., Oxford University Press, p. 436.

[63] §15 of the German Produkthaftungsgesetz.

[64] See in more detail: Van Dam, C.C. (2013), *European Tort Law*, 2nd edn., Oxford University Press, p. 436.

[65] Vellinga, N.E. (2020), *Legal Aspects of Automated Driving: On Drivers, Producers, and Public Authorities*, dissertation, University of Groningen, Chapter 5; European Commission Expert Group on Liability and New Technologies - New Technologies Formation (2019), *Liability for Artificial Intelligence and other emerging digital technologies*, European Union, finding 14.

general public. Apart from the Product Liability Directive, national laws can provide for the liability of the producer of an automated vehicle, the owner of the vehicle, its user and other parties involved. In addition, contractual liability, so liability arising from the lack of the performance of a contract, could be relevant. Both contractual liability and liability of parties involved for damage caused by an automated vehicle are matters of civil law. Furthermore, criminal liability of the parties involved can also be relevant, depending on the circumstances. However, criminal liability does not aim to indemnify the injured party. Therefore, it is not explored further in this paper. The German Data Ethic Commission stresses the importance of liability in regulating algorithmic systems.[66] Figure 9 provides an overview of the different kinds of liability mentioned in this paper.

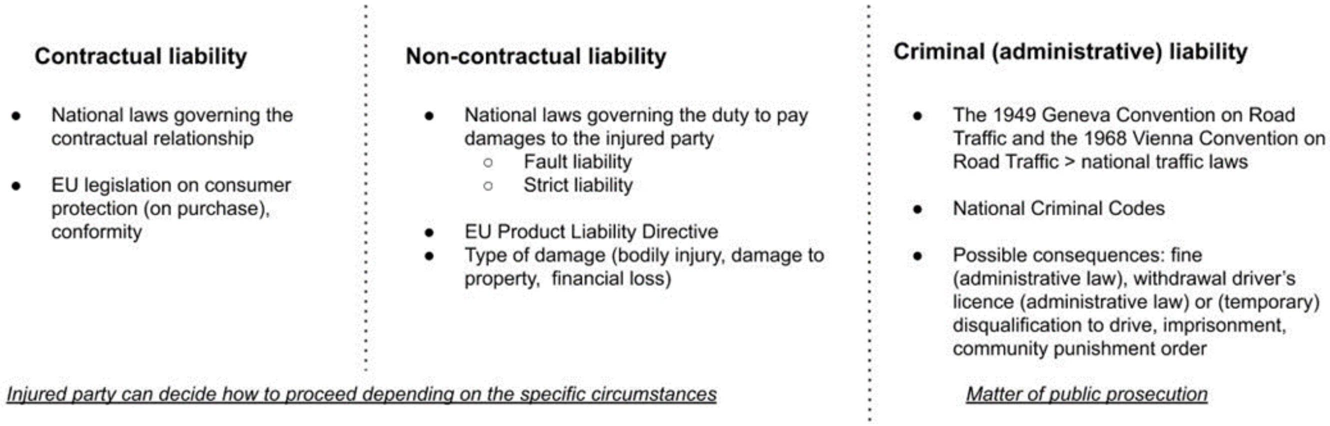

Figure 9 – Different kinds of liability

8.3.11 Overview of key findings

1) An automated vehicle as a whole is a product within the meaning of the Product Liability Directive (PLD);

2) It is unclear whether software is deemed to be a product within the meaning of the PLD.

3) Where two or more producers are liable for the same damage, they are liable jointly and severally;

4) The injured party has to prove damage, defect, and the causal relationship between the two;

5) A new product might be formed if substantial changes to the core characteristics of the existing product are made;

6) Splitting the automated vehicle into two separate products (the vehicle and the software 'driver') is (probably) not in line with the PLD and its aim of consumer protection.

7) A product is defective within the PLD when the product does not provide the safety which a person is entitled to expect at the time the product was put into circulation.

   a. Expectations of the public, not of the injured party;

   b. WP.1 and WP.29 influence through their work these justified expectations.

8) The development risk defence is one of the six defences that can be invoked by the producer to avoid liability.

   a. The consequence of this defence is that the injured party can be burdened with the costs of scientifically unknown risks;

   b. Member States can deviate from this defence.

[66] Data Ethics Commission (2019), *Opinion of the Data Ethics Commission*, Berlin, Data Ethics Commission of the Federal Government, p. 175, 219ff, recommendation 72.

9 Relevant regulations and standards

This section of TR02 covers the current relevant regulations and standards on the event data recorder (EDR) and the data storage system for automated driving (DSSAD), including WP.29's legislative efforts on DSSAD/EDR. Many standards are not legally binding. However, it is important to note that (non)compliance with these standards can be taken into consideration by judges in relation to questions on liability (fault, negligence, EU product liability).

The UNECE World Forum for Harmonization of Vehicle Regulations (WP.29)

Documents on the recent developments regarding the EDR/DSSAD within WP.29:

Reports

ECE/TRANS/WP.29/1157 - Reports of the World Forum for Harmonization of Vehicle Regulations on its 183rd session Administrative Committee of the 1958 Agreement on its seventy-seventh session Executive Committee of the 1998 Agreement on its sixtieth session Administrative Committee of the 1997 Agreement on its fourteenth session (March 2021): see *working documents* for outcomes of meeting.

ECE/TRANS/WP.29/1155 - Reports of the World Forum for Harmonization of Vehicle Regulations on its 182nd session Administrative Committee of the 1958 Agreement on its seventy-sixth session Executive Committee of the 1998 Agreement on its fifty-ninth session Administrative Committee of the 1997 Agreement on its fifteenth session (November 2020): Working Party on General Safety Provisions (GRSG) had agreed to request withdrawal of documents ECE/TRANS/WP.29/2020/100 and ECE/TRANS/WP.29/2020/123 from the agenda (item 4.7.1) of this session of WP.29 in order to resume considerations. The Chair of GRSG recalled that the IWG on EDR/DSSAD was expected to deliver a new UN Regulation under the 1958 Agreement. He added that the IWG had prepared a document titled - Guidance on EDR performance elements appropriate for adoption in the 1958 and 1998 Agreement Resolutions or Regulations (ECE/TRANS/WP.29/2020/100) - which would be further developed and which was expected to be adopted at the March 2021 session of WP.29 along with the proposal for a new UN Regulation on EDR.

Working documents

ECE/TRANS/WP.29/2021/58 - Proposal for the 01 series of amendments to UN Regulation No. [XXX]on Event Data Recorder: This text was adopted by the Working Party on General Safety at its 120th session, held in January 2021 (see ECE/TRANS/WP.29/GRSG/99). It is based on GRSG-120-03 and GRSG-120-05. It is submitted to World Forum for Harmonization of Vehicle Regulations (WP.29) and the Administrative Committee of the 1958 Agreement (AC.1) for consideration and vote at their March 2021 sessions. *March 2021 voting: 37 votes in favour, 2 abstentions (ECE/TRANS/WP.29/1157)*

ECE/TRANS/WP.29/2020/123/Rev.1 - Proposal for a new UN Regulation on Event Data Recorder: This text was adopted by the Working Party on General Safety at its 120th session, held in January 2021 (see ECE/TRANS/WP.29/GRSG/99). It is based on ECE/TRANS/WP.29/2020/123 as amended by GRSG-119-03/Rev.1, GRSG-120-02 and GRSG-120-05. It is submitted to World Forum for Harmonization of Vehicle Regulations (WP.29) and the Administrative Committee of the 1958 Agreement (AC.1) for consideration and vote at their March 2021 sessions. *March 2021 voting: 37 votes in favour, 2 abstentions (ECE/TRANS/WP.29/1157)*

ECE/TRANS/WP.20/2020/100/Rev.1 - Guidance on Event Data Recorder (EDR) Performance Elements Appropriate for Adoption in 1958 and 1998 Agreement Resolutions or Regulations: This text was adopted by the Working Party on General Safety (GRSG) at its 118th session, held in July 2020 (see ECE/TRANS/WP.29/GRSG/97). It is based on GRSG-118-13. It is submitted to World Forum for Harmonization of Vehicle Regulations (WP.29) for consideration at its November 2020 sessions. *March 2021: no voting, WP.29 adopted the extension of the mandate for the IWG on EDR/DSSAD until 2022 (ECE/TRANS/WP.29/1157).*

Informal documents

GRSG-120-05: EDR/DSSAD IWG Revisions to GSRG-120-01, 02, and 03

GRSG-120-03: (EDR/DSSAD) Proposal for a new 01 series of amendments to a new UN Regulation on Event Data Recorder

GRSG-120-02: Proposal for a new UN Regulation on Event Data Recorder

GRSG-119-03, GRVA-07-60: Proposal to amend document ECE/TRANS/WP.29/2020/. Draft new UN Regulation on Event Data Recorder

GRSG-119-02, GRVA-07-61: Proposal to amend document ECE/TRANS/WP.29/2020/100. Draft Guidance on Event Data Recorder (EDR) Performance Elements Appropriate for Adoption in 1958 and 1998 Agreement Resolutions or Regulations

GRSG-118-13: Event Data Recorder (EDR) Performance Elements Appropriate for Adoption in 1958 and 1998 Agreements

GRVA-07-58: IWG on EDR/DSSAD Status Report September 2020

GRVA-07-57: Review of the existing national / regional activities and a proposed way forward for DSSAD

<u>European Union</u>

Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (GDPR): The GDPR concerns the protection of natural persons with regard to the processing of personal data and rules relating to the free movement of personal data. This includes the processing of personal data by automated means. Six principles relating to processing of personal data are listed. Rules on lawfulness, consent and the processing of special categories of personal data are among the many topics dealt with in the GDPR.

Regulation (EU) 2019/2144 of the European Parliament and of the Council of 27 November 2019 on type-approval requirements for motor vehicles and their trailers, and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users, amending Regulation (EU) 2018/858 of the European Parliament and of the Council and repealing Regulations (EC) No 78/2009, (EC) No 79/2009 and (EC) No 661/2009 of the European Parliament and of the Council and Commission Regulations (EC) No 631/2009, (EU) No 406/2010, (EU) No 672/2010, (EU) No 1003/2010, (EU) No 1005/2010, (EU) No 1008/2010, (EU) No 1009/2010, (EU) No 19/2011, (EU) No 109/2011, (EU) No 458/2011, (EU) No 65/2012, (EU) No 130/2012, (EU) No 347/2012, (EU) No 351/2012, (EU) No 1230/2012 and (EU) 2015/166 (General Safety Regulation): This Regulation requires, from mid-2022 onwards, vehicles to be equipped with an event data recorder. It lists a number of requirements for this EDR, including requirements on data to be collected as well as data protection measures.

<u>United States</u>

49 CFR Part 563 - EVENT DATA RECORDERS: This part of the Code of Federal Regulations (CFR) contains uniform, national requirements for vehicles equipped with event data recorders concerning the collection, storage, and retrievability of onboard motor vehicle crash event data. The collected data should help be valuable for effective crash investigations and for analysis of safety equipment performance. This part lists the data elements that should be recorded.

<u>Standards</u>

IEEE 1616-2004 - IEEE Standard for Motor Vehicle Event Data Recorder (MVEDR): This standard defines a protocol for MVEDR output data compatibility and export protocols of MVEDR data elements. It does not prescribe which specific data elements shall be recorded, or how the data are to be collected, recorded and stored. (see in addition IEEE 1616a-2010 - IEEE Standard for Motor

Vehicle Event Data Recorders (MVEDRs) Amendment 1: MVEDR Connector Lockout Apparatus (MVEDRCLA))

IEEE P7001 - IEEE Draft Standard for Transparency of Autonomous Systems: aims to describe measurable, testable levels of transparency, so that autonomous systems can be objectively assessed and levels of compliance determined.

SAE J1698_201703: These series describe common definitions and operational elements of event data recorders. It consists of:

- SAE J1698-1 - Event Data Recorder - Output Data Definition
- SAE J1698-2 - Event Data Recorder - Retrieval Tool Protocol
- SAE J1698-3 - Event Data Recorder - Compliance Assessment

SAE J3237 Operational Safety Metrics for Verification and Validation (V&V) of Automated Driving Systems (ADS): this report contains definitions and lexicon for describing operational safety metrics for quantifying the operational safety performance of ADS and ADS-operated vehicles.

SAE J3197 Automated Driving System Data Logger: this is a recommended practice that provides common data output formats and definitions for a variety of data elements that may be useful for analysing the performance of (ADS) during an event that meets the trigger threshold criteria specified in this document. This document is intended to govern data element definitions, to provide a minimum data element set, and to specify a common ADS data logger record format as applicable for motor vehicle applications.

ISO/PAS 21448: Road Vehicles – Safety of the Intended Functionality (SOTIF): Safety Of The Intended Functionality (SOTIF) refers to the absence of unreasonable risk due to hazards resulting from functional insufficiencies of the intended functionality or by reasonably foreseeable misuse by persons. This standard is intended to be applied to intended functionality where proper situational awareness is critical to safety, and where that situational awareness is derived from complex sensors and processing algorithms; especially emergency intervention systems and Advanced Driver Assistance Systems (ADAS) with levels 1 and 2 on the OICA/SAE standard J3016 automation scales. This document can be considered for higher levels of automation; however, it is pointed out that additional measures might be necessary.

ISO 26262: Road vehicles – Functional safety: This document concerns safety-related systems that include one or more electrical and/or electronic (E/E) systems and that are installed in series production road vehicles, excluding mopeds. It covers possible hazards caused by malfunctioning behaviour of these systems.

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