Legal Aspects of Automated Driving

Vellinga, N. E.

DOI:
10.33612/diss.112916838

Legal Aspects of Automated Driving

On Drivers, Producers, and Public Authorities

Nynke E. Vellinga

Colofon

Cover: © Ida Varošanec

Printing: Ridderprint BV, <www.ridderprint.nl>

ISBN e-book: 978-94-034-2265-7
ISBN printed book: 978-94-034-2266-4

Legal Aspects of Automated Driving

On Drivers, Producers, and Public Authorities

PhD thesis

to obtain the degree of PhD at the
University of Groningen
on the authority of the
Rector Magnificus Prof. C. Wijmenga
and in accordance with
the decision by the College of Deans.

This thesis will be defended in public on

Thursday 20 February 2020 at 16.15 hours

by

Nynke Elske Vellinga

born on 8 November 1988
in Leeuwarden

Supervisors

Prof. A.J. Verheij
Prof. G.P. Mifsud Bonnici

Assessment Committee

Prof. A.R. Lodder
Prof. J.B.H.M. Simmelink
Prof. M.H. Wissink

Acknowledgements

There are many people I want to express my gratitude to for the help and support I have been so lucky to receive, but naming every single person would require an entire annex to this thesis. Therefore, I will only name a few people that have contributed in an exceptional way to the PhD process.

First of all, my supervisors, Albert and Jeanne. Thank you for having faith in me, that I could, despite uncertainties, finish a PhD research and for not losing faith during rough patches. If it had not been for you, this thesis would not lie before you today.

I am extremely grateful to those who made sure that I did not at any point – literally – fell apart: doctor Bergwerff and Jantsje (for keeping me alive), their team, André (foar hieltyd alles wer te plak setten), Manon, Kirsten, Edwin and the Brink-team. Without your help it would have been impossible not to fall apart and to live the life I am living today.

Dear Lauren, Ida and Yasmin, thank you for your help with this thesis and the fun we had in the process. Ida, thank you so much for the beautiful cover. Thank you Lauren for all the hard work you put into the language check. Thanks to the three of you, the thesis does not look like a hot mess.

Thank you Oskar, Karen, Gerard, Catherine and Ida for chocolate, Christmas lights and bringing the Circle of Life to our office, for all the laughter and support. You are the best officemates ever!

I would like to express my gratitude to all my colleagues at the Private Law department and the TLS department. A special thanks goes out to my colleagues of the TLS and European Law departments for their understanding, their jokes and the joint lunches: Peter, Martin, Lauren, Esra, Carolin, Jonida, Matthijs (chocolate!), Justin, Mel, Carola, Lorenzo, Adi, Evgeni, Bettina, Hans, Saleh and Karien. Thank you Charlotte, Sarah, Carien, Leonieke, Carlijne, Tim and Benedikt of the Private Law department for our weekly meetings, new ideas, and making me feel part of your department even though my office was at the other side of the building. Stefan and Evert, thank you for giving me the opportunity to teach. Thank you Berend, Pauline, Hein, Kai, Monique and Eveline for your continuous support and encouragement.

Pierte en Rients, tige tank foar jimme stipe en help troch de jierren hinne.

Willie, Gert, Tineke and Ellen, thank you for turning a necessity into so much fun, your laughter, and kind words of encouragement.

Ydwine, tige tank foar dyn briefkes, leave wurden, en foar alle wille dy’t wy tegearre belibbe hawwe.

Dear Trix, you have been such a great support and you are always so helpful. Thank you for that, and thank you for all the fun we have had working together. You are an amazing friend!

I have been very fortunate with my loving family. I would like to thank in particular André, Jaqueline, Elske, Henk, Albert, Caroline, Erwin and Lara for your encouragements, support, and warm words.

Dear Namkje, you are the best sister ever! Thank you for leading the way, for all the fun we have had and for your loving support.

Leave Heit and mama, words cannot describe how grateful I am to you. You have been the best support anyone can ever wish for. Thank you for teaching me that the size of my medical file does not define me and that I can achieve anything I set my mind to. Your loving, encouraging words, your help whenever and wherever I needed it, and your endless support have led me in life to where I am today. Ik haw jimme ûneinich leaf.

Table of Contents

1 Introduction -- 13
1.1 The Coming Collision Between Automated Vehicles and the Law ------------- 13
1.2 Technology, Terminology and Taxonomy--- 15
1.3 Safety Expectations --- 19
1.4 Changing Roles and Effects-- 21
1.5 Research Question -- 23
1.6 Delimitations of Research --- 26
1.7 Sources and Methodology--- 29
1.8 Legal Framework-- 31
1.8.1 Geneva Convention on Road Traffic 1949 and the Vienna Convention on Road Traffic 1968--- 31
1.8.2 Product Liability Directive-- 33
1.8.3 International Regulations for Preventing Collisions at Sea of 1972 (COLREGS 1972) -- 34
1.8.4 Convention on International Civil Aviation (Chicago Convention) -------- 35
1.8.5 Directive 2007/46/EC on the Approval of Motor Vehicles----------------- 36
1.8.6 Dutch Civil Code -- 36
1.9 Structure -- 37
2 From the Testing to the Deployment of Self-Driving Cars: Legal Challenges to Policymakers on the Road Ahead--- 39
2.1 Introduction-- 40
2.2 Terminology and Technology -- 41
2.3 Interests at Stake and Actors Involved -- 45
2.4 Legal Consistency --- 48
2.5 Testing: Four Jurisdictions' Legal Frameworks ------------------------------------ 49
2.5.1 Binding Regulation: California -- 49
2.5.2 Non-binding Regulation: USA and UK-- 50
2.5.3 Granting Exemptions: The Netherlands -- 54
2.5.4 Evaluating the Legal Instruments --- 55

2.6 Post-testing: The Driver in International and National Traffic Laws ----------- 59
2.6.1 The Driver in International Law: Vienna Convention on Road Traffic 1968 and the Geneva Convention on Road Traffic 1949-------------------------------------- 59
2.6.2 The Driver in National Law: The Netherlands, California and the United Kingdom -- 63
2.6.3 The Interpretation of *Driver* --- 66
2.7 Post-testing: Liability and Insurance -- 68
2.7.1 Current Developments-- 68
2.7.2 The Effects of Liability Law and the Influence of Insurance ---------------- 71
2.8 Conclusion -- 75
Epilogue: New Legal Developments-- 77
3 Automated Driving and its Challenges to International Traffic Law: Which Way to Go? --- 81
3.1 Introduction --- 82
3.2 The Functions of the Notion of *Driver* --- 84
3.2.1 The Function of the Notion of *Driver* in Technical Regulations ------------ 84
3.2.2 The Function of the Notion of *Driver* in Capacity Requirements ---------- 85
3.2.3 The Function of the Notion of *Driver* in Rules of Conduct ------------------ 85
3.2.4 The Function of the Notion of *Driver* in Liability Law ----------------------- 87
3.3 The Notion of *Driver* in the Conventions--- 87
3.3.1 The Functions of the Notion of *Driver* in the Conventions------------------ 87
3.3.2 The Notion of *Driver* and Control --- 88
3.3.3 The Definition of the Notion of *Driver* --- 88
3.3.4 The Interpretation of the Notion of *Driver* ------------------------------------ 89
3.4 The Driver of an Automated Vehicle -- 91
3.4.1 The Possible Drivers of an Automated Vehicle ------------------------------- 91
3.4.2 An Automated Vehicle is Driverless within the Meaning of the Conventions -- 93
3.5 The Laws of Other Modes of Transport as a Source of Inspiration [Option 1] -- 94
3.5.1 Maritime and Aviation Traffic Law -- 94

3.5.2 A Distinction Between Operation and Responsibility ------------------------ 95
3.5.3 The Vehicle and the Conventions --- 96
3.5.4 Responsibility -- 98
3.5.5 Arguments For and Against This Approach ------------------------------------ 99
3.6 The Notion of *Driver*: A different driver per function [Option 2] --------------100
3.6.1 The Interpretation of the Notion of *Driver* Depending on its Function-100
3.6.2 The Notion of *Driver* in Technical Requirements-----------------------------100
3.6.3 The Notion of *Driver* in Capacity Requirements -----------------------------101
3.6.4 The Notion of *Driver* in Rules of Conduct -------------------------------------101
3.6.5 Arguments For and Against This Approach -----------------------------------102
3.7 The User Operating the Controls? [Option 3] -------------------------------------103
3.7.1 The Start Button as a Control of the Automated Vehicle ------------------103
3.7.2 The Controls and the Driver of an Automated Vehicle ---------------------103
3.7.3 Arguments For and Against This Approach -----------------------------------104
3.8 Functioneel Daderschap [Option 4] ---105
3.8.1 The Dynamic Driving Task and the Notion of *Driver*-------------------------105
3.8.2 Inspiration from Dutch Law--106
3.8.3 Functioneel Daderschap and the Conventions -------------------------------108
3.8.4 Arguments For and Against This approach -----------------------------------109
3.9 The Way Forward ---110
3.9.1 The Four Approaches---110
3.9.2 Towards a Driverless Future---111
Epilogue: Developments on the Notion of *Driver*-------------------------------------112
4 Careless Automated Driving? --121
4.1 Introduction ---122
4.2 The User of the Vehicle and his Duty of Care -------------------------------------123
4.2.1 Renting a Vehicle: An Example--123
4.2.2 Duty of Care ---125
4.2.3 Consenting to the Current State of the Vehicle ------------------------------125
4.2.4 Risks Created --126

4.2.5 Severity of the Consequences ---------- 127
4.2.6 Preliminary Conclusion ---------- 128
4.3 The Owner of the Vehicle and His Duty of Care ---------- 128
4.3.1 Duty of Care ---------- 128
4.3.2 Ability to Prevent the Automated Vehicle From Driving ---------- 128
4.3.3 Consequences of a Duty for the Owner ---------- 129
4.4 The Manufacturer of the Vehicle and His Duty of Care ---------- 129
4.4.1 Duty of Care ---------- 129
4.4.2 Fail-safe ---------- 130
4.4.3 Consequences of Equipping the Vehicle with a Fail-safe ---------- 130
4.5 The Role of the Vehicle Authority ---------- 131
4.5.1 Protection of Road Users ---------- 131
4.5.2 Requirement to Equip the Automated Vehicle with a Fail-safe ---------- 131
4.5.3 Consequences of the Requirement for the Position of the Vehicle Authority ---------- 132
4.6 Conclusion ---------- 133
Epilogue: A Closer Look at the Liability of the Vehicle Authority ---------- 134
5 Automated Driving: Liability of the Software Producer and the Producer of the Automated Vehicle ---------- 137
5.1 Introduction ---------- 138
5.2 Technology ---------- 139
5.2.1 Degree of Automation ---------- 139
5.2.2 Machine Learning ---------- 139
5.3 Two Scenarios ---------- 140
5.4 The Product Liability Directive ---------- 141
5.5 The Software of the Automated Vehicle as a Product ---------- 142
5.5.1 Software and the Product Liability Directive ---------- 142
5.5.2 Electricity ---------- 143
5.5.3 Software, its Carrier and the Absence of a Carrier ---------- 143
5.5.4 Software of the Automated Vehicle ---------- 147

5.6 When is an Automated Vehicle Defective? -- 148
5.6.1 Justified Expectations -- 149
5.6.2 Different Types of Defects -- 151
5.6.3 An Independent Expectation for the Automated Vehicle -- 153
5.6.4 The Time When the Product Was Put Into Circulation -- 155
5.7 The Defences of the Producer -- 155
5.7.1 The Existence of the Defect at the Moment the Product Was Put Into Circulation -- 156
5.7.2 The Development Risk Defence -- 159
5.8 Conclusion -- 162
Epilogue: Consequences of the Proposed Derogation from the Development Risk Defence -- 164
6 On Automated Driving, Type-approval, Road Authorities and Liability: a Dutch Example -- 167
6.1 Introduction -- 168
6.2 Type-approval -- 168
6.3 The Liability of the Road Authority: a Dutch Example -- 168
6.3.1 An Example -- 168
6.3.2 The Liability of a Road Authority Under Dutch Tort Law -- 169
6.3.3 The Influence of the Type-approval -- 169
6.4 Conclusion -- 170
Epilogue: (Type-)approval and Liability Risks -- 171
7 Conclusion -- 177
7.1 Main findings -- 177
7.1.1 The Geneva Convention and Vienna Convention Are Not Compatible With Automated Driving -- 177
7.1.2 Software should be a Product within the Meaning of the EU Product Liability Directive -- 178
7.1.3 Two Defences of the Producer Lead To Undesirable Results -- 178
7.1.4 The Influence Of The (Type-)approval Of A Vehicle On Liability Risks Will Increase -- 179

7.2 Additional Findings ---------- 182
7.3 Further Research: The Road Ahead ---------- 183
Table of Cases ---------- 185
Table of Treaties, Instruments, and Legislation ---------- 187
Bibliography ---------- 191
Summary ---------- 225
Samenvatting ---------- 233

1 Introduction

1.1 The Coming Collision Between Automated Vehicles and the Law

Road traffic is on the verge of a new technology: automated driving. In the coming years or decades,[1] the driver will be replaced by an automated system which takes over the driving task. Drivers will no longer have to drive, but rather can divert their attention to other activities. Automated vehicles can come in all shapes and sizes. Tests are taking place with, for instance, self-driving vehicles moving cargo[2] or small buses bringing multiple people from a station to a hospital.[3] Cars can become mobile meeting rooms, hotel rooms, or even gyms. All of this is part of developments to offer mobility to everyone and to make travelling easier whilst bringing down pollution and increasing road safety. Automated vehicles are expected to contribute to all of these goals. For instance, by making a human driver superfluous, automated vehicles could be used by people currently unable to drive (such as children and people with physical impairments).[4] Additionally, there could possibly be a positive impact on the environment, because of ride-sharing and the reduction in distance between vehicles.[5]

---

[1] See for an overview of the predictions of multiple vehicle manufacturers Jon Walker, 'The Self-Driving Car Timeline – Predictions from the Top 11 Global Automakers' (*Emerj.com,* 14 May 2019) <https://emerj.com/ai-adoption-timelines/self-driving-car-timeline-themselves-top-11-automakers/> accessed 1 August 2019.

[2] See for instance Volvo, 'Vera' <www.volvotrucks.com/en-en/about-us/automation/vera.html> accessed 30 July 2019.

[3] See for instance 'Proef met zelfrijdend busje in Scheemda wordt verlengd' (*provinciegroningen.nl,* 13 May 2019) <www.provinciegroningen.nl/actueel/nieuwsartikel/proef-met-zelfrijdend-busje-in-scheemda-wordt-verlengd/> accessed 30 July 2019.

[4] See for instance Srikanth Saripalli, 'Are self-driving cars the future of mobility for disabled people?' (*The Conversation online*, 6 October 2017) <http://theconversation.com/are-self-driving-cars-the-future-of-mobility-for-disabled-people-84037> accessed 30 July 2019; and Ashley Halsey, Michael Laris, 'Blind man sets out alone in Google's driverless car' (*Washington Post online*, 13 December 2016) <www.washingtonpost.com/local/trafficandcommuting/blind-man-sets-out-alone-in-googles-driverless-car/2016/12/13/f523ef42-c13d-11e6-8422-eac61c0ef74d_story.html?noredirect=on&utm_term=.25d3bbde7b7a> accessed 30 July 2019.

[5] Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167, 171; Chris Urmson,William Whittaker, 'Self-Driving Cars and the Urban Challenge'(2015) 23(2) IEEE Intelligent Systems 66; Jeffery B. Greenblatt, Susan Shaheen, 'Automated Vehicles, On-Demand Mobility, and Environmental Impacts' 2(3) Current Sustainable/Renewable Energy Reports 74.

However, the main reason to take the driver out of the loop is road safety: in over 90% of road accidents a human fault has contributed to or caused the accident.[6] Automated vehicles are expected to reduce that number dramatically.[7] An automated vehicle does not get distracted, intoxicated or tired. It has 360 degree vision and responds quicker to events than humans are capable of. Automated vehicles have a faster reaction speed,[8] and the sensors of an automated vehicle do not have to adjust to changing lighting conditions in the way human eyes have to.[9]

As amazing as this may sound, traffic accidents will not become confined to the past. Automated vehicles will have limitations regarding which roads they can be used on and their use could be limited to certain weather conditions.[10] Technical issues occur appear, such as a failing sensor, and software issues can arise. Besides all of this, an automated vehicle is also at risk of being hacked.[11] So although automated vehicles are expected to be safer than human drivers, unfortunately road accidents will not be avoided entirely. As a consequence, legal questions regarding liability will rise, as well as legal questions concerning traffic laws. For instance, who is liable for damage caused by an automated vehicle? And does an automated vehicle need to obey the same traffic rules as a human driver?

---

[6] Santokh Singh, 'Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey' (National Highway Traffic Safety Administration February 2015) <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115> accessed 1 May 2019.
[7] See for instance the US National Highway Traffic Safety Administration's (NHTSA) safety expectations: at National Highway Traffic Safety Administration, 'Automated Vehicles for Safety' <www.nhtsa.gov/technology-innovation/automated-vehicles-safety> accessed 4 July 2019); Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167, 169-170, 173.
[8] Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167, 169.
[9] Werner Möhler, Jochen Buck, Christoph Müller, 'Technische Fragestellungen' in Jochen Buck, Helmut Krumbholz (eds), *Sachverständigenbeweis im Verkehrsrecht: Unfallrekonstruktion, Biomechanik, Messtechnik, Bildidentifikation, Alkohol und Drogen* (Nomos 2013) 44-7.
[10] Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167, 169-170, 177.
[11] Something which has already been done with a conventional vehicle back in 2015: Andy Greenberg, 'Hackers remotely kill a Jeep on the highway – with me in it' (*Wired*, 21 July 2015) <www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/> accessed 4 July 2019. See also Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167, 177-178.

To answer these and other legal questions, a good understanding of the technology of automated vehicles, the risks and benefits is necessary. This will be explored in sections 1.2-1.4. Next, the main research questions and several sub-questions are discussed in section 1.5. Furthermore, the delimitation and methodology of this research are described in sections 1.6 and 1.7. The legal framework is discussed in section 1.8. Finally, the structure of this thesis is set out in section 1.9.

1.2 Technology, Terminology and Taxonomy

When it comes to automated driving, numerous terms have been used by scholars, the media, and producers. Terms such as self-driving car, autonomous vehicle or automated vehicle are being used to describe vehicles with different capabilities. In recent years, there has been a development in terms used to describe the different levels of automation of vehicles. This development is reflected in the terms used in the papers that form the chapters of this thesis. Which term is used is clearly stated in each chapter. In this introduction, the term 'automated vehicle' is used for a vehicle which is able to completely drive by itself without human interference. In other words: the term 'automated vehicle' is used to describe a so-called SAE Level 5 vehicle.

Back in 2014, the SAE (Society of Automotive Engineers) issued a standard on taxonomy and definitions concerning the capabilities of automated vehicles, thereby providing more clarity.[12] This standard has seen some revisions, most recently in 2018. Other institutions, such as the US National Highway Traffic Safety Administration (NHTSA)[13] and the German Bundesanstalt für Straßenwesen (BASt),[14] have, in recent years, also published overviews of definitions and of the different degrees of automation of vehicles. The SAE Levels, however, are more widely known and used, and are therefore used in this research. The SAE makes a distinction between six different levels of automation, explaining which part of the dynamic driving task is performed by the human driver or by the automated driving system. The dynamic driving task entails all of the real-time operational and tactical functions

---

[12] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018).
[13] National Highway Traffic Safety Administration, 'Preliminary Statement of Policy Concerning Automated Vehicles' (2013) 4ff. The NHTSA now also uses the SAE Levels, see National Highway Traffic Safety Administration, 'Automated Vehicles for Safety' <www.nhtsa.gov/technology-innovation/automated-vehicles-safety> accessed 4 July 2019.)
[14] Tom M Gasser (Projektgruppenleitung) and others, 'Bericht zum Forschungsprojekt F1100.5409013.01 des Arbeitsprogramms der Bundesanstalt für Straßenwesen: Rechtsfolgen zunehmender Fahrzeugautomatisierung' (Bundesanstalt für Straßenwesen 2012) 9ff.

required to operate a vehicle; such as longitudinal and lateral motion control, monitoring the environment, responding to objects and events, and manoeuvre planning. It does not include actions such as trip scheduling and selecting a destination.[15] The automated driving system is the combination of hardware and software that enable the vehicle to perform the entire dynamic driving task.[16] As shown in Table 1, at the lower SAE Levels of Automation, the automated driving system is unable to perform all parts of the dynamic driving task.

[15] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018) 6-7.
[16] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018) 3.

Level 0	• no driving automation • the human driver needs to perform the entire dynamic driving task
Level 1	• driver assistance • a system is capable of performing a subtask of the dynamic driving task, namely either the longitudinal or lateral vehicle motion control. The remainder of the dynamic driving task is performed by the driver
Level 2	• partial driving automation • a system performs both the longitudinal and lateral vehicle motion control, whilst the remainder of the dynamic driving task is performed by the driver

Table 1. *The three lower SAE Levels of Automation.*[17]

[17] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018).

At SAE Level 3, a significant change takes place.[18] At all other levels than the lowest two, the automated driving system of the vehicle is capable of performing the entire driving task. In the case of an SAE Level 3, and as shown in Table 2, the system can only do so under specific conditions (on specific roads, under specific weather conditions etc.), which define the so-called operational design domain.

Level 3	• conditional driving automation • the automated driving system can perform the entire dynamic driving task within its operational design domain. The user is receptive to a request to intervene and can do so in a timely manner. He is expected to resume the performance of the dynamic driving task when requested.
Level 4	• high driving automation • there is no longer an expectation that the user will resume the performance of the dynamic driving task when requested. The automated driving system performs the entire dynamic driving task within a specific operational design domain, for instance on a highway. The automated driving system can achieve a minimal risk condition when necessary
Level 5	• full driving automation • the automated driving system performs the entire dynamic driving task under all driver-manageable road conditions within its region of the world. So, the automated driving system no longer has a specific operational design domain in which it can function. The automated driving system can also achieve a minimal risk condition and there is no expectation that a user will intervene.

Table 2. *The three higher SAE Levels of Automation.*[19]

The emphasis of this research lies on SAE Level 5 vehicles. Terms like self-driving car, autonomous vehicle and automated vehicle will be used to discuss a SAE Level 5

[18] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018) 21-26.
[19] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018).

vehicle which is fully automated and can drive independently, without human interference.

In identifying the legal challenges that automated driving poses, assumptions need to be made. This is necessary as automated vehicles, SAE Level 5, are not yet deployed on public roads and the exact form in which automated vehicles will be deployed on public roads in the future is uncertain. In this research, the assumption is made that an SAE Level 5 automated vehicle is feasible. This automated vehicle will not have the conventional controls of a conventional vehicle, such as a brake pedal, steering wheel etc. The vehicle could be equipped with an emergency brake, but no other means for the user or passengers to directly influence the driving behaviour of the vehicle will be available. The automated vehicle will be able to function without human interference. A user will only need to determine the destination of the trip before driving off and undertaking other activities during the trip. By taking the driver out of the loop, road safety is expected to benefit.

1.3 Safety Expectations

Automated driving is seen as a technology that has the potential to save many lives. In 2016, over 3600 persons died every single day on the world's public roads, amounting to 1.35 million lives lost.[20] This number has been steadily increasing.[21] A number of European countries have also observed this increase.[22] In the Netherlands, for instance, 2018 saw a substantial increase in the number of road fatalities, up 11% when compared to the previous year.[23] Road traffic safety is of global concern. The United Nations has made road safety part of their Sustainable Development Goals. Sustainable Development Goal 3 on ensuring healthy lives and promoting well-being for all at all ages includes Target 3.6, which reads: "By 2020, halve the number of

[20] World Health Organization, 'Global Status Report on Road Safety 2018' (2018) <www.who.int/violence_injury_prevention/road_safety_status/2018/en/> accessed 1 May 2019, 2.

[21] See for instance World Health Organization, 'Global Status Report on Road Safety, 2015' (2015) <www.who.int/violence_injury_prevention/road_safety_status/2015/en/> accessed 18 April 2017, 2; and World Health Organization, 'Global Status Report on Road Safety, 2018' (2018) <www.who.int/violence_injury_prevention/road_safety_status/2018/en/> accessed 1 May 2019, 2. However, given the population growth, the number of road traffic fatalities relative to the size of the population has been stable: World Health Organization, 'Global Status Report on Road Safety, 2018' (2018) <www.who.int/violence_injury_prevention/road_safety_status/2018/en/> accessed 1 May 2019, 2.

[22] European Transport Safety Council, 'Road deaths in the European Union – latest data' <https://etsc.eu/euroadsafetydata/> accessed 29 July 2019.

[23] SWOV, 'Road deaths in the Netherlands' (SWOV Fact sheet, 18 April 2019) <www.swov.nl/en/facts-figures/factsheet/road-deaths-netherlands> accessed 29 July 2019.

global deaths and injuries from road traffic accidents."[24] This target is part of the Decade of Action for Road Safety 2011-2020.[25] The World Health Organization formulated a plan for this Decade of Action.[26] One of the activities identified in this plan is the encouragement of the universal deployment of improved vehicle safety technologies through, among other things, providing incentives to accelerate the uptake of new technologies.[27] New technologies are also identified by the European Union as a means to improve road safety and contribute to the so-called Vision Zero.[28] Vision Zero is the aim of the EU to reduce road fatalities to zero by 2050.[29] Automated vehicles are anticipated to help contribute towards achieving this goal, as it is expected to increase road safety by eliminating the human error that contributes to over 90% of accident causes.[30] However, this is an expectation, and as yet it has not been proven whether, and to what extent, automated vehicles s will decrease the number and severity of accidents and increase road safety.[31] It is, however, widely

---

[24] United Nations, 'Sustainable Development Goal 3' <https://sustainabledevelopment.un.org/sdg3> accessed 30 July 2019.

[25] United Nations Road Safety Collaboration, 'Decade of Action for Road Safety 2011-2020 seeks to save millions of lives' (*World Health Organization*) <www.who.int/roadsafety/decade_of_action/en/> accessed 30 July 2019.

[26] World Health Organization, 'Global Plan for the Decade of Action for Road Safety 2011-2020' (*World Health Organization* 2011) <www.who.int/roadsafety/decade_of_action/plan/plan_english.pdf?ua=1> accessed 30 July 2019.

[27] World Health Organization, 'Global Plan for the Decade of Action for Road Safety 2011-2020' (*World Health Organization* 2011) <www.who.int/roadsafety/decade_of_action/plan/plan_english.pdf?ua=1> accessed 30 July 2019, 15.

[28] European Commission, 'Annex 1: 'Strategic Action Plan on Road Safety' COM (17 May 2018) 293 final 5-6; European Commission, 'On the road to automated mobility: An EU strategy for mobility of the future' (Communication from the Commission) COM (2018) 283 final; Declaration of Amsterdam on Cooperation in the field of connected and automated driving, 14-15 April 2016, available at <https://english.eu2016.nl/documents/publications/2016/04/14/declaration-of-amsterdam> accessed 11 April 2017 (Declaration of Amsterdam 2016).

[29] European Commission, 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' (white paper) COM (2011) 144 final, 10. See also European Commission, 'Annex 1: 'Strategic Action Plan on Road Safety' COM (17 May 2018) 293 final.

[30] Santokh Singh, 'Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey' (National Highway Traffic Safety Administration February 2015) <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115> accessed 1 May 2019; National Highway Traffic Safety Administration, 'Automated Vehicles for Safety' <www.nhtsa.gov/technology-innovation/automated-vehicles-safety> accessed 4 July 2019; and Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167, 169-170, 173.

[31] See for instance Michael Sivak and Brandon Schoettle, 'Road Safety with Self-Driving Vehicles: General Limitations and Road Sharing with Conventional Vehicles' (The University of Michigan

assumed that automated vehicles will significantly improve road safety and bring down the number of road traffic fatalities.[32]

1.4 Changing Roles and Effects

Different parties are involved in the development, deployment and use of automated vehicles. Some of these parties are unknown to conventional vehicles, others are not.

Automated vehicles are, like any vehicle, produced by one or more *producers*. Besides the producer of the vehicle as a whole, there will probably be several other producers providing different parts, such as the sensors or cameras, or the software of the vehicle. As the driving task will no longer be performed by a human driver but by the automated driving system, the liability risks of each of these producers might change.

Although an automated vehicle will have an *owner* just like a conventional vehicle, it is likely that ownership will change with the changes expected in mobility. Owners will likely be *fleet operators* themselves, or they could hire a fleet operator to manage an entire fleet of automated vehicles for them. These vehicles can be rented out to consumers, either for an entire trip or as the so-called last mile solution. This last mile solution should bridge the gap between public transport and the last mile or so from, for instance, the train station to the final destination.

An automated vehicle will, just like a conventional vehicle, have *passengers*. There will be passengers using an automated vehicle privately, or passengers sharing an automated bus to bring them from a train station to their destination. Whether an automated vehicle will have a driver, however, is very much debated in the legal field. It is usually fairly easy to identify who is the driver of a conventional vehicle: often times this is the person with their hands on the wheel, feet by the pedals and sitting in the driver's seat. It becomes much more difficult to identify the driver of an SAE Level 5 vehicle, as this vehicle might not be equipped with these controls and performs the driving task itself. This development gives rise to the question whether

---

Transportation Research Institute, Ann Arbor, January 2015) <https://deepblue.lib.umich.edu/bitstream/handle/2027.42/111735/103187.pdf?sequ> accessed 1 May 2019.

[32] See for instance for the European Commission, 'Annex 1: 'Strategic Action Plan on Road Safety' COM (17 May 2018) 293 final and Declaration of Amsterdam 2016; see for the US: US Department of Transportation, 'Preparing for the Future of Transportation: Automated Vehicles 3.0' (Policy initiative, October 2018) <www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf> accessed 1 May 2019.

an automated vehicle even has a driver. Therefore, the person using the vehicle and activating its automated driving system will be referred to as *user*.

Automated vehicles could be driving down public roads in the future. So they will also have to interact with other *road users*. These other road users could be the drivers of conventional vehicles, cyclists, pedestrians etc. How the interaction between these different road users and automated vehicles will take place is subject to research, as the common forms of interaction, like hand gestures, are impossible for automated vehicles. The interaction between road users and automated vehicles could take on various forms in the future. Prototypes of automated vehicles have been shown equipped with a sign, telling a pedestrian it is safe to cross the road, or light effects indicating the next action of the vehicle to cyclists.[33]

What is also subject to research is the necessity of communication between the automated vehicle and the infrastructure.[34] Road side units (RSU's) could provide the vehicle with information on the condition of the road, congestion, road works or weather, for example.[35] Whether and to what extent this form of communication is necessary for an automated vehicle is at the moment of writing uncertain. The *road authority*, regardless of whether this communication with the infrastructure will be developed, will see its role changing with the arrival of automated vehicles. Automated vehicles will need a different infrastructure than human drivers driving conventional vehicles. For instance, automated vehicles could depend on the lane markings in order to establish their position on the road. Whereas human drivers are able to work with somewhat worn-down lane markings, this could prove unmanageable for an automated vehicle that might not be able to 'see' or correctly identify these worn-down lane markings as lane markings. Road authorities will have to take these developments into account and change (the maintenance of) the infrastructure accordingly.

[33] See for example <www.drive.ai/> accessed 14 June 2019; Daimler, 'Automated Driving: How do we develop trust between humans and machines?' <www.daimler.com/innovation/case/autonomous/future-insight-2.html> accessed 14 June 2019.
[34] It is uncertain if and to what extent automated vehicles will rely on communication with the infrastructure (V2I), communication with other vehicles (V2V) or communication with another entity (for instance a pedestrian) (V2X). Therefore, this is not further explored in this research.
[35] See for instance the C-ITS Corridor project: Rijkswaterstaat, 'C-ITS Corridor project' <https://itscorridor.mett.nl/home+_eng/c-its+corridor_eng/default.aspx> accessed 14 June 2019.

Vehicle authorities will also see a change in their role. Under current EU legislation,[36] a vehicle – which includes an automated vehicle – will need to be approved by a vehicle authority of an EU Member State for it to be allowed on public roads in all Member States. Software-updates making substantial changes to the behaviour of a vehicle will need to be assessed and approved by a vehicle authority.[37] Therefore, the vehicle authority will still play a role long after the automated vehicle itself has been approved. The technical requirements set for a motor vehicle will also need to be rewritten or added to with the development of automated vehicles.

1.5 Research Question

As already briefly touched upon, the development of automated vehicles gives rise to many legal questions.[38] These questions concern many different legal aspects, as shown by Table 3.

[36] 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.
[37] Art. 13 ff 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.
[38] See for instance the policy and regulatory needs ERTRAC, a European technology platform, has identified: ERTRAC, 'Connected Automated Driving Roadmap' (Version 8, 8 March 2019)<www.ertrac.org/uploads/documentsearch/id57/ERTRAC-CAD-Roadmap-2019.pdf> accessed 1 May 2019, 47-48.

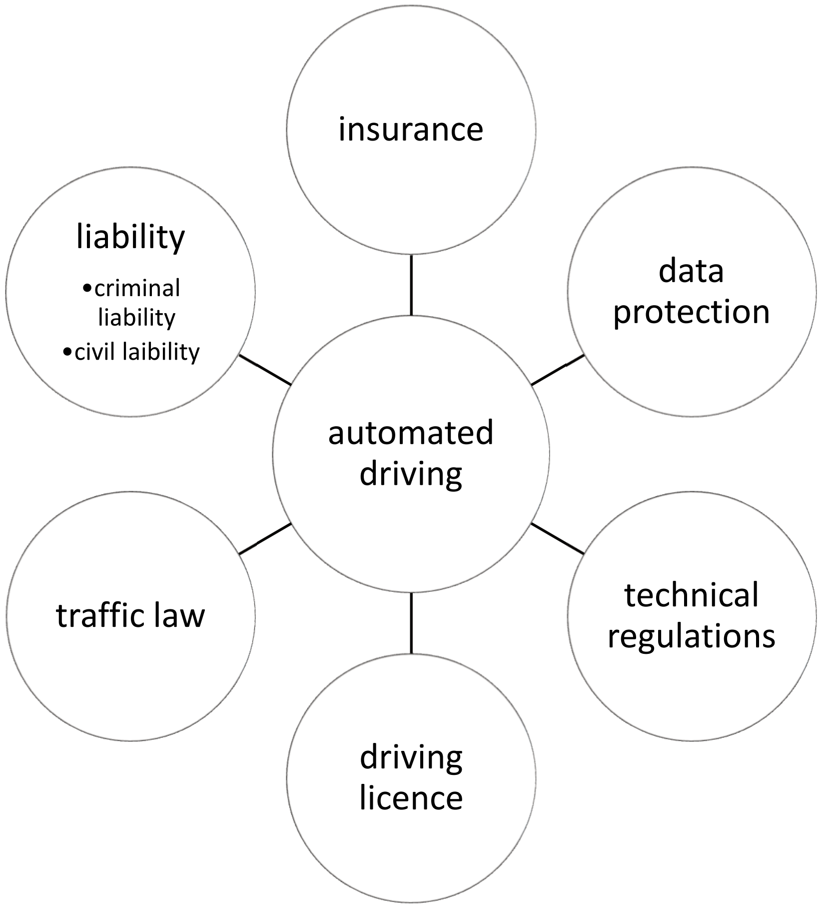

Table 3. *Different legal aspects involved in automated driving.*

Answering all those questions goes beyond the scope of one PhD research. This research focuses on two fields concerning the most pressing questions: traffic law and civil liability. These two fields can make or break the development of automated driving: if traffic laws do not accommodate automated driving, automated vehicles will not be allowed on public roads and if the questions regarding civil liability are not answered it is unlikely consumers will accept automated vehicles.[39] The central research question reads:

Are legislative measures concerning traffic laws and civil liability needed in order to facilitate the deployment of self-driving cars on public roads within the EU, and if so, which legislative measures concerning traffic laws and civil liability should be taken?

[39] Johanna Zmud, Ipek N Sener, Jason Wagner, 'Consumer Acceptance and Travel Behavior Impacts of Automated Vehicles' (Texas A&M Transportation Institute, January 2016) 15, 56.

A series of sub-questions need to be answered in order to come to an answer to this central question. These sub-questions require the more in-depth exploration of the legal issues of the specific field.

1. *Which legislative measures are already undertaken by legislators in California (USA), the United Kingdom and the Netherlands?*
   To identify the key legal issues, an overview of the legislative steps undertaken by several governments is discussed first. These steps include the regulatory framework for trials of automated vehicles on public roads, as well as preparatory documents on revising legislation in different jurisdictions in order to accommodate automated driving.
2. *Does an automated vehicle have a driver within the meaning of the Geneva Convention on Road Traffic 1949 and the Vienna Convention on Road Traffic 1968, and if not, how can these Conventions be revised to accommodate automated vehicles?*
   The Geneva Convention and the Vienna Convention are of great importance globally: countries that are party to these Conventions need to bring their national traffic laws in to compliance with the Conventions. The notion of *driver* is central to both Conventions. It is studied whether an automated vehicle has a driver within the meaning of the Geneva Convention and Vienna Convention. Several options to revise the Conventions in order to accommodate automated driving are explored.
3. *Which stakeholder should have a duty to prevent an automated vehicle with a safety-critical defect from participating in road traffic?*
   This sub-question pertains to the role of different stakeholders. The role of the user, the owner and/or fleet operator, the producer and the vehicle authority are explored.
4. *If an automated vehicle causes damage because of a 'learning error' of the self-learning software of the vehicle, or by a glitch in a software update, can the producer of the automated vehicle be held liable for this damage under the Product Liability Directive?*
   If, despite any precautions, an automated vehicle has caused damage, the question arises if the producer of the automated vehicle can be held liable for that damage if a problem with the vehicle has been the cause of the accident.

The EU Product Liability Directive[40] does not offer certainty on whether or not software is a product within the meaning of the Directive. Therefore, the legal position of the producer is uncertain.

5. *What influence has the deployment of automated vehicles on the liability risks of the road authority*?
   The liability of the road authority is discussed on the basis of a Dutch example. Automated vehicles will be dependent on different infrastructure than human drivers and conventional vehicles, subsequently changing the liability risks for the road authorities in charge of the infrastructure and its maintenance.

These questions cover two of the main legal hurdles for deploying automated vehicles: traffic laws and tort law. These are questions that need to be dealt with in order to make deployment legally possible (traffic laws) and to provide clarification on who is liable when an automated vehicle causes damage (tort law), thereby encouraging adoption by the general public.[41] The discussed questions cover the most pressing issues, but not all legal questions concerning automated driving.

1.6 Delimitations of Research

As described above, there are many legal questions surrounding automated driving. Given the length and timeframe for this research, it is impossible to answer every single question. Therefore, some questions will not be discussed in this thesis.

When it comes to discussing the Geneva Convention and the Vienna Convention, the notion of 'driver' in the traffic rules of both Conventions is central as it is an important stumbling block for the deployment of automated vehicles (sub-question 2). Both Conventions also cover driving permits (Chapter IV Geneva Convention and Chapter V Vienna Convention). However, the question whether driving permits should still be necessary for those using automated vehicles will not be explored in this thesis, as this depends highly on the technical capabilities of the vehicles and is more a political than a legal question.

---

[40] 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.

[41] Eva Fraedrich, Barbara Lenz, 'Societal and Individual Acceptance of Autonomous Driving' in: Maurer and others (eds), *Autonomous Driving* (Springer 2016). 632; Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167, 179-180.

Technical regulations will need an extensive overhaul as they are written for conventional vehicles with conventional drivers.[42] How they should be revised is mainly a technical matter, not so much a legal one. Therefore, this topic is not covered in this research.

Automated driving gives rise to moral dilemmas (see for example Image 1). In a situation in which it is impossible for an automated vehicle to avoid an accident and result in casualties, the question rises as to whose lives it should save.[43] Although these are interesting dilemmas, it goes beyond the scope of this research to discuss them in-depth.

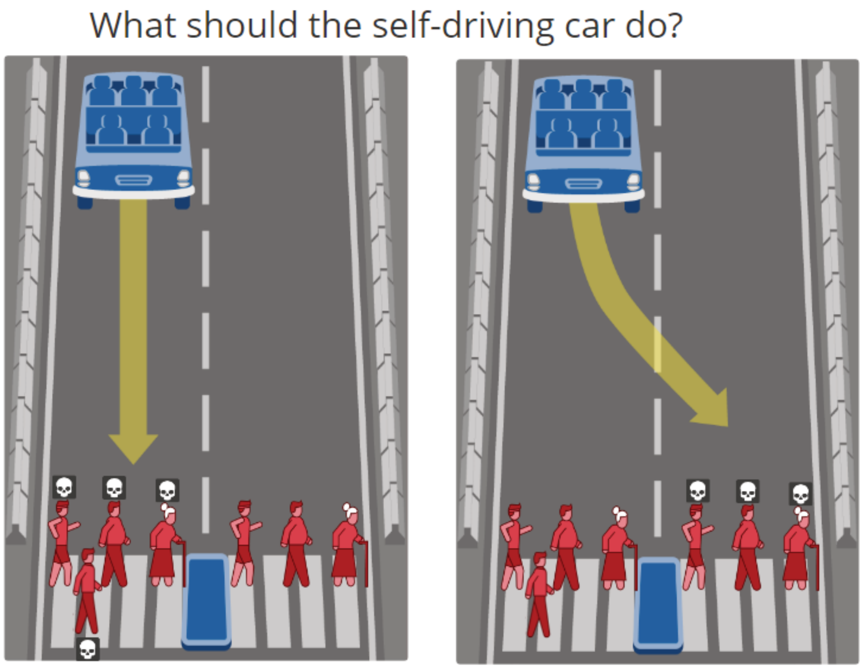

Image 1. *Screenshot from moral dilemma of the MIT Moral Machine.*[44]

Fault-based liability for damage caused by an automated vehicle is briefly discussed in answering sub-question 3 (Which stakeholder should have a duty to prevent an automated vehicle from participating in road traffic with a safety-critical defect?). This research will provide an indication on how users of an automated vehicle should

[42] See for instance United Nations Economic and Social Council, ‘Framework document on automated/autonomous vehicles’ (15 April 2019) UN Doc ECE/TRANS/WP.29/2019/34 of Working Party 29, responsible for harmonization of vehicle regulations.
[43] See Massachusetts Institute of Technology, ‘Moral Machine’ <http://moralmachine.mit.edu/> accessed 19 August 2019; and Edmond Awad and others, ‘The Moral Machine experiment’ (2018) 563 Nature volume 59.
[44] Massachusetts Institute of Technology, ‘Moral Machine’ (screenshot) <http://moralmachine.mit.edu/> accessed 19 August 2019.

behave and which duties they have. Fault-based liability is not explored at great depth as it is expected that there will be a shift from fault-based liability of the driver to risk-based liability of the producer of automated vehicles.[45] Damage caused by automated vehicles is more likely to be caused by a problem with the hardware or software of the automated vehicle than by a person using the vehicle, as that person will only have very limited means to influence the driving behaviour of the vehicle (e.g. an emergency brake). Therefore, the emphasis of this research lies on the strict liability of the producer of the automated vehicle under the Product Liability Directive.

In addition, matters of insurance will only be briefly touched upon. The development of automated vehicles has given rise to questions on new or different frameworks of insurance.[46] The length and scope of this thesis is not suitable for the necessary in-depth research into all aspects of insurance. Therefore, the topic will only be touched upon briefly.

Another important matter is data protection. Automated vehicles could gather as much as 1 terabyte of data a day.[47] Vehicle data, such as speed, brake power and steering can be monitored. New technological developments make it possible to also track heartrate, eye movements etc. of the persons using a vehicle, which raises new questions concerning the protection of the data of the users of automated vehicles, particularly SAE Levels 2-4. This is where the interests of road safety and data protection could collide: if, for instance, a sensor tracking the eye movements of the driver picks up that the driver is falling asleep, the vehicle could interfere by parking itself at the side of the road. This requires an extensive research, but given the length of this thesis it will be limited to an initial exploration of the legal challenges

---

[45] Gerhard Wagner, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707, 708-709; Kiliaan APC van Wees, 'Voertuigautomatisering en productaansprakelijkheid' (2018) 4 Maandblad voor Vermogensrecht 112-113; Jan De Bruyne and Jochen Tanghe, 'Liability for Damage Caused by Autonomous Vehicles: A Belgian Perspective' (2017) 8(3) Journal of European Tort Law 324, 348.
[46] See for instance Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability' (2015) 31(4) Computer Law & security Review 506, para 4.2.5; Van Wees, Vellinga and Vellinga in Van den Acker, 'Visies op de autonome auto', (2015) 63 Verkeersrecht; Kiliaan APC van Wees, 'Zelfrijdende auto's, aansprakelijkheid en verzekering; over nieuwe technologie en oude discussies', (2016) (2) Tijdschrift voor Vergoeding Personenschade 29.
[47] Leslie Hook, 'Driverless cars: mapping the trouble ahead' (*Financial Times*, 21 February 2018) <www.ft.com/content/2a8941a4-1625-11e8-9e9c-25c814761640> accessed 4 July 2019; Stan Dmitriev, 'Autonomous cars will generate more than 300 TB of data per year' <www.tuxera.com/blog/autonomous-cars-300-tb-of-data-per-year/>accessed 4 July 2019.

regarding the processing of data concerning health by the automated vehicle as this concerns data of which it has previously not been possible to gather on such a scale.

1.7 Sources and Methodology

This research requires a good understanding of the field of automated driving. Many articles, policy papers and conference attendances have provided a solid understanding of the technical developments and constrains. Against this technical backdrop, this research comprises of a doctrinal analysis of legislation, case law, legal literature and preparatory legislative documents.[48] Both digital and non-digital sources have been consulted. Depending on the sub-question, different sources from different jurisdictions are of more importance to that specific part of the research.

To develop understanding of the technology needed for automated vehicles and its impact on society, many articles and reports were studied. Essential to developing this understanding was the attendance of a number of international conferences which focussed on all aspects of automated driving, such as the Transport Research Arena 2018 and the ITS (Intelligent Transport Systems) World Congress 2018. These conferences have also offered the indispensable opportunity to speak to experts in the field, to deepen understanding of the topic. This has proven to be essential for answering all the research questions.

The first research sub-question, which concerns the status of the legal developments regarding automated driving, is answered by studying primary sources from different jurisdictions (California (USA), the United Kingdom and the Netherlands).[49] These jurisdictions have been selected on the basis of their efforts to accommodate the (testing of) automated vehicles in their legal system and their different legal approaches to accommodating the (testing of) automated vehicles. Policy documents, journal articles etc. are reviewed as well, in order to give an apt overview of the legal developments at the moment of writing, but also to shed light on planned legal developments. This part of the research is of a descriptive nature, as it outlines

---

[48] Terry Hutchinson, Nigel Duncan, 'Defining and describing what we do: doctrinal legal research' (2012) 17(1) Deakin law review 83, 110ff; Ian Dobinson and Francis Johns, 'Law as Qualitative Research' in: Mike McConville, *Research Methods for Law* (Edinburgh University Press 2017) 20ff; J.B.M. Vranken, '*Mr. C. Assers Handleiding tot de beoefening van het Nederlands Burgerlijk Recht. Algemeen Deel****.* Een synthese' (Kluwer 2014) 2014/8.

[49] Konrad Zweigert, Hein Kötz, *Introduction to Comparative Law. Volume 1 – The Framework* (second revised edition, Clarendon Press 1987) 28ff.

the existing legal developments that are of relevance to answering the other sub-questions. It identifies common legal challenges.

Concerning the sub-question relating to the Geneva Convention and Vienna Convention, this research follows a functional approach and is reform-oriented.[50] In establishing whether an automated vehicle has a driver within the meaning of the Conventions, Dutch and German case law will be studied as well as discussion papers of Working Party 1, which is responsible for keeping both Conventions up-to-date, and other literature on the matter. A solution for the problem arising from the Geneva and Vienna Convention is searched for in international maritime and aviation traffic laws, as well as a national legal system: Dutch criminal law (analogy).[51] This way, the best solution to the problem will be identified, providing a proposal for a revision of the Conventions.[52]

The last three research questions will be studied through doctrinal research. [53] For the third sub-question, international literature and case law are reviewed. Using examples from Dutch case law, the effects of assigning a duty of care to a party are explored.

Case law does not provide much support for answering the fourth sub-question. This sub-question evolves around the status of software under the Product Liability Directive. Although there is an established body of case law on matters concerning the Product Liability Directive, there is not a body of case law specifically on the status of software under the Directive. Therefore, legal literature will be the main source for this part of the research. This review of literature will contribute to establishing the status of software under the Product Liability Directive and the role of both the software producer and the producer of the entire automated vehicle.

For the fifth and final sub-question, an example from Dutch law is used to indicate the growing influence of the (type-)approval of automated vehicles on the liability

---

[50] Konrad Zweigert, Hein Kötz, *Introduction to Comparative Law. Volume 1 – The Framework* (second revised edition, Clarendon Press 1987)28ff; Ian Dobinson and Francis Johns, 'Law as Qualitative Research' in: Mike McConville, *Research Methods for Law* (Edinburgh University Press 2017)22.
[51] Geoffrey Samuel, *An Introduction to Comparative Law Theory and Method* (Hart Publishing 2014) 67-68; Terry Hutchinson, Nigel Duncan, 'Defining and describing what we do: doctrinal legal research' (2012) 17(1) Deakin law review 83, 111.
[52] Ian Dobinson and Francis Johns, 'Law as Qualitative Research' in: Mike McConville, *Research Methods for Law* (Edinburgh University Press 2017) 22; Geoffrey Samuel, *An Introduction to Comparative Law Theory and Method* (Hart Publishing 2014) 67.
[53] Ian Dobinson and Francis Johns, 'Law as Qualitative Research' in: Mike McConville, *Research Methods for Law* (Edinburgh University Press 2017) 20ff.

risks of the road authority. Therefore, the research will comprise mainly of a study of the relevant Dutch case law and legal literature.

1.8 Legal Framework

This research entails questions concerning public law and private law. The legal instruments studied are therefore diverse, although all relevant to automated driving. The Conventions and Directive that are central to this thesis are the Geneva Convention on Road Traffic 1949, the Vienna Convention on Road Traffic 1968 and the so-called Product Liability Directive (Directive 85/374/EEC). In addition to these Conventions and the Product Liability Directive, four other legal instruments are discussed in this thesis.

1.8.1 Geneva Convention on Road Traffic 1949 and the Vienna Convention on Road Traffic 1968

Both the Geneva Convention on Road Traffic of 1949 and the Vienna Convention on Road Traffic of 1968 entail, among others, traffic rules that could form a legal hurdle for the deployment of automated vehicles. The Geneva Convention and the Vienna Convention are currently in force in many countries across the globe: 98 countries are party to the Geneva Convention,[54] while the Vienna Convention has 78 parties (some of which are also party to the Geneva Convention).[55] Those parties are obliged to bring their national laws in conformity with the rules of the road from the Convention(s) they are party to (art. 6 Geneva Convention, art. 3 Vienna Convention). Through the adoption of uniform traffic rules, the Conventions aim to promote international road traffic and to increase road safety.

Both Conventions have their roots in the beginning of the 20th century, when the call for easier cross-border traffic arose.[56] In 1909, only a year after the introduction of

[54] See United Nations Treaty Collection, 'List of Contracting Parties to the Convention on Road Traffic, Geneva, 19 September 1949 <https://treaties.un.org/Pages/ViewDetailsV.aspx?src=TREATY&mtdsg_no=XI-B-1&chapter=11&Temp=mtdsg5&clang=_en> accessed 27 June 2019.

[55] See United Nations Economic Commission for Europe, 'List of Contracting Parties to the Convention on Road Traffic, Vienna, 8 November 1968' (UNECE, 1 February 2007) <www.unece.org/fileadmin/DAM/trans/conventn/CP_Vienna_convention.pdf> accessed 27 June 2019.

[56] Frank Schipper, *Driving Europe: Building Europe on Roads in the Twentieth Century* (Amsterdam: Aksant 2008) 65.

the Ford Model T,[57] the International Convention on Motor Traffic was signed in Paris.[58] This Convention entailed, among other things, conditions for motor vehicles, conditions for drivers and an international travelling pass.[59] With an increase in motor vehicle traffic, several other Conventions followed.[60] By 1948 these Conventions were deemed obsolete, so the United Nations Economic and Social Council called for a Conference on Road and Motor Transport.[61] The result of this Conference was the Geneva Convention on Road Traffic of 1949. As time progressed, however, greater uniformity of national regulations regarding road traffic was deemed necessary.[62] This would require extensive amendments to the Geneva Convention, which was not possible under the amendment-procedure of the Convention.[63] Therefore, a new Convention was drafted and signed at Vienna on 8 November 1968. Nowadays, efforts are being made to accommodate automated driving under the Conventions.

So far, these efforts have led to the expansion of art. 8 of the Vienna Convention (the necessary majorities for the amendments to the Geneva Convention were not reached).[64] Art. 8(5) Vienna Convention, which states that every driver should at all times be able to control his vehicle, needed clarification in light of the rise in advanced driver assistant systems (ADAS) and, ultimately, fully automated vehicles. For that purpose, paragraph 5bis was added to art. 8, which states that ADAS can, under certain conditions, be in conformity with art. 8(5) Vienna Convention.

---

[57] Ford, 'Model T Facts' (*Ford.com*) <https://media.ford.com/content/fordmedia/fna/us/en/news/2013/08/05/model-t-facts.html> accessed 1 May 2019.

[58] Attachment email from Robert Nowak, UN, to author (1 June 2017). See also Ernst Hollander, 'International Traffic Law: Its Forms and Requirements' (1923) 17(3)The American Journal of International Law 470-488, 483-484. See for an extensive historical overview: Frank Schipper, *Driving Europe*: *Building Europe on roads in the twentieth century* (Amsterdam: Aksant September 2008).

[59] See for instance 'Convention with Respect to the International Circulation of Motor Vehicles' (1910) 4(4) The American Journal of International Law 316 ; US Department of Transportation, 'Workshop on Governance of the Safety of Automated Vehicles' (Summary Report) (2016) <www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/12837-workshop_on_governance_of_automated_vehicles_03062017_final_version-tag.pdf> accessed on 1 May 2019. See also Frank Schipper, *Driving Europe*: *Building Europe on roads in the twentieth century* (Amsterdam: Aksant September 2008) 65-67.

[60] For instance, the 1926 International Convention relating to Road Traffic.

[61] Attachment email from Robert Nowak, UN, to author (1 June 2017).

[62] Attachment email from Robert Nowak, UN, to author (1 June 2017).

[63] Attachment email from Robert Nowak, UN, to author (1 June 2017).

[64] ECE/TRANS/WP.1/2014/; United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 April 2014) UN Doc ECE/TRANS/WP.1/145; Economic Commission for Europe Inland Transport Committee (73rd Session) 'Automated Driving, Informal document No. 2' (11 July 2016).

Working Party 1 (WP.1), the body of the United Nations Economic Commission for Europe (UNECE) responsible for keeping the Geneva Convention and the Vienna Convention up-to-date, also adopted a Resolution on the deployment of highly and fully automated vehicles in road traffic.[65] Currently, WP.1 is also exploring which other activities a driver is allowed to engage in when the vehicle is (partially) driven by an automated system and the discussion on how to accommodate fully automated driving is developing further.[66]

1.8.2 Product Liability Directive

Another EU Directive studied in this research, more specifically for the fourth sub-question, is Directive 85/374/EEC on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products, or the Product Liability Directive, from 1985. This Directive establishes a strict liability for the producer of a defective product. The first draft of the Directive dates back from as early as 1974,[67] triggered by, among other things, the Thalidomide affair and the growing influence of American law on the development of product liability.[68] The Product Liability Directive aims to prevent divergences distorting competition and affecting the movement of goods within the common market as well as to prevent a differing degree of protection for the consumer against damage caused by a defective product to his health or property.[69]

The European Commission has published five reports on the application of the Directive.[70] The most recent report (2018) pays attention to the development of Artificial Intelligence (AI), which was reason to evaluate the Product Liability

---

[65] United Nations Economic and Social Council, 'Global Forum for Road Traffic Safety: resolution on the deployment of highly and fully automated vehicles in road traffic' (14 January 2019) UN Doc ECE/TRANS/WP.1/2018/4/Rev.3.
[66] See for instance United Nations Economic and Social Council, 'Report of the seventy-eighth session' (25-29 March 2019) UN Doc ECE/TRANS/WP.1/167.
[67] L Dommering-van Rongen, *Productaansprakelijkheid. Een rechtsvergelijkend onderzoek* (Kluwer 2000) 5ff. See also Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 420-470.
[68] Simon Whittaker, *The development of product liability* (Cambridge University Press 2010) 20ff; L Dommering-van Rongen, *Productaansprakelijkheid. Een rechtsvergelijkend onderzoek* (Kluwer 2000) 5.
[69] Recitals Product Liability Directive.
[70] European Commission, 'Liability of defective products' (*ec.europa.eu*) <https://ec.europa.eu/growth/single-market/goods/free-movement-sectors/liability-defective-products_en> accessed 12 July 2019.

Directive.[71] The evaluation shows that the status of software under the Product Liability Directive is unclear.[72] This important point is one of the topics discussed in this thesis.

1.8.3 International Regulations for Preventing Collisions at Sea of 1972 (COLREGS 1972)

As maritime traffic and legislation is familiar with a degree of automation of the tasks involved in sailing a ship (i.e. autopilot), maritime traffic law can offer inspiration on how to handle automation in road traffic law. Like the Convention on International Civil Aviation , which is discussed below, the International Regulations for Preventing Collisions at Sea of 1972 (COLREGS 1972) can provide solutions to the challenges posed by automated driving to the Geneva Convention and the Vienna Convention. Therefore, these instruments are studied in this thesis.

Well before international road traffic rules were deemed necessary, international rules on traffic at sea were in place. In the 19th century, several regulations were in place by the time the first International Maritime Conference was held in 1889.[73] This conference led to new regulations on the prevention of collisions at sea, the International Rules of 1897.[74] Several revisions followed, until in 1960 the number of ships equipped with radar had increased so substantially, that a provision concerning the conduct of vessels in restricted visibility was adopted at the Conference on Safety of Life at Sea in London in 1960.[75] This Conference was convened by the Inter-Governmental Maritime Consultative Organization (ICMO), which would later

[71] European Commission, '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, 1, 8-10.

[72] European Commission, 'Evaluation of Council Directive 85/374/EEC on the approximation of laws, regulations and administrative provisions of the Member States concerning liability for defective products FINAL REPORT' (January 2018) xii, 1-2, 6, 24, 36-39, 62, 65-67, 70-71, 76, 85. See also European Commission, 'Liability for emerging digital technologies' (Commission Staff Working Document) SWD (2018) 137 final, 10-11, 18.

[73] AN Cockcroft, LNF Lameijer, *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea* (Elsevier 2012) xi-xii.

[74] AN Cockcroft, LNF Lameijer, *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea* (Elsevier 2012) xi-xii; Raymond F Farwell, *Farwell's Rules of the Nautical Road* (United States Naval Institute 1959) 3.

[75] AN Cockcroft, LNF Lameijer, *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea* (Elsevier 2012) xi-xii. The developments around radar were already discussed in 1948: Raymond F Farwell, *Farwell's Rules of the Nautical Road* (United States Naval Institute 1959) 10-11.

become the International Maritime Organization (IMO).[76] The 1960 Collision Regulations were replaced by the COLREGS 1972.[77] These COLREGS are still in force today. They will be discussed in chapter 3 of this thesis.

1.8.4 Convention on International Civil Aviation (Chicago Convention)

There are also international "rules of the road" for the sky. Aviation is, just like maritime traffic, familiar with a certain degree of automation (i.e. autopilot). Therefore, aviation traffic law, more specifically the Convention on International Civil Aviation is studied in this research as it illustrates how a degree of automation in traffic can be accommodated in legislation. The Convention on International Civil Aviation, known as the Chicago Convention, dates back to 1944. Technical developments in aviation during the First and Second World War had opened up the possibilities of civil aviation.[78] During the Second World War, 55 states convened in Chicago to agree on the Chicago Convention.[79] They also decided on establishing the International Civil Aviation Organization (ICAO), later a specialised agency of the United Nations, which manages the Chicago Convention and formulates Standards and Recommended Practices (so-called SARPs) to enhance safety.[80] The first Standards and Recommended Practices relating to Rules of the Air, which entailed traffic rules, were adopted in 1948 as Annex 2 of the Chicago Convention.[81] After several amendments and revisions, Annex 2 of the Chicago Convention no longer entails recommended practices, but it does entail standards on the "rules of the road" for aircraft. States that have signed up to the Chicago Convention are obliged to bring their own regulations in conformity with these traffic rules.[82]

---

[76] AN Cockcroft, LNF Lameijer, *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea* (Elsevier 2012) xi-xii.
[77] AN Cockcroft, LNF Lameijer, *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea* (Elsevier 2012) xi-xiii; Inter-Governmental Maritime Consultative Organization, 'Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)' (adopted 20 October 1972, entered into force 15 July 1977) 1050 UNTS 16.
[78] I H Philepina Diederiks-Verschoor, *An introduction to air law* (revised by Pablo Mendes de Leon, 9th rev ed, Wolters Kluwer 2012) 10ff.
[79] ICAO, 'The History of ICAO and the Chicago Convention' (*icao.int*) <www.icao.int/about-icao/History/Pages/default.aspx> accessed 10 July 2019.
[80] ICAO, 'ICAO and the United Nations' (*icao.int*) <www.icao.int/about-icao/History/Pages/icao-and-the-united-nations.aspx> (accessed 10 July 2019); ICAO, 'About ICAO' (*icao.int*) <www.icao.int/about-icao/Pages/default.aspx> accessed 10 July 2019.
[81] Foreword to Annex 2 of International Civil Aviation Organization (ICAO), Convention on Civil Aviation (adopted 7 December 1944, entered into force 4 April 1947) 15 UNTS 295 (Chicago Convention).
[82] Article 12 Chicago Convention.

1.8.5 Directive 2007/46/EC on the Approval of Motor Vehicles

The European Union Directive on a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (Directive 2007/46/EC or Type-approval Directive) will briefly be discussed as this research explores the influence of the approval of automated vehicles on the liability risks of the stakeholders involved in automated driving. Before a (type of) vehicle is allowed on EU public roads, it needs to be approved by a vehicle authority of one of the Member States (art. 1, 2, 3 Type-approval Directive). Given art. 34, Annexes IV and XI of the Type-approval Directive, the 1958 UNECE Regulations are applicable.[83] These UNECE Regulations entail many technical requirements for vehicles. The UNECE Working Party 29 is responsible for the harmonisation of these regulations and is currently discussing how to deal with the development of automated vehicles.[84]

1.8.6 Dutch Civil Code

To illustrate the influence of the (type-)approval of an automated vehicle on the liability risks of one specific stakeholder, the road authority, the provision on the liability of the road authority of the Dutch Civil Code is explored. It goes beyond the scope of this research to include a study of liability for roads in other EU Member States.[85] The Dutch Civil Code (Burgerlijk Wetboek or BW) entails, since its revision in 1992, besides the general fault-based liability of art 6:162 BW, a strict liability for roads in art. 6:174 paragraph 2 BW.[86] The possessor of a road – when it comes to a public road, usually the road authority (Rijkswaterstaat, council)[87] – is liable if the condition of a road does not offer the safety one is entitled to expect. How this expectation can be influenced, will be studied in this thesis.

---

[83] See also Sebastian Polly, *EU Product Compliance, Safety and Liability: A Best Practice Guide for the Automotive Sector* (Beuth Verlag 2018) 8ff.

[84] See The United Nations Economic Commission for Europe, 'Introduction' (*unece.org*) <www.unece.org/trans/main/wp29/meeting_docs_wp29.html> accessed 9 July 2019.

[85] See for England, Germany, and France: Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 482-488.

[86] Arlette JJG Schrijns, Christa PJ Wijnakker, 'Aansprakelijkheid van de wegbeheerder ex art. 6:174 BW' in Cees van Dam (ed), *Aansprakelijkheid van de wegbeheerder* (ANWB, The Hague 2013); Fokko T Oldenhuis, 'Commentaar op art. 6:174 BW' in: C.J.J.M. Stolker (red.), *Groene Serie Onrechtmatige daad* (Wolters Kluwer 2012) art. 6:174 BW, aant. 2.3.

[87] See Rijkswaterstaat, 'Wegbeheerders' (*rijkswaterstaat.nl*) <www.rijkswaterstaat.nl/kaarten/wegbeheerders.aspx> accessed 31 July 2019.

1.9 Structure

This research can roughly be divided into two parts: the first part on public law matters, the second part focusing on issues regarding private law. This order and division have been chosen because the public law matters need to be resolved before the private law issues can arise: the automated vehicle has to be allowed on public roads before liability questions will arise. Because of the high pace of technical developments in the automotive sector, the chapters of this thesis have been published as separate papers in different journals. This has given the opportunity to stay on top of any technical and legal developments, and adjust the research accordingly. It does unfortunately also mean that a small repetition in describing the technological developments has proven to be unavoidable. In addition, some developments have taken place after the publication of the papers or certain aspects of the topic of a paper could not be discussed within the paper due to limitations to the word count. Therefore, epilogues will complement the different chapters. The journals in which the papers have been published have been chosen on the basis of their scope and the audience they reach. The chapters have all undergone minor alterations since publication.

The second chapter was published in 2017 in the Computer Law and Security Review.[88] Even though there have been further legal developments in the jurisdictions mentioned, the paper still provides a good basis for the thesis as it outlines the most pressing legal issues with regards to automated driving. An epilogue to this chapter will provide an update on the latest legal developments.

The third chapter is published open access online, pending publication in print, in Law, Innovation and Technology.[89] The epilogue to this chapter describes the latest developments on the notion of *driver* in the Geneva Convention and the Vienna Convention, as well as the influence of these developments on the findings of the research.

The fourth chapter examines with which party a duty for preventing a defective automated vehicle from driving rests. This paper is the bridge between the general part of this thesis and the second part focusing on private law matters. The chapter has been published as a conference paper in the proceedings of the ITS European

---

[88] Nynke E Vellinga, 'From the testing to the deployment of self-driving cars: Legal challenges to policymakers on the road ahead' (2017) 33(6) Computer Law & Security Review 847, 847-863.
[89] Nynke E Vellinga, 'Automated driving and its challenges to international traffic law: which way to go?' (2019) Law, Innovation and Technology, DOI:10.1080/17579961.2019.1665798.

Congress 2019 and was presented at that conference.[90] The liability risks of the vehicle authority are described in the epilogue.

The fifth chapter is an in-depth analysis of the notion of software(update) under the Product Liability Directive. This chapter was submitted for publication to the Journal of European Tort Law and is pending review. In the epilogue, the consequences in the Dutch and German jurisdictions of proposed changes are explored.

The sixth chapter comprises of the English translation of a publication in the highly regarded Dutch Journal Nederlands Juristenblad, published in September 2019.[91] The epilogue focuses on a topic related to automated driving that has not been discussed in the previous chapters: data protection.

Finally, Chapter 7 focuses on the findings of this research and proposals for future legislative steps.

---

[90] Nynke E Velinga, 'Careless automated driving?' (13th ITS European Congress, Eindhoven, June 2019).

[91] Nynke E Vellinga, 'Zelfrijdende auto's en aansprakelijkheidsrisico's voor wegbeheerders' (2019) Nederlands Juristenblad 2213.

2 From the Testing to the Deployment of Self-Driving Cars: Legal Challenges to Policymakers on the Road Ahead

This Chapter was published in the Computer Law & Security Review: NE Vellinga, 'From the testing to the deployment of self-driving cars: Legal challenges to policymakers on the road ahead' (2017) 33(6) Computer Law & Security Review 847

Abstract: Self-driving cars and self-driving technology are tested on public roads in several countries on a large scale. With this development not only technical, but also legal questions arise. This article will give a brief overview of the legal developments in multiple jurisdictions – the United States of America (more specifically California), United Kingdom and the Netherlands – and will highlight several legal questions regarding the testing and deployment of self-driving cars.

Policymakers are confronted with the question of how the testing of self-driving cars should be regulated. The discussed jurisdictions all chose a different approach. Different legal instruments – binding regulations, non-binding regulations and granting exemptions – are used to regulate the testing of self-driving cars. Are these instruments suitable for the objectives the jurisdictions want to achieve?

As technology matures, self-driving cars will at some point become available to the general public. Regarding this post-testing phase, two pressing problems arise: how to deal with the absence of a human driver, and how does this affect liability and insurance? The Vienna Convention on Road Traffic 1968 and the Geneva Convention on Road Traffic 1949, as well as national traffic laws, are based on the notion that only a human can drive a car. To what extent a different interpretation of the term 'driver' in traffic laws and international Conventions could accommodate the deployment of self-driving cars without a human driver present will be discussed in this article.

When the self-driving car becomes reality, current liability regimes could fall short. Liability for car accidents might shift from the driver or owner to the manufacturer of the car. This could have a negative effect on the development of self-driving cars. In this context, it will also be discussed to what extent insurance can influence the further development of self-driving cars.

2.1 Introduction

In May 2016, on a road in Florida, USA, a car and a tractor trailer collided, killing the person in the car. Although accidents like these happen every day,[1] this accident was different.[2] The car involved was a Tesla Model S, equipped with the so-called 'Autopilot', a technical feature allowing the car to drive itself under the supervision of the conventional driver. The 'Autopilot' was turned on at the time of the accident. The person in the car overlooked the truck, but so did the 'Autopilot'.[3] This fatal crash sparked a discussion on the safety of self-driving technology.[4] Currently self-driving cars and self-driving technology (like Tesla's Autopilot) are tested on public roads in

---

[1] Every year over 1,2 million people die in road traffic. See, World Health Organization, 'Global Status Report on Road Safety 2015' (2015) <www.who.int/violence_injury_prevention/road_safety_status/2015/en/> accessed 18 April 2017.

[2] Anjali Singhvi, Karl Russel, 'Inside the Self-Driving Tesla Fatal Accident' (*The New York Times,* 12 July 2016) <www.nytimes.com/interactive/2016/07/01/business/inside-tesla-accident.html?_r=0> accessed 30 March 2017. See for a more extensive legal contemplation of the accident, Lennart S Lutz, 'Unfälle mit dem Tesla Autopiloten: Implikationen für das automatisierte Fahren?' (2016) Deutsches Autorecht 506; The police report of the accident is available at <http://documents.latimes.com/tesla-accident-report/> accessed 3 May 2017.

[3] The Tesla Team, 'A Tragic Loss' (*Tesla*, 30 June 2016) <www.tesla.com/blog/tragic-loss?redirect=no> accessed 30 March 2017. The American National Highway Traffic Safety Administration started an investigation into this accident: 'NHTSA Letter to Telsa' (8 July 2016) <www.documentcloud.org/documents/2991479-NHTSA-letter-to-Tesla.html> accessed 29 November 2016; the final report is available at National Highway Traffic Safety Administration, 'Report on Investigation PE 16-007' (2017) <https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF> accessed 9 February 2017.

[4] Anjali Singhvi, Karl Russel, 'Inside the Self-Driving Tesla Fatal Accident' (*The New York Times*, 12 July 2016) <www.nytimes.com/interactive/2016/07/01/business/inside-tesla-accident.html?_r=0> accessed 30 March 2017; Danny Yadron, Dan Tynan, 'Tesla driver dies in crash while using autopilot mode' (*The Guardian*, 1 July 2016) <www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk> accessed 30 March 2017; Larry Greenemeier, 'Deadly Tesla Crash Exposes Confusion over Automated Driving. Amid a federal investigation, ignorance of the technology's limitations comes into focus' (*Scientific American*, 8 July 2016) <www.scientificamerican.com/article/deadly-tesla-crash-exposes-confusion-over-automated-driving/> accessed 4 April 2017; Bill Vlasic and Neal E Boudette, 'Self-Driving Tesla Was Involved in Fatal Crash, U.S. says' (*The New York Times*, 30 June 2017) <www.nytimes.com/2016/07/01/business/self-driving-tesla-fatal-crash-investigation.html?_r=0> accessed 11 April 2017; 'Letter from the Federation of European Motorcyclists' Associations (FEMA), Koninklijke Nederlandse Motorrijders Vereniging (KNMV) and Motorrijders Actie Groep (MAG) to the Dutch Vehicle Autorithy (RDW)' (14 October 2016) <www.fema-online.eu/website/wp-content/uploads/RDW_141016_EN.pdf> accessed 11 April 2017; 'Tesla soll in Deutschland nicht mehr mit "Autopilot" werben' (*heise online*, 16 October 2016) <www.heise.de/newsticker/meldung/Tesla-soll-in-Deutschland-nicht-mehr-mit-Autopilot-werben-3351230.html> accessed 11 April 2017.

several countries on a large scale.[5] With this development not only technical, but also legal questions arise. Policymakers are confronted with the question of how this development can be regulated. For the short term, the main question that arises is how trials with self-driving cars should be regulated.

This article will first describe the current state of technological developments (section 2.2) and will look into the interests at stake and actors involved (section 2.3). Before taking a closer look at the legislative developments in different jurisdictions, the legal consistency across different jurisdictions will be discussed (section 2.4). Subsequently, how trials with self-driving cars are regulated in different jurisdictions will be studied (section 2.5). The jurisdictions that will be discussed – the USA (more specifically California), the United Kingdom, and the Netherlands – all chose a different approach. Are these approaches suitable for the objectives the jurisdictions want to achieve? As technology matures, self-driving cars will at some point become available to the general public. Regarding this post-testing phase, two pressing problems arise: how to deal with the absence of a human driver, and how does this affect liability and insurance? After addressing these questions, recommendations will be made regarding these topics (section 2.6, section 2.7)).

2.2 Terminology and Technology

In the media and literature, several terms are used to describe a vehicle that can operate without a human driver, either under certain circumstances or for the complete trip. Terms like self-driving car, driverless car, and autonomous car are all commonly used terms but do not necessarily have the same meaning in every context. In this article, these three terms – self-driving car, driverless car, and autonomous car – are used to describe a motor vehicle that can operate during a

[5]On the public roads of California alone, Google's self-driving car company Waymo had a fleet of 60 self-driving cars driving over 600,000 miles on Californian public roads (50% more miles than in 2015): California Department of Motor Vehicles, 'Report on Autonomous Mode Disengagements For Waymo Self-Driving Vehicles in California' (December 2016) <www.dmv.ca.gov/portal/wcm/connect/946b3502-c959-4e3b-b119-91319c27788f/GoogleAutoWaymo_disengage_report_2016.pdf?MOD=AJPERES> accessed 11 April 2017; An overview of trials across the globe is available at Tom Alkim, 'Overview roadmaps and pilots' (*Knowledge Agenda Automated Driving*, 9 March 2017) <http://knowledgeagenda.connekt.nl/engels/2017/03/09/overview-roadmaps-and-pilots/> accessed 9 March 2017.

whole trip without human interference; it does not require a user to intervene when a problem occurs.[6]

The degree to which a car is able to drive independently, without human interference, has been definied by SAE International.[7] The level of automation is described on a scale from 0 (no automation) to 5 (full driving automation):

- Level 0: no driving automation. The whole dynamic driving task (the lateral and longitudinal vehicle motion control, the detection of and response to objects and events) is performed by the human driver.
- Level 1: driver assistance. A driving automation system performs either the lateral or the longitudinal vehicle motion control under specific conditions, while the human driver performs the remainder of the dynamic driving task.
- Level 2: partial driving automation. Under specific conditions, the driving automation system is able to perform both the lateral and the longitudinal vehicle motion control. The human driver has to supervise the system and performs the remainder of the dynamic driving task (that is, detection of and response to objects and events).
- Level 3: conditional driving automation. The automated driving system performs the complete dynamic driving task under certain conditions. The user has to be able to take over the driving and respond appropriately to a request of the system to intervene.
- Level 4: high driving automation. The automated driving system performs the complete dynamic driving task under certain conditions, without the expectation that a user will respond to a request to intervene.

---

[6] Level 5 of SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. *Standard J3016* (revised September 2016).

[7] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. *Standard J3016* (revised September 2016); Other descriptions are available, see for instance National Highway Traffic Safety Administration, 'Preliminary Statement of Policy Concerning Automated Vehicles' (2013) and Tom M Gasser (Projektgruppenleitung) and others, 'Bericht zum Forschungsprojekt F1100.5409013.01 des Arbeitsprogramms der Bundesanstalt für Straßenwesen: Rechtsfolgen zunehmender Fahrzeugautomatisierung' (Bundesanstalt für Straßenwesen 2012).

- Level 5: full driving automation. The automated driving system performs the complete dynamic driving task under all conditions, without the expectation that a user will respond to a request to intervene.[8]

An important difference to point out is the difference between Level 2 and Level 3: from Level 3 upwards the complete dynamic driving task is performed by the automated driving system. In cars where a human is still expected to stay alert and be ready to intervene when necessary (SAE Level 3 and lower), distractions for the person in the car could prove problematic. When the person hands over control to the car, chances are that the person gets distracted and no longer stays alert. Ford, among others, has already seen this happen during trials with its self-driving cars: Ford's engineers who were supposed to be monitoring the car started dozing off. For that reason, Ford, but also Waymo, decided to skip these lower levels of automation and immediately aim for cars of SAE Level 4 and higher.[9] This issue will not be discussed further as this article will focus on vehicles of SAE Level 5, full driving automation.[10]

Although Level 5 is far more advanced than the currently commercially available cars, Ford has already announced their intention to make Level 4 vehicles available for commercial mobility services by 2021,[11] and Tesla intends that all of its cars produced

[8] SAE International, Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016 (revised September 2016).
[9] See Keith Naughton, 'Google's Driverless Car Czar on Taking the Human Out of the Equation. How John Krafcik went from mechanical to digital and why he thinks you have to go fully autonomous' (*Bloomberg Businessweek*, 4 August 2016) <www.bloomberg.com/features/2016-john-krafcik-interview-issue/> accessed 4 May 2017; Keith Naughton, 'Ford's Dozing Engineers Side With Google in Full Autonomy Push' (*Bloomberg Technology*, 17 February 2017) <www.bloomberg.com/news/articles/2017-02-17/ford-s-dozing-engineers-side-with-google-in-full-autonomy-push> accessed 4 May 2017; Jamie Condliffe, 'Semi-Autonomous Cars Could Increase Distracted Driving Deaths' (*MIT Technology Review*, 21 September 2016) <www.technologyreview.com/s/602441/semi-autonomous-cars-could-increase-distracted-driving-deaths/> accessed 4 May 2017; Alex Davies, 'The very human problem blocking the path to self-driving cars' (*Wired*, 1 January 2017) <www.wired.com/2017/01/human-problem-blocking-path-self-driving-cars/> accessed 4 May 2017.
[10] Several jurisdictions have formulated a roadmap to indicate how the transition to Level 5 will be shaped. An overview of these roadmaps is available at Tom Alkim, 'Overview roadmaps and pilots' (*Knowledge Agenda Automated Driving*, 9 March 2017) <http://knowledgeagenda.connekt.nl/engels/2017/03/09/overview-roadmaps-and-pilots/> accessed 9 March 2017.
[11] Ford, 'Ford Targets Fully Autonomous Vehicle for Ride Sharing in 2021; Invests in New Tech Companies, Doubles Silicon Valley Team' (16 August 2016)

from October 2016 onwards have full self-driving hardware.[12] "Full self-driving capability" should become available in 2017.[13] Not only the hardware, but also the capabilities of the software are of great importance.[14] This can be illustrated by the Tesla accident described above: the software of the car was not to blame, as it was not designed to prevent of these kinds of accidents. It was designed to avoid or mitigate rear-end collisions.[15]

A self-driving car is not necessarily the same as a connected car.[16] The term 'connected car' refers to a car that is able to communicate with its surroundings, e.g. another car or the infrastructure.[17] So, a connected car can 'contact' a traffic light to 'tell' the traffic light that he is approaching this traffic light. A self-driving car might have this ability as well, but it is not necessarily a component of a self-driving car.[18] A self-driving car can truly drive itself without the need to communicate with other vehicles or the infrastructure. Contrary to a self-driving car, a connected car cannot

---

<https://media.ford.com/content/fordmedia/fna/us/en/news/2016/08/16/ford-targets-fully-autonomous-vehicle-for-ride-sharing-in-2021.html> accessed 11 April 2017.

[12] The Tesla Team, 'All Tesla Cars Being Produced Now Have Full Self-Driving Hardware' (19 October 2016) <www.tesla.com/blog/all-tesla-cars-being-produced-now-have-full-self-driving-hardware> accessed 11 April 2017.

[13] Alan Ohnsman, 'Musk Wants To Begin Shifting Teslas To "Full" Self-Driving Capability Within 6 Months' (*Forbes*, 24 January 2017) <www.forbes.com/sites/alanohnsman/2017/01/24/elon-musk-targets-full-self-driving-capability-for-teslas-within-6-months/#7808d76c79ee> accessed 11 April 2017; Fred Lambert, 'Tesla's software timeline for "Enhanced Autopilot" transition means "Full Self-Driving Capability" as early as next year' (*Electrek*, 20 October 2016) <https://electrek.co/2016/10/20/tesla-enhanced-autopilot-full-self-driving-capability/> accessed 11 April 2017.

[14] Stephen Mason, 'The presumption that computers are 'reliable'' in Stephen Mason and Daniel Seng (eds), *Electronic Evidence* (fourth edition, Institute of Advanced Legal Studies for the SAS Humanities Digital Library, School of Advanced Study, University of London, 2017); See also the letter from Stephen Mason and Peter B Ladkin to *Financial Times* 'Decision algorithms of driverless cars recall the trolley problem' *Financial Times* (7 October 2017) <www.ft.com/content/3e9a8832-898c-11e6-8aa5-f79f5696c731> accessed 10 May 2017.

[15] National Highway Traffic Safety Administration, 'Report on Investigation PE 16-007' (January 2017) <https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF> accessed 9 February 2017.

[16] Bryant W Smith, 'A Legal Perspective on Three Misconceptions in Vehicle Automation' in Gereon Meyer and Sven Beiker (eds), *Road Vehicle Automation, Lecture Notes in Mobility* (Springer International Publishing Switzerland 2014), 89-90.

[17] Hod Libson, Melba Kurman, *Driverless: Intelligent Cars and the Road Ahead* (The MIT Press 2016), 17.

[18] See for instance 'Googles autonome Autos sind nicht immer online' (*heise online*, 16 January 2017) <www.heise.de/newsticker/meldung/Googles-autonome-Autos-sind-nicht-immer-online-3592661.html> accessed 13 January 2017.

drive independently. The connected car will not be discussed any further in this article.

2.3 Interests at Stake and Actors Involved

Hopes are high for self-driving cars. They could potentially ease road congestion and reduce emissions.[19] The major benefit of self-driving cars, however, is the expected decrease in accidents. Every year over 1.2 million people die on the world's roads.[20] In around 90% of the road traffic accidents, human error caused, or at least played a part in, the accident.[21] In literature, expectations are expressed that self-driving cars will eliminate human error, and therefore significantly improve road safety.[22] However, this expectation is yet to be proven.[23]

---

[19] See for instance Zia Wadud, 'Self-driving cars: will they reduce energy use?' (University of Leeds, Mobility and Energy Futures Studies) <www.its.leeds.ac.uk/fileadmin/documents/research/MobilityEnergyFutures_-_SelfDrivingCars.pdf> accessed 18 April 2017; Hod Libson and Melba Kurman, *Driverless: Intelligent Cars and the Road Ahead* (The MIT Press 2016), 15.

[20] World Health Organization, 'Global Status Report on Road Safety 2015' (2015) <www.who.int/violence_injury_prevention/road_safety_status/2015/en/> accessed 11 April 2017.

[21] Bryant W Smith, 'Human error as a cause of vehicle crashes' (*The Center for Internet and Society*, 18 December 2013) <http://cyberlaw.stanford.edu/blog/2013/12/human-error-cause-vehicle-crashes> accessed 9 March 2017.

[22] European Transport Safety Council, 'Prioritising the Safety Potential of Automated Driving in Europe' (Briefing, April 2016), para 2; James M Anderson and others, 'Autonomous Vehicle Technology. A Guide for Policymakers' (RAND Corporation, 2016), 12-16. See also Brandon Schoettle, Michael Sivak, 'A Preliminary Analyses of Real-World Crashes Involving Self-Driving Vehicles' (The University of Michigan Transportation Research Institute, Ann Arbor, October 2015) <http://umich.edu/~umtriswt/PDF/UMTRI-2015-34.pdf> accessed 18 April 2017; Myra Blanco and others, 'Automated Vehicle Crash Rate Comparison Using Naturalistic Data' (Virginia Tech Transportation Institute January 2016) <www.vtti.vt.edu/PDFs/Automated%20Vehicle%20Crash%20Rate%20Comparison%20Using%20Naturalistic%20Data_Final%20Report_20160107.pdf> accessed 18 April 2017.

[23] Letter from Martyn Thomas to *Financial Times* 'Future with the driverless car needs careful planning' *Financial Times* (30 September 2016) <www.ft.com/content/df918048-83ff-11e6-a29c-6e7d9515ad15> accessed 28 April 2017; Brandon Schoettle, Michael Sivak, 'A Preliminary Analyses of Real-World Crashes Involving Self-Driving Vehicles' (The University of Michigan Transportation Research Institute, Ann Arbor, October 2015) <http://umich.edu/~umtriswt/PDF/UMTRI-2015-34.pdf> accessed 18 April 2017; Myra Blanco and others, 'Automated Vehicle Crash Rate Comparison Using Naturalistic Data' (Virginia Tech Transportation Institute January 2016) <www.vtti.vt.edu/PDFs/Automated%20Vehicle%20Crash%20Rate%20Comparison%20Using%20Naturalistic%20Data_Final%20Report_20160107.pdf> accessed 18 April 2017. See also the letter from Stephen Mason and Peter B Ladkin to *Financial Times* 'Decision algorithms of driverless cars recall the trolley problem' *Financial Times* (7 October 2017) <www.ft.com/content/3e9a8832-898c-11e6-8aa5-f79f5696c731> accessed 10 May 2017; the letter from John Boothman to the *Financial Times* 'Driverless cars can steer us into a safe and sophisticated future' *Financial Times* (23 September

There are several actors who could benefit from the development of self-driving cars: manufacturers, governments and consumers, to name a few, could possibly all benefit from the self-driving car. Manufacturers can benefit from producing and selling self-driving cars. For governments, the self-driving cars can offer a solution to several problems: road congestion, traffic deaths and emissions etc.[24] Consumers will benefit from safer cars which will most likely lead to lower insurance premiums.[25] An increase in mobility is also expected.[26]

However, the self-driving car also has disadvantages that should not be disregarded. There will be a significant impact on the job market: truck drivers, bus drivers, and taxi drivers will no longer be needed as the car takes over their work.[27] Moreover, self-driving cars might prove susceptible to new risks, such as being hacked.[28]

2016) <www.ft.com/content/1199ec78-7ff6-11e6-8e50-8ec15fb462f4> accessed 28 April 2017; 'The future of self-driving cars is in human hands. Clear rules are instrumental to the transition towards a driverless era' *Financial Times* (16 September 2016) <www.ft.com/content/abf1738a-7bec-11e6-ae24-f193b105145e> accessed 28 April 2016; Stephen Mason, 'The presumption that computers are 'reliable'' in Stephen Mason and Daniel Seng (eds), *Electronic Evidence* (fourth edition, Institute of Advanced Legal Studies for the SAS Humanities Digital Library, School of Advanced Study, University of London, 2017).

[24] See for instance Rex Merrifield, 'Choreographing automated cars could save time, money and lives' (*Horizon*, 14 March 2017) <https://horizon-magazine.eu/article/choreographing-automated-cars-could-save-time-money-and-lives_en.html> accessed 11 April 2017. Self-driving cars can, however, have disadvantages for governments as well. For instance, fewer traffic tickets means less revenues: Sam Tracy, 'Autonomous Vehicles Will Replace Taxi Drivers, But That's Just the Beginning' (*Huffington Post*, updated 10 June 2016) <www.huffingtonpost.com/sam-tracy/autonomous-vehicles-will-_b_7556660.html> accessed 30 March 2017.

[25] James M Anderson and others, 'Autonomous Vehicle Technology. A Guide for Policymakers' (RAND Corporation, 2016), 18, 114, 118; Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167. See also Munich Reinsurance America, Inc., 'Autonomous Vehicles. Considerations for Personal and Commercial Lines Insurers' (2016).

[26] See for instance Daniel J Fagnant, Kara Kockelman, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167, para 2.3.

[27] See for instance Sam Tracy, 'Autonomous Vehicles Will Replace Taxi Drivers, But That's Just the Beginning' (*Huffington Post*, updated 10 June 2016) <www.huffingtonpost.com/sam-tracy/autonomous-vehicles-will-_b_7556660.html> accessed 30 March 2017.

[28] Hacking, however, is also a risk to conventional cars: Andy Greenberg, 'Hackers remotely kill a Jeep on the highway – with me in it' (*Wired*, 21 July 2015) <www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/> accessed 9 March 2017. See also SAFEtec, a project funded by the EU, at European Commission, 'Security Assurance FramEwoRk for neTworked vEhicular teChnology' <http://cordis.europa.eu/project/rcn/207209_en.html> accessed 28 August 2019 and Steve Gillman, 'Hackers could blackmail owners of self-driving cars – Dr Alexander Köller, TomTom' (*Horizon*, 16 March 2017) <https://horizon-magazine.eu/article/hackers-could-blackmail-owners-self-driving-cars-dr-alexander-kr-ller-tomtom_en.html?utm_source=HORIZON&utm_campaign=c7f3d2c038-

Software can be fallible.[29] Furthermore, it is not clear yet how self-driving cars will behave under all weather conditions, and in all situations. Therefore, testing the self-driving cars in real traffic is pivotal to improving the technology and reaching its full potential.

During the test phase, when the technology has not yet reached its full potential, the self-driving car can compromise road safety.[30] In order to benefit from the road safety improvements of self-driving cars in the long run, however, the further development of the technology and thus its testing on public roads is essential. This testing should be conducted in a safe manner, but should also provide enough opportunities for further innovation. Manufacturers, but also testing and research organisations, such as universities, can be involved in the testing.[31] To ensure road safety, a very strict regulatory regime might potentially be the best way to go. However, overregulation can inhibit developments.[32] On the other hand, flexible regulation, which can keep pace with new technological developments, can stimulate innovation.[33] In the long run, the general public will profit from the result of this innovation, through improved road safety. So the legislator will have to strike a balance between all of these interests.[34]

News_Alert_20170217&utm_medium=email&utm_term=0_bdcf6f64ca-c7f3d2c038-105634345> accessed 11 April 2017 and Stephen Mason, 'The presumption that computers are 'reliable'' in Stephen Mason and Daniel Seng (eds), *Electronic Evidence* (fourth edition, Institute of Advanced Legal Studies for the SAS Humanities Digital Library, School of Advanced Study, University of London, 2017).

[29] See for instance Stephen Mason, 'The presumption that computers are 'reliable'' in Stephen Mason and Daniel Seng (eds), *Electronic Evidence* (fourth edition, Institute of Advanced Legal Studies for the SAS Humanities Digital Library, School of Advanced Study, University of London, 2017).

[30] See for example Chris Ziegler, 'A Google self-driving car caused a crash for the first time. A bad assumption led to a minor fender-bender' (*The Verge*, 29 February 2016) <www.theverge.com/2016/2/29/11134344/google-self-driving-car-crash-report> accessed 11 April 2017.

[31] See for instance Mcity of the University of Michigan, an enclosed test track simulating urban and suburban environments: 'Mcity Test Facility' <www.mtc.umich.edu/test-facility> accessed 28 August 2019.

[32] Jonathan B Wiener, 'The regulation of technology, and the technology of regulation' (2004) 26 Technology in Society 483.

[33] Michiel A Heldeweg, *Smart rules & regimes: publiekrechtelijk(e) ontwerpen voor privatisering en technologische innovatie*, (extended version of inaugural lecture Universiteit Twente, of 24 september 2009, Universiteit Twente 2010), 99.

[34] Michiel A Heldeweg, *Smart rules & regimes: publiekrechtelijk(e) ontwerpen voor privatisering en technologische innovatie*, (extended version of inaugural lecture Universiteit Twente, of 24 september 2009, Universiteit Twente 2010), 74-77. See also European Parliament resolution of 16

2.4 Legal Consistency

Because road safety will most likely improve significantly due to self-driving cars,[35] countries want to be at the forefront of this development. A general look at the legal developments in different jurisdictions unveils that each jurisdiction has chosen their own route to a future of self-driving cars.[36] Both the European Union and the US federal government acknowledge this as an unwanted development.[37] Manufacturers and consumers should not be confronted with different legal requirements in different jurisdictions as this could hinder innovation.[38] The Model State Policy identified within the US Federal Automated Vehicles Policy should prevent the rise of such a patchwork of varying legislation in different jurisdictions.[39] Under the presidency of the Netherlands (January-June 2016), the EU member states signed a Declaration on more cooperation in the field of connected and automated driving.[40] With this Declaration, the Member States acknowledge the importance of a coordinated approach in order to facilitate the cross-border use of connected and automated vehicles.[41] One of the objectives of the Member States is to "(…) work towards a coherent European framework for the deployment of interoperable connected and automated driving (…)."[42] Legal consistency will be promoted,

---

February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)) [2017], section 24-29.

[35] European Transport Safety Council, 'Prioritising the Safety Potential of Automated Driving in Europe' (Briefing, April 2016), para 2.

[36] See also the different roadmaps used: Tom Alkim, 'Automated Driving Roadmaps' (*Dropbox*) <www.dropbox.com/s/ji5qz5rtkkgf8jn/Overview%20Roadmaps%20Automated%20Driving_final_withoutaspect.pdf?dl=0> accessed 28 August 2019.

[37] See also Testimony of Dr. Chris Urmson (Director, Self-Driving Cars, Google [x]) before the Senate Committee on Commerce, Science and Technology Hearing, 'Hands Off: The Future of Self-Driving Cars' (15 March 2016), James Hedlund, 'Autonomous Vehicles Meet Human Drivers: Traffic Safety Issues for States' (Governors Highway Safety Association 2017) <http://src.bna.com/lVf> accessed 10 February 2017.

[38] International Transport Forum, Corporate Partnership Board, 'Automated and Autonomous Driving. Regulation under uncertainty' (OECD/ITF 2015), para 3.

[39] U.S. Department of Transportation/National Highway Traffic Safety Administration, 'Federal Automated Vehicles Policy' (September 2016) <www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016> accessed 18 April 2017 (Federal Policy), 37. See also U.S. Department of Transportation/National Highway Traffic Safety Administration, 'Fact Sheet: AV Policy Section II: Model State Policy' (September 2016).

[40] Declaration of Amsterdam on Cooperation in the field of connected and automated driving, 14-15 April 2016, available at <https://english.eu2016.nl/documents/publications/2016/04/14/declaration-of-amsterdam> accessed 11 April 2017 (Declaration of Amsterdam 2016).

[41] Declaration of Amsterdam, 2016.

[42] Declaration of Amsterdam, 2016, Shared objectives, I.a. and Action by the European Commission, IV.c.

recognizing the importance of allowing sufficient flexibility in a legal framework, in order to facilitate the introduction and cross-border use of automated and connected vehicles.[43]

2.5 Testing: Four Jurisdictions' Legal Frameworks

To provide for the safe testing of self-driving cars, the USA, the Netherlands, and the UK all choose a different route. The US State of California shall also be considered. The different legal instruments used by these jurisdictions – binding regulations, non-binding regulations, granting exemptions – will be addressed below (sections 2.5.1-2.5.3). How suitable these legal instruments are for achieving the aims the jurisdictions strive for will be discussed in section2.5.4.

2.5.1 Binding Regulation: California

One of the US States at the forefront of legal developments is California.[44] Since 2012, California has had legislation in place to accommodate for the testing of self-driving cars.[45] Division 16.6, Section 38750 of the California Vehicle Code is devoted to autonomous vehicles. This section entails definitions, requirements for insurance and the operator and how to act in case of a failure etc. As follows from the California Code of Regulations, a so-called Manufacturer's Testing Permit is needed for testing self-driving vehicles on public roads.[46] A Testing Permit will only be issued when all of

[43] Declaration of Amsterdam, 2016, Joint agenda, II.a. See also Erica Palmerini and others, 'Regulating Emerging Robotic Technologies in Europe: Robotics facing Law and Ethics: Guidelines on Regulating Robotics' (Robolaw 2014) <www.robolaw.eu/RoboLaw_files/documents/robolaw_d6.2_guidelinesregulatingrobotics_20140922.pdf> accessed 6 February 2017, 67-68 and Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability' (2015) 31(4) Computer Law & security Review 506, para 4.2.1.4.

[44] Although self-driving cars are being tested on the roads of Austin, Texas and Phoenix, Arizona, both states currently do not have regulated this (see for example <https://waymo.com/ontheroad/> accessed 12 April 2017). In 2015, four bills were considered but not passed by the Texas Legislature (SB 1167, HB 4194, HB 3690, and HB 933). On inquiry, the Arizona Department of Transport stated "MVD [Motor Vehicle Department, *NEV*] does not have any policy regarding autonomous vehicles at this time." (September 20, 2016). Through an Executive Order (2015-09) certain pilot programs are allowed in Arizona. An operator with the ability to "direct the vehicle's movement if assistance is required" is required (Executive Order 2015-09). See for an overview of the legislative developments: National Conference of State Legislatures, 'Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation' <www.ncsl.org/research/transportation/autonomous-vehicles-legislation.aspx> (accessed 22 December 2016) and Gabriel Weiner, Bryant W Smith, 'Automated Driving: Legislative and Regulatory Action' (*The Centre for Internet and Society*, 27 April 2017) <cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action> accessed 12 April 2017.

[45] Senate Bill 1298.

[46] 13 California Code of Regulation (CCR) §227.04 (d), §227.24. Recently, Uber challenged this: Anthony Levandowski, 'Statement from Anthony Levandowski on Self-Driving in San Francisco', (*Uber*

the requirements laid down in the California Code of Regulations and California Vehicle Code are met, and all of the necessary testing required to satisfy the Department for Motor Vehicles that the vehicles are safe to operate on public roads has been completed.[47] The form that needs to be submitted to the Department for Motor Vehicles requires the details of the vehicle tester, the vehicles to be tested and the driver/operator.[48] However, the roads on which the vehicle will be tested and the weather conditions under which the vehicle will be tested are not requested in the form. The neighbouring state Nevada does limit the testing of self-driving cars to certain roads.[49] Also, to get a testing permit (or "license") in Nevada an "(…) applicant must further provide proof that such autonomous vehicle or vehicles of the applicant have been driven in various conditions for a number of miles that demonstrates the safety of the vehicle or vehicles in those conditions. Such conditions include, without limitation, operating the autonomous vehicle in various weather conditions, on various types of roads and during various times of the day and night."[50]

2.5.2 Non-binding Regulation: USA and UK

Flexibility, i.e. the ability to keep up with the technological developments, can be offered through a non-binding regulation. If new technology emerges, a non-binding regulation can be adjusted without going through an often time-consuming legislative

Newsroom, 16 December 2016) <https://newsroom.uber.com/statement-from-anthony-levandowski-on-self-driving-in-san-francisco/> accessed 22 December 2016; Heather Somerville, 'Uber removes self-driving cars from San Francisco roads' (*Reuters*, 22 December 2016) <www.reuters.com/article/us-uber-selfdriving-idUSKBN14B04Z> accessed 22 December 2016. See also Bryant W Smith, 'Uber vs. the Law' (*The Center for Internet and Society*, 17 December 2016) <https://cyberlaw.stanford.edu/blog/2016/12/uber-vs-law> accessed 22 December 2016.

[47] California Vehicle Code section 38750 (e)(1). See also 13 CCR §227.04, §227.26, §227.28, and State of California Department of Motor Vehicles 'Application Requirements for Autonomous Vehicle Tester Program – Testing with a Driver' (*Department of Motor Vehicles*) <www.dmv.ca.gov/portal/dmv/detail/vehindustry/ol/auton_veh_tester> accessed 12 April 2017.

[48] 13 CCR §227.26, §227.28. The form is available at California Department of Motor Vehicles, 'Autonomous Vehicle Tester (ATV) Program Application for Manufacturer's Testing Permit'<www.dmv.ca.gov/portal/wcm/connect/f8eb6c00-6039-4e4c-82b0-2e9c4b18c38b/ol311.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=f8eb6c00-6039-4e4c-82b0-2e9c4b18c38b> accessed 20 December 2016. See also the new the draft form OL311, available at <www.dmv.ca.gov/portal/wcm/connect/3339d9b1-f033-44a8-8c7e-40a31e809b31/ol311draft.pdf?MOD=AJPERES> accessed 10 April 2017.

[49] Nevada Administrative Code (NAC) 482A.120. See on the possibilities in Arizona *n*37.

[50] NAC 482A.110(3)(b).

process. Both the federal government of the United States and the government of the United Kingdom favour this route, for now.[51]

2.5.2.1 United States: Federal Level

The US Department of Transportation[52] and National Highway Traffic Safety Administration (NHTSA) have formulated a Federal Automated Vehicles Policy.[53] This Policy is divided into four sections. The first section consists of the Vehicle Performance Guidance for Automated Vehicles (hereinafter: NHTSA Guidance) which is intended for the pre-deployment stage of designing, developing and testing automated vehicles.[54] Although the NHTSA Guidance is not mandatory, it should be considered by everyone involved in manufacturing, designing, testing and possibly selling self-driving vehicles.[55] The NHTSA Guidance sets expectations for manufacturers developing and deploying automated vehicle technology.[56] It is intended for the testing and deployment of automated vehicles on public roads.[57] This NHTSA Guidance should ensure "that when a self-driving car crosses from Ohio into Pennsylvania, its passengers can be confident that other vehicles will be just as

[51] The UK Department for Transport and the Centre for Connected and Autonomous Vehicles already published a set of proposals for reforming existing legislation: Department for Transport and the Centre for Connected and Autonomous Vehicles, 'Pathway to Driverless Cars: Proposals to support advanced driver assistance systems and automated vehicle technologies' (July 2016) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/536365/driverless-cars-proposals-for-adas-and_avts.pdf> accessed 20 August 2019.
[52] The US Department of Transportation recently established a Federal Committee on Automation: 'USDOT Announces New Federal Committee on Automation' (11 January 2017) <https://content.govdelivery.com/accounts/USDOT/bulletins/17fb003#.WHa9qqkV59c.twitter> accessed 13 January 2017.
[53] U.S. Department of Transportation/National Highway Traffic Safety Administration, 'Federal Automated Vehicles Policy' (September 2016) <www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016> accessed 18 April 2017. Up until September 2016 the federal involvement on this topic was relatively limited; the NHTSA had only published a Preliminary Statement of Policy Concerning Automated Vehicles (2013) and an U.S. Department of Transportation/National Highway Traffic Safety Administration, '"DOT/NHTSA Policy Statement Concerning Automated Vehicles" 2016 Update to "Preliminary Statement of Policy Concerning Automated Vehicles"' (2016).See also Testimony of Dr. Chris Urmson (Director, Self-Driving Cars, Google [x]) before the Senate Committee on Commerce, Science and Technology Hearing, 'Hands Off: The Future of Self-Driving Cars' (15 March 2016).
[54] Federal Policy 2016, 6.
[55] Federal Policy 2016, 11.
[56] U.S. Department of Transportation/National Highway Traffic Safety Administration, 'Fact Sheet AV Policy Section I: Vehicle Performance Guidance for Automated Vehicles' (September 2016); Bryant W Smith, 'US Department of Transportation's Automated Driving Guidance' (*The Center for Internet and Society,* 19 September 2016) <https://cyberlaw.stanford.edu/blog/2016/09/us-department-transportations-automated-driving-guidance> accessed 12 April 2017.
[57] Federal Policy 2016, 12.

responsibly deployed and just as safe."[58] The NHTSA Guidance outlines 15 safety assessment areas.[59] This 15-point Safety Assessment covers various topics regarding automated driving such as failures, crashworthiness, privacy and cybersecurity.[60] Manufacturers (or other entities involved) can voluntarily provide reports on how the NHTSA Guidance has been met.[61] This, together with public input, might lead to a revision of the guidance.[62]

The second section of the Federal Automated Vehicles Policy is the Model State Policy. As multiple States have already passed laws concerning (the testing of) automated vehicles, this Model State Policy should prevent the rise of a patchwork of inconsistent laws and regulations among all the jurisdictions involved[63] – although it might be too late to prevent such a development given the legislative efforts already undertaken by multiple states.[64] Again, public feedback is requested in order to refine the Policy.[65] It sets forth the responsibilities of the State and the Federal responsibilities regarding automated driving and provides model procedures and requirements for State laws.[66] The Model State Policy covers several subjects, including registration of vehicles, law enforcement considerations, liability and insurance, and administrative matters. The Model State Policy also recommends that each jurisdiction examines its legislation to identify possible barriers to the safe testing, deployment and operation of self-driving cars (SAE Level 3-5).[67] Gaps in laws and regulations (e.g. gaps concerning motor vehicle insurance, liability, occupant

---

[58] Barack Obama, 'Barack Obama: Self-driving cars, yes, but also safe. New technologies and regulations will be explored at a White House conference in Pittsburgh' (*Pittsburgh Post-Gazette*, 19 September 2016) <www.post-gazette.com/opinion/Op-Ed/2016/09/19/Barack-Obama-Self-driving-yes-but-also-safe/stories/201609200027> accessed 10 April 2017.
[59] Federal Policy 2016, 34.
[60] For a brief overview: U.S. Department of Transportation/National Highway Traffic Safety Administration, 'Fact Sheet AV Policy Section I: Vehicle Performance Guidance for Automated Vehicles' (September 2016).
[61] Federal Policy 2016, 15.
[62] U.S. Department of Transportation/National Highway Traffic Safety Administration, 'Fact Sheet AV Policy Section I: Vehicle Performance Guidance for Automated Vehicles' (September 2016); Federal Policy 2016, 11, 34-36.
[63] See Testimony of Dr. Chris Urmson (Director, Self-Driving Cars, Google [x]) before the Senate Committee on Commerce, Science and Technology Hearing, 'Hands Off: The Future of Self-Driving Cars' (15 March 2016).
[64] Federal Policy 2016, 37. See also Fact Sheet: AV Policy Section II: Model State Policy.
[65] Federal Policy 2016, 37.
[66] Federal Policy 2016, 37, 39.
[67] Federal Policy 2016, 40.

safety, education and training, environmental impact etc.) should be identified and addressed by the State.[68]

The other two sections of the Federal Automated Vehicles Policy cover the regulatory tools of the NHTSA, both current ones and potential new options.[69] One of the existing regulatory tools is the letter of interpretation. In such a letter the NHTSA gives its view on the meaning of existing regulation.[70] This tool has already been used to interpret some Federal Motor Vehicle Safety Standards, after a request by Google.[71]

2.5.2.2 United Kingdom

The UK Department for Transport issued a Code of Practice to provide guidance for anyone wanting to conduct the testing of (highly) automated vehicles on public roads.[72] The Code of Practice is non-statutory and although non-compliance with the Code of Practice might be relevant in regards to liability, it does not guarantee immunity from liability in legal proceedings.[73] Like the NHTSA Guidance, the Code of Practice deals with failure warning, privacy and cybersecurity. However, the Code of Practice also addresses requirements regarding the test driver (the Code states that "a suitably licenced and trained test driver or test operator should supervise the vehicle at all times and be ready and able to over-ride automated operation if necessary").[74] The US Federal Policy lacks these requirements for (test) drivers as this

---

[68] Federal Policy 2016, 44.

[69] See for a brief overview: U.S. Department of Transportation/National Highway Traffic Safety Administration, 'Fact Sheet: AV Policy Section III: Current Regulatory Tools'(September 2016) and U.S. Department of Transportation/National Highway Traffic Safety Administration , 'Fact Sheet: AV Policy Section IV: Modern Regulatory Tools' (September 2016).

[70] Federal Policy 2016, 48.

[71] National Highway Traffic Administration, 'Letter responding to a letter from Dr. Chris Urmson (Director of the Self-Driving Car Project, Google, Inc.)' (4 February 2016) <http://isearch.nhtsa.gov/files/Google%20--%20compiled%20response%20to%2012%20Nov%20%2015%20interp%20request%20--%204%20Feb%2016%20final.htm> accessed 9 August 2018.

[72] Department for Transport, 'The Pathway to Driverless Cars: A Code of Practice for testing' (2015) (Code of Practice for testing 2015), para 2.1, 2.3.The definition the Code of Practice for testing 2015 uses for highly automated vehicle is: "A vehicle in which a driver is required to be present and can take manual control at any time. However in certain situations, the vehicle can offer an automated mode which allows the driver to 'disengage' from the driving task and undertake other tasks." (para 2.6). Fully automated vehicle: "a vehicle in which a driver is not necessary. The vehicle is designed to be capable of safely completing journeys without the need for a driver in all traffic, road and weather conditions that can be managed by a competent human driver."(para 2.8).

[73] Code of Practice for testing 2015, para 1.5.

[74] Code of Practice for testing 2015, para 4.1.

falls within the competence of the States, not the federal, government. The States are responsible for traffic laws and enforcement, vehicle licence and registration, and motor vehicle insurance and liability regimes, whereas the US federal government bears responsibility for setting and enforcing compliance with safety standards, educating the public about motor vehicle safety issues, and issuing guidance to achieve national goals.[75]

2.5.3 Granting Exemptions: The Netherlands

The Dutch choose another route; instead of drafting extensive new laws or formulating non-binding regulations, the Dutch Vehicle Authority (RDW) has been given the competence to grant exemptions from certain laws if these exemptions are useful for the testing of automated vehicle functions.[76] Exemptions can be granted regarding chapters 3 and 5 of the *Regeling voertuigen* and, if necessary, the *Reglement Verkeersregels en verkeerstekens 1990* (hereinafter RVV 1990). Chapters 3 and 5 of the *Regeling voertuigen* contain rules on type approval and certain technical requirements, whereas the RVV 1990 outlines traffic rules (e.g. speed limits (art. 19-22), giving way (art. 15), how to overtake (art. 11) etc.). The RDW will decide where and under what circumstances the testing can be carried out.[77] First, the RDW will analyse the application, the testing plan and the test results that are available at that time. If this analysis is satisfactory, all functionalities that the applicant wants to test on public roads will be tested on an enclosed test track. The exemption will only be granted if these tests are passed as well.[78] The conditions of the exemption will be decided upon by the RDW. Possible conditions are the type of road and the weather conditions under which testing is allowed, but additionally, it could also require obtaining additional insurance.[79]

The in 2016 published draft for an 'experimenteerwet', i.e. an Act concerning experiments or trials, proposed enlarging the scope of the existing exemption powers

---

[75] Federal Policy 2016 2016, 7, 38 and U.S. Department of Transportation/National Highway Traffic Safety Administration, 'Fact Sheet: AV Policy Section II: Model State Policy' (September 2016). See also Lauren Isaac, 'Driving Towards Driverless: a guide for government agencies' (*WSP/Parsons Brinckerhoff*, 2016) <https://web.archive.org/web/20170323072545/http://www.wsp-pb.com/Globaln/USA/Transportation%20and%20Infrastructure/driving-towards-driverless-WBP-Fellow-monograph-lauren-isaac-feb-24-2016.pdf> accessed 20 august 2019.
[76] Besluit van 15 juni 2015 tot wijziging van het Besluit ontheffingverlening exceptionele transporten (ontwikkeling zelfrijdende auto), Staatsblad 2015/248 (hereinafter: Het Besluit, Staatsblad 2015/248). See also *Kamerstukken II* 2014/2015, 31305, 210.
[77] Nota van Toelichting, Het Besluit, Staatsblad 2015/248.
[78] Het Besluit, Staatsblad 2015/248, 4-5.
[79] Het Besluit, Staatsblad 2015/248, 5.

of the RDW.[80] The draft opens up the possibility to grant exemptions from the *Wegenverkeerswet 1994* (hereinafter WVW 1994). The WVW 1994 imposes certain tasks on the driver, e.g. not leaving the place of an accident (art. 7).[81] Therefore granting exemptions from the WVW 1994 is necessary to enable the testing of autonomous cars without a (test) driver in the car.[82] The aim is for the 'experimenteerwet' to enter into force on 1 January 2018.[83]

2.5.4 Evaluating the Legal Instruments

The choice of the right legal instrument is of great importance as it can stimulate or inhibit further technological development.[84] To benefit from the newest technological developments the legal instrument will need to be flexible, i.e. it will need to have the ability to keep pace with these technological developments. This is beneficial for the manufacturers, however manufacturers will also want to have some degree of legal certainty; they need to know what requirements the self-driving car they are developing needs to fulfil in order to be allowed on public roads.[85] Other road users also will need a certain level of legal certainty: what can they expect, and if an accident happens, how will they be compensated for the damages suffered? The chosen legal instrument will need to offer possibilities for the government to ensure road safety, either by setting requirements for trials or by the possibility to intervene if safety gets compromised. The jurisdictions discussed above all take a different

---

[80] Netherlands Ministry of Infrastructure and Water Management, 'Draft for Internet consultation, Amendment of the Road Traffic Act 1994 in connection with the enabling of experiments with automated systems in vehicles' (*overheid.nl*, July 2016) <www.internetconsultatie.nl/experimenteerwet_zelfrijdendeauto> accessed 12 January 2017 (also available in English) (Draft, Explanatory Memorandum).

[81] Draft, Explanatory Memorandum, para 2.2, Nynke E Vellinga, Wim H Vellinga, Kiliaan APC van Wees, 'Testen van autonome of zelfrijdende auto's op de openbare weg' (2016) 64 Verkeersrecht 218. See also Kiliaan APC van Wees, 'Enkele juridische aspecten van de (deels) zelfrijdende auto' (2015) Computerrecht 313.

[82] Draft, Explanatory Memorandum, para 2.5.

[83] Netherlands Ministry of Infrastructure and Water Management, 'Reacties op de internetconsultatie *Experimenteerwet zelfrijdende auto'* (*overheid.nl*, 7 July 2016 – 1 September 2016) <www.internetconsultatie.nl/experimenteerwet_zelfrijdendeauto> accessed 12 January 2017.

[84] Jonathan B Wiener, 'The regulation of technology, and the technology of regulation' (2004) 26 Technology in Society 483; *Kamerstukken II* 2014/15, 33009, 10; Bryant W Smith, 'How Governments Can Promote Automated Driving' (2016) New Mexico Law Review (forthcoming) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016, 7. See also International Transport Forum, Corporate Partnership Board, 'Automated and Autonomous Driving. Regulation under uncertainty' (OECD/ITF 2015), para 3.

[85] See for instance Testimony of Dr. Chris Urmson (Director, Self-Driving Cars, Google [x]) before the Senate Committee on Commerce, Science and Technology Hearing, 'Hands Off: The Future of Self-Driving Cars' (15 March 2016).

approach to accommodating the testing of self-driving cars, although they all strive for safe testing and want to benefit from the newest available technology. The discussed jurisdictions all use different legal instruments to achieve these goals: California has chosen a binding regulation, a non-binding regulation is preferred by the federal US government and the government of the UK, while the Dutch government has chosen exemptions under conditions. Are the instruments chosen by the described jurisdictions suitable to achieve their objectives?

For achieving safe testing the safety requirements set by the legislator in a legal instrument are of great importance. Both binding regulations and an exemption under conditions are legally binding, so their requirements need to be fulfilled by, for example, the manufacturer or the testing organisation. These instruments are therefore suitable for a government that wants to keep the testing in check. Both instruments are also suitable for upholding road traffic safety. If road safety is compromised during testing or if the conditions of the exemption are violated, then the exemption can be withdrawn. If safety requirements in binding law are violated this can constitute a criminal offence, entitling the police to intervene. This way road safety is ensured. More supervision can be exercised through the safety requirements in a binding regulation or in the conditions of an exemption. For instance, the reporting and recording (e.g. using a 'black box' that records all of the data that a car collects prior to an incident) of incidents can be used to assess the risks the self-driving car poses to road safety.[86]

The manufacturer or testing organisation will also want to know what safety requirements he has to fulfil, so he can adjust the design or the testing procedure in

[86] See on recording data and accidents: ACE Spek, 'Over toelating van autonome testvoertuigen op de weg en het onderzoek van ongevallen' (2016) 64 Verkeersrecht 2 and Kiliaan APC van Wees, 'Over zwarte dozen in auto's en wie er in mag kijken; verkennende beschouwingen over EDR en de exhibitieplicht' (2011) 59 Verkeersrecht 337; Brandon Schoettle, Michael Sivak, 'A Preliminary Analyses of Real-World Crashes Involving Self-Driving Vehicles' (The University of Michigan Transportation Research Institute, Ann Arbor, October 2015) <http://umich.edu/~umtriswt/PDF/UMTRI-2015-34.pdf> accessed 18 April 2017; Myra Blanco and others, 'Automated Vehicle Crash Rate Comparison Using Naturalistic Data' (Virginia Tech Transportation Institute January 2016) <www.vtti.vt.edu/PDFs/Automated%20Vehicle%20Crash%20Rate%20Comparison%20Using%20Naturalistic%20Data_Final%20Report_20160107.pdf> accessed 18 April 2017. See also California Department of Motor Vehicles, 'Autonomous Vehicle Disengagement Reports 2016' (2016) <www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/disengagement_report_2016> accessed 12 April 2017; see for the UK: Code of Practice for testing 2015, para 5.6, Department for Transport, Department for Transport, 'The Pathway to Driverless Cars: A detailed review of regulations for automated vehicle technologies' (2015) (Review of regulations 2015) , para 14.12-14.15

order to meet the requirements. An exemption – that can be tailored to every individual situation – does not provide the manufacturer or testing organisation with legal certainty on the testing requirements prior to applying for such an exemption. Both binding and non-binding regulations offer legal certainty. However, because it is legally not binding, a non-binding regulation can be ignored. Yet this can have consequences if, for instance, the self-driving car causes an accident during a trial.[87] The non-compliance with non-binding regulations can contribute to a finding of negligence in liability procedures. If this is the case, then it provides an incentive for the manufacturer or testing organisation to comply with the non-binding regulation.

A non-binding regulation has an advantage over a binding regulation: a non-binding regulation can be easily updated without have to go through an often time-consuming legislative process.[88] This makes a non-binding regulation more suitable for keeping up with the fast developing self-driving technology.[89] Exemptions are suitable for this as well: every exemption can be tailored to the testing of the newest technological abilities.[90] The flexibility of these instruments, and consequently, their ability to keep up with technological developments, is important given the aim of the jurisdictions to benefit from the newest technological developments.[91]

When looking at the ability to keep up with technological developments, the Dutch approach of granting exemptions, subject to conditions, for each project provides the optimum possibility to cater for each project individually.[92] Weather conditions, different types of roads, traffic intensity - all of these can be excluded or included in the exemption. Although this approach is very flexible, it might be time-consuming to

---

[87] An example of this is the UK Code of Practice 2015.

[88] For example: Van den Heuvel, 'Wetten moeten meeademen met snelheid technologie', *Het Financieële Dagblad* (8 January 2016) <https://fd.nl/opinie/1134451/wetten-moeten-meeademen-met-snelheid-technologie> accessed 12 April 2017.

[89] Michiel A Heldeweg, *Smart rules & regimes: publiekrechtelijk(e) ontwerpen voor privatisering en technologische innovatie*, (extended version of inaugural lecture Universiteit Twente, of 24 september 2009, Universiteit Twente 2010), 80-81, 99.

[90] *Kamerstukken* 2014/15, 31305, 212; Bryant W Smith, 'How Governments Can Promote Automated Driving' (2016) New Mexico Law Review (forthcoming) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016, 39.

[91] Michiel A Heldeweg, *Smart rules & regimes: publiekrechtelijk(e) ontwerpen voor privatisering en technologische innovatie*, (extended version of inaugural lecture Universiteit Twente, of 24 september 2009, Universiteit Twente 2010), 76-77, 99. See also Bryant W Smith, 'How Governments Can Promote Automated Driving' [2016] New Mexico Law Review (forthcoming) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016, 38-39.

[92] See also Bryant W Smith, 'How Governments Can Promote Automated Driving' (2016) New Mexico Law Review (forthcoming), available at <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016, 39.

maintain if more and more applications for trials are filed. More importantly, it does not provide much legal certainty for the testing institutions or manufacturer.[93] From this perspective, the approach of California, with new legislation specifically for (the testing of) self-driving cars, provides more legal certainty. This legal certainty, however, limits (to a certain extent) the ability to keep pace with technical developments. A good middle ground could be a non-binding regulation, as seen in the UK and on a federal level in the US. This non-binding regulation can provide guidelines to the manufacturers and testing institutions, without losing the possibility of deviating from the regulation. Given the status of the non-binding US Federal Automated Vehicles Policy and the UK Code of Practice, they can relatively easily be kept up to date as they do not have to go through an often time-consuming legislative process. Guidelines like the UK Code of Practice can give manufacturers and other parties involved in testing self-driving cars certainty on what they can expect and which requirements they need to fulfil. For a government wanting to keep the testing of self-driving cars in check, combining the guidelines with a system of granting exemptions from existing binding regulations (which exemptions can be subject to conditions), would give the government power to control trials and withdraw exemptions when the safety of the public is compromised. Adapting to new, often difficult to foresee,[94] technical developments can be done either by adjusting the guidelines or – for a small number of trials – granting exemptions that allow the newest possibilities to be tested.[95] If this new technology matures and it has proven to be safe in trials, the guidelines can be adjusted. This way it would be possible to slowly transfer from testing with a human driver inside the testing vehicle, to testing with a human driver outside of the vehicle, to testing entirely without a human driver. By combining a non-binding regulation with a system of granting

---

[93] See also Nynke E Vellinga, Wim H Vellinga, Kiliaan APC van Wees, 'Testen van autonome of zelfrijdende auto's op de openbare weg' (2016) 64 Verkeersrecht 218.

[94] Surden and Williams advise design regulations to be broadly stated at a high level of abstraction as the technological developments are difficult to predict: Harry Surden, Mary-Anne Williams, 'Self-Driving Cars, Predictability, and Law' (2016) 38 Cardozo Law Review 121, 174-78. See also Bryant W Smith, 'How Governments Can Promote Automated Driving' (2016) New Mexico Law Review (forthcoming) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016, 38-39. The Governors Highway Safety Association urges states not to rush with legislation for self-driving vehicles as it could hinder the development of self-driving vehicles and may be soon out of date: James Hedlund, 'Autonomous Vehicles Meet Human Drivers: Traffic Safety Issues for States' (Governors Highway Safety Association) available at <http://src.bna.com/lVf> accessed 10 February 2017.

[95] Smith also acknowledges the flexibility exemptions can offer: Bryant W Smith, 'How Governments Can Promote Automated Driving' [2016] New Mexico Law Review (forthcoming) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016, 39.

exemptions, the interests of the government, the manufacturer, the testing organisation, and the general public are provided for. Therefore, this combination is preferred over the other legal instruments discussed.

2.6 Post-testing: The Driver in International and National Traffic Laws

As described above, legislators are already taking steps to accommodate the testing of self-driving cars. But as the technology develops further, from a technical perspective a human driver will become redundant. Therefore, for many legislators the question arises: are cars without human drivers[96] allowed on public roads? The answer to this question is determined not only by reference to national law, but also to international law. Both the 1949 Geneva Convention on Road Traffic and the 1968 Vienna Convention on Road Traffic are relevant in this respect. So before taking a closer look at national laws (section 2.6.2), the Conventions will be discussed (section 2.6.1). If cars without human drivers are allowed on public roads, no legislative action is needed. However, if cars without human drivers are not allowed to drive on public roads, legislative measures will be necessary (section 2.6.3).

2.6.1 The Driver in International Law: Vienna Convention on Road Traffic 1968 and the Geneva Convention on Road Traffic 1949

The Geneva Convention has over 90 Contracting Parties, while the Vienna Convention has over 60 Contracting Parties. As a result, both Conventions greatly influence the traffic laws across the globe.[97] Out of the countries discussed above, the Netherlands is the only country that is a party to both the 1949 Geneva Convention and the 1968 Vienna Convention.[98] Both the US and the UK have ratified the 1949 Geneva

[96] Smith argues for establishing a clear legal distinction between a driver and a passenger of a vehicle: Bryant W Smith, 'How Governments Can Promote Automated Driving' [2016] New Mexico Law Review (forthcoming) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016, 29.

[97] United Nations Treaty Collection, 'List of Contracting Parties to the Convention on Road Traffic, Geneva, 19 September 1949' <https://treaties.un.org/doc/Publication/MTDSG/Volume%20I/Chapter%20XI/xi-b-1.en.pdf> accessed 12 April 2017; United Nations Economic Commission for Europe, 'List of Contracting Parties to the Convention on Road Traffic, Vienna, 8 November 1968' (UNECE, 1 February 2007) <www.unece.org/fileadmin/DAM/trans/conventn/CP_Vienna_convention.pdf> accessed 12 April 2017.

[98] United Nations Economic Commission for Europe, 'List of Contracting Parties to the Convention on Road Traffic, Vienna, 8 November 1968' (UNECE, 1 February 2007) <www.unece.org/fileadmin/DAM/trans/conventn/CP_Vienna_convention.pdf> accessed 12 April 2017; On the Netherlands: Tractatenblad 2008, 76.

Convention on Road Traffic.[99] However, while the UK has signed but has not ratified the 1968 Vienna Convention, the United States have neither signed nor ratified it.

Discussions on both Conventions are mainly held by the Global Forum for Road Traffic Safety, also known as Working Party 1, of the United Nations Economic Commission for Europe Inland Transport Committee. The primary function of Working Party 1 is "to serve as guardian of the United Nations legal instruments aimed at harmonizing traffic rules."[100] Working Party 1, open to participation from all countries, meets twice a year.[101] As Working Party 1 focuses on the improvement of road safety, automated driving is relevant for the Working Party. The Working Party has an Informal Group of Experts on Automated Driving. The attention of the Working Party is mainly directed at the 1949 Geneva Convention and the 1968 Vienna Convention as both Conventions might pose obstacles with regards to automated driving.

The Geneva Convention and the Vienna Convention both have a similar requirement with regards to the requirement of having a driver[102] in a vehicle. Article 8 paragraph 1 of the Geneva Convention demands that "Every vehicle or combination of vehicles proceeding as a unit shall have a driver", whereas Article 8 paragraph 1 of the Vienna Convention has a different formulation: "Every moving vehicle or combination of vehicles shall have a driver". Both Conventions also demand the driver to be in control of his vehicle.[103]

With the emergence of Advanced Driver Assistance Systems or ADAS, the question arose if a driver can still be in control of his vehicle when part of the driving task is

---

[99] Available at United Nations Treaty Collection, 'List of Contracting Parties to the Convention on Road Traffic, Geneva, 19 September 1949' <https://treaties.un.org/doc/Publication/MTDSG/Volume%20I/Chapter%20XI/xi-b-1.en.pdf> accessed 12 April 2017.

[100] United Nations Economic Commission for Europe, 'About us' <www.unece.org/trans/roadsafe/rsabout.html> accessed 1 December 2016.

[101] United Nations Economic Commission for Europe, 'About us' <www.unece.org/trans/roadsafe/rsabout.html> accessed 1 December 2016, documents relating to those meetings can be accessed through this website.

[102] The definition of 'driver' is given in Art. 4 paragraph 1 of the Geneva Convention on Road Traffic (adopted 19 September 1949, entered into force 26 March 1952) 125 UNTS 3 (Geneva Convention) and Art. 1 (v) of the Vienna Convention on Road Traffic (adopted 8 November 1968, entered into force 21 May 1977) 1042 UNTS 17 (Vienna Convention).

[103] Art. 8 paragraph 4 Geneva Convention, art. 8 paragraph 5 Vienna convention. The formulation of both Conventions differ. Art. 10 Geneva Convention and art. 39 paragraph 1 Vienna Convention further elaborate on the control a driver should have over his vehicle. See also Lennart S Lutz, 'Anforderungen an Fahrerassistenzsysteme nach dem Wiener Übereinkommen über den Straßenverkehr' (2014) Neue Zeitschrift für Verkehrsrecht 67.

performed by an assistance system.[104] To provide clarity, amendments to both Conventions were proposed. The proposed amendments to the Geneva Convention[105] were not accepted by the contracting parties. The very similar amendments to the Vienna Convention, however,[106] were adopted, and entered into force in March 2016.[107] These amendments should take away any doubt there might be regarding the compliance of the driver assistance systems already available to the general public with the Vienna Convention.[108] As specified in the amendments, there needs to be a possibility for the driver to override these systems and there it should be possible for the driver to switch off the driver assistance system.[109] However, not

---

[104] See for instance Lennart S Lutz, 'Die bevorstehende Änderung des Wiener Übereinkommens über den Straßenverkehr: Eine Hürde auf dem Weg zu (teil-) autonomen Fahrzeugen ist genommen!' ([2014)] Deutsches Autorecht 446. See also Walter Frenz, Erika Casimir-van den Broek, 'Völkerrechtliche Zulässigkeit von Fahrerassistenzsystemen' (2009) Neue Zeitschrift für Verkehrsrecht 529; Frank Albrecht,'"Fährt der Fahrer oder das System?"- Anmerkungen aus rechtlicher Sicht' (2005) Straßenverkehrsrecht 373.

[105] United Nations Economic and Social Council, 'Consistency between the Convention on Road Traffic (1949) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/4; United Nations Economic and Social Council, 'A Safe System Approach' (11 July 2014) UN Doc ECE/TRANS/WP.1/2014/4/Rev.1.

[106] The reason for this probably lies in the higher threshold for accepting amendments to the Geneva Convention (see Economic Commission for Europe Inland Transport Committee (73rd Session) 'Automated Driving, Informal document No. 4' (14 September 2016)); art. 31 paragraph 3 Geneva Convention, see for the procedure to amend the Vienna Convention art. 49 of the Vienna Convention.

[107] United Nations Economic and Social Council, 'Consistency between the 1971 European Supplement to the Convention on Road Traffic (1968) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/3; United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 April 2014) UN Doc ECE/TRANS/WP.1/145; United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 July 2014) UN Doc ECE/TRANS/WP.1/145/Corr.1, announcement available at United Nations, 'Convention on Road Traffic Vienna, 8 November 1968, Proposal of Amendments to Articles 8 and 39 of the Convention' (23 September 2014) <https://treaties.un.org/doc/Publication/CN/2014/CN.569.2014-Eng.pdf> accessed 7 December 2016.

[108] United Nations Economic and Social Council, 'Consistency between the 1971 European Supplement to the Convention on Road Traffic (1968) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/3; United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 April 2014) UN Doc ECE/TRANS/WP.1/145, 11 under 2 and 3.

[109] United Nations Economic and Social Council, 'Consistency between the 1971 European Supplement to the Convention on Road Traffic (1968) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/3; United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 April 2014) UN Doc ECE/TRANS/WP.1/145, 11 under 4 and 6; Bryant W Smith, 'Automated Vehicles Are Probably Legal in the United States' (2014) 1 Texas A&M Law Review 411, 440.

every system that cannot be switched off or overridden by the driver is inconsistent with the Vienna Convention. Systems like brake assist which supports the driver when making an emergency stop by maximising braking deceleration, are deemed to be in conformity with the Vienna Convention, as these systems help the driver to maintain control of his vehicle.[110]

These amendments, however, do not seem to address the issue of the completely self-driving car, which would allow a 'driver' to be involved in other tasks than driving.[111] Crucially, the amendments have not affected the requirement that every moving vehicle should have a driver.[112]

In order to help move legislative developments along, Sweden proposed to make automated driving a new work item on the agenda of Working Party 1.[113] Since then, automated driving has been getting more and more attention from the Working Party. Together the governments of Belgium and Sweden proposed an amendment to Article 8 of the Vienna Convention.[114] The proposed amendments have opened up a

---

[110] United Nations Economic and Social Council, 'Consistency between the 1971 European Supplement to the Convention on Road Traffic (1968) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/3; United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 April 2014) UN Doc ECE/TRANS/WP.1/145, 11 under 5.

[111] Economic Commission for Europe Inland Transport Committee (73rd Session) 'Automated Driving, Informal document No. 4' (14 September 2016), para 3; Lennart S Lutz, 'Die bevorstehende Änderung des Wiener Übereinkommens über den Straßenverkehr: Eine Hürde auf dem Weg zu (teil) autonomen Fahrzeugen ist genommen!' (2014) Deutsches Autorecht 446, 449-450; Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017, para 4.7; Benjamin von Bodungen, Martin Hoffmann, 'Das Wienerübereinkommen über den Straßenverkehr und die Fahrzeugautomatisierung (Teil 1). Wege Aus dem Zulassungsdilemma' (2016) Straßenverkehrsrecht 41, C.II; Benjamin von Bodungen, Martin Hoffmann, 'Das Wienerübereinkommen über den Straßenverkehr und die Fahrzeugautomatisierung (Teil 2). Wege Aus dem Zulassungsdilemma' (2016) Straßenverkehrsrecht 93. Lutz expresses less doubt regarding the scope of the amendments: Lennart S Lutz, 'Autonome Fahrzeuge als rechtliche Herausforderung' (2015) Neue Juristische Wochenschrift 119.

[112] Art. 8 paragraph 1 Vienna Convention ("Every moving vehicle or combination of vehicles shall have a driver").

[113] United Nations Economic and Social Council, 'Proposal for a new work item on the agenda of the Working Party on Road Traffic Safety' (11 July 2017) UN Doc ECE/TRANS/WP.1/2014/7.

[114] United Nations Economic and Social Council, 'Automated Driving' (28 July 2015) UN Doc ECE/TRANS/WP.1/2015/8. See also Economic Commission for Europe, Inland Transport Committee (70th Session), 'Autonomous Driving Informal document No. 2' (12 March 2015). See for an analysis of the proposed amendment Benjamin von Bodungen, Martin Hoffmann, 'Belgien und Schweden schlagen vor: Das Fahrsystem soll Fahrer werden!' (2015) Neue Zeitschrift für Verkehrsrecht 521.

discussion on if, how and in what way the Vienna Convention and the Geneva Convention should evolve given the development of self-driving cars. A wider interpretation of the current provisions of the Conventions is one of the options being explored.[115] Current trials of self-driving cars with a human driver are allowed under the Vienna Convention: exemptions from Annex 5, regarding the technical conditions of vehicles, can be granted for experiments which have the purpose of keeping up with technical developments and seek to improve road safety.[116] Deviating from the traffic rules of the Vienna Convention is most likely allowed as well, as long as this is not inconsistent with the objectives and scope of the Vienna Convention.[117]

2.6.2 The Driver in National Law: The Netherlands, California and the United Kingdom

As mentioned above, the Conventions greatly influence national traffic laws. So it is no surprise that these traffic laws are based on the notion that only a human can drive a car. For the purpose of testing self-driving cars, the Netherlands and California are taking steps to accommodate testing without a human driver inside of the vehicle.

As is apparent from the above discussion of the Dutch legal situation, test driving autonomous vehicles on public roads without a human driver inside the vehicle is not yet allowed in the Netherlands. However, this will change if the 'experimenteerwet' enters into force – which is most likely expected to happen in 2018.[118]

---

[115] Economic Commission for Europe Inland Transport Committee (73rd Session) 'Automated Driving, Informal document No. 4' (14 September 2016); Economic Commission for Europe, Inland Transport Committee (70th Session), 'Autonomous Driving Informal document No. 2' (12 March 2015); United Nations Economic and Social Council, 'Annotated provisional agenda for the seventy-fourth session' (10 January 2017) UN Doc ECE/TRANS/WP.1/156. See on the interpretation of art. 8 of both Conventions: Bryant W Smith, 'Automated Vehicles Are Probably Legal in the United States' (2014) 1 Texas A&M Law Review 411. See also European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)) [2017], section 61-62.

[116] Art. 60(c) Annex 5, Vienna Convention.

[117] Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017, para 4.8; Walter Frenz, Erika Casimir-van den Broek, 'Völkerrechtliche Zulässigkeit von Fahrerassistenzsystemen' (2009) Neue Zeitschrift für Verkehrsrecht 529.

[118] Netherlands Ministry of Infrastructure and Water Management, _ _ 'Reacties op de internetconsultatie Experimenteerwet zelfrijdende auto' (overhied.nl, 7 July 2016 – 1 September 2016) <www.internetconsultatie.nl/experimenteerwet_zelfrijdendeauto> accessed 12 January 2017.

California is ahead of the Netherlands in this respect:[119] the governor of California has recently signed off a new bill that permits the testing of autonomous vehicles without equipment like a brake paddle, steering wheel and accelerator in the car.[120] However, the bill is for just one pilot project.[121] Although at the moment this project is the first and only Californian project which will actually be without a human driver, other projects could follow because the Californian Department of Motor Vehicles has proposed new legislation.[122]

This new legislation, the so-called Autonomous Vehicles Express Terms, would open up the possibility for a manufacturer to apply for a 'Permit to Deploy Autonomous Vehicles on Public Roads', which covers operation of autonomous vehicles by members of the public.[123] Several requirements need to be fulfilled. For instance, the vehicle needs to be equipped with a technology data recorder.[124] There should be a

---

[119] This being said, California is not the first state with legislation enabling the testing of self-driving vehicles without a test driver inside the vehicle. In Michigan, it is now allowed to test self-driving cars without a human driver and without steering equipment like a steering wheel and brake paddle (Senate Bill 995, 996, 997, 998, Senate Journal Number 77, 13 December 2016). Even though there is some discussion on how to interpret this legislation, it is clear that this is allowed (see for instance Kristen Korosec, 'Michigan Just Passed the Most Permissive Self-Driving Car Laws in the Country' (*Fortune*, 9 December 2016) <http://fortune.com/2016/12/09/michigan-self-driving-cars/> accessed 21 December 2016; Aarian Marshall, 'Michigan just embraced the driverless future' (*Wired*, 9 December 2016) <www.wired.com/2016/12/michigan-just-embraced-driverless-future/> accessed 21 December 2016; Bryant W Smith, 'Michigan's automated driving bills' (*The Center for Internet and Society*, 6 September 2016) <https://cyberlaw.stanford.edu/blog/2016/09/michigans-automated-driving-bills> accessed 7 February 2017.

[120] Assembly Bill No. 1592, 29 September 2016. Ford has the intent to bring such a vehicle to the market no later than 2021: Ford, 'Ford Targets Fully Autonomous Vehicle for Ride Sharing in 2021; Invests in New Tech Companies, Doubles Silicon Valley Team' <https://media.ford.com/content/fordmedia/fna/us/en/news/2016/08/16/ford-targets-fully-autonomous-vehicle-for-ride-sharing-in-2021.html> (16 August 2016) accessed 11 April 2017.

[121] Section 38755 (a).

[122] Department of Motor Vehicles, *Autonomous Vehicles Express Terms* (March 2017) <www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto> accessed 12 April 2017 (Autonomous Vehicles Express Terms). See also the Revised Draft Deployment Regulations, released September 2016 and Draft Deployment Regulations, released December 2015.

[123] §228.06 Autonomous Vehicles Express Terms, Initial Statement of Reasons, March 2017, available at <www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto> accessed 12 April 2017. The previous Draft Deployment Regulations originally required a licenced operator in the vehicle who can resume control of the vehicle at all times. This led to critique from (amongst others) Google (Chris Urmson, 'The View from the Front Seat of the Google Self-Driving Car, Chapter 3' (*Medium*, 17 December 2015) <https://medium.com/@chris_urmson/the-view-from-the-front-seat-of-the-google-self-driving-car-chapter-3-476ea9deed9a#.wqzn8phbb> accessed 6 January 2017), see also Autonomous Vehicles Express Terms.

[124] §228.06 (a)(5) Autonomous Vehicles Express Terms.

communication link between the vehicle and a remote operator, if any, which allows two-way communication between the remote operator and any passengers in case a failure occurs that would endanger the safety of either the passengers or other road users.[125] A copy of a safety assessment letter which can be submitted voluntarily to the NHTSA,[126] needs to be submitted to the Department for Motor Vehicles.[127] There is also a special subsection on cybersecurity: "A certification that the autonomous vehicles have self-diagnostic capabilities that meet current industry best practices for detecting and responding to cyber-attacks, unauthorized intrusions, and false or spurious messages or vehicle control demands" should be submitted and approved by the Department of Motor Vehicles.[128] A vehicle demonstration test conducted by an independent third party, to assess the vehicle's performance and capabilities, was not included in the Autonomous Vehicles Express Terms because of the inability to formulate pass/fail criteria that could be used by the independent third party demonstration testers.[129] It is as yet unknown if and when the Autonomous Vehicles Express Terms are expected to enter into force.

The UK government has not only published the Code of Practice, described above, but also a review of the regulations for automated vehicle technologies.[130] This review entails several topics, for example, roadworthiness and maintenance, standards for new vehicles, road infrastructure standards, driver behaviour, event or collision data recorders etc.[131] An important finding of the review is that "(…)there are no barriers in road traffic law that would stop the testing of automated vehicles on public roads, provided a test driver supervises the actions of the vehicle sufficiently to take control in time to operate the vehicle safely and to a "proper" standard."[132] This finding has been translated into a requirement in the Code of

---

[125] §228.06 (b)(1) Autonomous Vehicles Express Terms. See also Nissan's recently introduced Seamless Autonomous Mobility (SAM): Eric Abent, 'Nissan debuts Seamless Autonomous Mobility system based on NASA tech' (*Slashgear*, 5 January 2017) <www.slashgear.com/nissan-debuts-seamless-autonomous-mobility-system-based-on-nasa-tech-05470542/> accessed 6 January 2016.
[126] Federal Policy 2016, 15.
[127] §228.06 (d) Autonomous Vehicles Express Terms.
[128] §228.06 (a)(9) Autonomous Vehicles Express Terms.
[129] Autonomous Vehicles Express Terms, Initial Statement of Reasons, March 2017, available at <www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto> accessed 12 April 2017. See also §228.08 Autonomous Vehicles Express Terms.
[130] Department for Transport, 'The Pathway to Driverless Cars: A detailed review of regulations for automated vehicle technologies' (2015) (Review of regulations 2015).
[131] Review of regulations 2015.
[132] Review of regulations 2015, para 5.15. See also para 5.12-5.14, 5.18, 10.23. Because trials need to be in line with existing laws, a driver needs to be present.

Practice stating that a trained test driver or test operator[133] should always supervise the vehicle and be able to override the automated driving system when needed.[134] The responsibility for ensuring the safe operation of the vehicle at all times, regardless of whether it is driving in automated mode or manual mode, rests with the test driver or the test operator.[135] Contrary to California, the UK government has not yet taken steps to allow vehicles without a human driver on public roads, neither for testing purposes nor for deployment.[136]

2.6.3 The Interpretation of *Driver*

As described above, the Vienna and Geneva Conventions, as well as national laws are, at least for now, adhering to the thought that a car needs a human driver. So if a human driver becomes redundant, traffic laws will need to adapt. In California, the draft Autonomous Vehicles Express Terms would open up the possibility to deploy cars that do not need a human driver on public roads. Drafting new regulations to open up such a possibility is one way to go, but there is another route that legislators can take. Interpretation of the term 'driver' can lead to the conclusion that a driver is not necessarily a human[137] but could also be the self-driving car's system.[138] The NHTSA has already interpreted the term 'driver' in this way: for certain Federal Motor Vehicle Safety Standards the NHTSA is of the opinion that the 'driver' in these specific standards can also be the self-driving system.[139] Working Party 1 also explores a

---

[133] Definition of test operator: "A test operator is someone who oversees testing of an automated vehicle without necessarily being seated in the vehicle, since some automated vehicles might not have conventional manual controls and/or a driver's seat. In this case it is expected that a 'test operator' would still be able to over-ride automated operation of the vehicle at any time." Code of Practice for testing 2015, para 2.11.

[134] Code of Practice for testing 2015, para 4.1. See also para 2.10-2.11, 4.3, 4.15, 5.17; Review of regulations 2015, para 5.15.

[135] Code of Practice for testing 2015, para 4.2. See also Review of regulations 2015, para 5.13-5.14.

[136] Centre for Connected & Autonomous Vehicles, 'Pathway to Driverless Cars: Proposals to support advanced driver assistance systems and automated vehicle technologies' (July 2016), p. 8 and para 3; Centre for Connected & Autonomous Vehicles, 'Pathway to Driverless Cars: Consultation on proposals to support Advanced Driver Assistance Systems and Automated Vehicles, Government Response' (2017) (Government Response 2017).

[137] Bryant W Smith, 'Automated Vehicles Are Probably Legal in the United States' (2014) 1 Texas A&M Law Review 411, 434, 440-41.

[138] In a different context: Paul T Schrader, 'Haftungsrechtlicher Begriff des Fahrzeugführers bei zunehmender Automatisierung von Kraftfahrzeugen' (2015) Neue Juristische Wochenschrift 3537, V.2; Paul T Schrader, 'Haftungsfragen für Schäden beim Einsatz automatisierter Fahrzeuge im Straßenverkehr' (2016) Deutsches Autorecht 242, V.1.

[139]National Highway Traffic Administration, 'Letter responding to a letter from Dr. Chris Urmson (Director of the Self-Driving Car Project, Google, Inc.)' (4 February 2016) <http://isearch.nhtsa.gov/files/Google%20--

broader interpretation of the Conventions.[140] However, especially in the stage of development where a completely self-driving car is not yet available and therefore the driving task is shared between the human driver and the self-driving system, this can lead to interesting outcomes. For instance, art. 8 paragraph 6 of the Vienna Convention ("A driver of a vehicle shall at all times minimize any activity other than driving.(…)"), aiming to prevent distracted driving, is clearly directed at the human driver but does not seem relevant when the self-driving system is the driver of the car. Certain rules of conduct will also have consequences for the design of the vehicle if the self-driving system can be regarded as the driver. An example from Dutch traffic law can illustrate this: art. 160 WVW 1994[141] (in brief) states that the driver should stop his vehicle immediately when instructed to do so by authorised officials (e.g. a police officer). So a self-driving car driven by the self-driving system should be able to understand the instructions of a person, and it should be able to identify that person as an authorised official.[142] That seems quite a challenging task for a self-driving system.

Another obstacle for a broader interpretation is the definition of a driver in art. 1(v) of the Vienna Convention: ""Driver" means any person who drives a motor vehicle or other vehicle (including a cycle), or who guides cattle, singly or in herds, or flocks, or draught, pack or saddle animals on a road." This definition of driver is an obstacle for interpreting 'driver' so extensively that the self-driving system could be regarded as 'driver' because a self-driving system can hardly be regarded to be a person. However, it has been argued that the 'person' referred to in art. 1(V) of the Vienna Convention is not necessarily a human person, but could also be a legal person.[143] In

---

%20compiled%20response%20to%2012%20Nov%20%2015%20interp%20request%20--%204%20Feb%2016%20final.htm> accessed 9 August 2018. See also Françoise Gilbert and Raffaele Zallone, 'Connected cars. Recent legal developments' (2016) <http://robots.law.miami.edu/2016/wp-content/uploads/2015/07/GILBERT-ZALLONE-Connected-Cars-REVISED_2016-03-29.pdf> accessed 3 February 2017, 9-11. However, Smith points out that the driver is not seen as a legal entity in the Federal Motor Vehicle Safety Standards: Bryant W Smith, 'Michigan's automated driving bills' (*The Center for Internet and Society,* 6 September 2016) <https://cyberlaw.stanford.edu/blog/2016/09/michigans-automated-driving-bills> accessed 7 February 2017.

[140] United Nations Economic and Social Council, 'Report of the seventy–third session of the Working Party on Road Traffic Safety' (12 October 2016) UN Doc ECE/TRANS/WP.1/155, under 19.

[141] The 1968 Vienna Convention has a similar provision in art.6 paragraph 2, but this is directed to 'road-users'.

[142] Nynke E Vellinga, Wim H Vellinga, Kiliaan APC van Wees, 'Testen van autonome of zelfrijdende auto's op de openbare weg' (2016) 64 Verkeersrecht 218.

[143] Economic Commission for Europe Inland Transport Committee (73rd Session) 'Automated Driving, Informal document No. 4' (14 September 2016).

this context, the discussion on assigning robots legal personality could be of relevance.[144]

2.7 Post-testing: Liability and Insurance

Although a significant decline in road accidents is expected,[145] self-driving cars will not be infallible. With the occurrence of accidents also comes questions on liability and insurance. At the current stage, most jurisdictions have not adopted a new liability regime regarding self-driving cars. However, some jurisdictions have supplementary provisions on liability and insurance. Below, some issues regarding liability and insurance will be highlighted.

2.7.1 Current Developments

In the US, the States, not the federal government, are responsible for motor vehicle insurance[146] and liability regimes (mainly based on negligence).[147] American legal literature mainly focuses on product liability.[148] The Californian draft Autonomous

---

[144] See for instance: Nathalie Nevejans, 'European Civil Law Rules in Robotics. Study' (Directorate-General For Internal Policies Policy Department C: Citizens' Rights and Constitutional Affairs, Legal Affairs, 2016) <www.europarl.europa.eu/RegData/etudes/STUD/2016/571379/IPOL_STU(2016)571379_EN.pdf> accessed 20 August 2019; SM Solaiman, 'Legal personality of robots, corporations, idols and chimpanzees: a quest for legitimacy' (2017) 25(2) Artificial Intelligence and Law 155); European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)) [2017], section 59f.

[145] However, it is not yet proven that self-driving cars will indeed reduce road traffic accidents. See the letter from Martyn Thomas to *Financial Times* 'Future with the driverless car needs careful planning' *Financial Times* (30 September 2016) <www.ft.com/content/df918048-83ff-11e6-a29c-6e7d9515ad15> accessed 28 April 2017.

[146] Twelve states have no-fault auto insurance laws: Insurance Information Institute, 'Background on: No-fault auto insurance' (*Insurance Information Institute*, 6 November 2018) <www.iii.org/issue-update/no-fault-auto-insurance> accessed 20 August 2019.

[147] Federal Policy 2016, p. 45, Dorothy J Glancy, Robert W Peterson, Kyle F Graham, *A Look at the Legal Environment for Driverless Vehicle* (Legal Research Digest 69, Transportation Research Board 2016). See also Gary E Marchant, Rachel E Lindor, 'The Coming Collision Between Autonomous Vehicles and the Liability System' (2012) 52 Santa Clara Law Review 1321.

[148] See, among others, Kevin Funkhouser, 'Paving the road ahead: autonomous vehicles, products liability, and the need for a new approach' (2013) Utah Law Review 437; Jeremy Levy, 'No Need to Reinvent the Wheel: Why Existing Liability Law Does Not Need to Be Preemptively Altered to Cope with the Debut of the Driverless Car' (2016) 9 Journal of Business, Entrepreneurship & the Law 355; Gary E Marchant, Rachel E Lindor, 'The Coming Collision Between Autonomous Vehicles and the Liability System' (2012) 52 Santa Clara Law Review 1321; Stephen S Wu, 'Unmanned Vehicles and US Product Liability' (2012) 21(2) Journal of Law, Information, and Science 234; Andrew P. Garza, '"Look Ma, No Hands!": Wrinkles and Wrecks in the Age of Autonomous Vehicles' (2012) 46 New England Law Review 581; Jeffrey K Gurney, 'Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles' (2013) University of Illinois Journal of Law, Technology & Policy 247; Dorothy J

Vehicles Express Terms contain a provision, stating that the manufacturer will have prove its ability to "respond to a judgment or judgments for damages for personal injury, death, or property damage arising from collisions or accidents caused by the autonomous vehicles produced by the manufacturer in the form of an instrument of insurance, a surety bond, or proof of self-insurance."[149] In the case of a SAE Level 5 vehicle, the manufacturer is at all times responsible for the safe operation of their vehicle, including ensuring compliance with all traffic laws.[150]

In the Netherlands, the current liability (fault liability, but a strict liability regime applies if more vulnerable road users are injured by a motor vehicle)[151] and insurance regime applies, but it is possible that exemptions granted for testing are bound to certain conditions regarding insurance.[152] For instance, additional insurance can be a condition of the exemption.[153] The overall opinion expressed in Dutch legal literature is that the current liability regime is sufficient; a victim of a crash will be able to get compensation.[154] However, some remarks are made. For instance, a concern has

---

Glancy, Robert W Peterson, Kyle F Graham, *A Look at the Legal Environment for Driverless Vehicle* (Legal Research Digest 69, Transportation Research Board 2016); James M Anderson and others, 'Autonomous Vehicle Technology. A Guide for Policymakers' (RAND Corporation, 2016), 118.

[149] §228.04 (a)(1) Autonomous Vehicles Express Terms. Such an instrument has to be in the amount of five million dollars: see §228.04 (a)(1) in conjunction with §227.10, §227.08, §227.14 Autonomous Vehicles Express Terms and in conjunction with California Vehicle Code section 38750, subdivision b, 3.

[150] §228.28 (b) Autonomous Vehicles Express Terms. See §228.28 (b) for a SAE Level 4 vehicle, see §228.28 (a) for a SAE Level 3 vehicle.

[151] Cees van Dam, Gerrit van Maanen, 'The development of traffic liability in the Netherlands' in Wolfgang Ernst (ed), *The development of traffic liability* (Volume 5, Cambridge University Press, 2010). See also Eric FE Tjong Tjin Tai, Sanne Boesten, 'Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten' (2016) Nederlands Juristenblad 656.

[152] Nota van Toelichting, Besluit van 15 juni 2015 tot wijziging van het Besluit ontheffingverlening exceptionele transporten (ontwikkeling zelfrijdende auto); Staatsblad 2015/248. See also Draft, Explanatory Memorandum, 2.5.

[153] Besluit van 15 juni 2015 tot wijziging van het Besluit ontheffingverlening exceptionele transporten (ontwikkeling zelfrijdende auto), Staatsblad 2015/248, p. 5.

[154] Eric FE Tjong Tjin Tai, Sanne Boesten, 'Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten' (2016) Nederlands Juristenblad 656; Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017; Esther FD Engelhard, 'Wetgever, pas op! De (vrijwel) autonome auto komt eraan' (2017) (3) Ars Aequi 230; Kiliaan APC van Wees, 'Enkele juridische aspecten van de (deels) zelfrijdende auto' (2015) Computerrecht 313; Kiliaan APC van Wees, 'Over intelligente voertuigen, slimme wegen en aansprakelijkheid' (2010) 58 Verkeersrecht 33; Nynke E Vellinga, 'De civielrechtelijke aansprakelijkheid voor schade veroorzaakt door een autonome auto' (2014) 62 Verkeersrecht 151; Kees NJ De Vey Mestdagh, Jeroen Lubbers, '"Nee hoor, u wilt helemaal niet naar Den Haag…" Over de techniek, het recht en de toekomst van de

been expressed that although it might be possible for the manufacturer to call on the devlopment risk defence[155] to avert liability, the possessor[156] of the self-driving car cannot invoke that defence.[157] The possessor would then be strictly liable for the development risks, even though the possessor is not involved in the development.[158]

Under English law, liability is mainly based on the tort of negligence, although negligence is interpreted rather strictly.[159] Compulsory liability insurance was first introduced by the Road Traffic Act 1930, and went through several changes.[160] Now, the compulsory liability insurance will undergo more changes because of the development of self-driving cars. The UK Department for Transport and the Centre for Connected and Autonomous Vehicles took the next step towards self-driving cars by issuing proposals to update the legal framework and consulting the public.[161] These proposals are divided into three categories, one of which is insurance.[162] After consulting the public, the government response was published.[163] The proposal concerning insurance was agreed upon by government and is now part of the Vehicle

zelfrijdende auto' (2015) 4 Ars Aequi 267; Kiliaan APC van Wees, 'Zelfrijdende auto's, aansprakelijkheid en verzekering; over nieuwe technologie en oude discussies' (2016) (2) Tijdschrift voor Vergoeding Personenschade 29; Kiliaan APC van Wees, 'Aansprakelijkheidsaspecten van (deels) zelfrijdende auto's' (2015) (5) Aansprakelijkheid, Verzekering & Schade 170; AI Schreuder, 'Aansprakelijkheid voor 'zelfdenkende' apparatuur' (2014) (5/6) Aansprakelijkheid, Verzekering & Schade.

[155] Art. 6:185 Burgerlijk Wetboek; 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.

[156] Art. 6:173 Burgerlijk Wetboek. See also art. 3:107 Burgerlijk Wetboek.

[157] Eric FE Tjong Tjin Tai, Sanne Boesten, 'Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten' (2016) Nederlands Juristenblad 656, para 4.5. Van Wees does not share this view: Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017, para 7.5; See also Esther FD Engelhard, 'Wetgever, pas op! De (vrijwel) autonome auto komt eraan' (2017) (3) Ars Aequi 230.

[158] Eric FE Tjong Tjin Tai, Sanne Boesten, 'Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten' (2016) Nederlands Juristenblad 656, para 4.5. See also Kiliaan APC van Wees, 'Aansprakelijkheidsaspecten van (deels) zelfrijdende auto's' (2015) (5) Aansprakelijkheid, Verzekering & Schade 170.

[159] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013).

[160] Roderick Bagshaw, 'The development of traffic liability in England and Wales' in Wolfgang Ernst (ed), *The development of traffic liability* (Volume 5, Cambridge University Press, 2010).

[161] Centre for Connected & Autonomous Vehicles, 'Pathway to Driverless Cars: Proposals to support advanced driver assistance systems and automated vehicle technologies' (July 2016) (Proposals 2016).

[162] Proposals 2016, 8. See also Proposals 2016, 16.

[163] Government Response 2017.

Technology and Aviation Bill (HC Bill 143) that is before Parliament.[164] Although the option of a first party insurance (enabling the victim of a collision, regardless of liability, to claim directly from the insurer of the vehicle he is travelling in) is discussed in the proposal,[165] the proposal does not entail significant changes in liability rules as "(…) a fault based approach combined with existing product liability law, rather than a new strict liability regime, is the best approach for our legal system (…) the existing common law on negligence should largely be able to adapt to this new technology."[166] The bill, however, does contain the extending of compulsory insurance[167] requirements to automated vehicles.[168] A single insurer model is proposed, where an insurer covers the driver's use of the self-driving car and the self-driving technology.[169] An innocent victim, regardless of whether he is inside or outside of the vehicle, can claim from this insurer if at the time of the collision the self-driving technology was active.[170] The insurer can recover the costs from the manufacturer, if the manufacturer is found to be liable.[171] The aim of the bill is to ensure that victims of a collision would be in no worse a position if they are injured by an automated vehicle than if they are injured by a conventional vehicle.[172]

2.7.2 The Effects of Liability Law and the Influence of Insurance

Given the current state of technical and legal developments, a human driver is still indispensable. Therefore, current liability regimes do not fall short. When the truly

---

[164] The Vehicle Technology and Aviation Bill HC Bill (2016-17)143 is available at <www.publications.parliament.uk/pa/bills/cbill/2016-2017/0143/cbill_2016-20170143_en_2.htm> accessed 12 April 2017.
[165] Proposals 2016, para 2.34-2.39.
[166] Proposals 2016, para 2.20. See also para 2.21-2.22. See also the Response of the Association of British Insurers: 'Pathway to Driverless Cars: Proposals to support advanced driver assistance systems and automated vehicle technologies. Response of the Association of British Insurers and Thatcham Research'<://www.abi.org.uk/~/media/Files/Documents/Consultation%20papers/2016/09/090916_ABI_Thatcham_response_CCAV_Automated_Driving_Consultation.pdf> accessed 10 January 2017.
[167] See Road Traffic Act 1988, section 143-145.
[168] Vehicle Technology and Aviation Bill HC Bill (2016-17) [143], cls 1-7; Proposals 2016, para 2.9. See also Review of regulations 2015, ch13 on insurance.
[169] Vehicle Technology and Aviation Bill HC Bill (2016-17) [143], cl 2(1); Government Response 2017, para 3.11. Smith points out the important role of insurance companies in establishing the safety and desirability of self-driving vehicles: Bryant W Smith, 'How Governments Can Promote Automated Driving' (2016) New Mexico Law Review (forthcoming) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016.
[170] Vehicle Technology and Aviation Bill HC Bill (2016-17) [143] cl, 2(3); Government Response 2017, para 3.12.
[171] Vehicle Technology and Aviation Bill HC Bill (2016-17) [143], cl 5; Government Response 2017, para 3.14.
[172] Proposal 2016, para 2.12.

self-driving car becomes reality, however, gaps in the liability regimes could develop.[173] If liability for car accidents were to shift from the human driver or owner of the car to the manufacturer of the self-driving car, this might have a negative effect on the development of the self-driving car.[174] However, Volvo announced it will accept "full liability" if one of its cars causes an accident whilst driving in autonomous mode.[175]

Although such an inhibiting effect of liability law should be considered, it is of greater importance that the victim of a self-driving car accident is not worse off than a victim of a conventional car accident. From that point of view, a first-party insurance regime is worth considering as it would mean that the victim of a collision with a self-driving car is not confronted with questions concerning proving fault of a party involved.[176]

---

[173] See also European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)) [2017].

[174] Melinda F Lohmann, 'Liability Issues Concerning Self-Driving Vehicles' (2016) 7 European Journal of Risk Regulation 335, Robolaw 2014, 58-60; Gary E Marchant, Rachel E Lindor, 'The Coming Collision Between Autonomous Vehicles and the Liability System' (2012) 52 Santa Clara Law Review 1321; James M Anderson and others, 'Autonomous Vehicle Technology. A Guide for Policymakers' (RAND Corporation, 2016), 118-19.Garza, however, is of the opinion that a possible increase in liability will not be of great concern to manufacturers: Andrew P. Garza, '"Look Ma, No Hands!": Wrinkles and Wrecks in the Age of Autonomous Vehicles' (2012) 46 New England Law Review 581, 606; Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability' (2015) 31(4) Computer Law & Security Review 506.

[175] Reportedly, so would Mercedes-Benz and Google: Jim Gorzelany, 'Volvo Will Accept Liability For Its Self-Driving Cars' (*Forbes*, 9 October 2015) <www.forbes.com/sites/jimgorzelany/2015/10/09/volvo-will-accept-liability-for-its-self-driving-cars/#54e7c3d43d80> accessed 2 February 2017; Miles Branman, 'Volvo, Google, and Mercedes-Benz will accept liability in self-driving car accidents' (*Digital Trends*, 8 October 2015) <www.digitaltrends.com/cars/automaker-responsibility-in-self-driving-car-accidents-news/> accessed 2 February 2017.

[176] Kiliaan APC van Wees, 'Enkele juridische aspecten van de (deels) zelfrijdende auto' (2015) Computerrecht 313; Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017, para 12.5; Van Wees, Vellinga, Vellinga in van den Acker, 'Visies op de autonome auto' (2015) 63 Verkeersrecht; Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability' (2015) 31(4) Computer Law & Security Review 506, para 4.2.5; Kiliaan APC van Wees, 'Zelfrijdende auto's, aansprakelijkheid en verzekering; over nieuwe technologie en oude discussies' (2016) (2) Tijdschrift voor Vergoeding Personenschade 29. De Schrijver and Van Fraeyenhoven also point out the need to restructure insurance in Belgium: Steven de Schrijver, Olivier van Fraeyenhoven, 'Self-driving cars in Belgium: a clash between innovation and liability?' <http://astrealaw.be/backend/admin/sites/default/files/wwl_tmt_2016_-_article.pdf> accessed 2 February 2017. See also Reactie ANWB, 'Wetsvoorstel Verkeersongevallen' (1998) 46 Verkeersrecht 33. Dutch insurers are exploring the option of first-party insurance: Verbond van Verzekeraars, 'Toekomstvisie Automotive. Onderweg naar morgen' (2015)

The victim would be compensated by the first-party insurer, who can then take recourse against another party (the user of the vehicle, the owner of the vehicle, or the manufacturer) to recover the costs.[177] Such a first-party insurance, or traffic insurance, was discussed in the UK proposals but is already in place in Sweden.[178] Since 1975, Sweden has had this first-party insurance system.[179] The injured party only has to prove his injury was caused by a motor vehicle in traffic in order for the first-party insurer to pay compensation.[180] For such a first-party insurance it is irrelevant whether or not the injured party was a passenger of the vehicle.[181] In case no party can be held liable – for instance, in the case of an unavoidable accident – the first-party insurer will also cover the damages.[182]

However, the higher the risks concerning self-driving cars are, the less likely it becomes that insurance companies will be willing to insure such a high risk. As the self-driving car is still a recent innovation, some risks are known, such as hacking, however others are not yet known.[183] Therefore, the overall risk related to self-

---

<www.verzekeraars.nl/actueel/nieuwsberichten/Documents/2015/November/Onderweg%20naar%20morgen.pdf> accessed 12 April 2017.

[177] See also Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017, para 12.5; Verbond van Verzekeraars, 'Toekomstvisie Automotive. Onderweg naar morge*n*' (2015) <www.verzekeraars.nl/actueel/nieuwsberichten/Documents/2015/November/Onderweg%20naar%20morgen.pdf> accessed 12 April 2017; Kiliaan APC van Wees, 'Zelfrijdende auto's, aansprakelijkheid en verzekering; over nieuwe technologie en oude discussies' (2016) (2) Tijdschrift voor Vergoeding Personenschade 29.

[178] See for a more extensive consideration of the Swedish traffic insurance: Robolaw 2014, 64-65, Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability' (2015) 31(4) Computer Law & security Review 506, para 4.2.5; Sandra Friberg and Bill W Dufwa, 'The development of traffic liability in Sweden' in Wolfgang Ernst (ed), *The development of traffic liability* (Volume 5, Cambridge University Press, 2010) (Friberg and Dufwa 2010).

[179] Friberg and Dufwa 2010.

[180] Friberg and Dufwa 2010, 218.

[181] Kiliaan APC van Wees, 'Zelfrijdende auto's, aansprakelijkheid en verzekering; over nieuwe technologie en oude discussies' (2016) (2) Tijdschrift voor Vergoeding Personenschade 29; Esther FD Engelhard, 'Wetgever, pas op! De (vrijwel) autonome auto komt eraan' (2017) (3) Ars Aequi 230.

[182] Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017, para 12.5; Esther FD Engelhard, 'Wetgever, pas op! De (vrijwel) autonome auto komt eraan' (2017) (3) Ars Aequi 230. Schreuder proposes a strict liability for the possesor of the vehicle in case of such an unavoidable accident: AI Schreuder, 'Aansprakelijkheid voor 'zelfdenkende' apparatuur' (2014) (5/6) Aansprakelijkheid, Verzekering & Schade.

[183] See also Corien Prins, 'Schadelijke beestjes' (2017) Nederlands Juristenblad 507.

driving cars might be so high that insurances companies would be hesitant in insuring this risk. This would inhibit the development of self-driving cars.[184]

An option to ensure insurability of self-driving cars is to limit the amount of damages one can claim. Take a look, for instance, at the insurance of ships: there is often a maximum amount of damages one can claim. The 1976 Convention on Limitation of Liability for Maritime Claims[185] sets limits to liability based on the tonnage of the ship.[186] Otherwise the risks would become so high, no insurance company would consider insuring it, or the insured would not be able to pay the high premium.[187] If, for instance, a ship sails into a railway bridge, the damages do not only consist of the damage done to the bridge and the ship, but also entail the costs of the cancellation of rail traffic for a certain period of time and the damage to the cargo. So the amount of compensation would be so high, it is very unlikely an insurance company will be willing to take on such a risk. The premium has to acceptable from an economic point of view, to keep the ship economically viable.[188]

To encourage insurance companies to insure self-driving cars despite the unknown risk, the government could consider serving as a reinsurer.[189]

---

[184] See also Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017, para 10.
[185] See also United Nations Convention on the Carriage of Goods by Sea (adopted 31 March 1978, entered into force 1 November 1992) 1695 UNTS 3 (the "Hamburg Rules"). See also James M Anderson and others, 'Autonomous Vehicle Technology. A Guide for Policymakers' (RAND Corporation, 2016), 131; Jeremy Levy, 'No Need to Reinvent the Wheel: Why Existing Liability Law Does Not Need to Be Preemptively Altered to Cope with the Debut of the Driverless Car' (2016) 9 Journal of Business, Entrepreneurship & the Law 355, 369-72.
[186] See art. 2, 6 of the Convention on Limitation of Liability for Maritime Claims (adopted 19 November 1976, entered into force 1 December 1986) 1456 UNTS 221.
[187] Leslie J Buglass, 'Limitation of liability from a maritime insurance viewpoint' (1978-1979) 53 Tulane Law Review 1364, 1364-1365, Jeremy Levy, 'No Need to Reinvent the Wheel: Why Existing Liability Law Does Not Need to Be Preemptively Altered to Cope with the Debut of the Driverless Car' (2016) 9 Journal of Business, Entrepreneurship & the Law 355, 373-74. See in a different context: - Verbond van Verzekeraars, 'Toekomstvisie Automotive. Onderweg naar morgen' (2015) <www.verzekeraars.nl/actueel/nieuwsberichten/Documents/2015/November/Onderweg%20naar%20morgen.pdf> accessed 12 April 2017.
[188] Leslie J Buglass, 'Limitation of liability from a maritime insurance viewpoint' (1978-1979) 53 Tulane Law Review 1364, 1364-1365, 1393-1394; Niels Frenk, 'Utopische wetgeving en verzekerbaarheid' (2006) (4) Aansprakelijkheid, Verzekering & Schade, para 3.
[189] Corien Prins, 'Schadelijke beestjes' (2017) Nederlands Juristenblad 507; T Vanden Borre, 'Kanalisatie in het debat betreffende de verzekerbaarheid van risico' (2001) (6) Aansprakelijkheid, Verzekering & Schade 175, para 3.2; Jeremy Levy, 'No Need to Reinvent the Wheel: Why Existing

So, insurance can affect the development of self-driving cars.[190] The insurability, however, can be influenced by the government. If governments set safety requirements for self-driving cars, and these requirements are set to a high standard, the risk regarding insuring this innovation could decrease. Consulting insurers before setting these requirements is important as they can indicate whether they consider insuring the risk is economically viable.

This being said, if self-driving cars indeed prove to be a lot safer than human driven cars, this could be enough to make it attractive for insurance companies to insure such a new technology. The risk of accidents would be more limited than the risk of accidents with a conventional car. The unknown risks of the new technology could be outweighed by the lower risks of accidents. If accident rates decline, consumers will benefit from lower premiums.[191]

2.8 Conclusion

Several months after the accident with the Tesla Autopilot, Tesla upgraded the software for its cars. From now on, the radar will no longer be used as a supplementary sensor but as a primary control sensor.[192] This probably would have avoided the accident in May 2016 in Florida.[193] Although technology is developing fast, legal developments seem to be catching up slowly.

Liability Law Does Not Need to Be Preemptively Altered to Cope with the Debut of the Driverless Car' (2016) 9 Journal of Business, Entrepreneurship & the Law 355, 373-74.

[190] See also James M Anderson and others, 'Autonomous Vehicle Technology. A Guide for Policymakers' (RAND Corporation, 2016), 132; European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)) [2017], section 57-59; Jeremy Levy, 'No Need to Reinvent the Wheel: Why Existing Liability Law Does Not Need to Be Preemptively Altered to Cope with the Debut of the Driverless Car' (2016) 9 Journal of Business, Entrepreneurship & the Law 355.

[191] James M Anderson and others, 'Autonomous Vehicle Technology. A Guide for Policymakers' (RAND Corporation, 2016), 114-15; James M Anderson, Paul Heaton, Stephen J Caroll, 'The U.S. Experience with No-Fault Automobile Insurance A Retrospective' (RAND Corporation, 2010), 141-42. See also Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017.

[192] The Tesla Team, 'Upgrading Autopilot: Seeing the World in Radar' (*Tesla*, 11 September 2016) <www.tesla.com/de_DE/blog/upgrading-autopilot-seeing-world-radar?redirect=no> accessed 12 January 2017.

[193] 'Nach tödlichem Crash: Tesla verspricht Verbesserung der „Autopilot"-Funktion' (*Der Spiegel Online*, 12 September 2016) <www.spiegel.de/auto/aktuell/tesla-motors-verspricht-verbesserung-der-autopilot-funktion-a-1111949.html> accessed 12 January 2017. However, the NHTSA did not identify a safety-related defect: National Highway Traffic Safety Administration, 'Report on

Regarding the regulation of the testing phase of self-driving cars, different legal instruments – binding regulations, non-binding regulations and granting exemptions – are used by the jurisdictions discussed (section 2.5). With regards to the legal framework for testing, a framework combining both a system of exemptions from existing laws and providing non-binding guidance is preferred. Such a framework can provide sufficient flexibility to keep up with rapid technological developments as well as providing enough control so that governments can set conditions for trials and withdraw exemptions in case public safety cannot be guaranteed.

Two pressing legal problems regarding the post-testing phase need to be addressed: how to deal with the absence of a human driver (section 2.6) and the consequences this has for liability and insurance (section 2.7). A possible line of thought is to wider interpret the notion of 'driver' in current traffic laws and conventions. To what extent the broader interpretation of the term 'driver' in traffic laws can accommodate the deployment of self-driving cars without a human driver present is a sufficient solution needs further research.

Regarding liability and insurance, the influence insurance has on the development of self-driving cars should not be disregarded. The government has to take this affect into account when drafting regulations for self-driving cars.

Investigation PE 16-007' (January 2017) <https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF> accessed 9 February 2017.

Epilogue: New Legal Developments

During this research, there have been many developments in the field of automated driving. This epilogue discusses the most important developments that have taken place between the completion of Chapter 2 and the completion of the thesis as a whole. The legal developments concerning the notion of *driver* within the meaning of the Geneva Convention and the Vienna Convention are discussed in-depth in the epilogue following Chapter 3 which chapter covers this specific topic.

At the start of the research back in the autumn of 2016, automated vehicles were in the early phases of testing. Google had just clocked 2 million miles driven on public roads with automated test vehicles[1] and a Tesla Model S had been involved in a fatal accident.[2] Two years later, an automated test vehicle of Uber was involved in a fatal accident, killing a pedestrian.[3] Despite these great losses, significant leaps forward have been made. The automated test vehicles of Google, now Waymo, have driven over 10 million miles on public roads without major incidents.[4] They now offer a test taxi service with automated test vehicles under the name of Waymo One to a number of residents of Phoenix, Arizona.[5] Ford is exploring the option of combining an automated delivery van with a robot that can deliver a package to your front door,[6] while Volvo has begun tests with an automated truck transporting shipping containers on a few public roads around the port of Gothenburg.[7] Legislators have also made progress on legislation for the testing and deployment of automated vehicles. Some steps were already announced in the previous chapter, other changes are more recent.

---

1 See John Krafcik, <https://twitter.com/johnkrafcik/status/1020343952266973186> accessed 9 July 2019.

2 Danny Yadron, Dan Tynan, 'Tesla driver dies in crash while using autopilot mode' The Guardian (London, 1 July 2016) <www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk> accessed 30 March 2017.

3 Troy Griggs, Daisuke Wakabayashi, 'How a Self-Driving Uber Killed a Pedestrian in Arizona' New York Times (New York City, 21 March 2018) <www.nytimes.com/interactive/2018/03/20/us/self-driving-uber-pedestrian-killed.html> accessed 9 July 2019.

4 John Krafcik, 'Where the next 10 million miles will take us' (*Medium*, 10 October 2018) <https://medium.com/waymo/where-the-next-10-million-miles-will-take-us-de51bebb67d3> accessed 21 March 2019.

5 Waymo, <https://waymo.com/> accessed 9 July 2019.

6 Ken Washington, 'Meet Digit: A Smart Little Robot That Could Change the Way Self-Driving Cars Make Deliveries' (*Medium*, 22 May 2019) <https://medium.com/self-driven/meet-digit-self-driving-delivery-last-mile-solution-418d9995bb97> accessed 2 August 2019.

7 Volvo, 'Vera's First Assignment' (13 June 2019) <www.volvotrucks.com/en-en/news/volvo-trucks-magazine/2019/jun/Veras-First-Assignment.html> accessed 2 August 2019.

A new legislative development is the Resolution on the deployment of highly and fully automated vehicles in road traffic, adopted by Working Party 1 of the UNECE to encouraging national governments to undertake, among other things, legislative action in order to accommodate automated vehicles.[8] An example of legislative action on a national level is the Dutch bill on a new framework for testing automated vehicles on public roads, the 'experimenteerwet'.This new framework has entered into force as of July 1st, 2019.[9] The 'experimenteerwet' has altered the system of granting exemptions from existing regulations to a system in which a permit is given by which exemptions from existing regulations can be granted (art. 149aa WVW 1994).[10] This was one of the approaches on legislating testing of automated vehicles discussed in Chapter 2. Meanwhile, there seems to be a tendency in the United States towards testing in Arizona instead of California.[11] This tendency would support the findings in the previous chapter that a system of granting exemptions and of non-binding regulations are preferred over binding regulations as California has an extensive legal framework for testing automated vehicles,[12] whereas Arizona has a very limited legal framework leaving those testing the vehicles with more room to experiment.[13]

In the course of this research, legislation for the post-testing deployment of automated vehicles has been drafted in several jurisdictions. One of those jurisdictions is California, a State that was already on the forefront of developing

---

[8] United Nations Economic and Social Council, 'Global Forum for Road Traffic Safety (WP.1) resolution on the deployment of highly and fully automated vehicles in road traffic' (14 January 2019) UN Doc ECE/TRANS/WP.1/2018/4/Rev.3, 6(d).

[9] Besluit van 25 juni 2019, houdende vaststelling van het tijdstip van inwerkingtreding van de Wet van 26 september 2018 tot wijziging van de Wegenverkeerswet 1994 in verband met mogelijk maken van experimenten met geautomatiseerde systemen in motorrijtuigen en het Besluit van 6 december 2018 tot wijziging van het Besluit ontheffingverlening exceptioneel vervoer en het Kentekenreglement in verband met mogelijk maken van experimenten met geautomatiseerde systemen in motorrijtuigen, Staatsblad 2019/240.

[10] The new 'expermenteerwet' has also opened up the possibility to tests automated vehicles on public roads without there being a driver inside of the vehicle (art. 149aa WVW 1994).

[11] Andrew J. Hawkins, 'The self-driving car war between Arizona and California is heating up. Arizona says human-free driving is a-okay' (*The Verge,* 2 March 2018) <www.theverge.com/2018/3/2/17071284/arizona-self-driving-car-governor-executive-order> accessed 19 August 2019.

[12] See Article 3.7 of Title 13, Division 1, Chapter 1 of the California Code of Regulations (CCR) and <www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/testing> accessed 19 August 2019.

[13] See Executive Order 2018-04: Advancing Autonomous Vehicle Testing and Operating; Prioritizing Public Safety and Arizona Department of Transportation, <www.azdot.gov/motor-vehicles/professional-services/autonomous-vehicle-notification-and-certification/overview> accessed 19 August 2019.

legislation on the testing of automated vehicles.[14] California has taken the next step and now has legislation on the post-testing deployment of automated vehicles. It is now possible to deploy automated vehicles on public roads for public use. In order to get a permit for the deployment of an automated vehicle, the manufacturer of the vehicle will have to meet multiple requirements and will have to provide clarity on the vehicle's limitations.[15] If the vehicle is fully automated and therefore does not have a driver, there needs to be a communication link for a remote operator to communicate with the passengers of the vehicle.[16]

The United Kingdom has also taken legislative steps towards the post-testing deployment of automated vehicles, specifically concerning insurance. The UK has adopted the Automated and Electrical Vehicles Act 2018 (AEVA 2018),[17] which entails new rules on insurance. Section 2 subsection (1) of the AEVA 2018 reads:

> "Where—
> (a) an accident is caused by an automated vehicle when driving itself on a road or other public place in Great Britain,
> (b) the vehicle is insured at the time of the accident, and
> (c) an insured person or any other person suffers damage as a result of the accident,
> the insurer is liable for that damage."

So, if an insured automated vehicle causes an accident, the damage to any person involved, for instance the user of the vehicle, is covered by the insurance.[18] The insurer's liability can be excluded or limited if software alterations have been made by the insured person, or with his knowledge, that are forbidden under the insurance policy (Section 4 subsection (1) under (a) AEVA 2018). This is also the case when the insured person has not installed safety-critical software updates of which he knew, or ought to have known, that these updates were safety-critical (Section 4 subsection (1) under (b) AEVA 2018). According to Section 5, the insurer can seek redress from

---

[14] See on a federal level the Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act or the SELF DRIVE Act (2017-2018).
[15] 13 CCR § 228.06.
[16] 13 CCR § 228.06 (b)(1).
[17] The discussed Part I of the Automated and Electric Vehicles Act 2018 does not extend to Northern Ireland, it only extends to England and Wales and Scotland (Section 22 subsection (1).
[18] See however Section 3 subsection (2) on contributory negligence.

any other person that is liable for the accident, for instance the producer of the vehicle.[19]

These legal developments are notable and interesting developments as they provide for new approaches for accommodating automated driving in legislation. However, the legal developments discussed in this epilogue do not change the findings of this research. The UK AEVA 2018 underlines the importance of taking insurance into account when it comes to legislating automated driving. In addition, the apparent tendency in the US to choose to test automated vehicles in a State with less strict regulation supports the conclusion from Chapter 2 that a framework combining both a system of exemptions from existing laws and providing a non-binding guidance is preferred over a legal framework with strict rules. In the next chapter and epilogue, the developments around the notion of *driver* within the meaning of the Geneva Convention and the Vienna Convention is discussed in-depth.

[19] See more extensive on the AEVA 2018: Mathias N. Schubert, 'Der Automated and Electric Vehicles Act 2018. Ein (weiterer) Irrweg für das Vereinigte Königreich?' (2019) 19 (4) Straβenverkehrsrecht 124.

3 Automated Driving and its Challenges to International Traffic Law: Which Way to Go?

This Chapter is an extended version of a paper previously published in Law, Innovation and Technology: NE Vellinga, 'Automated driving and its challenges to international traffic law: which way to go?' (2019) Law, Innovation and Technology, DOI:10.1080/17579961.2019.1665798

Abstract: As more and more automated vehicles are driving down public roads for test purposes, it becomes necessary to address the challenges that this technological development poses to law. One of those challenges is the central concept of *driver* in traffic laws, more importantly the Geneva Convention on Road Traffic of 1949 and the Vienna Convention on Road Traffic of 1968. These Conventions form the base of many national traffic laws across the globe. The notion of *driver* is a central notion within these Conventions. In this Chapter, it will be argued that an automated vehicle does not have a *driver* within the meaning of the Conventions. Four different approaches on how to revise the Geneva Convention and the Vienna Convention will be discussed. A comparison of the approaches will bring out the (dis)advantages of each approach and will lead to the recommendation of one of the approaches.

3.1 Introduction

Slowly, but gradually, more and more automated vehicles are driving down public roads for test purposes. Given the progress made by several companies during the testing of their vehicles, it will only be a matter of time before these vehicles become available to the general public.[1] Until then, legislators are facing legal challenges, posed by the absence of a human driver behind the wheel. The dynamic driving task - the longitudinal and lateral vehicle motion control, the monitoring of the environment via the detection of objects and events and responding to those objects and events, the manoeuvre planning and the enhancing of conspicuity (signalling, gesturing etc.)[2] – is performed by a human when driving a conventional vehicle. In an automated vehicle, however, the dynamic driving task is performed by the self-driving system of that vehicle.[3]

By shifting the performance of the dynamic driving task from the control of the human driver to the self-driving system gives rise to legal questions regarding traffic laws. The Geneva Convention on Road Traffic of 1949 and the Vienna Convention on Road Traffic 1968, which lie at the base of many national traffic laws, are built around the notion of *driver*: in the 35 articles of the Geneva Convention, the word *driver* is used 30 times, whereas in the Vienna Convention (56 articles) the word *driver* is used over 140 times (all excluding annexes). Both Conventions are of great global importance as Contracting Parties are required to base their national traffic laws on the Conventions (art. 3 Vienna Convention, art. 6 Geneva Convention), therefore leading to uniform traffic rules across borders. At the moment of writing, the Geneva Conventions has 97 Contracting

---

[1] For instance, Google claims to have driven over 8 million miles with their test vehicles on public roads: <waymo.com/ontheroad/> accessed 15 August 2018.

[2] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. *Standard J3016* (revised June 2018) 6-7. See also Economic Commission for Europe Inland Transport Committee (75th Session) 'Automated Driving, Informal document No. 8' (4 September 2017) 9-10; John A Michon, 'A Critical View Of Driver Behavior Models: What Do We Know, What Should We Do?' in L Evans, RC Schwing (eds), *Human behaviour and traffic safety* (New York: Plenum Press, 1985).

[3] The strategic functions involved in driving, such as the scheduling of the trip and determining a destination, are always performed by a human. SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. *Standard J3016* (revised June 2018) 5-7; Economic Commission for Europe Inland Transport Committee (75th Session) 'Automated Driving, Informal document No. 8' (4 September 2017) 10.

States,[4] whereas the younger Vienna Convention has 77 Contracting Parties (several of which are also party to the Geneva Convention).[5]

The legal questions regarding traffic law discussed in this paper, are primarily questions of public law. The outcomes of these questions are, however, also important for tort law as the violation of a statutory rule, such as a traffic rule, can give rise to liability.[6] In regimes with a no-fault compensation scheme, as discussed recently in this journal,[7] this is of lesser importance. A no-fault compensation scheme would provide compensation without needing to identify a liable person, or obtain proof of negligence and causality, thus making the question of whether or not a statutory rule has been violated less relevant to obtaining compensation.[8]

In this chapter, reference will be made to the SAE Levels of automation. SAE International has described six levels of automation, ranging from Level 0 (no driving automation) to Level 5 (full driving automaton).[9] For the purpose of this chapter, 'automated vehicle' means a SAE Level 4 or an SAE Level 5 vehicle.[10] These vehicles are able to drive themselves either for an entire trip (Level 5) or part of a trip (Level 4).[11]

What are the consequences of the absence of a human behind the wheel, and the resulting shift in the control over the performance of the dynamic driving task, for the Geneva and Vienna Conventions? Do these Conventions require

---

[4] The United Nations Economic Commission for Europe (UNECE), 'UN Transport Agreements and Conventions: Convention on Road Traffic, of 19 September 1949' (*unece.org*) <www.unece.org/trans/maps/un-transport-agreements-and-conventions-07.html> accessed 28 June 2018.
[5] The United Nations Economic Commission for Europe (UNECE), 'UN Transport Agreements and Conventions: Convention on Road Traffic, of 8 November 1968' (*unece.org*) <www.unece.org/trans/maps/un-transport-agreements-and-conventions-08.html> accessed 28 June 2018.
[6] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 279ff, p408ff.
[7] Maurice HM Schellekens, 'No-fault compensation schemes for self-driving vehicles' (2018) 10(2) Law, Innovation and Technology 314.
[8] Maurice HM Schellekens, 'No-fault compensation schemes for self-driving vehicles' (2018) 10(2) Law, Innovation and Technology 314.
[9] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. *Standard J3016* (revised June 2018).
[10] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. *Standard J3016* (revised June 2018) 19ff.
[11] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. *Standard J3016* (revised June 2018) 19ff.

revision in order to accommodate automated driving? In this chapter, it will be argued that, according to the ircurrent interpretation, an automated vehicle does not have a *driver* within the meaning of the Conventions.

Four different approaches on how to revise the Conventions in order to accommodate automated driving will be discussed. First, it will be explored how traffic laws governing other modes of transport that are familiar with a degree of automation accommodate this automation and whether this approach would be suitable to apply to a revision of the Geneva Convention and Vienna Convention [Option 1]. Another way to accommodate automated driving would be to take a novel interpretation of the Conventions. In order to do this, one would need to view the Conventions as 'living instruments'. Next, it will be considered how the interpretation of the notion of *driver* can depend on the notion's function [Option 2] and whether or not a user can be regarded to be the *driver* within the meaning of the Conventions when interpreting the Conventions differently [Option 3]. The final approach that is explored is the *functioneel daderschap* approach, which is based around the theory of *functioneel daderschap* from Dutch Law [Option 4]. These approaches will be compared to one another, thereby arguing that the *functioneel daderschap* approach is the preferred option.

3.2 The Functions of the Notion of *Driver*

The notion of *driver* is central to the Geneva and ienna Conventions. The notion of *driver* serves as a starting point for putting requirements in place to guarantee the safe interaction of road traffic. Depending on the context, the notion of *driver* can have a different function. This will be illustrated by examples from the Conventions and from national legislation. Within the Geneva Convention and the Vienna Convention, the notion of *driver* is mainly present in capacity requirements and rules of conduct.

3.2.1 The Function of the Notion of *Driver* in Technical Regulations

In technical regulations, the notion of *driver* serves as a passive object. In this context, the driver has no rights or obligations; the function of the notion is only to describe the person sitting in a certain place in the vehicle. See, for instance, a provision from UNECE Regulation No 79:[12]

[12] This UN Regulation is, as many other regulations, annexed to the Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which

> “Any fault which impairs the steering function and is not mechanical in nature must be signaled clearly to the driver of the vehicle.(…)”[13]

A definition for the notion of *driver* in the technical regulations can be found, for instance, in the U.S. Federal Motor Vehicle Safety Standards (FMVSS):

> “Driver means the occupant of a motor vehicle seated immediately behind the steering control system.”[14]

Here the notion of *driver* describes a certain object. The driver in these technical regulations has no rights or duties. The function of the use of the notion of *driver* is merely descriptive.

3.2.2 The Function of the Notion of *Driver* in Capacity Requirements

In capacity requirements, the function of the notion of *driver* is more substantive. The driver himself has to meet certain requirements. He has to have the necessary knowledge and skills before he is allowed on the road (art. 8 paragraph 4 Vienna Convention) and he needs a driving permit (art. 41 paragraph 1(a) Vienna Convention). Holding a driving permit is a necessary obligation, as it is proof of his competence to drive. Even if the driver holds a driving permit, he still needs to be in a fit condition to drive (art. 8 paragraph 3 Vienna Convention). These capacity requirements can also be found in national legislation, see, for instance, art. 107 of the Dutch Wegenverkeerswet 1994. In this context, the function of the notion of *driver* is to set certain requirements for the driver.

3.2.3 The Function of the Notion of *Driver* in Rules of Conduct

Within traffic law, the notion of *driver* is central. The driver has to comply with certain rules of conduct (Chapter II of both the Geneva Convention and the Vienna Convention). A duty of care is often imposed upon the driver. The rules of conduct are directed at (among others) the driver, as he is the one who has

---

can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions (Geneva, 20 March 1958). This agreement has 52 Parties (incl. the EU) and is referred to in the Vienna Convention on Road Traffic 1968 (see art. 8 paragraph 5bis). See for the current status of the 1968 Agreement: United Nations, ‘Status of the 1958 Agreement (and of the annexed regulations)’ <www.unece.org/?id=25980> accessed 25 September 2019.

[13] UNECE Regulation No. 79, 5.4.1.1.

[14] 49 CFR 571.3 (b).

to behave in a certain way. Take, for example, art. 7 paragraph 3 of the Vienna Convention:

> "Drivers shall show extra care in relation to the most vulnerable road-users, such as pedestrians and cyclists and in particular children, elderly persons and the disabled."

Here, the notion of *driver* is not just a description for the person sitting behind the wheel, but rather carries rights and duties within traffic laws. The function of the notion of *driver* is to address someone who is driving a vehicle in accordance with traffic rules. This can also be illustrated through examples from national traffic laws:

> Germany:[15] §3(1) Straßenverkehrsordnung (StVO): "Wer ein Fahrzeug führt, darf nur so schnell fahren, dass das Fahrzeug ständig beherrscht wird (…)."

> Netherlands: art. 15 lid 1 Reglement verkeersregels en verkeerstekens 1990: "Op kruispunten verlenen bestuurders voorrang aan voor hen van rechts komende bestuurders."[16]

The rules of conduct show who is responsible for the operation of the vehicle: responsibility rests with the driver. At the base of many liability questions lies the violation of a traffic rule, as breaching a statutory duty can be punishable under criminal law or prove negligence in a civil liability case. However, depending on national criminal law or civil law, certain requirements will also need to be fulfilled in order to assess the liability of the driver. For instance, a causal link, damage or the absence of a ground for exculpation, might all need to be proven before the driver can be held (civilly or criminally) liable. So, responsibility does not automatically equal liability.[17]

---

[15] Germany has already taken legislative measures to allow some level of automation of vehicles: §1a-1c of the German StVG on automated driving.
[16] This can be translated as: at an intersection, drivers shall give way to drivers coming from the right.
[17] See with regards to the Vienna Convention: Benjamin von Bodungen and Martin Hoffmann, 'Belgien und Schweden schlagen vor: Das Fahrsystem soll Fahrer werden!' (2015) Neue Zeitschrift für Verkehrsrecht 521.

3.2.4 The Function of the Notion of *Driver* in Liability Law

In line with the above, the notion of *driver* also has a function in liability law. Whereas in the previous section, the notion's function determined who has to behave in certain ways, the function of the notion of *driver* as discussed in this section takes it a step further: it sees to who bears the legal consequences in the form of criminal or civil liability for misconduct. Depending on national law, the driver could be liable for ignoring the rules of conduct. Under national civil law, the driver could have a duty to pay damages:

> §18(1) Straßenverkehrsgesetz (StVG): "(…) ist auch der Führer des Kraftfahrzeugs oder des Anhängers zum Ersatz des Schadens nach den Vorschriften der §§ 8 bis 15 verpflichtet. Die Ersatzpflicht ist ausgeschlossen, wenn der Schaden nicht durch ein Verschulden des Führers verursacht ist."

The notion of *driver* can also be present in a criminal liability context. For instance, driving under the influence of alcohol or drugs can be a punishable offence (see, for instance, art. 8 of the Dutch Wegenverkeerswet 1994). If an offender qualifies as *driver*, this can also open up more possibilities regarding punishment. The driver could, for instance, be facing a driving disqualification (see, for example, art. 179 Wegenverkeerswet 1994). It is not always the driver that gets punished for his misconduct: under Dutch law, under specific circumstances, the holder of the registration number of the vehicle can be fined for minor traffic offences committed with his vehicle, without being in the driver's seat himself (art. 5 Wet adminstratiefrechtelijke handhaving verkeersvoorschriften).

In this chapter, the function of the notion of *driver* in rules of conduct will be discussed further, as this is the function that is most present in the Geneva Convention and the Vienna Convention. The other functions will be touched upon briefly.

3.3 The Notion of *Driver* in the Conventions

3.3.1 The Functions of the Notion of *Driver* in the Conventions

Both the Geneva Convention and the Vienna Convention contain rules of the road (Chapter II). These rules evolve largely around the notion of *driver*. The notion's function in this context concerns the function of the notion of *driver* in rules of conduct as discussed above: duties are imposed on the driver. For instance, a driver has to, before making a turn, make sure that he can do so without danger to other road users (art. 12 paragraph 4(a) Geneva Convention) and the driver should not drive whilst being distracted: “A driver of a vehicle shall at all times minimise any activity other than driving.”(art. 8 paragraph 6 Vienna Convention). These and other provisions are based on art. 8 paragraph 1 Geneva Convention and art. 8 paragraph 1 Vienna Convention.[18]

> Art. 8 paragraph 1 Vienna Convention: “Every moving vehicle or combination of vehicles shall have a driver.”

The driver can perform these duties as he is able to control his vehicle:

> Art. 8 paragraph 5 Vienna Convention: “Every driver shall at all times be able to control his vehicle or to guide his animals.”
>
> Art. 13 paragraph 1 Vienna Convention: “Every driver of a vehicle shall in all circumstances have his vehicle under control so as to be able to exercise due and proper care and to be at all times in a position to perform all manoeuvres required of him (…).”

3.3.2 The Notion of *Driver* and Control

What consequences do the provisions discussed above have for automated driving? The requirement of control seems to leave a bit of room for a driver to let the car handle (parts of) the dynamic driving task, especially art. 8 paragraph 5 Geneva Convention and art. 8 paragraph 5 Vienna Convention. Both provisions require that the driver should at all times be able to control his vehicle. These provisions could, however, be understood as meaning that the driver does not have to exercise that control at all times, it could suffice when the driver is able to exercise that control at any given time. However, even if this is the case, there would still need to be a driver that can exercise the control at any given time. Because an automated vehicle does not have a human performing the dynamic driving task, this raises the question of if an automated vehicle even has a *driver* within the meaning of the Geneva Convention and the Vienna Convention.

3.3.3 The Definition of the Notion of *Driver*

The Conventions provide the following definition for *driver*:

[18] For matters of readability, the Geneva Convention will only be quoted in case it significantly deviates from the Vienna Convention.

> Art. 1(v) Vienna Convention: ""Driver" means any person who drives a motor vehicle or other vehicle (including a cycle), or who guides cattle, singly or in herds, or flocks, or draught, pack or saddle animals on a road (…)"[19]

This does not provide much clarity. Is the person who falls asleep behind the wheel still the driver of the vehicle? Or the person who pulls the hand brake from the passenger's seat? And regarding automated driving: is the person who only decides on the destination of a self-driving vehicle the driver of that vehicle?

3.3.4 The Interpretation of the Notion of *Driver*

There has not been much discussion on the definition of driver in the Conventions.[20] During the drafting process of the Geneva Convention, the matter was raised briefly. The French representative stated "that to define driver, (…), was not to define the word at all."[21] The French definition of driver in the official translation of the Geneva Convention therefore reads:

> "Le terme "conducteur" désigne toutes personnes qui assument la direction de véhicules, y compris les cycles, guident des animaux de trait, de charge, de selle, des troupeaux sur une route, ou qui en ont la maîtrise effective (…);"[22]

Since the rise of driver assistance systems, the notion of *driver* has been subject to discussion in WP.1, the United Nations ECE organ responsible for keeping the Conventions up to date, more frequently. The debate has, so far, not led to a clear position on the definition of *driver*.[23] A complete picture of a more precise interpretation of the notion of *driver* is therefore not yet provided for. However,

---

[19] See also art. 4 paragraph 1 Geneva Convention.
[20] Bryant Walker Smith, 'Automated Vehicles Are Probably Legal in the United States' (2014) 1 Texas A&M Law Review 411 428-429.
[21] United Nations Conference on Road and Motor Transport, Committee III on Road Traffic, Summary Record of the Seventeenth Meeting Held at the Palais des Nations, Geneva, on Tuesday, 6 September 1949 at 3 pm (21 November 1949) E/CONF8/CIII/SR17/Rev.1 2.
[22] Translated: 'The term "driver" refers to all persons who assume the direction of vehicles, including cycles, guide draft animals, pack animals, saddle animals, herd animals on a road, or who have effective control.'
[23] See for instance Economic Commission for Europe, Inland Transport Committee (74th Session), 'Autonomous Driving Informal document No. 2' (14 March 2017); Economic Commission for Europe, Inland Transport Committee (73rd Session), 'Autonomous Driving Informal document No. 4' (14 September 2016).

a closer look into the definition of *driver* given by Contracting Parties in their national laws can provide more insight.

In German law,[24] reference to the *driver* (in German: Fahrzeugführer) is made in, amongst others, the Straßenverkehrsordnung (StVO), Straßenverkehrsgesetz (StVG) and the Strafgesetzbuch (StGB). The German constitutional court (BGH) has described *driver* and *driving* as follows:

> "Führer eines Kraftfahrzeuges im Sinne dieser Bestimmung ist, wer das Fahrzeug in Bewegung zu setzen beginnt, es in Bewegung hält oder allgemein mit dem Betrieb des Fahrzeugs oder mit der Bewältigung von Verkehrsvorgängen beschäftigt ist. Bringt ein Kraftfahrer sein Fahrzeug nicht verkehrsbedingt zum Stehen, bleibt er solange Führer des Kraftfahrzeugs, wie er sich noch im Fahrzeug aufhält und mit dessen Betrieb oder mit der Bewältigung von Verkehrsvorgängen beschäftigt ist. Dies ist regelmäßig erst dann nicht mehr der Fall, wenn er sein Fahrzeug zum Halten gebracht und den Motor ausgestellt hat."[25]

The Dutch interpretation of *driver* (bestuurder) deviates from the German definition, even though both countries are parties to the Vienna Convention:[26] if a person influences the direction and/or speed in which the vehicle is moving by operating the controls, he is driving the vehicle and therefore he is regarded to be the driver of that vehicle, regardless of his position in the vehicle.[27] The passenger that pulls the hand brake is at that moment the driver of that vehicle.[28] Even a vehicle that is being towed can have a driver, as long as the

[24] Germany is party to the Vienna Convention, but not to the Geneva Convention.
[25] Translated: 'Driver of a motor vehicle within the meaning of this provision is who starts to set the vehicle in motion, who keeps the vehicle moving or who is generally occupied with the operation of the vehicle or with the handling of traffic operations. If a driver does not bring his vehicle to a halt due to traffic conditions, he remains the driver of the motor vehicle so long as he is still in the vehicle and occupied with the operation of the vehicle or with the handling of traffic operations. This is usually no longer the case if he has stopped the vehicle and turned off the engine.' BGH 4 StR 592/16, 27 April 2017, ECLI:DE:BGH:2017:270417U4STR592.16.0. See with regards to the Vienna Convention: Ulrich Franke, 'Rechtsprobleme beim automatisierten Fahren - ein Überblick'(2016) 86(2) Deutsches Autorecht 61.
[26] See also Advies Raad van State, *kamerstukken* II 2017/18, 34838, 4. See more extensively on the Dutch *bestuurdersbegrip*: Joep BHM Simmelink, *Algemeenheden in het wegenverkeersrecht* (Dissertation, Tilburg University 1995), para 2.3.3.1.
[27] HR 13 August 2005, ECLI:NL:HR:2005:AT7292, NJ 2005/542.
[28] HR 13 August 2005, ECLI:NL:HR:2005:AT7292, NJ 2005/542.

person can influence the direction the vehicle is traveling in.[29] A driver does not necessarily have to be inside the vehicle:[30] a person walking next to the car, whilst the motor is running and determining the direction of the vehicle by using the steering wheel, while leaning through the opened window, is the driver of that vehicle.[31]

From these descriptions of the notion of *driver*, it follows that the driver can decide on the direction and speed (lateral and longitudinal control) by operating at least some of the controls of the vehicle.[32] His actions have an immediate effect on the speed and direction of the vehicle, and these decisions are made on the spot. This gives rise to the question whether or not an automated vehicle has a *driver* within the meaning of the Geneva Convention and the Vienna Convention.

3.4 The Driver of an Automated Vehicle

3.4.1 The Possible Drivers of an Automated Vehicle

Given these features of the notion of *driver*, who or what can possibly be regarded to be the driver of an automated vehicle? Perhaps the manufacturer of the vehicle, the company that programmed the software, the system of the automated vehicle (the self-driving system), or the person that uses the vehicle to get to work? What these parties all have in common is that in one way or another they influence the direction and/or speed of the vehicle.

3.4.1.1 The Manufacturer as the Driver of the Automated Vehicle?

The manufacturer of the vehicle and the company that programmed the software influence the direction and/or speed of the vehicle before the automated vehicle drives down public roads by equipping the vehicle with certain radars, cameras, and by programming the software in a certain way. Can either of these legal persons be regarded to be the driver of the automated vehicle? The definition of *driver* from art. 4 paragraph 1 Geneva Convention and

[29] HR 2 February 1965, ECLI:NL:HR:1965:AB3467, NJ 1965/281; HR 26 January 1971, ECLI:NL:HR:AB5997, NJ 1971/208; HR 1 December 1987, ECLI:NL:HR:1987:AB7814, NJ 1988/689; HR 2 October 1990, ECLI:NL:HR:1990:ZC8593, NJ 1991/380.
[30] See regarding stepping out of the vehicle: HR 21 October 2003, ECLI:NL:HR:2003:AL3411, VR 2004/36.
[31] HR 12 June 1990, ECLI:NL:HR:1990:ZC8550, NJ 1991/29, VR 1990/158. See also HR 23 February 1999, ECLI:NL:HR:1999:ZD348, VR 2000/81.
[32] See also Joep BHM Simmelink, *Algemeenheden in het wegenverkeersrecht* (Dissertation, Tilburg University 1995) 77.

art. 1(v) Vienna Convention requires that the driver is a person. Although this does not seem to exclude a legal person, given the current state of the discussion, the time of writing of the Conventions and the overall structure of the Conventions (a legal person with a driving permit (art. 41 Vienna Convention, art. 24 Geneva Convention), a fit physical and mental condition of a legal person (art. 8 paragraph 3 Vienna Convention)?), in this context, by *person* a human is meant. Therefore, neither the manufacturer of the automated vehicle nor the company that programmed the software can be classified as the driver of the automated vehicle within the meaning of the Geneva Convention or the Vienna Convention.

3.4.1.2 The Self-Driving System as the Driver of the Automated Vehicle?

As the *driver* within the meaning of the Geneva Convention and the Vienna Convention is a human, the self-driving system (SDS) of the vehicle, that makes all the decisions regarding the dynamic driving task, is not the *driver* within the meaning of the Conventions because the system is not human. However, in a different context– that of technical regulations – the notion of *driver* is sometimes interpreted in such a way that it does capture the self-driving system. An example is the interpretation the United States National Highway Traffic Safety Administration (or NHTSA) gave of several US Federal Motor Vehicle Safety Standards (FMVSS): 'If no human occupant of the vehicle can actually drive the vehicle, it is more reasonable to identify the "driver" as whatever (as opposed to whomever) is doing the driving. In this instance, an item of motor vehicle equipment, the SDS, is actually driving the vehicle.'[33] Even if the definition of *driver* would be different, applying this reasoning to the notion of *driver* in the Geneva Convention and the Vienna Convention would still prove challenging. The *driver* in the Geneva Convention and the Vienna Convention has rights and obligations, whereas the driver in technical regulations (often) has not. In technical regulations, the notion of *driver* is used to describe a passive object.[34]

---

[33] National Highway Traffic Administration, 'Letter responding to a letter from Dr. Chris Urmson (Director of the Self-Driving Car Project, Google, Inc.)' (4 February 2016) <http://isearch.nhtsa.gov/files/Google%20--%20compiled%20response%20to%2012%20Nov%20%2015%20interp%20request%20--%204%20Feb%2016%20final.htm> accessed 9 August 2018.

[34] See for instance UNECE Regulation No. 79. Uniform provisions concerning the approval of vehicles with regard to steering equipment (adopted 20 March 1958, entered into force 1

3.4.1.3 The User as the Driver of the Automated Vehicle?

In the future, someone might summon an automated vehicle to pick him up after, for instance, doing the groceries. This user – the person using the automated vehicle for a trip, although he is not necessarily inside or in the vicinity of the vehicle – decides on the direction of the vehicle travels by providing its destination and he dispatches the vehicle. Is deciding on the destination and dispatching the automated vehicle enough to regard the user as the driver of the vehicle within the meaning of the Geneva Convention and the Vienna Convention? The user meets the requirement that the driver has to be human. But does the user 'drive'? As discussed, the *driver* within the meaning of the Conventions will have to decide on the direction and speed by operating at least some of the controls of the vehicle. His actions have an immediate effect on the speed and direction of the vehicle. Although the user does decide on the destination of the vehicle, it does not decide on the direction and speed at any given point in time during the trip. The user does not decide to make a left turn, to swerve, to brake. The actions of the user do not have immediate effect – he might change the destination but that does not have the same direct effect as swerving, braking etc. The user cannot exercise any lateral or longitudinal control. In other words: the user does not perform the dynamic driving task. Taking all of this into account, the user cannot be regarded to be the *driver* within the meaning of the Conventions.[35]

3.4.2 An Automated Vehicle is Driverless within the Meaning of the Conventions

As all the parties discussed cannot be regarded to be the *driver* within the meaning of the Geneva Convention and the Vienna Convention, the Conventions will need to be revised or a new convention on road traffic law will need to be drafted in order to accommodate automated driving. Below, some possible ways to revise the Conventions so that they can accommodate automated driving are discussed.

December 1988) 1519 UNTS 288, para 5.4.1.1: 'Any fault which impairs the steering function and is not mechanical in nature must be signaled clearly to the driver of the vehicle.(…)'.

[35] It can be argued that if the user pulls the emergency brake of the automated vehicle (if the vehicle is equipped with one) for that short moment he is the driver of that vehicle.

3.5 The Laws of Other Modes of Transport as a Source of Inspiration [Option 1]

3.5.1 Maritime and Aviation Traffic Law

Aviation and maritime transport are two modes of transport that have already been confronted with (a degree of) automation. Although the level of automation of an autopilot of a vessel or aircraft might not be as high as the expected level of automation of an automated vehicle – the autopilot on board an aircraft or ship needs a certain level of supervision and might not respond to objects and events (see, for instance, paragraph 10 of the IMO Recommendation on navigational watchkeeping) – , maritime and aviation traffic law could provide inspiration for revising the Geneva Convention and the Vienna Convention.

International rules on air traffic can be found in Annex 2 to the Convention on International Civil Aviation (Chicago Convention). See, for example, the provision on how to handle a head-on situation:

> 3.2.2.2 Annex 2 Chicago Convention: "(…) When two aircraft are approaching head-on or approximately so and there is danger of collision, each shall alter its heading to the right."

This traffic rule is not directed at the pilot (as the traffic rules from the Geneva and Vienna Conventions are directed at the driver of the vehicle), but at the aircraft itself. The responsibility for complying with these and other air traffic rules lies with the pilot-in-command.[36] It is not relevant if this pilot-in-command actually operates the controls:

> 2.3.1 Annex 2 Chicago Convention: "The pilot-in-command of an aircraft shall, whether manipulating the controls or not, be responsible for the operation of the aircraft in accordance with the rules of the air, except that the pilot-in-command may depart from these rules in circumstances that render such departure absolutely necessary in the interests of safety."

So even though the pilot-in-command might not be operating the controls, perhaps he is not even anywhere near the controls, he is responsible for the

[36] See on the "see-and-avoid" requirement': Douglas Marshall, 'Unmanned Aerial Systems and International Civil Aviation Organization Regulations' (2009) 85 North Dakota Law Review 693.

operation of the aircraft. It is not relevant if the operation of the aircraft is performed by a pilot, the autopilot or someone else; the pilot-in-command is responsible.

A similar situation can be found in maritime traffic law, in the United Nations International Regulations for Preventing Collisions at Sea of 1972 (COLREGS 1972). Here, the master of the ship is one of the persons responsible for the operation of the ship in accordance with the traffic rules:

> Rule 2 a COLREGS 1972: “Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.”

The master of the ship can be, alongside the owner or the crew, held responsible for the operation of the ship even though he might not have been operating the controls.[37] The traffic rules from the COLREGS are also, similarly to the Chicago Convention, not directed at a person but at the vessel:

> Rule 14 COLREGS 1972: “(…) When two power-driven vessels are meeting on reciprocal or nearly reciprocal courses so as to involve risk of collision, each shall alter her course to starboard so that each shall pass on the port side of the other.(…)”

3.5.2 A Distinction Between Operation and Responsibility

As follows from the above, the structure of the traffic rules of Annex 2 to the Chicago Convention and the COLREGS 1972 differ from the structure of the rules of conduct of the Geneva Convention and the Vienna Convention:

- The traffic rules are directed at the vessel or aircraft, not at the person that might operate the controls;
- Responsibility for compliance with the traffic rules lies with a person that does not necessarily operate the controls.

As a result, it is not important if the autopilot or a crew member performs the tasks involved in flying or sailing; the aircraft or vessel has to ‘behave’ in

[37] AN Cockcroft, LNF Lameijer, *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea* (Elsevier 2012).

accordance with the traffic rules and someone bears responsibility for this. A distinction is made between who or what performs the dynamic driving task and who is responsible for the performance of the dynamic driving task: the dynamic driving task is performed by a pilot of an aircraft by operating the yoke or by the autopilot that keeps the aircraft at a certain height and course, whilst the pilot-in-command is responsible for the performance of the dynamic driving/flying task (2.3.1 Annex 2 Chicago Convention). Responsibility in this context does not equal liability. Under national law more factors can play a role in establishing (civil or criminal) liability.

This approach can be used in revising the road traffic law.[38] When applying the same structure as in maritime and aviation traffic law, the self-driving system of the automated vehicle performs the dynamic driving task, for which perhaps a person can be held responsible. This opens up the possibility to assign responsibility to a legal person, like the manufacturer. This approach would accommodate traffic of mixed levels of automation without the need for a different law or other instrument for each level of automation. If the conventional driver performs the dynamic driving task, he can be held responsible for the performance of that task; if the self-driving system performs the dynamic driving task the responsibility for the performance of that dynamic driving task can be assigned to a (legal) person).

3.5.3 The Vehicle and the Conventions

To revise the Conventions using the same approach as that taken in the discussed aviation and maritime traffic law, three steps need to be taken:

1. A vehicle should no longer need to have a driver;
2. The rules of conduct need to be directed at the vehicle instead of the driver;
3. A person or persons (not necessarily a human) should be made responsible for the operation of the vehicle in accordance with the traffic rules.

As a result, a distinction is made between who or what performs the dynamic driving task and who is responsible for the performance of the dynamic driving task. There is still someone responsible for the operation of the vehicle like the

[38] See also NE Vellinga, 'Self-driving vehicles: preparing road traffic law for a driverless future' (25th World ITS Congress 2018, Copenhagen, 17-21 September 2018).

conventional driver is under the current Conventions, even though there is no longer a *driver* as within the current meaning of the Geneva and Vienna Conventions, and vehicles of all levels of automation need to obey the same traffic rules.

To reach this result, art. 8 paragraph 1 of the Geneva Convention and art. 8 paragraph 1 of the Vienna Convention, that both state that every vehicle should have a driver, need to be revised. As discussed above an automated vehicle does not have a *driver* within the meaning of the Conventions. So in order to accommodate automated driving, these provisions will either need to be revised or deleted. For example, the provisions could state that a vehicle should have a driver or a self-driving system. Either way, it can no longer be required for a vehicle to have a driver.

The next step is to revise the rules of conduct in such a way that they are no longer directed at the driver but at the vehicle, just like the rules on avoiding a head-on collision of Annex 2 of the Chicago Convention and the COLREGS 1972. Take, for example, art. 11 paragraph 1(a) of the Vienna Convention on overtaking (see also art. 11 paragraph 1 Geneva Convention) which states:

> "Drivers overtaking shall do so on the side opposite to that appropriate to the direction of traffic."

A revised provision, that is directed at the vehicle instead of the driver, could state:

> "Vehicles overtaking shall do so on the side opposite to that appropriate to the direction of traffic."

Other rules of conduct do not need revision to accommodate automated driving because they are only suitable for a situation where there is a conventional driver behind the wheel. A revision would not benefit road safety or it is simply not possible for a vehicle to perform the obligation. See, for instance, art. 7 paragraph 5 on the wearing of safety belts:

> "The wearing of safety belts is compulsory for drivers and passengers of motor vehicles, occupying seats equipped with such belts, save where exceptions are granted by domestic legislation."

It would not benefit road safety to also make it compulsory for vehicles to wear safety belts (aside from the question how a vehicle can actually wear such a belt). This provision can therefore be left as it is; this way it remains compulsory for passengers (of conventional vehicles and of automated vehicles) and conventional drivers to wear safety belts, which contributes to safety.[39]

3.5.4 Responsibility

To come to a separation between who or what performs the dynamic driving task and who or what is responsible, it will be necessary to, just like in Annex 2 of the Chicago Convention and the COLREGS 1972, assign a person as the person who bears responsibility for the operation of the automated vehicle in accordance with the traffic rules. This person could be a human, or perhaps a legal person. After all, the responsible (legal) person does not have to be able to perform the dynamic driving task, he only bears responsibility for the performance of the dynamic driving task. With whom the responsibility rests is of importance as it can play a role in establishing liability, although this role would be limited if a no-fault compensation scheme is in place.[40]

Regarding conventional vehicles, there does not seem to be a reason why the conventional driver cannot remain responsible. But who should bear the responsibility for the performance of the dynamic driving task of an automated vehicle?

It can be argued that the manufacturer of the vehicle or the company that programmed the software should be responsible as they can influence the operation of the vehicle by the choices they make in hardware (radars, cameras, processing power etc.) and software (for instance, by programming the distance between the automated vehicle and the vehicle driving in front of it). However, the user and the owner of the vehicle can also influence the operation of the vehicle somewhat (by (lack of) maintenance, by choosing (not) to use the vehicle, by ignoring a software update etc.). Perhaps they should bear responsibility, or perhaps multiple persons should bear responsibility. An example of the latter is Rule 2 a of the COLREGS 1972: the owner of the vessel, the master of the vessel and/or the crew can be held responsible for the

[39] World Health Organization, *World report on road traffic injury prevention* (WHO 2004).
[40] Maurice HM Schellekens, 'No-fault compensation schemes for self-driving vehicles' (2018) 10(2) Law, Innovation and Technology 314.

operation of the vehicle.[41] Further discussion is needed in order to come to a decision regarding the assignment of a responsible person.[42]

3.5.5 Arguments For and Against This Approach

The approach discussed above has several advantages. It provides for mixed traffic, where vehicles of different levels of automation share the public roads. The newest model of a fully automated vehicle, a car with adaptive cruise control or an old-timer: all vehicles have to 'behave' in accordance with the same traffic rules.[43] Once agreement has been reached on who should be responsible for the operation of the vehicle in accordance with the traffic rules, all parties involved will have more certainty on their legal position. For the legal position of conventional drivers driving conventional vehicles, all these changes would not have any negative consequences: in the end, their position remains as it is. Besides, the Vienna Convention is familiar with the discussed approach, as it already has a provision formulated according to this approach:

> "A vehicle shall not overtake another vehicle which is approaching a pedestrian crossing marked on the carriageway or sign-posted as such, or which is stopped immediately before the crossing, otherwise than at a speed low enough to enable it to stop immediately if a pedestrian is on the crossing. (…)" (art. 11 paragraph 9 Vienna Convention)

The approach does, nevertheless, require an extensive overhaul of both the Geneva Convention and the Vienna Convention. Multiple provisions of both

---

[41] AN Cockcroft, LNF Lameijer, *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea* (Elsevier 2012).

[42] This also raises the question if perhaps robots should be assigned legal personhood and be responsible for their own actions, see for instance: Nevejans N, 'European Civil Law Rules in Robotics. Study' (Directorate-General For Internal Policies Policy Department C: Citizens' Rights and Constitutional Affairs, Legal Affairs, 2016) <www.europarl.europa.eu/RegData/etudes/STUD/2016/571379/IPOL_STU(2016)571379_EN.pdf> accessed 20 August 2019, 14ff; European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)) [2017] para 59; European Commission, 'Artificial Intelligence for Europe' COM (2018) 237 final, 25; 'Open Letter to the European Commission Artificial Intelligence and Robotics'<www.robotics-openletter.eu/> accessed 9 August 2018; Ton Hartlief, 'Van knappe koppen en hun uitvindingen' (2018) Nederlands Juristenblad 1265.

[43] See in a different context on the importance of this: Benjamin von Bodungen and Martin Hoffmann, 'Belgien und Schweden schlagen vor: Das Fahrsystem soll Fahrer werden!' (2015) Neue Zeitschrift für Verkehrsrecht 521.

Conventions will have to be amended. The amending processes of both Conventions – especially of the Geneva Convention – are time-consuming (art. 31 Geneva Convention, art. 49 Vienna Convention). Coordinating the amendment processes to avoid divergence between the two Conventions will be challenging, as well as reaching the required majorities. This has already proven to be difficult[44] and might not be politically feasible. Instead of choosing to take the route of amending the Conventions, drafting a new convention using the approach discussed above could also provide the desired result. This way, the difficult amending process can be avoided. However, less drastic options should also be explored.

3.6 The Notion of *Driver*: A different driver per function [Option 2]

3.6.1 The Interpretation of the Notion of *Driver* Depending on its Function

On the assumption that the Conventions might be interpreted relatively flexibly as *living instruments,*[45] it might be possible to accommodate the notion of a *driver* to automated vehicles. Interpreting the notion of *driver* differently per provision would give a very fractured and perhaps unworkable result. As described above, the function of the notion of *driver* can differ depending on the context. In order to achieve more coherence, the interpretation of the notion of *driver* will be discussed per function of the notion.

3.6.2 The Notion of *Driver* in Technical Requirements

The function that is only sporadically present in the Vienna Convention and Geneva Convention, is the function of the notion of *driver* in the context of a technical nature. In the Vienna Convention, this function is present in art. 30 paragraph 2(b), art. 30bis, art. 32 paragraph 2(a); in the Geneva Convention, this function is only present in art. 22 paragraph 1. These provisions require that the driver's view not be blocked, lighting be sufficient for the driver to see clearly and the vehicle to be in such a condition so as to not endanger the driver. In

[44] See United Nations Economic and Social Council, 'Consistency between the Convention on Road Traffic (1949) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/1; United Nations Economic and Social Council, 'A Safe System Approach' (11 July 2014) UN Doc ECE/TRANS/WP.1/2014/4/Rev.1; United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 April 2014) UN Doc ECE/TRANS/WP.1/145.

[45] See for instance *Tyrer v. United Kingdom* App no 5856/72 (ECtHR, 25 April 1978) with regard to the Convention for the Protection of Human Rights and Fundamental Freedoms.

these contexts, the driver has no rights or obligations, the notion is only of a descriptive nature. The driver is a passive object. Therefore, when looking at it from a *living instrument* perspective, the notion of *driver* in this context can not only be interpreted as the human who drives the vehicle, but also as the self-driving system. That would lead, for instance, to the requirement that the self-driving system's 'view' should not be blocked. In more concrete terms: the sensors and cameras of the self-driving vehicle should not be blocked, as this impedes the 'view' of the self-driving system.

3.6.3 The Notion of *Driver* in Capacity Requirements

Another context in which the notion of *driver* appears in the Conventions, is in the requirements that are set for drivers. Drivers should hold a driving permit as proof of their competence (Chapter V Geneva Convention, Chapter IV Vienna Convention) and they should have the necessary physical and mental ability and be in a fit physical and mental condition to drive (art. 8 paragraph 3 Vienna Convention). The driver should also possess the knowledge and skill necessary for driving (art. 8 paragraph 4 Vienna Convention). There is no purpose in demanding a vehicle or a self-driving system should be in a certain physical or mental condition. These requirements are clearly written with a human driver in mind. In this context, the interpretation of the notion of *driver* can therefore remain as 'a human who drives a vehicle'.

3.6.4 The Notion of *Driver* in Rules of Conduct

The notion of *driver* is central to the traffic rules of both Conventions (Chapter II Geneva Convention, Chapter II Vienna Convention). Duties are imposed upon the driver: the driver has to overtake in a certain manner (art. 11 Geneva Convention, art. 11 Vienna Convention), the driver should show extra care around vulnerable road users (art. 7 paragraph 3 Vienna Convention), the driver should not brake abruptly unless it is necessary to do so for safety reasons (art. 17 paragraph 1 Vienna Convention), and so on. A *living instrument* approach would open up the possibility of broadening the interpretation of the notion of *driver* from 'the human who drives', to 'who or what drives the vehicle'. The traffic rules would no longer be directed only at the human driver, but also at the self-driving system or the vehicle itself. This way, the Conventions could accommodate automated driving.

The requirement that every vehicle should have a driver (art. 8 paragraph 1 Geneva Convention, art. 8 paragraph 1 Vienna Convention), is achieved through this approach. In this context, the notion of *driver* should be interpreted as who or what drives the vehicle. So, this can be a human driver when the vehicle is a conventional vehicle, or the self-driving system of an automated vehicle. However, before it is possible to use the *living instrument* approach to interpret the Conventions, the definitions of the notion of *driver* given by the Conventions need changing. Currently, the Conventions state that the *driver* is the *person* who drives the vehicle (art. 4 paragraph 1 Geneva Convention, art. 1 (v) Vienna Convention). This definition prevents interpreting the *driver* as being the self-driving system. Therefore, the definition needs either to be changed to state that the *driver* is *anything* or *any person* driving the vehicle, or to be completely removed from the Conventions. This last option provides optimal flexibility for the years to come, in order to accommodate for unforeseen developments.

3.6.5 Arguments For and Against This Approach

The *living instrument* approach shines a new light on the interpretation of the notion of *driver*. One way to interpret the notion of *driver* is, as discussed, to interpret the notion per function instead of having one and the same interpretation of the notion throughout the Conventions. An advantage of this approach is that, besides the deletion of the definition of *driver* (art. 4 paragraph 1 Geneva Convention, art. 1 (v) Vienna Convention), it does not require amendments to be made to the Conventions. This avoids a complex and lengthy amendment process. However, the approach comes with a degree of uncertainty as to the interpretation of the notion of *driver*, and therefore where the responsibility for the traffic behavior lies, can differ depending on the notion's function in that specific context. This can be overcome by capturing the interpretation of the notion of *driver* in its different functions in an agreement between the Contracting Parties of the Geneva Convention and the Vienna Convention (ex. Art. 31(3)(a) Vienna Convention on the Law of Treaties). Although this requires consensus between the parties, it could well be an easier process than amending the Conventions as it does not require following a fixed process. This also provides flexibility; if unforeseen circumstances arise, the agreement can be adjusted if needed without having to go through the amendment procedure. It may, however, still leave the national legislator with uncertainty concerning the compatibility of national traffic laws with the (interpretation of the notion of *driver* in the) Geneva Convention and the Vienna Convention. Besides, it leaves the question of who is responsible for the acts of the driver, if the driver is the self-driving system, unanswered.

3.7 The User Operating the Controls? [Option 3]

3.7.1 The Start Button as a Control of the Automated Vehicle

Perhaps a less complicated solution than the approach discussed in the previous section is possible. In the previous paragraph, the focus was on who or what operated the vehicle and who or what performed the dynamic driving task. In this paragraph, the emphasis will lie more on the operation of the controls of the vehicle. After all, the traditional controls of the vehicle will disappear: a fully automated vehicle will probably not have pedals or a steering wheel. It will however have a new element: a start button[46] with which to dispatch the vehicle. Given the starting point that the Conventions are *living instruments*, can this start button be regarded as a *control* of the vehicle and if so, does that mean that the user of the vehicle – the human using the start button to dispatch the vehicle and who determines its destination – can be regarded as the driver of the automated vehicle?

3.7.2 The Controls and the Driver of an Automated Vehicle

It can be argued that, although the automated vehicle does not have the traditional controls, the start button is the control of a fully automated vehicle. The start button almost forms a sort of overlapping control which allows the self-driving system to use the controls that are needed for steering, braking, accelerating etc. Though this interpretation of *control* might not fit with the current interpretation of the notion of *control*, the *living instrument* approach opens up the possibility for this novel interpretation.

If the start button can be regarded as a control of the automated vehicle, it can be argued that the user is the driver of the automated vehicle: the user operates the control (the start button), thereby in a sense deciding over the direction and speed of the vehicle, and the user is human. This would mean that the user fills the void the conventional driver left behind. The Conventions do not need to be amended to provide for this new interpretation. However, for some provisions it is not necessary to change but desirable nevertheless. For instance, art. 8 paragraph 3 Vienna Convention:

---

[46] See for instance Darrell Etherington, 'Waymo's first product will be its own on-demand ride hailing service' (*TechCrunch*, 7 November 2017) <https://techcrunch.com/2017/11/07/waymos-first-commercial-product-will-be-its-own-on-demand-ride-hailing-service/?guccounter=1> accessed 16 August 2018.

> "Every driver shall possess the necessary physical and mental ability and be in a fit physical and mental condition to drive."

What is the purpose of requiring the user – the driver – to be in a fit mental and physical condition while he is not the one performing the dynamic driving task like a conventional driver does. The self-driving system is performing the dynamic driving task. For the same reason, one could wonder if it serves any purpose to require the user/driver to hold a driving permit, like a conventional driver (art. 24 Geneva Convention, art. 41 paragraph 1 Vienna Convention).

3.7.3 Arguments For and Against This Approach

As discussed above, the approach that a start button is also a control of a vehicle does not require amendments to the Geneva Convention and Vienna Convention, unlike the approach from maritime and aviation traffic law and the approach of a different interpretation of the notion of *driver* per function. It is also provides a clearer approach than interpreting the notion of *driver* differently per function of the notion.

Nevertheless, there is a complication. The *start button is a control* approach puts the responsibility for the operation of the vehicle with the new driver: the user of the vehicle. The responsibility for the operation of a conventional vehicle lies with the conventional driver. The responsibility lies with the conventional driver as he performs the dynamic driving task: he decides to stop for a red traffic light, to slow down when driving past a playground, to swerve for someone stepping out onto the road, etc. The user would, however, under this approach bear responsibility for the operation of the vehicle - which can subsequently play a role in (civil and criminal) liability matters (also depending on the insurance scheme)[47] - but he would not perform the dynamic driving task and he would not explicitly decide on any manoeuvre the self-driving system makes. One could argue that the user has accepted how the self-driving system performs the dynamic driving task by pressing the start button: by pressing the start button the user makes the conscious decision to let the self-driving system perform the dynamic driving task, thereby agreeing on the lateral and longitudinal movements of the vehicle. But is that enough justification for holding the user responsible for the actions of the self-driving system? At the

[47] Maurice HM Schellekens, 'No-fault compensation schemes for self-driving vehicles' (2018) 10(2) Law, Innovation and Technology 314.

end of the day, the Parties to the Geneva Convention and to the Vienna Convention will have to answer that question.

3.8 Functioneel Daderschap [Option 4]

3.8.1 The Dynamic Driving Task and the Notion of *Driver*

This paragraph is taking the performance of the dynamic driving task as a point of departure. It can be argued that, in essence, the driver is who or what has deciding influence on the performance of the dynamic driving task. Does this provide possibilities for automated driving without the need for an extensive overhaul of the Geneva Convention and the Vienna Convention?

By focusing on the performance of the dynamic driving task, the self-driving system comes back into the frame as a possible driver. The self-driving system decides, through its combination of hardware and software, if the vehicle brakes, swerves or accelerates etc. If the self-driving system 'sees' via its sensors a pedestrian suddenly stepping onto the road, its software will calculate to swerve, or brake. If, for instance, a sensor breaks, the system will decide: continue as normal, warn the user of the automated vehicle, or make an emergency stop. All those decisions are made on the spot, in specific conditions. Therefore, the dynamic driving task of an automated vehicle is performed by the self-driving system of the vehicle. So, it can be argued that, when only taking the performance of the dynamic driving task into account, the self-driving system of the automated vehicle is the driver of that vehicle.

The (legal) person having the most influence on the performance of the dynamic driving task by the self-driving system is the manufacturer of (the self-driving system of) the automated vehicle. The manufacturer can, through the hardware and software, determine in advance and to some extent, how the automated vehicle will respond to a certain situation or event. The manufacturer can decide how much distance the automated vehicle should keep from a vehicle travelling in front of it, that the automated vehicle will stop for a red traffic light, and that the automated vehicle will slow down when approaching a pedestrian crossing. The manufacturer equips the vehicle with certain hardware and has the software programmed in a certain way. So why not attribute the acts of the vehicle or the self-driving system to the manufacturer; why not hold the manufacturer responsible for the performance of the dynamic driving task?

3.8.2 Inspiration from Dutch Law

Dutch law is familiar with the attribution of acts to a legal person. In 1979, a case regarding the statements of an alderman concerning who was liable for the collapse of a roof of a primary school was brought before the Dutch Supreme Court (Hoge Raad).[48] The Hoge Raad decided that the statements by the alderman could be attributed to its municipality, meaning that a legal person (in this case the municipality) can not only commit a tort through one of his administrative organs but also through someone like the alderman, if his acts in society are seen as acts of the legal person.[49] The act of the alderman is seen as the conduct of the municipality itself.[50]

Under Dutch criminal law, the acts of an individual can be attributed to the legal person that in effect had control over the conduct, meaning that the legal person can commit a crime through another person. The Dutch criminal code (Wetboek van Straftrecht or Sr) already stated that a legal person can commit a criminal offence (art. 51 Sr),[51] when in 2003, a case reached the Hoge Raad raising questions regarding the attribution of a criminal offence to a legal person.[52] This case concerned a manager of a company that managed farmlands, who was convicted by the Court of Appeal for the wrongful use of animal manure on those farmlands (an economic offence).[53] The manager pleaded for dismissal of the criminal charges as, among others, she was not the owner of the farmlands and she had not given anyone permission to use the manure on the farmlands.[54] This case gave the Hoge Raad reason to explain under what circumstances a criminal offence can be attributed to a legal person and is regarded to be a criminal offence committed by the legal person itself,

---

[48] HR 6 April 1979, NJ 1980/34, m. nt. C.J.H. Brunner.
[49] HR 6 April 1979, NJ 1980/34, m. nt. C.J.H. Brunner, r.o. 1. See also HR 11 November 2005, ECLI:NL:HR:2005:AT6018, NJ 2007/231 m.nt. Vranken, r.o. 3.6; HR 7 October 2016, ECLI:NL:HR:2016:2285, JOR 2016/325 m. nt. B.M. Katan.
[50] HR 6 April 1979, NJ 1980/34, m. nt. C.J.H. Brunner.
[51] Art. 51 lid 1 Sr: 'Strafbare feiten kunnen worden begaan door natuurlijke personen en rechtspersonen.'
[52] HR 21 October 2003, ECLI:NL:HR:2003:AF7938, NJ 2006/328 (drijfmestarrest) m. nt. P. Mevis; Markus J Hornman, 'De strafrechtelijke aansprakelijkheid van leidinggevenden van ondernemingen: Een beschouwing vanuit multidimensionaal perspectief/Criminal Liability of Corporate Executives. A Multidimensional Approach' (Dissertation, University of Utrecht 2016) paras 2.5.2, 3.3ff.
[53] Conclusie A-G Wortel, ECLI:NL:PHR:2003:AF7938, 5.
[54] Conclusie A-G Wortel, ECLI:NL:PHR:2003:AF7938, 11.

further developing the theory of *functioneel daderschap*.[55] The legal person is regarded to be the offender when the conduct can reasonably be imputed to him.[56] Whether this is reasonable depends on the specific circumstances of the case. The Hoge Raad did not give a general rule. An important guideline, however, is that if the act took place within the sphere of the legal person, this act can, in principle, be regarded to be committed by the legal person.[57] According to the Hoge Raad, such an act could exist in one or more of the following circumstances:

- If it concerns an act or an omission from someone under an the employment of, or who is on another basis employed for the benefit of, the legal person;
- If the conduct fits into the normal business operations of the legal person;
- If the conduct has been useful to the legal person in his business operations;
- If the legal person had the power to determine whether the conduct would or would not take place, and this or similar conduct was, given the actual course of events, accepted or would have been accepted by the legal person. 'Accepting' also includes not exercising the care that can reasonably be required of the legal person to prevent the conduct.[58]

This shows that under certain conditions an act can be attributed to a legal person and is regarded to be the act of the legal person.[59] An offence can be

---

[55] HR 21 October 2003, ECLI:NL:HR:2003:AF7938, NJ 2006/328 (drijfmestarrest) m. nt. P. Mevis. See also Simone N de Valk, 'Aansprakelijkheid voor leidinggevenden naar privaatrechtelijke, strafrechtelijke en bestuursrechtelijke maatstaven' (Dissertation, University of Groningen 2009) para 5.4.3.
[56] HR 21 October 2003, ECLI:NL:HR:2003:AF7938, NJ 2006/328 (drijfmestarrest) m. nt. P. Mevis, r.o. 3.3.
[57] HR 21 October 2003, ECLI:NL:HR:2003:AF7938, NJ 2006/328 (drijfmestarrest) m. nt. P. Mevis, r.o. 3.4.
[58] HR 21 October 2003, ECLI:NL:HR:2003:AF7938, NJ 2006/328 (drijfmestarrest) m. nt. P. Mevis, r.o. 3.4. See also HR 23 February 1954, NJ 1954/378 (ijzerdraad-arrest); HR 14 January 1992, NJ 1992/413.
[59] Simone N de Valk, 'Aansprakelijkheid voor leidinggevenden naar privaatrechtelijke, strafrechtelijke en bestuursrechtelijke maatstaven' (Dissertation, University of Groningen 2009) para 5.4.3; Markus J Hornman, 'De strafrechtelijke aansprakelijkheid van

perpetrated not only by the person that commits the conduct, but also by the legal person that has the power to dispose over the conduct. Although the legal person did not "get his hands dirty", he is the *functioneel dader* (freely translated: *vicarious perpetrator*). So, the emphasis lies on who has the power to, through the relationship within the company or with the individual, determine the conduct, not so much on who actually commits the conduct. This approach from Dutch case law can be used as an example with regards to the acts of the self-driving system of an automated vehicle being attributed as the acts of the manufacturer of that vehicle.

3.8.3 Functioneel Daderschap and the Conventions

If the *functioneel daderschap* approach is applied to automated driving, the acts of the self-driving system, that performs the dynamic driving task, can be regarded to be the acts of the manufacturer of the automated vehicle. For instance, if the automated vehicle overtakes another vehicle on the wrong side of that vehicle (art. 11 (1)(a) Vienna Convention, see also art. 11 (1) Geneva Convention), this act can be seen as an act of the manufacturer of this vehicle.

It can be argued that the manufacturer of the automated vehicle, including the self-driving system, had the power to determine whether the conduct would or would not take place, via the hard- and software with which the manufacturer equipped the automated vehicle. He has influence over the response of the vehicle/system to a traffic light, what distance the vehicle will keep from a vehicle travelling in front of it, if the full capacity of the brakes is used when stopping for someone who suddenly crosses the road, etc. The manufacturer's acceptance of the behaviour of the vehicle can be derived from the decision of the manufacturer to put the vehicle, with all its flaws, into circulation. It can be argued that this reasoning also applies to an act of an automated vehicle equipped with self-learning software. After all, it was the manufacturer who decided to equip the vehicle with self-learning software, and he consciously put it into circulation. Looking at it from this perspective, the conduct of the self-driving system falls within the sphere of the manufacturer. Therefore, it could be reasonable to attribute the acts of the self-driving system to the manufacturer and consider them to be acts of the manufacturer. So, along the

---

leidinggevenden van ondernemingen: Een beschouwing vanuit multidimensionaal perspectief/Criminal Liability of Corporate Executives. A Multidimensional Approach' (Dissertation ,University of Utrecht 2016) para 3.4.

lines of the discussed Dutch case law, the manufacturer can be held responsible for the conduct of the automated vehicle, which can subsequently lead to criminal or civil liability for the manufacturer. The manufacturer becomes, as it were, the 'vicarious driver' of the automated vehicle.

This *functioneel daderschap* approach provides an incentive for the manufacturer to only put automated vehicles into circulation that have been tried and tested. If, nonetheless, the manufacturer commits a traffic offence through an automated vehicle that ignored a traffic rule, the manufacturer could be fined for the misconduct of the automated vehicle or perhaps the (type-) approval of the vehicle could get withdrawn. If the vehicle not only ignores traffic laws but also causes damage, the manufacturer could be exposed to a civil liability claim.[60]

This approach could fit within the Geneva Convention and the Vienna Convention, if the definition of *driver* is deleted from the Conventions (art. 4 (1) Geneva Convention, art. 1 (v) Vienna Convention). The current definition does not leave room to qualify the system as *driver* because the system is not a person. This definition needs to change in order to facilitate the interpretation of *driver* as meaning what/who performs the dynamic driving task.

3.8.4 Arguments For and Against This approach

The incentive to only put automated vehicles into circulation that have been tried and tested could stimulate increased road traffic safety, in line with the aims of the Geneva Convention and the Vienna Convention. The *functioneel daderschap* approach also provides clarity regarding the responsibilities of the parties involved. The approach does not require a substantial revision of the Conventions, thus avoiding a possibly unsuccessful, complicated and lengthy amendment process. A possible disadvantage of the *functioneel daderschap* approach, however, is that it might hinder innovation. If manufacturers are confronted with high fines or the possible withdrawal of the type-approval of their automated vehicle, this could make manufacturers hesitant to put new automated vehicles with new technologies into circulation. That way, road traffic could be deprived from technology that benefits road safety. Another disadvantage is that not all contracting parties to the Conventions might be

[60] See, however, on no-fault insurance schemes for self-driving vehicles: Maurice HM Schellekens, 'No-fault compensation schemes for self-driving vehicles' (2018) 10(2) Law, Innovation and Technology 314.

familiar with this theory or a similar doctrine, making this *functioneel daderschap* approach incongruous with their legal system.[61]

3.9 The Way Forward

3.9.1 The Four Approaches

Given the current interpretation of the notion of *driver*, an automated vehicle does not have a *driver* within the meaning of the Geneva Convention and the Vienna Convention. Above, four approaches on how to accommodate automated driving in the Conventions have been discussed.

The first approach, drawing inspiration from maritime and aviation traffic law, ties in with the existing art. 11 paragraph 9 of the Vienna Convention as that particular traffic rule is already addressed at the vehicle. Despite this, this approach does require an extensive overhaul of the Conventions.

The Geneva Convention and Vienna Convention could be regarded as *living instruments*, which opens up the possibility of revising the Conventions through new ways of interpretation. This can be done by interpreting the notion of *driver* per each of the notion's functions that the notion has within the Conventions (the second discussed approach). This provides flexibility, but it also causes uncertainty as the correct interpretation might not always be clear to the national legislator or judge. It also does not answer the question of who is responsible for the operation of the automated vehicle.

The third approach, regarding the start button as a control of the vehicle, does answer this question. If the start button is regarded as a control of the vehicle, the user can be regarded as the driver of the automated vehicle. This would mean that the user is responsible for the operation of that vehicle.

The *functioneel daderschap* approach puts responsibility for the operation of the automated vehicle with the manufacturer of that vehicle. The acts of the self-driving system are considered to be the acts of the manufacturer.

Given these four approaches, which approach is most suitable for a driverless future?

[61] Erik Gritter, 'Effectiviteit en aansprakelijkheid in het economisch ordeningsrecht' (Dissertation, University of Groningen 2003) ch 4.

3.9.2 Towards a Driverless Future

Out of the four approaches presented as options for revising the Geneva and Vienna Conventions in order to accommodate automated driving, the *functioneel daderschap* approach offers a considerable benefit over the other approaches: it provides a clear legal framework without the need for extensive amendments to the Conventions. The definition of driver will need to be deleted from the Conventions in order to enable the *functioneel daderschap* approach, but that is just a minimal change compared to the overhaul of the Conventions that is required when following the approach from maritime and aviation law discussed above. The only approach that does not require any amendments at all to either the Geneva Convention or the Vienna Convention is the approach that regards the start button of the automated vehicle as a control within the meaning of the notion of *driver*, making the user the driver of the automated vehicle. However, that approach also puts the responsibility for the performance of the dynamic driving task on the user, who has no actual influence over the performance of the dynamic driving task. The manufacturer has, through the hardware and software it equips the vehicle with, the most influence over the performance of the dynamic driving task. The *functioneel daderschap* approach gives the opportunity to put the responsibility for the performance of the dynamic driving task with the (legal) person that has the most influence over the performance of the dynamic driving task: the manufacturer. The *functioneel daderschap* approach therefore provides an answer to the question who is responsible for the performance of the dynamic driving task, a question that is left unanswered by the approach adhering to maritime and aviation traffic law and the approach concerning a different interpretation of the notion of *driver* depending on its function. Therefore, out of the discussed approaches, the *functioneel daderschap* approach is the most suitable for the Conventions in order to accommodate automated driving, providing a clear legal framework for all the parties involved.

Epilogue: Developments on the Notion of *Driver*

Since the completion of the previous chapter in which a recommended way forward was formulated, the discussion on the notion of *driver* within the meaning of the Geneva Convention and Vienna Convention has continued. There have also been some legal developments on a national level. These developments do not follow the proposed *functioneel daderschap* approach (section 3.9), but offer different approaches. In addition, a relevant court decision was reached by a Dutch court on this notion of *driver*.

In the previous chapter, it was argued that the *driver* is a human who decides on the speed and direction of the vehicle by operating (at least some of) the controls. This interpretation was recently validated in a case relating to a Tesla owner who had used his mobile phone whilst the vehicles so-called Autopilot-function was engaged.[1] A Dutch court confirmed that a driver is a human that decides on speed and direction of the vehicle by operating at least some of the controls, including the Autopilot function, of the vehicle.[2]

Working Party 1, the body of the United Nations ECE responsible for updating the Geneva Convention and the Vienna Convention, continues work on the notion of *driver* in both Conventions. Recently, the United Kingdom submitted a discussion document to Working Party 1 on proposed amendments to the Vienna Convention to support the use of automated vehicles.[3] A new definition of driver is one of the proposed amendments (changes to the current definition are in bold):

> “(v) “Driver” means any person who, **from inside or outside of the vehicle,** drives a motor vehicle or other vehicle (**including a vehicle with an ADS or** a cycle) **or combination of vehicles**, or who guides cattle, singly or in herds, or flocks, or draught, pack or saddle animals on a road.”[4]

---

[1] Hof Arnhem-Leeuwarden, 31 July 2019, ECLI:NL:GHARL:2019:6122.

[2] Hof Arnhem-Leeuwarden, 31 July 2019, ECLI:NL:GHARL:2019:6122, r.o. 15 and 16.

[3] United Nations Economic and Social Council, ‘Discussion document for a package of article-by-article amendments to the 1968 Convention on Road Traffic to support the use of automated vehicles’ (5 July 2019) UN Doc ECE/TRANS/WP.1/2019/7.

[4] United Nations Economic and Social Council, ‘Discussion document for a package of article-by-article amendments to the 1968 Convention on Road Traffic to support the use of automated vehicles’ (5 July 2019) UN Doc ECE/TRANS/WP.1/2019/7, p. 3.

ADS stands for Automated Driving System, defined in the discussion document as “the combination of hardware and software to exercise dynamic control on a sustained basis on behalf of the driver.”[5] In addition, the United Kingdom also introduce changes to a number of other provisions, including art. 8 of the Vienna Convention. The proposals give rise to several questions, for instance, concerning the definition of driver: can someone *drive* a vehicle whilst not exercising dynamic control, as the dynamic control is exercised by the automated driving system (ADS)? And how can this driver be distinguished from the passengers?

France has also brought a proposal to the table. In contrast to the United Kingdom, France only proposes changes to art. 8 Vienna Convention in order to accommodate increasing vehicle automation, adding two new paragraphs to the article.[6] The proposed paragraph 5(b) would form an exception to paragraph 1 of art. 8 (“Every moving vehicle or combination of vehicles shall have a driver.”):

> “5 (b) As an exception to the paragraph 1 above, some vehicles systems can take over all of the driving tasks of the driver.
> (i) When an automated driving system assuming all dynamic driving tasks within a pre-defined design domain, with the expectation that the driver will respond to requests to intervene, is active, the driver behind the wheel is exempted from the driving task except in case he has to obey to instructions given by authorized officials, to follow the rules which apply towards priority vehicles, in case of an evident vehicle system failure and has to respond upon any request to intervene in accordance with what is requested by the automated driving system.
> Notwithstanding these exceptions, the driver behind the wheel can exercise other activities than driving provided these activities do not prevent him/her from responding safely to demands from the vehicle system for taking over the driving task. Moreover, these activities shall be consistent with the prescribed use of the vehicle systems and their defined functions. Such an automated system shall be in conformity with the conditions of construction, fitting, utilization and

[5] United Nations Economic and Social Council, ‘Discussion document for a package of article-by-article amendments to the 1968 Convention on Road Traffic to support the use of automated vehicles’ (5 July 2019) UN Doc ECE/TRANS/WP.1/2019/7, p. 3.
[6] United Nations Economic and Social Council, ‘Amendment proposal to Article 8 in the 1968 Convention on Road Traffic’ (9 January 2019) UN Doc ECE/TRANS/WP.1/2019/1.

> validation according to international legal instruments concerning wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles
> (ii) When an automated driving system assuming all of the driving tasks of the driver at all times, is active, the user is exempted from the driving task. Subsequently paragraphs 5 (first sentence) and 6 of this Article, and paragraph 1 of Article 13 do not apply. The provisions of the convention which apply to drivers, other than those linked to the driving tasks, apply to the person who has engaged the autonomous driving system. Such an automated system shall be in conformity with the conditions of construction, fitting, utilization and validation according to international legal instruments concerning wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles"[7]

These proposed changes to art. 8 of the Vienna Convention do not clarify if the automated driving system should comply with the rules of the road of Chapter II Vienna Convention, which entail traffic rules directed, among others, at the driver. The French do clarify the role of the user of a fully automated vehicle:

> "5 (c) Users of fully automated vehicles shall comply with the safety instructions given by the automated system. When the automated system assuming all driving tasks at all times, within a pre-defined design domain is under remote supervision and control, this automated system and the corresponding communication, supervision and control system shall be in conformity with the conditions of construction, fitting, utilization and validation according to international legal instruments concerning wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles"[8]

The aforementioned countries, together with other mainly European countries (e.g. the Netherlands, Spain and Germany etc.), seem to be the most involved in the discussions on the notion of *driver*. This could be explained by the economic importance of road transport for those countries and therefore the importance of legislation for international road traffic, as well as through the lack of

[7] United Nations Economic and Social Council, 'Amendment proposal to Article 8 in the 1968 Convention on Road Traffic' (9 January 2019) UN Doc ECE/TRANS/WP.1/2019/1, p. 2-3.
[8] United Nations Economic and Social Council, 'Amendment proposal to Article 8 in the 1968 Convention on Road Traffic' (9 January 2019) UN Doc ECE/TRANS/WP.1/2019/1, p. 3.

international land borders with other countries and therefore the lesser importance of legislation for international road traffic (for instance, the United States). However, the proposals of both the United Kingdom and France would require more extensive amendments, leave open a number of questions, and offer no more benefits than the *functioneel daderschap* approach proposed in Chapter 3. Therefore, these proposals do not change the findings of the previous chapter.

On a national level, the English Law Commission and Scottish Law Commission propose a new type of user for an automated vehicle in a consultation paper.[9] This new type of user, the 'user-in-charge', "would not be a driver whilst the automated driving system was in operation but must be qualified and fit to drive."[10] It would be the user-in-charge who has to take over in planned circumstances or after the vehicle has reached a minimal risk condition.[11] When the automated vehicle is performing the dynamic driving task, the user-in-charge is not the driver and can undertake other activities than driving.[12] The user-in-charge would bare criminal liability for offences that are not related to the performance of the dynamic driving task.[13] In addition, both Law Commissions refer to the US draft Uniform State Laws[14] and the Australian[15] example of an "Automated Driving System Entity" which should bear the

[9] Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*, para 3.24ff.
[10] Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*, para 3.27.
[11] Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*, para 3.27, 3.34.
[12] Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*, para 3.35.
[13] Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*, para 3.27, 7.37ff.
[14] Smith BW, 'Highly Automated Vehicles Act. Reporter's Version Release Note' (2018). See also Automated Operation of Vehicles Act Committee <www.uniformlaws.org/committees/community-home?CommunityKey=43730d6f-013d-4883-b2b7-98e66bda3239> accessed 5 September 2019.
[15] See for instance National Transport Commission, 'Automated Vehicle Program' (2019).

responsibility of ensuring the vehicle's safety.[16] This entity "should also be subject to a system of regulatory sanction if the vehicle acts in a way which would be considered a criminal offence if done by a human driver."[17] Possible sanctions could be fines or the withdrawal of the approval.[18]

Although these proposals are very interesting, many questions remain unanswered. The role of the Automated Driving System Entity needs more clarification,[19] as does the relationship between the Geneva Convention and Vienna Convention and the user-in-charge.[20] The introduction of a user-in-charge would require substantial amendments to both Conventions, as the user-in-charge is a new type of road user for which provisions from the Conventions may (e.g. art. 8 paragraph 3 Vienna Convention on a fit physical and mental condition to drive) or may not apply (e.g. art. 13 paragraph 1 Vienna Convention: should the user-in-charge, like the driver, have his vehicle under control?) . Therefore, this approach does at the moment not offer as good a solution as the *functioneel daderschap* approach.

Germany has already taken legislative steps to accommodate the post-testing deployment of automated vehicles. The country has adopted a change to the Straßenverkehrsgesetz (StVG) on the notion of *driver* (Fahrzeugführer). Several provisions were added or changed, including the new §1a Absatz 4 StVG which reads:

> "Fahrzeugführer ist auch derjenige, der eine hoch- oder vollautomatisierte Fahrfunktion im Sinne des Absatzes 2 aktiviert und zur Fahrzeugsteuerung verwendet, auch wenn er im Rahmen der

---

[16] Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*, para 1.44.
[17] Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*, para 1.44.
[18] Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*, para 1.44.
[19] Law Commission and Scottish Law Commission (2019), *Automated Vehicles: Analysis of Responses to the Preliminary Consultation Paper. Analysis of Responses to LCCP No 240/SLCDP No 166*, para 1.7.
[20] Law Commission and Scottish Law Commission (2019), *Automated Vehicles: Analysis of Responses to the Preliminary Consultation Paper. Analysis of Responses to LCCP No 240/SLCDP No 166*, para 3.19.

> bestimmungsgemäßen Verwendung dieser Funktion das Fahrzeug nicht eigenhändig steuert."[21]

This means that, under the StVG, the driver (Fahrzeugführer) of a vehicle is also the person that activates the automated driving system of an automated vehicle ("eine hoch- oder vollautomatisierte Fahrfunktion (…) aktiviert und zur Fahrzeugsteuerung verwendet"), even if it is within the intended scope of that system that the driver does no longer drives the vehicle himself ("auch wenn er im Rahmen der bestimmungsgemäßen Verwendung dieser Funktion das Fahrzeug nicht eigenhändig steuert"). From the definition given in §1a Abs. 2 StVG[22] it follows that this provision is only applicable up to SAE Level 3 (conditional driving automation) vehicles, not the SAE Level 5 vehicle that is central to this thesis.[23] Therefore, this new development in German law has no consequences for the findings of this research.[24] Nevertheless, the revision of the StVG illustrates the challenges posed by the notion of *driver* in traffic laws.

---

[21] Absatz 2 describes the automated driving system, including that the system can be overridden by the driver: "Kraftfahrzeuge mit hoch- oder vollautomatisierter Fahrfunktion im Sinne dieses Gesetzes sind solche, die über eine technische Ausrüstung verfügen,
1. die zur Bewältigung der Fahraufgabe – einschließlich Längs- und Querführung – das jeweilige Kraftfahrzeug nach Aktivierung steuern (Fahrzeugsteuerung) kann,
2. die in der Lage ist, während der hoch- oder vollautomatisierten Fahrzeugsteuerung den an die Fahrzeugführung gerichteten Verkehrsvorschriften zu entsprechen,
3. die jederzeit durch den Fahrzeugführer manuell übersteuerbar oder deaktivierbar ist,
4. die die Erforderlichkeit der eigenhändigen Fahrzeugsteuerung durch den Fahrzeugführer erkennen kann,
5. die dem Fahrzeugführer das Erfordernis der eigenhändigen Fahrzeugsteuerung mit ausreichender Zeitreserve vor der Abgabe der Fahrzeugsteuerung an den Fahrzeugführer optisch, akustisch, taktil oder sonst wahrnehmbar anzeigen kann und
6.die auf eine der Systembeschreibung zuwiderlaufende Verwendung hinweist.
Der Hersteller eines solchen Kraftfahrzeugs hat in der Systembeschreibung verbindlich zu erklären, dass das Fahrzeug den Voraussetzungen des Satzes 1 entspricht."

[22] See also §1b StVG.

[23] Jan-Erik Schirmer, 'Augen auf beim automatisierten Fahren! Die StVG-Novelle ist ein Montagsstück' (2017) 30 (6) Neue Zeitschrift für Verkehrsrecht 253; Matthias von Kaler, Sylvia Wieser, 'Weitere Rechtsetzungsbedarf beim automatisierten Fahren' (2018) 37 (6) Neu Zeitschrift für Verwaltungsrecht 369; Volker Lüdemann, Christine Sutter, Kerstin Vogelpohl, 'Neue Pflichten für Fahrzeugführer beim automatisierten Fahren – eine Analyse aus rechtlicher und verkehrspsychologischer Sicht' (2018) 31 (9) Neue Zeitschrift für Verkehrsrecht 411; Mathias N. Schubert, 'Der Automated and Electric Vehicles Act 2018. Ein (weiterer) Irrweg für das Vereinigte Königreich?' (2019) 19 (4) Straβenverkehrsrecht 124.

[24] This approach does not provide a solution for SAE Level 5 vehicles, and was therefore not discussed in Chapter 3.

In the context of insurance, the notion of *driver* is also of importance. Under the EU Motor Insurance Directive,[25] Member States need to take “appropriate measures to ensure that civil liability in respect of the use of vehicles normally based in its territory is covered by insurance.”[26] This insurance should cover, according to art. 12 (1) of the Motor Insurance Directive, liability for personal injuries to all passengers, other than the driver, arising out of the use of a vehicle. So, the insurance does not have to cover the damage sustained by the *driver* of the vehicle. The Motor Insurance Directive does not provide a definition of *driver*.[27] If, however, the definition of *driver* in this Directive deviates from the definition of *driver* given in the context of the Geneva Convention and Vienna Convention, this could have significant consequences. This can be illustrated by an example: an SAE Level 5 vehicle is equipped with an emergency break, which one of the passengers pulls in order to avoid a serious accident. An accident is not completely avoided, but there is less damage than would be the case if this person had not pulled the emergency brake. In pulling the emergency brake, and depending on the definition of *driver*, this person might become the driver of the automated vehicle within the meaning of the Motor Insurance Directive. If this would be the case, the damage the person that pulled the emergency brake suffered is not covered by the insurance, whilst the insurance does cover the damage suffered by the other persons in the vehicle who did not try to prevent a serious accident from occurring, by pulling the emergency brake. This illustrates that, depending on the exact definition, an automated vehicle might have a driver within the meaning of the Motor Insurance Directive, which driver would not be covered by the mandatory insurance. The matter of the notion of *driver* in the Motor Insurance Directive requires further research, which goes beyond the scope of this thesis.

---

[25] 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 OJ L 263/11 (Motor Insurance Directive).

[26] Recital 3 Motor Insurance Directive.

[27] The Benelux Court did, back in 1994 and therefore predating the Motor Insurance Directive of 2009, provide a defintion of *driver* in art. 3 of the Gemeenschappelijke Bepalingen behorende bij de Benelux-Overeenkomst betreffende de verplichte aansprakelijkheidsverzekering inzake motorrijtuigen : “onder 'bestuurder' dient te worden verstaan hij die het voertuig werkelijk en zelfstandig bestuurt en aldus in feite verantwoordelijk is voor het sturen”, see Court Benelux/Beneluxhof 8 December 1994, A 93/5 (Assurance Liégeoise/Adam), NJ 1995/529.

The discussed approaches on the notion of *driver* within the meaning of the Geneva Convention and Vienna Convention shed a new light on the challenge concerning the notion of *driver* in these Conventions. The approaches discussed in this epilogue differ from the approaches discussed in Chapter 3. This chapter concluded with the *functioneel daderschap* approach as recommended way forward. The approaches that have been discussed in this epilogue do not alter this conclusion, as these approaches have disadvantages (extensive amendments, only applicable to automated vehicles of SAE Level 3, etc.) that the *functioneel daderschap* approach does not have. Therefore, the *functioneel daderschap* approach remains the preferred way forward.

4 Careless Automated Driving?

This chapter was presented at the 13th ITS European Congress and was published in the conference proceedings of this Congress: NE Vellinga, 'Careless automated driving?' (13th ITS European Congress, Eindhoven, June 2019)

Abstract: With technology advancing, automated vehicles are getting closer to being deployed on public roads for the general public. Despite all of these technological developments, technology is not infallible. It could happen that a defect in an automated vehicle occurs whilst it is in use on public roads. Such a defect can range from a visible defect like a broken sensor, to an invisible defect such as a software bug. Not all defects will have an important influence on the driving of the vehicle, but some defects could result in dangerous situations on the road. Who should prevent an automated vehicle from driving down public roads with such a safety-critical defect? This chapter will explore with whom this duty of care should rest. The role of the user of the automated vehicle, the owner, the manufacturer and the vehicle authority (approval authority) will be discussed.

4.1 Introduction

Imagine that you ordered an automated vehicle to travel to work. The vehicle pulls up in front of you, ready to bring you to your destination. Before you step in and drive off, is there anything you need to do? Perhaps you have to check if the vehicle is in a good condition, that is has no visible defects. You might be asked to indicate that you accept the vehicle in its current state. Or perhaps you are allowed to just step into the vehicle and drive off, without checking the vehicle is in order. Or should the manufacturer make sure that its vehicle does not drive off when, for instance, a sensor is broken or a software update has not been installed? These questions boil down to one question: with whom should a duty of care rest to prevent an automated vehicle with a safety-critical defect from staying in use?

Such a duty of care can work in different ways: it can prevent behaviour which would violate the duty of care (preventive) or if, nonetheless, the duty of care is violated, it can result in legal consequences (repressive). These consequences could include, for instance, that the withdrawal of the vehicle's approval (through administrative law) or the requirement to pay damages for the harm caused by the violation of that duty of care (compensation through private law). A violation of a duty of care could also be a reason for withdrawing a permission (for instance, a driver's licence) and for criminal prosecution.

A duty of care to prevent an automated vehicle with a safety critical defect from being used is a duty that one of the parties discussed below should have towards (other) road users. After all, it benefits the safety of all road users if the use of an automated vehicle with the safety-critical defect is prevented. Because of this focus on prevention, the role of insurance and tort law, which come into play after a violation of a duty of care, will only be touched upon.

Within this chapter, the term 'automated vehicle' is used to describe a SAE Level 5 vehicle.[1] So, this automated vehicle is able to complete an entire trip without human support. The person that uses the vehicle will be referred to as the 'user' of the vehicle. This user only has to dispatch the vehicle and provide the vehicle with a destination. Once he is in the vehicle and the vehicle drives off, the user can sit back and relax, work, sleep or read etc. The user of the automated vehicle is not

[1] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018).

necessarily the owner of the vehicle: the ownership might lie with a fleet operator or perhaps even the manufacturer.

A distinction will be made between two different types of defects: visible defects and invisible defects (within this chapter, the term 'defect' does not necessarily means the same as the same term in the EU Product Liability Directive (Directive 85/374/EEC)). A visible defect can be that the automated vehicle's sensor is visibly broken (for instance, it is dangling by a thread, barely attached to the vehicle anymore, or the sensor has been visibly damaged by road grit). An invisible defect will mostly relate to software problems. An example of an invisible defect is an uninstalled, perhaps safety-critical, software update. If the onboard computer clearly signals to the user of the vehicle that an update has not been installed, the invisible defect becomes a visible defect. There are four actors that can influence whether or not a vehicle with such a defect will stay in use: the user of an automated vehicle, the owner of the automated vehicle (e.g. the fleet operator), the manufacturer of that vehicle, and the vehicle authority that issues the approval for vehicles.

4.2 The User of the Vehicle and his Duty of Care

4.2.1 Renting a Vehicle: An Example

Today, it is already possible to rent a conventional vehicle without needing to go to the rental agency to pick up the vehicle, similar to how in the future an automated vehicle could be rented. Take for instance, Greenwheels, a car rental/car sharing company operating in cities in the Netherlands and Germany.[2] To hire a car from Greenwheels, the renter has to make a reservation through an application on a smartphone or via the internet for a car that is parked in a convenient location. The renter goes to the car, unlocks it by using his phone or a card and after entering a code into the onboard computer and indicating that he did not find any new damage to the vehicle, the key to the vehicle is unlocked and the renter can drive off.[3] As is clearly shown in the instruction video on the company's website and is clearly stated in the company's terms and conditions, the renter has to inspect the vehicle before using it.[4] How far his duty reaches – whether or not he has to look at the engine, for

---

[2] Greenwheels, 'Home' (*greenwheels*.com, 2018) <www.greenwheels.com/nl/> accessed 18 October 2018.
[3] Greenwheels, 'Home' (*greenwheels*.com, 2018) <www.greenwheels.com/nl/> accessed 18 October 2018.
[4] Greenwheels, 'Algemene Voorwaarden' (*greenwheels*.com, 2018) <www.greenwheels.com/nl/sites/greenwheels.com.nl/files/content/AV/20180524%20Algemene%20Voorwaarden%20Greenwheels_NL_v1.0.pdf> accessed 18 October 2018, sections 11 and 12.

example – is not specified in the terms and conditions. The renter has a duty of care to inspect the vehicle and report any damage before using the vehicle. If he does not inspect the vehicle and does not report damage to the company, this has legal consequences: if the uninspected vehicle causes damage as a consequence of a defect of the vehicle that should have been discovered upon inspection, the renter can be held liable.[5] It is also stated in the terms and conditions that the renter should not use the vehicle if he discovers a defect or damage that could cause more damage to the vehicle or could have a negative effect on road safety.[6] So, for instance, if a wheel was askew under the car (i.e. a visible defect), the renter should have noticed this, he should have reported the defect to the rental company and should, depending on the severity of the defect, not drive the car. If he does not do so and the wheel falls off during the trip, causing an accident, the renter is, given the terms and conditions, liable for that damage.[7]

The user of an automated vehicle finds himself in a similar position to the position of the renter of the conventional vehicle in the example described above. The user of the automated vehicle also rents his vehicle (or a seat in the vehicle, depending on the type of vehicle, this could be more like a bus service) without needing to go to the rental agency to pick the vehicle up. He will only communicate with the rental agency through an application on his phone or the interface inside the vehicle. He might also be confronted with a duty to inspect the vehicle and report any damage or defects, all in conformity with instructions provided by, for instance, the onboard computer of the automated vehicle. Just like the renter of the conventional vehicle, the user of the automated vehicle could be held liable for damage caused by a defective vehicle, if he did not report the damage and did not inspect the vehicle. He could face a liability claim, insofar as the damage is not covered by insurance, by the injured third party, or he could be unable to claim damages from the fleet operator or

[5] Greenwheels, 'Algemene Voorwaarden' (*greenwheels*.com, 2018) <www.greenwheels.com/nl/sites/greenwheels.com.nl/files/content/AV/20180524%20Algemene%20Voorwaarden%20Greenwheels_NL_v1.0.pdf> accessed 18 October 2018, sections 11 and 12.

[6] Greenwheels, 'Algemene Voorwaarden' (*greenwheels*.com, 2018) <www.greenwheels.com/nl/sites/greenwheels.com.nl/files/content/AV/20180524%20Algemene%20Voorwaarden%20Greenwheels_NL_v1.0.pdf> accessed 18 October 2018 sections 11 and 12.

[7] Greenwheels, 'Algemene Voorwaarden' (*greenwheels*.com, 2018) <www.greenwheels.com/nl/sites/greenwheels.com.nl/files/content/AV/20180524%20Algemene%20Voorwaarden%20Greenwheels_NL_v1.0.pdf> accessed 18 October 2018, sections 11 and 12.

manufacturer of the vehicle if he himself got injured. He could also face criminal prosecution for the violation of traffic rules, and he could be confronted with consequences under administrative law (i.e. his driver's licence could get withdrawn, if such a licence is required for using automated vehicles). Unlike the user of the automated vehicle, however, the renter is driving the vehicle himself (or lets someone familiar to him drive the vehicle). The user of the automated vehicle is completely at the mercy of technology that is almost impossible for him to inspect for (invisible) damage or defects. Besides, damage to, or defects of, a conventional vehicle will often be visible, whereas an automated vehicle is more prone to invisible defects such as software failures. This raises the question of whether it is appropriate from the point of view of prevention to put that heavy a burden on the shoulders of the user. Can he even predict the – possibly grave – consequences of his indication that there is no damage to the vehicle and the software is up-to-date?

4.2.2 Duty of Care

In this example, the duty of the user the vehicle before using it, arises out of the contract with the provider of the service through which the user rents his automated vehicle. Besides the duty arising out of the contract, one could also argue that a duty to inspect the vehicle before using it, stems from a general duty of care not to expose other road users to unnecessary risks and harm.[8] There are several elements to the question of whether or not the user of the automated vehicle should be confronted with this duty to inspect the automated vehicle. These elements will be discussed below, starting with discussing the understanding the user might have of his duty of care.

4.2.3 Consenting to the Current State of the Vehicle

This duty of care can be manifested in, for instance, the actions the user has to undertake before he can drive off with the automated vehicle: the user might have to indicate on the onboard computer that he has inspected the vehicle in conformity with the provided instructions, that there is no defect or damage to the vehicle and that he accepts the vehicle in the state that it is in. Research has shown that, when it comes to terms and conditions and standard-form contracts, consumers generally do not read these conditions well and often accept the conditions without carefully reading them.[9] Consequently, consumers will not be aware of what they have just

---

[8] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013).

[9] See for instance Yannis Bakos, Florencia Margotta-Qurgler, David R Trossen, 'Does Anyone Read the Fine Print? Consumer Attention to Standard-Form Contracts' (2014) 43 The Journal of Legal Studies 1-35.

accepted. One study, for instance, showed that consumers asked to sign up to a (non-existent, but participants were unaware of that) social networking service accepted the terms and conditions and privacy policy without much reading: 74% immediately accepted the privacy policy without reading it and 81% of the participants that did read the privacy policy spent less than one minute reading the policy (given the length of the text, the expected reading time was between 29-32 minutes).[10] Only 1.7% of the participants noticed a clause in the terms of service stating that their first-born child must be given up to the social networking service.[11] So, minimal time was spend on reading the terms and privacy policy and, consequently, the understanding of what the terms and conditions and the privacy policy meant for the individual, cannot have been high.

To take the example of Greenwheels again: the renter of the car might have been shown the terms and conditions on the onboard computer, but he will probably not have read them carefully enough to understand what he is signing up to when he indicates that he inspected the vehicle. The same goes for the user of the automated vehicle: he might have had to read instructions about the inspection on the onboard computer, indicate on the onboard computer that he has inspected the vehicle and found no damage or defects before driving off, but he will probably not have read the instructions and probably does not understand the consequences of this action. Warnings might also not be effective.[12] This underlines the question of whether or not the user should be confronted with a duty of care to inspect the automated vehicle, even though he might not read the instructions on the inspection and might not understand the – possibly grave – consequences, thereby creating risks that the user could well be unaware of.

4.2.4 Risks Created

The user of the automated vehicle accepts being exposed to risks when he confirms the current state of the vehicle, namely the risks involved in travelling by motor vehicle on public roads. However, the user of the automated vehicle not only exposes

[10] Jonathan A Obar, Anne Oeldorf-Hirsch, 'The Biggest Lie on the Internet: Ignoring the Privacy Policies and Terms of Service Policies of Social Networking Services' (2018) Information, Communication & Society, 1-20. See on boilerplate contracts James Gibson, 'Click To Agree' (2013) Richmond Law Magazine 16.

[11] Jonathan A Obar, Anne Oeldorf-Hirsch, 'The Biggest Lie on the Internet: Ignoring the Privacy Policies and Terms of Service Policies of Social Networking Services' (2018) Information, Communication & Society, 1-20.

[12] Sanne B Pape, *Warnings and product liability: Lessons learned from cognitive psychology and ergonomics* (Dissertation, Erasmus University Rotterdam 2011).

himself to risks, but he also consents to exposing other road users to the risks involved in automated driving. After all, if something goes wrong, other road users could get hit and subsequently injured by the automated vehicle the user is travelling in. The user might not be aware of these risks and has very little – if any – influence on these risks.

4.2.5 Severity of the Consequences

An example of a situation where one party accepts the risks for another party, lies back a bit further in time. Nowadays, new heavy goods vehicles registered within the EU need to be fitted with blind spot mirrors (Directive 2003/97/EC) and older heavy goods vehicles need to be retrofitted with those mirrors (Directive 2007/38/EC, this requirement to retrofit older heavy goods vehicle only applies to certain categories of heavy good vehicles registered as of 1 January 2000: art. 2 Directive 2007/38/EC). Before these requirements were set, the dangers of driving without mirrors covering the blind spots of these heavy good vehicles were already known.[13] If an accident occurred that could have been prevented by installing a blind spot mirror, the driver of the heavy goods vehicle – or, depending on the circumstances, his employer – could face a claim for damages[14] and possibly criminal prosecution,[15] or the withdrawal of his driver's licence. The driver of a heavy-goods vehicle has a duty of care that does not stem from a contract, but from a more general duty not to expose other road users to unnecessary risks and harm.[16] The user who, even though he should have checked the vehicle, drives off with the automated vehicle exposes other road users to risks, just like the truck driver driving without a blind spot mirror. Just like the driver of the heavy goods vehicle, and depending on national law, the user of the automated vehicle can face a claim for damages and criminal prosecution if the automated vehicle causes an accident that could have been prevented if the user had checked the state of the vehicle. There is, however, a considerable difference between the position of the user of the automated vehicle and the driver of the heavy goods vehicle: unlike the driver of the heavy goods vehicle, the user has barely any influence on the driving behaviour of the vehicle. The driver of a heavy goods vehicle will be aware of the absence of the blind spot mirror, can take this into

---

[13] See for instance, already from 1981, A Blokpoel, JAG Mulder, 'Het zichtveld van bestuurders van vrachtswagens: Analyse van de problemen betreffende het zichtveld aan de rechterzijde van (rechtsafslaande) vrachtwagens - consult aan de Rijksdienst voor het Wegverkeer' (1981) <www.swov.nl/sites/default/files/publicaties/rapport/r-81-20.pdf> accessed 24 October 2018.

[14] See for instance Rechtbank Roermond 19 December 1974, ECLI:NL:RROE:1974:AJ4353.

[15] Rechtbank Amsterdam 28 January 2003, ECLI:NL:RBAMS:2003:AF3616.

[16] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013).

consideration while driving by being extra cautious or by asking for help in certain situations, whereas the user of the automated vehicle is entirely at the mercy of the defective automated vehicle, as are the other road users. Besides, the absence of a blind spot mirror is a visible problem, whereas the user of the automated vehicle is confronted with much less visible defects, such as problems with the software of the vehicle.

4.2.6 Preliminary Conclusion

Taking all of this into consideration, fundamental objections can be raised against confronting the user of an automated vehicle with a duty to inspect the vehicle and to confirm that he agrees to the consequences – as he might not understand these consequences and creates risks to other road users by doing so. The risk of travelling with a defective vehicle should not rest with the user, as it is very difficult for the user to inspect the vehicle for invisible defects (such as software problems), it can be difficult for users to understand the consequences of using a defective vehicle, and it puts the burden on one person – who might be a child, someone who is illiterate or someone that is just in a hurry and has no time to read instructions or conditions, even though it is in the public interest that a defective automated vehicle does not drive on public roads. It seems more reasonable to put this burden on the party that knows the vehicle better: the owner.

4.3 The Owner of the Vehicle and His Duty of Care

4.3.1 Duty of Care

In the scenario discussed in this chapter, the owner of the automated vehicle is the operator of the fleet who provides a sort of self-driving taxi service. He owns the automated vehicle, and can decide not to offer a vehicle for rent if it is in an unsafe condition. It can be argued that the owner has a duty of care to prevent his automated vehicle from driving when it has a safety-critical defect, based on a general duty not to expose road-users to unnecessary risks or harm.[17]

4.3.2 Ability to Prevent the Automated Vehicle From Driving

The owner of the automated vehicle could decide to not rent out a vehicle which has a safety-critical defect, in that way preventing it from driving down public roads. However, it might prove challenging for an owner to monitor the state of his vehicle whilst it is being used by others. The owner would need some sort of reliable wireless system built into the vehicle that immediately alerts the owner in case of a safety-

[17] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013).

critical visible or invisible defect. The owner would then have to stop offering that particular vehicle for his taxi service.

4.3.3 Consequences of a Duty for the Owner

If the owner were be confronted with a duty of care to prevent his automated vehicle from driving if the vehicle has a safety-critical defect, the owner would have to take steps to ensure that he is always informed about the state of his vehicle. The owner would have to depend on the information given to him by the system of the automated vehicle, which could well be fallible. If the vehicle has a safety-defect and, because of that defect, causes an accident, the owner could be confronted with legal consequences. For instance, if the owner needs to have a permit to rent the automated vehicle to others, this permit could be withdrawn. Depending on the circumstances, he might also be confronted with a claim for damages (although this risk could well be covered by insurance). Especially given the technical challenges of keeping the owner up to date regarding the state of the vehicle, it seems more obvious to look at the manufacturer or the user of the automated vehicle, who has more direct influence over the vehicle, to prevent it from being used when the vehicle has a safety-critical defect.

4.4 The Manufacturer of the Vehicle and His Duty of Care

4.4.1 Duty of Care

A duty of care for the manufacturer could be based on the general duty of care not to expose road users to unnecessary risks and harm, or on his quality of being a manufacturer.[18] A manufacturer can have a duty of care to prevent damage or injury arising from a defect of its product. Preventing harm caused by a defect can be achieved through installing a fail-safe, similar to, for instance, the fail-safe of traffic lights: if a defect is detected by the malfunction management unit, it will make all of the traffic lights at that intersection blink yellow lights.[19] The manufacturer could prevent any harm arising from a defective automated vehicle by equipping the automated vehicle with such a fail-safe that brings the vehicle to a safe stop or prevents it from driving off if a safety-critical defect has been detected.

---

[18] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013).

[19] Branden Ghena and others, 'Green Lights Forever: Analyzing the Security of Traffic Infrastructure' (Proceedings of the 8th USENIX Workshop on Offensive Technologies (WOOT) 2014) <https://jhalderm.com/pub/papers/traffic-woot14.pdf> accessed 24 October 2018.

4.4.2 Fail-safe

The manufacturer of the automated vehicle knows the vehicle better than anyone else. The manufacturer has equipped the vehicle with all sorts of hardware and software, and will therefore be familiar with the vehicle's weaker points. He will also be able – as far as technologically possible – to equip the automated vehicle with a fail-safe: as soon as the automated vehicle detects a safety-critical defect, it could bring itself to a safe stop (or 'minimal risk condition') or will not drive off in the first place.[20] The automated vehicle will come to a safe stop or will not drive off if it detects that, for instance, a sensor is broken or an important software update has not been installed, thereby making it unnecessary to require the user to inspect the automated vehicle. So, the manufacturer has great influence over the vehicle and has the opportunity to hinder it from driving off in case of a (visible or invisible) defect.

4.4.3 Consequences of Equipping the Vehicle with a Fail-safe

Just like a duty to inspect the vehicle puts a burden on the user of the vehicle, the requirement to build a fail-safe into the automated vehicle puts a burden on the manufacturer. The manufacturer has to build this fail-safe into the automated vehicle, thereby preventing unnecessary harm. The automated vehicle will have to undergo tests in order to confirm the fail-safe is functioning the way it should. The costs of those tests and the research and development needed to develop a good functioning fail-safe come at the expense of the manufacturer. This is not a disproportionately heavy burden (like the burden of the user discussed above) as the manufacturer sells its automated vehicles and can thereby pass on (part of) the costs to the buyers of these vehicles. The manufacturer reaps the benefits of the sale of the automated vehicle, so the financial burden of the fail-safe should not be insurmountable. Therefore, it is not too much to ask from a manufacturer to invest in a fail-safe. Besides, the manufacturer himself has an interest in developing an automated vehicle that is as safe as possible: accidents with automated vehicles are hardly good publicity.[21] And if an accident happens due to the absence of a (well

[20] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018); Waymo LLC, 'Waymo Fully Self-Driving Chrysler Pacifica. Emergency Response Guide and Law Enforcement Interaction Protocol' (updated 10 September 10 2018) <https://iatranshumanisme.com/wp-content/uploads/2019/02/waymo_law_enforcement_interaction_protocol_v2.pdf> accessed 24 October 2018.

[21] Fred Lambert, 'Elon Musk criticizes media on how they report on Tesla crashes' (*electrek.co,* 14 May 2018) <electrek.co/2018/05/14/tesla-crashes-elon-musk-lashes-out-media-report/> accessed 24 October 2018.

functioning) fail-safe, the manufacturer could face liability claims, depending on the circumstances.[22] The approval of the vehicle (type) could also be withdrawn (Directive 2007/46/EC). If that is not enough motivation for the manufacturer to voluntarily equip the automated vehicle with a fail-safe, governments could step in.

4.5 The Role of the Vehicle Authority

4.5.1 Protection of Road Users

Governments can, through their vehicle (approval) authority, influence road safety by only approving vehicles for use on public roads if they are sufficiently safe. Given the recitals of the European Directive 2007/46/EC on type-approval, the vehicle or approval authority is in charge of approving vehicles as safe enough for use on public roads, thereby protecting road users from unnecessary harm. By setting standards which need to be fulfilled by vehicles in order to get approval, governments can ensure a certain level of safety on public roads, which, subsequently, is in the public interest. The introduction of the requirement of blind spot mirrors, discussed above, is an example of governments stepping in to set a new (higher) standard, thereby increasing road safety and protecting road users against unnecessary harm.

4.5.2 Requirement to Equip the Automated Vehicle with a Fail-safe

As shown in the example of blind spot mirrors, it is not self-evident that governments will step in and set higher safety standards for vehicles once a safety-critical problem has been identified. Nevertheless, it might be necessary for governments to step in given that a fail-safe can come in different shapes and sizes. A manufacturer might want to keep the costs of a fail-safe as low as possible or only equip its high-end vehicles with a good quality fail-safe for competition reasons or in order to bring more affordable vehicles to the market. A government could find it necessary to set at least a minimum standard for fail-safes, so that every automated vehicle is equipped with a good fail-safe, ensuring road safety.

Within Europe, a minimum standard for fail-safes could be put in place through the European type-approval system: within the EU, a (type of) vehicle will be approved for use on public roads within the EU by the vehicle authority (approval authority) of a Member State on the basis of numerous vehicle requirements (Directive 2007/46/EC. This includes UNECE Regulations to which the Community has acceded,

---

[22] 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. See also Maurice HM Schellekens 'Self-driving cars and the chilling effect of liability law' (2015) 31(4) Computer Law and Security Review 506, 506-517.

see art. 34, 35). A fail-safe could become part of those vehicle requirements. As a result, only automated vehicles with such a fail-safe could be approved for use on public roads. Currently, the state of California already requires manufacturers wanting to deploy their vehicles post-testing on Californian public roads to indicate on their application for a permit to "(…) describe how the vehicle is designed to react when it is outside of its operational design domain or encounters the commonly-occurring or restricted conditions disclosed on the application. (…)" (13 California Code of Regulations § 228.06 (a)(3)), the reactions of which could include returning to a minimal risk condition .

4.5.3 Consequences of the Requirement for the Position of the Vehicle Authority

If it is decided that it is necessary to demand a fail-safe for the automated vehicle before a permit to drive on public roads will be granted, there will no longer be a need to burden the user with a duty of care to inspect the vehicle for visible and invisible defects. Besides, all manufacturers will be obliged to build a a fail-safe into their automated vehicles, preventing it from becoming an option for only certain (higher priced) vehicles preventing it from becoming a matter of competition between manufacturers. It can also be seen as a step towards the EU's commitment to reduce road deaths as defective automated vehicles will not be allowed to drive because of the fail-safe, thereby avoiding making victims.[23] Road safety is of public interest, so it can be seen as a task of the government to ensure or improve road safety by making a fail-safe mandatory for automated vehicles. The government (through the vehicle authority) should decide which fail-safe is sufficiently safe and therefore which risks are acceptable from a road safety perspective (similar to the example of blind spot mirrors discussed above). This way, accidents could be prevented. If a defective automated vehicle with a fail-safe that has been approved by the vehicle authority nevertheless causes an accident, the vehicle authority could face liability claims for approving an ineffective fail-safe. This risk of an accident despite a fail-safe has been accepted by the government by setting a minimum standard for fail-safes. What this minimum standard should be is something that has to be decided upon by the governments in consultation with manufacturers, as manufacturers should be able to indicate what is feasible from a technical perspective. Governments will have to weigh the costs (a delay in the introduction of automated vehicles, costs for development and testing of the fail-safe) and benefits

[23] European Commission, 'Towards a European road safety area: policy orientations on road safety 2011-2020' COM (2010) 389 final.

(the prevention of accidents, safer roads) of a certain fail-safe against each other. However, the approval of a vehicle with a fail-safe that meets the standards does not necessarily exempt the manufacturer from liability if this vehicle causes an accident. For the sake of brevity, see the EU Product Liability Directive (Directive 85/374/EEC).

4.6 Conclusion

In this chapter, the question of with whom the duty of care to prevent a defective automated vehicle from staying in use should lie was central. The roles of four actors – the user of the automated vehicle, its owner, the manufacturer of that vehicle, and the vehicle authority that approved the vehicle for use on public roads – has been discussed. Given the means and the positions of the actors, and the public interest in road safety, the vehicle authority should require that automated vehicles need to be equipped with a fail-safe that prevents the vehicle from driving when it has a safety-critical (visible or invisible) defect. Governments, through the EU, have the means to require such a fail-safe, thereby preventing road users from being exposed to the risks involved in letting an automated vehicle with a safety-critical defect operate on public roads. Manufacturers of automated vehicles are all confronted with the same requirement of including a fail-safe in their automated vehicles. Which fail-safe is safe enough should be determined by the government in cooperation with these manufacturers. The manufacturers can indicate what is technically and financially feasible, the government can decide on what is desirable from a road safety perspective. The government will have to balance costs and technical feasibility against the public interest of road safety. Because of this public interest in road safety, governments (through the EU, more particular Directive 2007/46/EC on the approval of vehicles, and at an even more international level through UNECE Working Party 29) are the designated actors to ensure that a defective automated vehicle will not stay in use, by requiring automated vehicles to be equipped with a fail-safe.

Epilogue: A Closer Look at the Liability of the Vehicle Authority

The previous chapter consisted of a conference paper for the ITS European Congress 2019. The format prescribed for by the Congress did not leave room for discussing the liability risk of the authority approving an unsafe (type of) vehicle and the developments on the technical requirements for vehicles. There are, however, several noteworthy developments that influence the technical requirements for vehicles as well as developments that influence the liability risks of the vehicle authority.

There have been developments in formulating technical requirements for automated vehicles. On the level of the United Nations, Working Party 29 is responsible for updating UN Regulations annexed to the 1958 Agreement concerning the Adoption of Harmonized Technical United Nations Regulations[1] These UN Regulations form an intricate framework for safeguarding, among other things, road safety through technical requirements. The European Union has acceded to UN Regulations on, for instance, seat belt anchorages, braking and indirect vision devices.[2] Consequently, the requirements from these UN Regulations need to be fulfilled in order to obtain the EU (type-)approval. Since June 2018, Working Party 29 has a dedicated subsidiary Working Party: the Working Party on Automated/Autonomous and Connected Vehicles or GRVA.[3] Advanced Driver Assistance Systems (ADAS) and the safety and security of vehicle automation and connectivity are two of the priorities of this GRVA.[4] One of the topics that is discussed by the GRVA is the future certification of automated driving systems.[5]

New technical developments have also driven the EU to review the General Safety Regulation.[6] The European Parliament, Council and Commission have reached a provisional political agreement on the revised General Safety Regulation.[7]

---

[1] <www.unece.org/trans/main/wp29/introduction.html> accessed 10 September 2019.

[2] Art. 34, Part I Annex IV, Annex XI Directive 2007/46/EC.

[3] <www.unece.org/trans/main/wp29/meeting_docs_grva.html> accessed 10 September 2019.

[4] <www.unece.org/trans/main/wp29/meeting_docs_grva.html> accessed 10 September 2019.

[5] See for instance United Nations Economic and Social Council, 'Proposal for the Future Certification of Automated/Autonomous Driving Systems' (19 November 2018) UN Doc ECE/TRANS/WP.29/GRVA/2019/13.

[6] Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor [2009] OJ L 200/1.

[7] European Commission Press Release, 'Road safety: Commission welcomes agreement on new EU rules to help save lives' (26 March 2019) <https://europa.eu/rapid/press-release_IP-19-

Consequently, from 2022,[8] vehicles will have to be equipped with, among other things, driver drowsiness and attention monitoring systems and intelligent speed assistance.[9] Automated vehicles will have to be equipped with driver readiness monitoring systems, event (accident) data recorders and more.[10] These and more new requirements will form part of the EU (type-)approval.

Recent events have shown that approval authorities can be exposed to liability risks. An approval authority could make a mistake and approve a vehicle that does not meet the standards. Depending on national law, the authority might be liable for subsequent damage. The Dutch approval authority (RDW) has already been criticised for the type-approval of Tesla's Model S with the so-called Autopilot-function for the European market. In an accident in Norway back in 2016, a Tesla with an engaged Autopilot-function rear-ended and severely injured a motorcyclist. This accident raised serious doubt about whether testing of the Autopilot-function sufficiently took into account motorcyclists.[11] The Federation of European Motorcyclists' Associations (FEMA), the Koninklijke Nederlandse Motorrijders Vereniging (KNMV) and the Motorrijders Actie Groep Nederland wrote a public letter to the RDW, expressing their concerns regarding the safety of the Autopilot-function and suggesting to the RDW to withdraw the type-approval.[12] The German Bundesanstalt für Straßenwesen,

---

1793_en.htm> accessed 10 September 2019. See also 'Procedure 2018/0145/COD' <https://eur-lex.europa.eu/procedure/EN/2018_145> accessed 10 September 2019.

[8] European Commission, 'Safety in the automotive sector' <https://ec.europa.eu/growth/sectors/automotive/safety_en> accessed 10 September 2019.

[9] European parliament and the Council, 'Proposal for a Regulation of the European Parliament and of the Council 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/… and repealing Regulations (EC) No 78/2009, (EC) No 79/2009 and (EC) No 661/2009' COM (2018) 286 final, art. 6.

[10] European parliament and the Council, 'Proposal for a Regulation of the European Parliament and of the Council 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/… and repealing Regulations (EC) No 78/2009, (EC) No 79/2009 and (EC) No 661/2009' COM (2018) 286 final, art. 11.

[11] Spiros Tsantilas, 'Motorcycle rear-ending raises questions on Tesla vehicle type approval in Europe' (*New Atlas,* 21 October 2016) <https://newatlas.com/tesla-autopilot-fema/46045/> accessed 17 September 2019.

[12] 'Letter from the Federation of European Motorcyclists' Associations (FEMA), Koninklijke Nederlandse Motorrijders Vereniging (KNMV) and Motorrijders Actie Groep (MAG) to the Dutch Vehicle Autorithy (RDW)' (14 October 2016) <www.fema-online.eu/website/wp-content/uploads/RDW_141016_EN.pdf> accessed 11 April 2017. See art. 30 of Directive 2007/46/EC on the withdrawal of approval.

after extensive testing of the Tesla Model S, even concluded that the vehicle with the Autopilot-function engaged posed considerable danger to traffic ("erheblichen Verkehrsgefährdung").[13] The name itself, *Autopilot,* has also come under scrutiny. The German Kraftfahrt-Bundesamt warned owners of vehicles equipped with this Autopilot-function that the function only *assists* the driver and that the driver should therefore always keep his eyes on the road.[14] Consumer organisations in the United States have also expressed their concerns over the name of the assistance system and how the name *Autopilot* could mislead consumers.[15] This is not without reason as the US National Transportation Safety Board found that overreliance on the Autopilot-function contributed to a fatal 2016 Tesla Model S accident in Florida.[16]

These recent development illustrate the increased attention for technical requirements specifically for automated vehicles as well as the liability risks the vehicle authority can be exposed to. The liability risks of another important stakeholder, i.e. the producer, are discussed in the next chapter.

---

[13] Gerald Traufetter, 'Tesla-Autopilot. Unfälle? Lebensgefahr? Dem Minister offenbar egal' *Der Spiegel* (Ausbage 41/2016. Hamburg, 7 October 2016) <www.spiegel.de/spiegel/tesla-autopilot-alexander-dobrindt-ignoriert-kritisches-gutachten-a-1115692.html> accessed 17 September 2019. See also Nadine Kieboom, 'RDW wil reactie zelfrijdende auto's op motorfietsen testen' (*Zelfrijdend Vervoer,* 17 December 2016) <www.zelfrijdendvervoer.nl/autopilot/2016/12/07/rdw-wil-reactie-zelfrijdende-autos-op-motorfietsen-testen/?utm_source=newsletter&utm_medium=email&utm_campaign=Nieuwsbrief%20week%202016-49> accessed 17 September 2019.

[14] 'Autopilot. Kraftfahrt-Bundesamt warnt Tesla-Besitzer' (*Der Spiegel Online*, 14 October 2016) <www.spiegel.de/auto/aktuell/tesla-autopilot-kraftfahrtbundesamt-warnt-tesla-besitzer-a-1116710.html> accessed 17 September 2019.

[15] 'Letter from the Center For Auto Safety and Consumer Watchdog to the Federal Trade Commission' (23 May 2018) <www.autosafety.org/wp-content/uploads/2018/05/CAS-and-CW-Letter-to-FTC-on-Tesla-Deceptive-Advertising.pdf> accessed 17 September 2019.

[16] National Transportation Safety Board, 'Collision Between a Car Operating With Automated Vehicle Control Systems and a Tractor-Semitrailer Truck Near Williston, Florida May 7, 2016. Accident report NTSB/HAR-17/02 PB2017-102600' (National Transportation Safety Board, 12 September 2017).

5 Automated Driving: Liability of the Software Producer and the Producer of the Automated Vehicle

This chapter was submitted for publication to the Journal of European Tort Law and is pending review.

Abstract: Even though automated vehicles are expected to bring great safety benefits, accidents will still occur with automated vehicles. An automated vehicle could be equipped with self-learning software (reinforcement learning), which learns whilst driving. This software could make a 'learning error' and, for instance, not recognise worn-down lane markings as such. Is the producer of the automated vehicle liable for the damage caused by this 'learning error'? And what if the damage is not caused by a 'learning error', but by a glitch in a software update, can the producer of the automated vehicle be held liable for the damage caused? And is such a software update a product? In this chapter, the challenges posed by automated driving to the European Product Liability Directive will be discussed. The legal position of the software producer as well as the legal position of the producer of the automated vehicle are explored in order to find answers to the questions mentioned.

5.1 Introduction

Automated vehicles are regarded as a vital element in enhancing road safety. Globally, over 1.3 million people die on public roads every year.[1] Within the EU alone, over 25,000 people die annually on public roads.[2] The EU is striving to reduce road fatalities to almost zero by 2050.[3] Automated driving is one of the technologies expected to contribute towards reaching that goal, as it takes the human driver, whose errors contribute to over 90% to road accidents,[4] out of the loop. During trials, ever more automated test vehicles are clocking more and more miles on public roads. The vehicles of Waymo, a subsidiary of Google, alone have already driven over 10 million miles on public roads.[5] Over the past ten years, the research conducted concerning automated vehicles has increased significantly, to the current point where almost all car manufacturers ,and several software companies (Google, but also Apple[6]), have invested in self-driving technology. With this increase in research into and development of automated vehicles, an interest in the legal challenges stemming from replacing the human behind the wheel with, basically, a computer, has also slowly increased.[7] This attention to the legal challenges is necessary as the law is not always 'driverless futureproof'. In this chapter, the EU Product Liability Directive will be explored on the basis of two scenarios. [8] The Directive entered into force in 1985,

---

[1] World Health Organization, 'Global Status Report on Road Safety 2018' (2018) <www.who.int/violence_injury_prevention/road_safety_status/2018/en/> accessed 1 May 2019.
[2] European Commission, 'Statistical Pocketbook 2017: EU Transport in Figures' (2017), 104.
[3] See on this so-called Vision Zero: European Commission, 'What We Do' (*ec.europa.eu* 2 April 2019) <https://ec.europa.eu/transport/road_safety/what-we-do_en> accessed 2 April 2019. See also Committee on Transport and Tourism, 'Report on autonomous driving in European transport (2018/2089(INI))' (European Parliament 2018) <www.europarl.europa.eu/doceo/document/A-8-2018-0425_EN.html> accessed 1 May 2019.
[4] Santokh Singh, 'Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey' (National Highway Traffic Safety Administration February 2015) <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115> accessed 1 May 2019.
[5] John Krafcik, 'Where the next 10 million miles will take us' (*Medium* 10 October 2018) <https://medium.com/waymo/where-the-next-10-million-miles-will-take-us-de51bebb67d3> accessed 21 March 2019.
[6] Apple Inc, 'Our Approach to Automated Driving System Safety' (February 2019) <www.apple.com/ads/ADS-Safety.pdf> accessed 21 March 2019.
[7] See for an overview Nynke E Vellinga, 'From the testing to the deployment of self-driving cars: Legal challenges to policymakers on the road ahead' (2017) 33(6) Computer Law & Security Review 847.
[8] 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 (Product Liability Directive). The European Parliament recognizes the shift in liability from the driver to the producer with the development of automated vehicles: European Parliament resolution of 12 February 2019 on a comprehensive European industrial policy on artificial intelligence and robotics (2018/2088(INI)) [2019], section 91,131-133. See also EU

so dates back to more than two decades before the development of automated vehicles. Is the Product Liability Directive equipped for this complex new technology?

5.2 Technology

5.2.1 Degree of Automation

With an abundance of terms, technical possibilities and possible misunderstandings, the SAE (Society of Automotive Engineers) has provided a clear overview with their six Levels of Automation.[9] The levels range from Level 0 (no automation) to Level 5 (full driving automation). A Level 5 vehicle is able to complete an entire trip without human intervention. This is a step more advanced than a Level 4 (high driving automation) vehicle, which is only able to drive some parts of a trip – for instance, on a highway – without human intervention. This chapter will focus on Level 5 vehicles, but the scenarios described below could also apply to a Level 4 vehicle. Whenever the words 'automated vehicle' are being used, this refers to a Level 5 unless otherwise stated.

5.2.2 Machine Learning

A Level 5 vehicle can drive independently from human input and supervision, because it is equipped with certain software and hardware (cameras, sensors, radars etc.), which make it possible for the vehicle to 'see' its surroundings. The software of the vehicle has to identify what the vehicle 'sees' and what the correct response is. In many cases, machine learning is involved: based on as much data as possible, the computer (through the use of algorithms) searches for a pattern in these data and makes a highly educated guess whether, for instance, the object is a duck or a human.[10] Automated vehicles use machine learning to identify objects and to identify what its next move should be. The software of automated vehicles learns by doing, and as such, it is to some extent, self-learning.[11] This is necessary for automated

---

Committee on Transport and Tourism, 'Report on autonomous driving in European transport (2018/2089(INI))' (European Parliament 2018) <www.europarl.europa.eu/doceo/document/A-8-2018-0425_EN.html> accessed 1 May 2019.

[9] SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018).

[10] See for instance Karen Hao, 'What is machine learning?' (*MIT Technology Review*, 17 November 2018) <www.technologyreview.com/s/612437/what-is-machine-learning-we-drew-you-another-flowchart/> accessed 14 March 2019.

[11] See for a short introduction on reinforcement learning: Will Knight, 'Reinforcement Learning: 10 Breakthrough Technologies 2017' (*MIT Technology Review*, 22 February 2017) <www.technologyreview.com/s/603501/10-breakthrough-technologies-2017-reinforcement-learning/> accessed 14 March 2019

vehicles as it is impossible to predict and program every single situation an automated vehicle might encounter: a Waymo self-driving test vehicle encountering a lady I a wheelchair chasing a duck on the public road would probably never have been predicted by software engineers or the producer of the vehicle.[12] Given the complexity of such a process, the outcome is often not predictable for experts.

5.3 Two Scenarios

Imagine an automated vehicle, SAE Level 5, driving down a public road within the European Union with a user inside of it. The user uses the automated vehicle to travel from his home to his office. At a specific point during the trip, the lane markings between two traffic lanes are worn down.[13] The automated vehicle does not recognize the worn down lane markings as lane markings. As a consequence, the automated vehicle crosses the worn down lane markings, colliding with an oncoming conventional vehicle. The occupants of both vehicles are hurt, and both vehicles are damaged.

Scenario 1: the event data recorder of the automated vehicle has captured the data from the accident. Research on that data shows that the automated vehicle's self-learning software made a 'learning mistake': during the time the vehicle spent on the road, the self-learning software 'learned' that worn down lane markings are a normal variant of the colour of the asphalt, thereby causing the accident. Test results from the producer of the vehicle and the authority approving the vehicle for use on public roads show that the software was, however, initially able to identify worn down lane markings as lane markings.

Scenario 2: the data collected by the event data recorder of the automated vehicle shows that the automated vehicle did not recognise the worn down lane marking as such because of a glitch in a software update. The software update was installed after the vehicle was sold to its current owner and had already been in use on public roads

[12] The Guardian, 'Google's self-driving car avoids hitting woman chasing a bird – video' (*The Guardian,* 17 March 2017) <www.theguardian.com/technology/video/2017/mar/16/google-waymo-self-driving-car-video-woman-bird> accessed 1 May 2019.

[13] See Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 on road infrastructure safety management (Directive 2008/96/EC) [2008] OJ L319/59 and amendment 12 in the EU Committee on Transport and Tourism, 'Report on the proposal for a directive of the European Parliament and of the Council amending Directive 2008/96/EC on road infrastructure safety management (COM(2018)0274 – C8-0196/2018 – 2018/0129(COD))' 11 January 2019, which underlines the importance of markings.

for some weeks. The software update was designed and provided by a company other than the producer of the vehicle.

In both scenarios, the injured party and the user of the automated vehicle decide to claim damages from the producer of the automated vehicle.[14]

5.4 The Product Liability Directive

The Product Liability Directive (PLD) dates back to 1985,[15] a time when a fully automated vehicle seemed a distant dream. It aims to prevent the distortion of competition and to prevent a negative effect on the movement of goods within the common market. It also aims to prevent, within the EU, the consumer from being subjected to varying degrees of protection when they have suffered damage to their health or property as a result of a defective product, through harmonising product liability law within the EU (preamble Product Liability Directive). The producer's liability without fault was deemed to be the only suitable means of avoiding the distortion of competition, the limitation of the free movement of goods and the uneven level of consumer protection against damage caused by a defective product (preamble Product Liability Directive).

In art. 1 of the Directive, the strict liability of the producer of a product is established: a producer is liable for damage caused by a defect in his product (art. 1 PLD). The injured person will have to prove the damage, the defect and the causal link between the two (art 4 PLD). Damage within the meaning of the Product Liability Directive entails death or personal injury and damage to, or destruction of, property, other than the defective product itself, intended and used for private use or consumption (art. 9 PLD). The injured person will have to bring a claim within three years after he became "aware, or should reasonably have become aware, of the damage, the defect and the identity of the producer" (art. 10 PLD). The producer of a product is, under the Product Liability Directive, not only the manufacturer of the final product or the producer of the raw materials, but also "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).[16] So, an automated vehicle can have multiple producers. For instance, the cameras can be manufactured

[14] Within this chapter, hacking of the vehicle will not be discussed at length. However, an injured party could, depending on the exact circumstances, hold the producer of the automated vehicle liable if the producer has not taken sufficient safety measures to prevent the hacking of the vehicle.
[15] See for the development of product liability law in Europe: Simon Whittaker (ed), *The Development of Product Liability* (Cambridge University Press 2010).
[16] For the role of the person who imports the product, see art. 3(2) PLD.

by one producer, the sensors by another, the chassis of the vehicle by yet another producer, and so on. If multiple producers are liable for the same damage, they will be jointly and severally liable (art. 5 PLD). It is up to the plaintiff to decide from which producer he wants to claim damages. The producer has the possibility to invoke (one of) the six defences listed in art. 7 of the Directive. Before exploring those defences in light of automated driving, whether an object is a product within the meaning of the Product Liability Directive, and more specifically whether software is a product, and when a product can be considered to be defective will be explored first.

5.5 The Software of the Automated Vehicle as a Product

5.5.1 Software and the Product Liability Directive

The Product Liability Directive states in art. 2 that "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. (…) 'Product' includes electricity." So, an automated vehicle is a product within the meaning of the Product Liability Directive, as it is a movable. A sensor of an automated vehicle is also a product: it is a movable incorporated into another movable (the automated vehicle). For software[17] (Scenarios 1 and 2), however, the situation is less clear.[18] It is intangible: you cannot hold an algorithm in the palm of your hand.[19] That is, unless the software is stored on a tangible device, like a hard drive or a USB-stick.[20] Does this mean that software does not fall within the scope of the Product Liability Directive?

---

[17] This does not include information.

[18] See for instance European Commission, 'Evaluation of 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' (Commission Staff Working Document) SWD (2018) 157 final,52.

[19] The importance of the intangible character of an object in light of the Product Liability Directive can be debated: Claudi Stuurman, Guy PV Vandenberghe, 'Softwarefouten: een 'zaak' van leven of dood?' (1988) Nederlands Juristenblad 1667, 1671.

[20] See for instance Jan De Bruyne, Jochen Tanghe, 'Liability for Damage Caused by Autonomous Vehicles: A Belgian Perspective' (2017) 8(3) Journal of European Tort Law 324; Kiliaan APC van Wees, 'Voertuigautomatisering en productaansprakelijkheid' (2018) 4 Maandblad voor Vermogensrecht 112; Reinoud JJ Westerdijk, *Produktenaansprakelijkheid voor software*: *beschouwingen over de aansprakelijkheid voor informatieprodukten* (Dissertation, Vrije Universiteit Amsterdam 1995) 82-87; Nynke E Vellinga, 'De civielrechtelijke aansprakelijkheid voor schade veroorzaakt door een autonome auto' (2014) 62 Verkeersrecht 151; Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019.

5.5.2 Electricity

The mentioning of electricity in art. 2 of the Directive may give more insights into whether or not software is, like electricity, a product.[21] There are two different perspectives that one can take regarding the explicit mentioning of electricity as a product in art. 2 PLD.[22] It can be argued that, because electricity is explicitly mentioned, it would not otherwise be regarded as a product within the meaning of the Product Liability Directive ("(…) 'product' means all movables(…)" (art. 2 PLD)).[23] This would mean that while electricity is not a moveable, it is nevertheless a product that falls under the scope of the Product Liability Directive. The other view, however, is that electricity is explicitly mentioned as a product to take away any doubt.[24] From that point of view, electricity is a product within the meaning of the Product Liability Directive. Apparently, however, electricity was included in the Product Liability Directive in this manner to make sure it would be handled the same way across the different Member States and has therefore limited meaning in the discussion around software.[25]

5.5.3 Software, its Carrier and the Absence of a Carrier

Several opinions can be identified from literature on whether or not, and under which circumstances, software can be considered a product within the meaning of the Product Liability Directive. A difference can be seen between the opinions expressed in literature in the late 80's and early 90's, where the carrier of the software plays an important role, whereas in later literature, perhaps under the influence of the more widespread use of wireless software updates, the discussion moves away from the carrier of the software. Four different opinions can be distinguished:

---

[21] Gerhard Wagner in Münchener Kommentar zum BGB: MüKoBGB/*Wagner*, 7. Aufl. 2017, ProdHaftG § 2 Rn. 17-20.

[22] Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019; Reinout JJ Westerdijk, *Produktenaansprakelijkheid voor software*: *beschouwingen over de aansprakelijkheid voor informatieprodukten* (Dissertation, Vrije Universiteit Amsterdam 1995) 89; MüKoBGB/*Wagner*, 7. Aufl. 2017, ProdHaftG § 2 Rn. 17-20; Pieter Kleve, Richard V de Mulder, 'De juridische status van software' (1989) Nederlands Juristenblad 1342, 1343-1344.

[23] Dimitry Verhoeven, *Productveiligheid en productaansprakelijkheid* (Dissertation, Antwerp 2017) 38; Helmut Redeker, *IT-Recht* (6th edition, CH Beck 2017) Rn. 830-833.

[24] Michael Lehman, 'Produkt- und Produzentenhaftung für Software' (1992) Neue Juristische Wochenschrift (NJW) 1721.

[25] Pieter Kleve, Richard V De Mulder, 'De juridische status van software' (1989) Nederlands Juristenblad 1342, 1343-1344; Claudi Stuurman, Guy PV Vandenberghe, 'Softwarefouten: een 'zaak' van leven of dood?' (1988) Nederlands Juristenblad 1667, 1671.

Software is not a product as it is not tangible

Some authors argue that software is not a product as it is not tangible, regardless of the device it is kept on.[26] This would mean that the software producer cannot be held liable for damage caused by a software failure. Tjong Tjin Tai and Koops doubt whether it would be desirable to have software fall within the scope of the Product Liability Directive. The authors point out that the Product Liability Directive is aimed towards products that have been industrially produced,[27] whereas software is, to a certain extent, produced by small developers or individuals and is quite regularly made available for free (especially Open Source Software), which could be hindered by application of the Product Liability Directive to software.[28]

There is, however, a rather strong indicator that software is intended to fall within the scope of the Product Liability Directive: back in 1989, when asked whether the Product Liability Directive also covered computer software, Lord Cockfield answered on behalf of the Commission that "under Article 2 of Directive 85/374/EEC of 25 July 1985 on liability for defective products (') the term 'product' is defined as 'all movables, with the exception of primary agricultural products — (not having undergone initial processing) — and game, even though incorporated into another movable or into an immovable'. Consequently, the Directive applies to software in the same way, moreover, that it applies to handicraft and artistic products."[29] There remains, however, ambiguity on whether software itself is a product, or whether only the combination of hardware and software should be regarded as a product within the meaning of the Product Liability Directive.

The combination of software and a tangible carrier is a product

Some authors argue that only the combination of software and a movable carrier or device (e.g. a hard drive) is a product within the meaning of the Directive. The

---

[26] Eric Tjong Tjin Tai, 'Liability for (Semi)Autonomous Systems: Robots and Algorithms' in Vanessa Mak, Eric Tjong Tjin Tai, Anna Berlee (eds), *Research Handbook on Data Science and Law* (Edward Elgar 2018) 55-82; Daily Wuyts, 'The product liability directive : more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34, 6; Eric FE Tjong Tjin Tai, Bert Jaap Koops, 'Zorgplichten tegen cybercrime' (2015) Nederlands Juristenblad 1065-1072, 1068.
[27] Preamble of the Product Liability Directive. See however: Dimitry Verhoeven, *Productveiligheid en productaansprakelijkheid* (Dissertation, Antwerp 2017) 38-39.
[28] Eric FE Tjong Tjin Tai, Bert Jaap Koops, 'Zorgplichten tegen cybercrime' (2015) Nederlands Juristenblad 1065-1072, 1068.
[29] European Commission, 'Answer of the Commission of the European Communities of 15 November 1988 to Written Question No 706/88 by Mr. Gijs de Vries (LDR, NL) (89/C 114/76)' (8 May 1989) OJ C144/42.

producer of this ‘bundle’ can subsequently be held liable for damage caused by a software failure.[30]

Software is a product when it is kept on a tangible carrier

A closely related view is also considered, and does not exclude the possibility of liability of the producer of this ‘bundle’: software is a product when it is stored on a tangible device, like a hard drive or an USB-stick.[31] In that case, the producer of the software can be held liable for damage caused by a software failure. However, if the software is not incorporated into the end product or is not stored on a tangible device, which is the case with ‘over-the-air’ software updates, this software would not be a product within the meaning of the Directive.[32] Therefore, if the software update causes damage because of a failure, liability of the producer of the software cannot be established through the Product Liability Directive.

Software is a product

Some authors argue that the device on which the software is kept is irrelevant: they argue that software is a product, regardless of whether or not it is stored on a

---

[30] Gerhard Wagner, ‘Produkthaftung für autonome Systeme’ (2017) 217(6) Archiv für die civilistische Praxis 707, 717; Gerhard Wagner, ‘Robot Liability’ (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019; MüKoBGB/*Wagner*, 7. Aufl. 2017, ProdHaftG § 2 Rn. 17-20, GBA Paquay, ‘Software als stoffelijk object’ (1990) Nederlands Juristenblad, 283; L Dommering-van Rongen, *Produktenaansprakelijkheid. Een nieuwe Europese privaatrechtelijke regeling vergeleken met de produktenaansprakelijkheid in de Verenigde Staten* (Dissertation, University of Utrecht 1991), 94-95.

[31] Daily Wuyts, ‘The product liability directive : more than two decades of defective products in Europe’ (2014) 5(1) Journal of European Tort Law 1-34, 5-6; Daily Wuyts, ‘ 5-6 Martin Ebers, ‘Autonomes Fahren: Produkt- und Produzenthaftung’ in Bernd H Oppermann, Jutta Stender-Vorwachs (eds), *Autonomes Fahren. Rechtsfolgen, Rechtsprobleme, technische Grundlagen* (CH Beck 2017) 110.

[32] L Dommering-van Rongen, *Produktenaansprakelijkheid. Een nieuwe Europese privaatrechtelijke regeling vergeleken met de produktenaansprakelijkheid in de Verenigde Staten* (Dissertation, University of Utrecht 1991), 94-95; Dimitry Verhoeven, *Productveiligheid en productaansprakelijkheid* (Dissertation, Antwerp 2017) 44-47. See also FW Grosheide, ‘Aansprakelijkheid voor informatie(-producten)’ (1998) 4 Tijdschrift voor Consumentenrecht en handelspraktijken 309, 311-312.

tangible device.[33] This view is shared by some Member States.[34] In the Estonian Law of Obligations, it is explicitly stated within the context of product liability that "electricity and computer software are also deemed to be movables."[35] Westerdijk points out that software can be regarded as a technical tool and is therefore similar to other products as it can cause damage without human interference, but he does assign some importance to the tangible carrier on which the software is stored.[36] De Bruyne and Tanghe argue that the drafters aimed at a wide material scope, shown by the inclusion of electricity, and therefore it could apply to software even if it is seen as intangible.[37] Wagner prefers this approach "that applies Art. 2 of the Directive in a functional way, excluding only real estate and services (…)."[38] As a consequence, the producer of the software can be held liable under the Product Liability Directive for

---

[33] Gerhard Wagner, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707-765; *Gerhard Wagner, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707* Paul Verbruggen and others, 'Towards Harmonised Duties of Care and Diligence in Cybersecurity' (Cyber Security Council, European Foresight Cyber Security Meeting 2016) 99 <ttp://ssrn.com/abstract=2814101> accessed 1 May 2019; Michael Lehman, 'Produkt- und Produzentenhaftung für Software' (1992) Neue Juristische Wochenschrift (NJW) 1721; Pieter Kleve, Richard V De Mulder, 'De juridische status van software' (1989) Nederlands Juristenblad 1342, 1343-44. See also Jürgen Reese, 'Produkthaftung und Produzentenhaftung für Hard– und Software' (1994) Deutsches Steuerrecht (DStR) 1121; Claudi Stuurman, Guy PV Vandenberghe, 'Softwarefouten: een 'zaak' van leven of dood?' (1988) Nederlands Juristenblad 1667, 1671; FW Grosheide, 'Aansprakelijkheid voor informatie(-producten)' (1998) 4 Tijdschrift voor Consumentenrecht en handelspraktijken 309, 312.

[34] France: Question N° 15677, de M. de Chazeaux Olivier, Question publiée au JO le 15/06/1998 page 3230; Réponse publiée au JO le 24/08/1998 page 4728. See also European Commission, 'Evaluation of 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' (Commission Staff Working Document) SWD (2018) 157 final, 36-39.

[35] Section 1063 subsection 1 of the Estonian Law of Obligations Act <www.riigiteataja.ee/en/eli/507022018004/consolide> accessed 26 April 2019. See also European Commission, 'Evaluation of 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' (Commission Staff Working Document) SWD (2018) 157 final, 36-39.

[36] Reinout JJ Westerdijk, *Produktenaansprakelijkheid voor software*: *beschouwingen over de aansprakelijkheid voor informatieprodukten* (Dissertation, Vrije Universiteit Amsterdam 1995) 201-202.

[37] Jan De Bruyne, Jochen Tanghe, 'Liability for Damage Caused by Autonomous Vehicles: A Belgian Perspective' (2017) 8(3) Journal of European Tort Law 324.

[38] Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019. See also MüKoBGB/Wagner, 7. Aufl. 2017, ProdHaftG § 2 Rn. 17-20; Gerhard Wagner, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707-765; Kees NJ De Vey Mestdagh, Jeroen Lubbers, '"Nee hoor, u wilt helemaal niet naar Den Haag…" Over de techniek, het recht en de toekomst van de zelfrijdende auto' (2015) 4 Ars Aequi 267, Helmut Redeker, *IT-Recht* (6th edition, CH Beck 2017) Rn. 830-833.

damage caused by a failure of his software, even if the damage was caused by a software update that was installed after the main product or carrier was put into circulation.[39] As Van Wees points out, a difference in the application of the Product Liability Directive depending on the existence of a carrier with which the software is delivered, seems arbitrary.[40] This is a fair point.

5.5.4 Software of the Automated Vehicle

It would be undesirable if a producer of software could avoid liability for a defect in its software by providing the software via an 'over-the-air update'.[41] Whether the software of the automated vehicle is a product remains for the European Court of Justice to decide. This will have far-reaching consequences for the legal position of the software producer: if software is regarded to be a product, the producer of the software could face liability claims for damage caused by a defect in his software. If software is not deemed to be a product, the software producer avoids liability.

At least regarding the software and its updates of an automated vehicle, it is reasonable to have software fall within the scope of the Product Liability Directive and to treat the software as a product.[42] It is industrially produced and it is traded just like other products. Treating the software of the automated vehicle as a product also provides more protection for the consumer:[43] if an automated vehicle causes damage because of a software failure, damages can be claimed from either the producer of the automated vehicle or the producer of the software. If software falls

---

[39] Paul Verbruggen and others, 'Towards Harmonised Duties of Care and Diligence in Cybersecurity' (Cyber Security Council, European Foresight Cyber Security Meeting 2016) 99 <ttp://ssrn.com/abstract=2814101> accessed 1 May 2019, 99.

[40] Kiliaan APC van Wees, 'Voertuigautomatisering en productaansprakelijkheid' (2018) 4 Maandblad voor Vermogensrecht 112-122. See also Cornelis Stuurman, *Technische normen en het recht: Beschouwingen over de interactie tussen het recht en technische normalisatie op het terrein van informatietechnologie en telecommunicatie* (Dissertation, Vrije Universiteit Amsterdam 1995) 225. See on the protection of the consumer: Paul Verbruggen and others, 'Towards Harmonised Duties of Care and Diligence in Cybersecurity' (Cyber Security Council, European Foresight Cyber Security Meeting 2016) <ttp://ssrn.com/abstract=2814101> accessed 1 May 2019, 100.

[41] See also Pieter Kleve, Richard V De Mulder, 'Voor een goed begrip (weerwoord op reacties op 'De juridische status van software')' (1990) Nederlands Juristenblad 283, 284.

[42] See also Art. 2(1) and (4) of the Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices, amending Directive 2001/83/EC [2017] OJ L117/1; and Recital 17 and Art. 2(2) of the Regulation (EU) 2017/746 of the European Parliament and of the Council of 5 April 2017 on in vitro diagnostic medical devices and repealing Directive 98/79/EC and Commission Decision 2010/227/EU [2017] OJ L117/176 that both recognize software as a(n in vitro) medical device.

[43] Claudi Stuurman, Guy PV Vandenberghe, 'Softwarefouten: een 'zaak' van leven of dood?' (1988) Nederlands Juristenblad 1667, 1671.

within the definition of a product within the meaning of the Product Liability Directive, the producer of the defective software update from Scenario 2 can be held liable for the damage caused by his software update.

Regardless, however, of which approach the European Court of Justice decides to take, the end producer of the entire product, of which the software is an (important) element, can be held liable for the damage caused by his end product (e.g. the automated vehicle) as a consequence of a software failure.[44]

5.6 When is an Automated Vehicle Defective?

A product, and therefore an automated vehicle such as the one mentioned in Scenarios 1 and 2, is defective if it does not provide the level of safety one is entitled to expect (art. 6(1) PLD). All circumstances should be taken into account, including the three factors listed in art. 6(1) of the Directive:

> "(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."

The justified expectations, or what can reasonably be expected from a product, are not the expectations of the injured person, but the expectations of the public at large.[45] Moreover, art. 6 of the Product Liability Directive refers to legitimate expectations, not to the actual expectations.[46] But what can one expect from an automated vehicle?

---

[44] See also European Commission, 'Evaluation of 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' (Commission Staff Working Document) SWD (2018) 157 final, 52. See also Recital 13 European Commission, 'Amended proposal for a Directive of the European Parliament and of the Council on certain aspects concerning contracts for the online and other distance sales of goods, amending Regulation (EC) No 2006/2004 of the European Parliament and of the Council and Directive 2009/22/EC of the European Parliament and of the Council and repealing Directive 1999/44/EC of the European Parliament and of the Council' COM (2017) 637 final, 31 October 2017.

[45] Preamble Product Liability Directive. See also Daily Wuyts, 'The product liability directive: more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34, 8ff.

[46] Daily Wuyts, 'The product liability directive: more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34, 9.

5.6.1 Justified Expectations

In literature, Schellekens,[47] as well as Tjong Tjin Tai and Boesten,[48] have suggested that an automated vehicle does not live up to justified expectations and is therefore defective, when the automated vehicle does not drive as a human-driven car would do.[49] In other words: an automated vehicle is defective when it is not as safe as a human driven car.[50] Wagner calls this the 'human driver test'.[51] Schellekens splits this 'human driver test' into two different standards. The first more specific standard is that the automated vehicle "should be safer than the best human driver."[52] This would mean that accidents can happen, but only those that could not have been avoided by, what Schellekens describes as, the best human driver.[53] The other more specific standard suggested by Schellekens could serve as a minimum standard: "The automated car should statistically be safer than human drivers."[54] Tjong Tjin Tai and Boesten point out that this is something which producers suggest will be the case, that automated vehicles are safer than human driven vehicles.[55] Schellekens signals that this standard might be difficult to use in practice, as it would require statistics on the large scale use of automated vehicles.[56] He therefore proposes a standard holding

---

[47] Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability law' (2015) 31(4) Computer Law and Security Review 506, 510-12.

[48] Eric FE Tjong Tjin Tai, Sanne Boesten, 'Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten' (2016) Nederlands Juristenblad 656, 660-661.

[49] See also Christian Gomille, 'Herstellerhaftung für automatisierte Fahrzeuge' (2016) 71(2) JuristenZeitung (JZ) 76, 77-78; and Martin Ebers, 'Autonomes Fahren: Produkt- und Produzenthaftung' in Bernd H Oppermann, Jutta Stender-Vorwachs (eds), *Autonomes Fahren. Rechtsfolgen, Rechtsprobleme, technische Grundlagen* (CH Beck 2017) 110.

[50] Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability law' (2015) 31(4) Computer Law and Security Review 506, 510.

[51] Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019 12.

[52] Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability law' (2015) 31(4) Computer Law and Security Review 506, 510. See also Esther FD Engelhard, 'Wetgever, pas op! De (vrijwel) autonome auto komt eraan' (2017) 3 Ars Aequi 230, 232.

[53] Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability law' (2015) 31(4) Computer Law and Security Review 506, 510.

[54] Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability law' (2015) 31(4) Computer Law and Security Review 506, 510.

[55] Eric FE Tjong Tjin Tai, Sanne Boesten, 'Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten' (2016) Nederlands Juristenblad 656, 660.

[56] Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability law' (2015) 31(4) Computer Law and Security Review 506, 512.

that an automated vehicle should be "at least as good as an average or good human driver."[57]

Although it is very understandable to want to compare a new product to its predecessor, with regards to automated vehicles this is not the way to go.[58] An automated vehicle and a human driven vehicle differ too greatly. The new elements essential to automated vehicles – the hardware and software that enable the vehicle to drive itself – replace the most dangerous element of the conventional vehicle: the human behind the wheel.[59] These new elements are also the elements that will give rise to defects or failures that are unknown to a human driven vehicle. An automated vehicle will make mistakes that a human driver would not make, and the other way around. An automated vehicle can experience a failure of its safety-critical software or the shutdown of a sensor, while a human driver can not experience either of these. However, a human driver could fall asleep behind the wheel or be intoxicated, something an automated vehicle will not experience.[60] Because of these differences, the automated vehicle will not be able to meet the 'human driver test', argues Van Wees.[61] Technology should be compared to technology, not to a human. Wagner supports this view and states that whether a specific accident caused by an automated vehicle could have been avoided by a reasonable human driver should be irrelevant.[62] Wagner calls for a "system-oriented concept of defect" in which the main question should be "whether the system in question, e.g. the fleet of cars operated by the same algorithm, causes an unreasonable number of accidents

[57] Maurice HM Schellekens, 'Self-driving cars and the chilling effect of liability law' (2015) 31(4) Computer Law and Security Review 506, 512.
[58] See also Gerhard Wagner, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707, 733 and Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019, 50.
[59] Over 90% of motor vehicle crashes are (partially) caused by human error: Santokh Singh, 'Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey' (National Highway Traffic Safety Administration February 2015) <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115> accessed 1 May 2019.
[60] See also Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019, Gerhard Wagner, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707, 736, and Kiliaan APC van Wees, 'Voertuigautomatisering en productaansprakelijkheid' (2018) 4 Maandblad voor Vermogensrecht 112, 117-118.
[61] Kiliaan APC van Wees, 'Voertuigautomatisering en productaansprakelijkheid' (2018) 4 Maandblad voor Vermogensrecht 112, 118.
[62] Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019, 13.

overall".[63] However, this seems to require a significant amount of data, which might not be available in the earlier days of automated driving.

5.6.2 Different Types of Defects

It can be helpful to, when establishing whether a product is defective, distinguish three types of defects: manufacturing defects, design defects and instruction defects.[64] This distinction originally comes from the United States of America, but it is also described in European product liability literature.[65]

An instruction defect is, for instance, a failure to warn consumers about certain dangers of the product.[66] Engelhard and Bruin see this type of defect as particularly relevant for automated vehicles because of their technical complexity.[67] Schreuder points out that when it comes to new, innovative products, consumers will largely be

---

[63] Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019, 13. See also Gerhard Wagner, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707,736-740.

[64] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 428; John CP Goldberg, Benjamin C Zipursky, *The Oxford Introductions to U.S. Law: Torts* (Oxford University Press 2010) 282ff. See in the context of automated driving: Eric FE Tjong Tjin Tai, Sanne Boesten, 'Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten' (2016) Nederlands Juristenblad 656, 660; Kiliaan APC van Wees*, '*Voertuigautomatisering en productaansprakelijkheid' (2018) 4 Maandblad voor Vermogensrecht 112-122; Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019, 12; Paul T Schrader, 'Haftungsfragen für Schäden beim Einsatz automatisierter Fahrzeuge im Straßenverkehr' (2016) 5 Deutsches Autorecht (DAR) 242, 243; AI Schreuder, 'Aansprakelijkheid voor 'zelfdenkende' apparatuur' (2014) (5/6) Aansprakelijkheid, Verzekering en Schade (AV&S); Daily Wuyts, 'The product liability directive : more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34, 10-11.

[65] See for instance John CP Goldberg, Benjamin C Zipursky, *The Oxford Introductions to U.S. Law: Torts* (Oxford University Press 2010) 282ff. See in a European context: Cees van Dam, *E European Tort Law* (2nd edn, Oxford University Press, 2013) 428. See for the influence of American law on European product liability: Simon Whittaker (ed), *The Development of Product Liability* (Cambridge University Press 2010).

[66] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 428. See for an extensive study of warning, instructions and product liability Sanne B Pape, *Warnings and product liability: Lessons learned from cognitive psychology and ergonomics* (Dissertation, Erasmus University Rotterdam 2011).

[67] Esther FD Engelhard, Roeland de Bruin, 'Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles' in Tatjana Evas *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles* (European Union 2017) 58.

unfamiliar with the product and its use, so consumers will depend to quite an extent on the information provided by the producer.[68]

A manufacturing defect is a defect that is not present in all of the products of a type. The defect is not inherent to the product, but rather it is a single article of that product type that does not meet the design as the manufacturer had intended.[69] With regards to automated vehicles, Wagner describes the installation of software of the automated vehicle being incomplete or faulty as a manufacturing defect.[70]

The third type of defect that has been distinguished is the design defect. Design defects concern, unlike manufacturing defects, all products of a specific type. A design defect in an automated vehicle could, for instance, be wrongly programmed software which offers hackers a chance to influence the driving of the automated vehicle.[71] Another example of a design defect is the choice to install self-learning software in an automated vehicle, which later turns out to be defective.[72] When it comes to design defects, the risk/utility test, which has its roots in American law, can offer guidance.[73] The question central to the risk/utility test is whether the foreseeable risks could have been reduced by an alternative design without the costs of the alternative design exceeding the costs avoided by it (that is the costs occurring

[68] AI Schreuder, ‘Aansprakelijkheid voor ‘zelfdenkende’ apparatuur’ (2014) (5/6) Aansprakelijkheid, Verzekering en Schade (AV&S).

[69] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 428.

[70] Gerhard Wagner, ‘Produkthaftung für autonome Systeme’ (2017) 217(6) Archiv für die civilistische Praxis 707, 725. See also Esther FD Engelhard, Roeland de Bruin, ‘Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles’ in Tatjana Evas *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles* (European Union 2017) 58. See also Gerhard Wagner, ‘Robot Liability’ (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019 12.

[71] *Gerhard Wagner, ‘Produkthaftung für autonome Systeme’ (2017) 217(6) Archiv für die civilistische Praxis 707*, 727; Esther FD Engelhard, Roeland de Bruin, ‘Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles’ in Tatjana Evas *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles* (European Union 2017) 58‘; Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 428; Gerhard Wagner, ‘Robot Liability’ (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019, 12.

[72] Eric FE Tjong Tjin Tai, Sanne Boesten, ‘Aansprakelijkheid, zelfrijdende auto’s en andere zelfsturende objecten’ (2016) Nederlands Juristenblad 656, 660-661.

[73] John CP Goldberg, Benjamin C Zipursky, *The Oxford Introductions to U.S. Law: Torts* (Oxford University Press 2010) 291-292, Gerhard Wagner, ‘Produkthaftung für autonome Systeme’ (2017) 217(6) Archiv für die civilistische Praxis 707, 731-733; Daily Wuyts, ‘The product liability directive : more than two decades of defective products in Europe’ (2014) 5(1) Journal of European Tort Law 1-34, 10-12.

from a design defect).[74] The risk/utility test can thereby be a factor that contributes to the finding that a product is defective.[75]

Not all European authors are in favour of using the distinction between instruction defects, manufacturing defects, and design defects in European product liability law. Wuyts opposes the use of the distinction between the three types of defects as it would undermine the normative character of art. 6 of the Product Liability Directive. Wuyts argues that a product that deviates from the production standard is not necessarily defective as it can still meet the legitimate expectations of the public.[76] He further argues that the risk/utility test can be taken into account when establishing the legitimate safety level, but not to establish the defect.[77]

The length of this chapter does not lend itself for a more in-depth consideration of the opinions on, and the use of, the distinction between the three types of defects and the risk/utility test, so it will merely offer these options as tools that may be used in determining whether or not a product, in this case the automated vehicle, is defective within the meaning of art. 6 PLD.

5.6.3 An Independent Expectation for the Automated Vehicle

As described above, the comparison of the automated vehicle with a human driver is not satisfactory. There are, however, some justified expectations that can be derived from this comparison, as automated vehicles will not be accepted by the public if they are in general less safe than the human driver of a conventional vehicle. So, an automated vehicle should be able to stop for a red traffic light, know the rules of the road, have a certain braking distance when it travels at a certain speed, have 360 degree vision and should be able to recognise humans, etc. These are all very general expectations.

To make these expectations more concrete, one should also look into how the expectations of automated vehicles can be formed independently from their

---

[74] Gerhard Wagner, 'Robot Liability' (19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019, 12; Daily Wuyts, 'The product liability directive: more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34, 10.

[75] See for instance the German Bundesgerichtshof (BHG) in BGH VI ZR 107/08, 16 June 2009, Gerhard Wagner, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707, 731-733; L Dommering-van Rongen, *Productaansprakelijkheid. Een rechtsvergelijkend overzicht* (Kluwer 2000) 45.

[76] Daily Wuyts, 'The product liability directive: more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34, 10-11.

[77] Daily Wuyts, 'The product liability directive: more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34, 11-12, 14.

predecessor, the human driver of the conventional vehicle. In order for these expectations to take shape, a strict comparison between how a human driven vehicle would drive, and the automated vehicle, is not necessary. This is because the expectations for the automated vehicle are not necessarily being formed through the experiences with the conventional vehicle, as the most important element of conventional driving – the human driver – is being removed from the equation. The general public should not only base their expectations on the experiences they have had with conventional vehicles, but should also rely (perhaps even primarily) on the information provided by the producers and governments. Producers will have to educate the general public and, more specifically, the users of the automated vehicle on the capabilities and limitations of this new technology. This can, for instance, be done through advertising, choosing the name of the product carefully, warnings, and through the interface inside the vehicle.[78] Given the substantial safety risks that are at stake – road traffic safety, human life – safety expectations of the automated vehicle will be very high, as Schrader and Gomille point out.[79]

Governments can also influence the expectations consumers might have of an automated vehicle through the requirements they set for these vehicles and their users. If a driver's licence is not required in order to use of the vehicle, this could give rise to the expectation that the vehicle can drive entirely without human interference. The (type-)approval[80] granted for the use of the automated vehicle on the public roads will also influence expectations: it could give the impression that it is, generally speaking, safe to use the automated vehicle on the public roads in the circumstances it has been approved for. It raises expectations as to what the vehicle is capable of. The approval could entail, for instance, what the reaction speed of the vehicle should be, what its braking capacity is, what its field of vision should be etc. The (type-)approval serves as a minimum standard for the justified expectations of

---

[78] See on product liability and warnings: Sanne B Pape, *Warnings and product liability: Lessons learned from cognitive psychology and ergonomics* (Dissertation, Erasmus University Rotterdam 2011).

[79] Paul T Schrader, 'Haftungsfragen für Schäden beim Einsatz automatisierter Fahrzeuge im Straßenverkehr' (2016) 5 Deutsches Autorecht (DAR) 242, 243; Christian Gomille, 'Herstellerhaftung für automatisierte Fahrzeuge' (2016) 71(2) JuristenZeitung (JZ) 76, 77.

[80] 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 (Framework Directive). See also European Commission, 'Guidelines on the exemption procedure for the EU approval of automated vehicles' (5 April 2019) <https://ec.europa.eu/docsroom/documents/34802> accessed 1 May 2019.

consumers. The (type-)approval will therefore have an increased and significant impact on the product liability question. Ultimately, it might not even be necessary to compare an automated vehicle to a conventional vehicle in order to establish the justified expectations of the new technology.

5.6.4 The Time When the Product Was Put Into Circulation

The expectations at the moment the product was put into circulation are central. However, a product is not defective "for the sole reason that a better product is subsequently put into circulation"(art. 6(2) PLD). This is of great importance in a field developing as quickly as automated driving technology. When a product is actually put into circulation, which is relevant to both Scenarios 1 and 2, will be discussed below because of its overlap with one of the defences available to the producer.

5.7 The Defences of the Producer

As discussed above, a product is defective if it did not meet the justified expectations of the consumers, taking all circumstances into account, including the time at which the product was put into circulation (art. 6(1) PLD). The producer can in turn invoke one of the six defences 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."

Two of those defences are of special interest when it comes to automated driving: the defence of art. 7(b) PLD which relates to the defect not existing at the time the product was put into circulation, and the so-called development risk defence (sometimes also referred to as the state of the art defence) of art. 7(e) PLD. In the context of the testing of automated vehicles on public roads by the producer himself, the defence of art. 7(a) PLD – that the producer did not put the vehicle into circulation – can also spark discussion. As the focus of this chapter lies on the deployment phase of automated vehicles, the defences of art. 7(b) and art. 7(e) PLD will be discussed further.

5.7.1 The Existence of the Defect at the Moment the Product Was Put Into Circulation

The defence of art. 7(b) of the Product Liability Directive reads that the producer of a product is not liable if he proves "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."[81] This defence could be invoked by the producer of the automated vehicle from scenario 1 above, where the automated vehicle caused damage to a third party due to a 'learning mistake' – the self-learning software had wrongly learned that worn down lane markings are not lane markings. The defence could also be invoked by the producer of an automated vehicle that caused damage due to a software update which contained a programming failure, which was installed after the vehicle was put into circulation (Scenario 2). The mistakes an automated vehicle makes during its lifetime due to software updates and self-learning software, however, might not be present at the moment the vehicle is put into circulation.

In 2006, in relation to art. 11 of the Product Liability Directive which relates to the time limitation in which a claim can be brought against the producer, the European Court of Justice (ECJ) decided that a product has been put into circulation "when it leaves the production process operated by the producer and enters a marketing process in the form in which it is offered to the public in order to be used or consumed."[82] This could mean that an automated vehicle that is being tested by its producer on public roads might not be put into circulation (which means the producer could successfully invoke the defence of art. 7(a) PLD). Van Dam explains that a product has been put into circulation if it has been put at the disposal of a third

---

[81] If the vehicle gets hacked, the producer of the automated vehicle will not be able to successfully invoke this defence when the producer did not provide the vehicle with sufficient safety features as to prevent hacking.

[82] Case C-127/04 *O'Byrne v Sanofi Pasteur MSD Ltd and Sanofi Pasteur SA* [2006] ECR I-01313, para 27.

party, which would be the case if a product is being used by a test subject.[83] However, the situation is clear when it comes to automated vehicles that have been deployed for general use by the general public, they will be considered to have been put into circulation.

The next step is to establish whether or not the defect of the product already existed when the vehicle was put into circulation. Firstly, the example regarding the self-learning software and the learning error (Scenario 1) shall be considered. In Scenario 1, the mistake in the learning process of the software has taken place after the vehicle was put into circulation. So, the producer could argue that the defect – the learning mistake – was not present when the vehicle was put into circulation. However, as Tjong Tjin Tai and Boesten point out, equipping the vehicle with self-learning software is a design choice, made by the producer.[84] So even though the error in the learning process occurred later, the producer has taken the risk of equipping the vehicle with self-learning software. The ECJ has stated that the defences of art. 7 PLD should be interpreted strictly in order to protect the interests of the victim.[85] In this case, that would mean that the producer cannot successfully invoke the defence of art. 7(b) PLD, as the basis of the learning error was a design choice made before the automated vehicle was put into circulation.[86]

Next up is the software update containing a programming failure, which subsequently caused damage (scenario 2). If software is considered to be a product within the meaning of the Product Liability Directive, the producer of the software update can successfully be held liable for the damage caused by that software update. But can the producer of the entire automated vehicle also be held liable for the damage its automated vehicle caused due to the software update? The answer to this question is

---

[83] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 433. See also Daily Wuyts, 'The product liability directive: more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34, 21-23. See Esther FD Engelhard, 'Wetgever, pas op! De (vrijwel) autonome auto komt eraan' (2017) 3 Ars Aequi 230, 231 and Esther FD Engelhard, Roeland de Bruin'Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles' in Tatjana Evas *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles* (2017) (European Union 2017)61 regarding the position of companies executing tests.

[84] Eric FE Tjong Tjin Tai, Sanne Boesten, 'Aansprakelijkheid, zelfrijdende auto's en andere zelfsturende objecten' (2016) Nederlands Juristenblad 656, 660-661.

[85] Case C-127/04 *O'Byrne v Sanofi Pasteur MSD Ltd and Sanofi Pasteur SA* [2006] ECR I-01313, para 25; Case C203/99 *Henning Veedfald v Århus Amtskommune* [2001] ECR I-03569, paras 14-15.

[86] See differently: Jan De Bruyne, Jochen Tanghe, 'Liability for Damage Caused by Autonomous Vehicles: A Belgian Perspective' (2017) 8(3) Journal of European Tort Law 324.

of particular importance if software is not considered a product within the meaning of the Directive. This is because if it is not a product, then the injured party might not be able to claim damages from the producer of the software update on the basis of the Product Liability Directive, and could therefore be left without compensation for his damages.[87]

If, however, the software update that caused the damage can be considered to be a product within the meaning of art. 2 of the Directive, the producer of that software update can be held liable under the Product Liability Directive. This producer has brought the software update into circulation by offering it to the owners or users of the automated vehicle.[88] It is, however, possible that the producer is able to successfully invoke the development risk defence (also called the state of the art defence). This defence will be discussed in the next section.

The producer of the automated vehicle, who is not necessarily the producer of the software update, could also possibly be held liable for the damage caused by the software update for his automated vehicle, depending on the view one takes. It can be argued that the automated vehicle as a whole has become defective because of the software update, but the producer could successfully argue that the defect did not exist when he put the vehicle into circulation. This would mean that the producer of the automated vehicle could avoid liability by offering software updates not before, but after the vehicle has been put into circulation. However, the rationale behind the defence of art. 7(b) of the Product Liability Directive lies in the influence the producer has over his product: once his product has left the production process he no longer has any influence over his product. With the development of the software update, this has changed. Long after a product was put into circulation, the producer can still greatly influence his product through providing software updates. For this reason, the producer should not be able to invoke the defence of art. 7(b) PLD. This does justice to the rationale of the Product Liability Directive as the producer would not be able to avoid liability by, instead of providing the vehicle with all the necessary software before putting it into circulation, only providing the necessary software (updates) after the vehicle is put into circulation.[89] Going back to

---

[87] Depending on national law, the producer of the software update might be liable under a fault-based liability regime.

[88] Case C-127/04 *O'Byrne v Sanofi Pasteur MSD Ltd and Sanofi Pasteur SA* [2006] ECR I-01313, para 27, Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 433.

[89] See for instance the over-the-air updates Tesla provides to unlock certain self-driving features: Tesla, 'Autopilot' (*Tesla.com*) <www.tesla.com/model3/design?redirect=no#autopilot> accessed 20 March 2019. See for the problems that arise from such an extensive update with regard to the

Scenario 2, this would mean that the producer of the automated vehicle that later got a defective software update would not be able to successfully invoke this defence.

It can also be argued that in the case of an extensive software update, which provides the vehicle with substantial new features, a whole new product comes into existence.[90] The updated vehicle could be regarded to be a new product, in which case the producer would not be able to avoid liability under the Product Liability Directive if this extensive software update entails an error which causes damage (scenario 2). The producer of the new automated vehicle would not be able to successfully invoke the defence of art. 7(b) of the Directive, as the defect was present when this new product was put into circulation.

If invoking the defence of art. 7(b) PLD is unsuccessful, the producer could, depending on the circumstances, invoke the defence of art. 7(e) PLD. This development risk defence, sometimes also referred to as the state of the art defence, is seen as highly relevant to the automated driving context.[91]

5.7.2 The Development Risk Defence

Art. 7(e) of the Product Liability Directive reads: "The producer shall not be liable as a result of this Directive if he proves: (…) (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 (…)." Art. 15(b) PLD offers Member States the option to (partially) exclude the development risk defence. Five countries have decided to make use of this option; some have chosen to only do so

limitation period in which to bring a claim forward (Art. 10 PLD): Jan De Bruyne, Jarich Werbrouck, 'Merging self-driving cars with the law' (2018) 34(5) Computer Law & Security Review 1150-53.

[90] Jan De Bruyne, Jarich Werbrouck, 'Merging self-driving cars with the law' (2018) 34(5) Computer Law & Security Review 1150-53.

[91] Esther FD Engelhard, Roeland de Bruin, 'Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles' in Tatjana Evas *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles* (2017) (European Union 2017) 61; Kiliaan APC van Wees, 'Voertuigautomatisering en productaansprakelijkheid' (2018) 4 Maandblad voor Vermogensrecht 112, 118-119; Eric Tjong Tjin Tai, 'Liability for (Semi)Autonomous Systems: Robots and Algorithms' in Vanessa Mak, Eric Tjong Tjin Tai, Anna Berlee (eds), *Research Handbook on Data Science and Law* (Edward Elgar 2018) 55-82.

regarding specific products.[92] With regards to automated vehicles, within the EU, this defence cannot be invoked in Luxembourg and Finland.[93]

In order to successfully invoke the development risk defence, the objective level of knowledge, and not the level of knowledge of the specific producer, must be such that the defect could not have been discovered.[94] This includes the most advanced level of knowledge available.[95] The ECJ adds: "that knowledge must have been accessible at the time when the product in question was put into circulation."[96] The ECJ does not elaborate on when knowledge is indeed considered accessible. Van Dam points out that the accessibility of knowledge might be doubtful if the knowledge has been published solely in a journal in one country and was not written in one of the commonly recognised languages.[97]

In Scenario 1, the automated vehicle collided with oncoming traffic because the automated vehicle failed to recognise worn down lane markings as such, due to a learning error of the self-learning software. This can be seen as a design defect that only manifests later. It is well known that software can entail defects, but whether it is impossible to discover those defects, given the scientific and technical knowledge at the time, is difficult to establish, especially when it comes to self-learning software. Because of the self-learning capacity of self-learning software, it is difficult – perhaps even impossible – to predict what it will learn exactly. In the long term, when automated vehicles are a normal occurrence, automated vehicles of different makes might be compared in order to get a better picture of the state of scientific and technical knowledge with regards to self-learning software.

However, if a producer successfully invokes the development risk defence, then the injured party will not get compensation for its damage under the Product Liability Directive.[98] The development risk gets passed onto the injured party. The injured

---

[92] See in more detail: Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 436.
[93] Esther FD Engelhard, Roeland de Bruin, 'Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles' in Tatjana Evas *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles* (2017) (European Union 2017) 61; Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 436.
[94] Case C-300/95 *Commission v UK* [1997] ECR I-02649.
[95] Case C-300/95 *Commission v UK* [1997] ECR I-02649. See also Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 435-436.
[96] Case C-300/95 *Commission v UK* [1997] ECR I-02649.
[97] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 435.
[98] Depending on national law, the injured party could still have other ways to get his damage compensated. See for instance §7 of the German Straβenverkehrsgesetz (StVG). See also Paul

party is just a random victim, who is suddenly confronted with the costs arising from an innovation that, is designed to benefit the society as a whole, as is hope for automated driving. Unlike the producer, the injured party has no influence over the driving behaviour or the development of the automated vehicle. If the producer successfully invokes the development risk defence, the costs of the development risk are passed onto this randomly injured party. It is not fair to confront this injured party with this burden.

This burden can be placed onto the producer by Member States by choosing to derogate from art. 7(e) of the Directive (art. 15 PLD). Member States could lay down in their legislation that the development risk defence is not applicable to defective automated vehicles.[99] That way, the development risk is put upon the producer of the new technology, instead of a randomly injured party.

If Member States decide against derogating from art. 7(e) of the Product Liability Directive, other options could help alleviate the costs for the injured party. For instance, producers, original equipment manufacturers, software developers and other parties involved in, and benefitting from, the production of automated vehicles (perhaps also governmental organisations and/or insurance companies) could contribute to a fund, from which the injured party gets compensated for the damage suffered.[100] This way, the party who just happens to be in the wrong place at the wrong time is not confronted with the costs of the development risk associated with the development of a new technology such as automated vehicles, particularly one which should benefit society as a whole. The costs should be borne by those parties who benefit the most financially from the development of automated vehicles.

Another option would be to require first party insurance, or traffic insurance. Every road user would insure himself for his own damage, claiming directly from his own insurance instead of the insurance of the party who caused the accident.[101] First party

---

Verbruggen and others, 'Towards Harmonised Duties of Care and Diligence in Cybersecurity' (Cyber Security Council, European Foresight Cyber Security Meeting 2016) 99 <ttp://ssrn.com/abstract=2814101> accessed 1 May 2019, 101-102. See also European Commission, 'Evaluation of 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' (Commission Staff Working Document) SWD (2018) 157 final, 38.

[99] As for instance in France the development risk defence cannot be invoked with regard to human products: Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press, 2013) 436.

[100] This approach would also be effective in cases of hacking of the automated vehicle.

[101] In cases of damage caused by hacking, a first party insurance could also be helpful as it does not confront the injured party with the question who is liable for the damage this party suffered.

insurance is an insurance against damage, not liability. The question of who was at fault is thus at first avoided, leaving insurance companies and producers to prosecute over the liability questions at a later stage. This approach has been explored in-depth by Van Wees and Schellekens, as it could offer a solution to the various liability questions surrounding automated driving and possibly dampen the chilling effect liability law could have on the development of automated vehicles.[102]

5.8 Conclusion

All of the various considerations on whether software is a product, the justified expectations for an automated vehicle, and the different defences available have a great influence on the scenarios described above. Depending on the outcome of the discussions on these topics, the injured parties from the scenarios might not be able to successfully claim damages from the producer of the automated vehicle or the producer of the software. National law could offer the opportunity for these injured parties to claim damages from another party, for instance the road authority. However, this way the producer of the automated vehicle is not confronted with the costs of the risk – the automated vehicle – it has created. This is an undesirable outcome as it does not provide the consumer protection aimed for in the Product Liability Directive and it does not provide any incentive for the producers to ensure that they only put safe products into circulation. For instance, by offering a software update only after the vehicle has been put into circulation, instead of equipping the vehicle with it before the vehicle is put into circulation (Scenario 2), the producer can successfully invoke the defence of art. 7(b) PLD and thereby avoid liability. This is not desirable as it is not in line with the rationale of the Product Liability Directive and the defence of art. 7(b). The producer has an extensive influence on the product after it is put into circulation, for which he should not be able to avoid liability. In these circumstances, the producer should not be able to invoke the defence of art. 7(b) of the Directive. To avoid confronting the injured party with the costs of developing a new technology and to provide an incentive for the producers of automated vehicles to only put vehicles which have been tried and tested into circulation, Member States could also consider derogating from the development risk defence of art. 7(e) of the Directive, so that this defence cannot be invoked when damage has been caused by

[102] Kiliaan APC van Wees, ‘Zelfrijdende auto’s, aansprakelijkheid en verzekering; over nieuwe technologie en oude discussies’ (2016) 2 Tijdschrift voor Vergoeding Personenschade (TVP) 29; Maurice HM Schellekens, ‘Self-driving cars and the chilling effect of liability law’ (2015) 31(4) Computer Law and Security Review 506, 506-517. See further on no-fault compensation schemes: Maurice HM Schellekens, ‘No-fault compensation schemes for self-driving vehicles’ (2018) 10(2) Law, Innovation and Technology 314.

an automated vehicle. This way, the producer of the automated vehicle cannot invoke the development risk defence, ensuring that this development risk is borne by the producer instead of a random road user who just happened to be the unlucky person injured by the automated vehicle. The same should apply to the producer of a software (update) for the automated vehicle (Scenarios 1 and 2). However, the producer of the defective software of an automated vehicle could avoid liability under the Product Liability Directive if it is decided that software is not a product within the meaning of art. 2 of the Directive. This is also undesirable as it would not provide an incentive for the producer, who has substantial influence over the driving behaviour of the vehicle through their software, to only bring software to the market that has been extensively tried and tested. The risk of using self-learning software should not lie with the random road user that gets injured due to a failure of that software, but with the producer of the automated vehicle and the producer of the software. To achieve this, the Product Liability Directive needs further clarification on the topics discussed, including on whether or not software is a product within the meaning of the Directive,[103] so that the protection of the consumer is guaranteed when automated vehicles hit the road.

[103] See also European Commission, 'Evaluation of 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' (Commission Staff Working Document) SWD (2018) 157 final.

Epilogue: Consequences of the Proposed Derogation from the Development Risk Defence

Following from the argument in the previous chapter, Member States are advised to derogate from the development risk defence of art. 7 (e) of the Product Liability Directive in the context of automated driving, thereby appointing the development risk to the producer instead of a random party injured by an automated vehicle. This is derogation possible under art. 15 (b) of the Directive. The effects and desirability of a derogation concerning automated driving, however, differ per Member State and depend on their national tort law. To illustrate this, the positions of the Netherlands and Germany are discussed in this epilogue.

In the case of the Netherlands, derogation from the development risk defence is especially desirable when the injured party is the user of another motor vehicle.[1] This injured party would not be able to claim his damage from any other stakeholder. Dutch law does recognise a strict liability for the keeper (bezitter) of a motor vehicle ex. art. 6:173 BW. However, the keeper will avoid liability if the defect already existed at the time that the product was put into circulation (art. 6:173 lid 2 BW), which seems the most likely scenario with automated vehicles. Only the producer can be held liable for such a defect that exists at the time that the product was put into circulation. So, by derogating from the development risk defence within art. 7(e) of the Product Liability Directive, the development risk comes to rest with the party who has the most influence over that risk – the producer – and the injured party is not left empty-handed.[2]

Compared to German law, however, the need to derogate from the development risk defence is less pressing from the perspective of the injured party. Under §7 of the German Straßenverkehrsgesetz (StVG), the keeper is also strictly liable for damage caused by his automated vehicle. However, the StVG does not contain the same exception as the Dutch civil code does concerning a defect present at the time the vehicle was put into circulation. Therefore, the keeper is fully liable under German law and the injured party can claim damages from the keeper, regardless of the

[1] If the injured party is a vulnerable road user that is not using a motor vehicle, for instance a cyclist or a pedestrian, the owner of the automated vehicle is liable under art. 185 Wegenverkeerswet 1994. The owner can avoid liability in case of force majeure, but a technical defect is not regarded to be force majeure: HR 16 april 1942, NJ 1942/394 (Torenbout-arrest).

[2] Insurance could compensate for the negative effects this has on the injured party.

position of the producer. The difference between the Germany liability regime and that of the Netherlands is illustrated by Table 1.

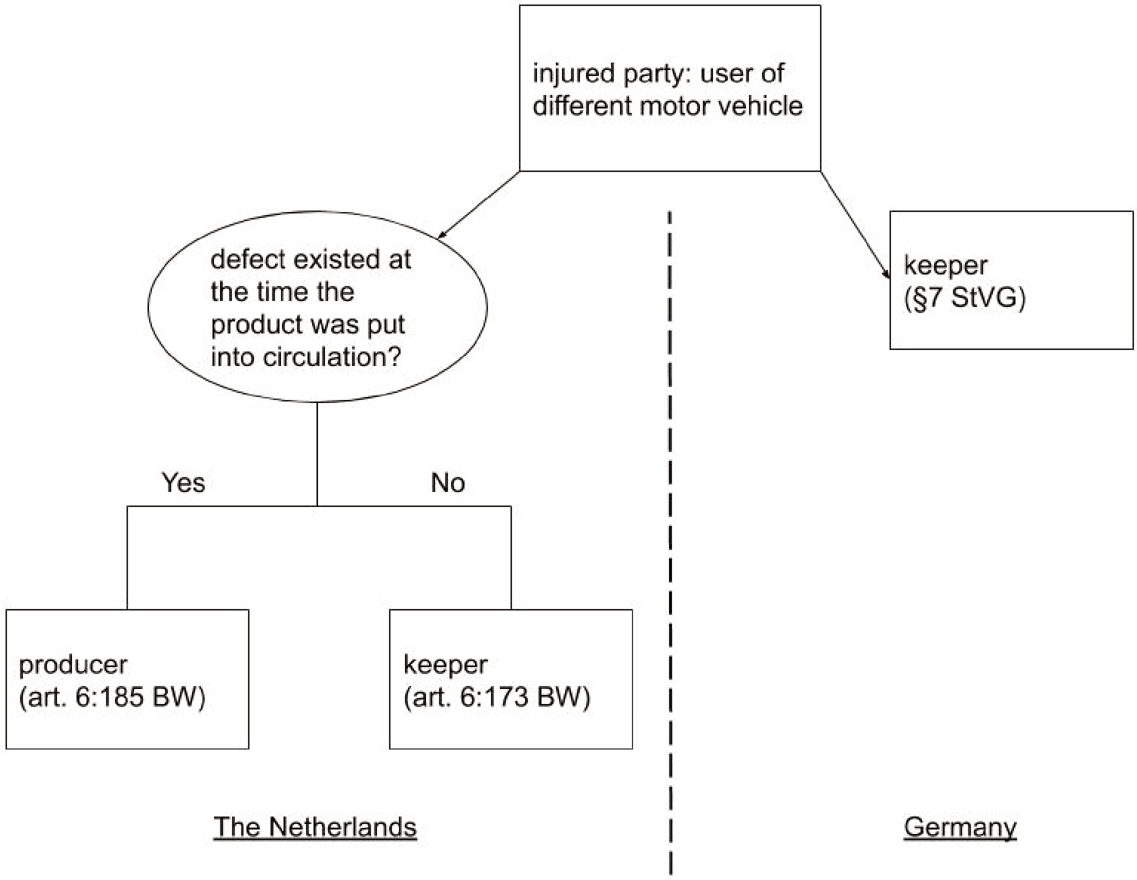

Table 1. *Comparison of the Dutch and German liability regimes concerning the question of who the injured party (the user of a vehicle) can hold liable for his damage caused by an automated vehicle SAE Level 5.*

These examples from Dutch and German law show that a derogation from art. 7(e) of the Product Liability Directive does not have the same consequences or urgency in each Member State from the perspective of the injured party. As discussed, a derogation from art. 7(e) of the Directive is nevertheless desirable as it places the development risk with the producer, which is the stakeholder with the most influence over the risk.[3] Therefore, a derogation from the development risk defence of art. 7(e) of the Product Liability Directive in the context of automated driving is advisable.

[3] See also European Commission, 'Evaluation of Council Directive 85/374/EEC on the approximation of laws, regulations and administrative provisions of the Member States concerning liability for defective products FINAL REPORT' (January 2018) 38, 83.

6 On Automated Driving, Type-approval, Road Authorities and Liability: a Dutch Example

A Dutch version of this chapter was previously published in the Nederlands Juristenblad (NJB): NE Vellinga, 'Zelfrijdende auto's en aansprakelijkheidsrisico's voor wegbeheerders' (2019) Nederlands Juristenblad 2213

Abstract: When discussing liability for damage caused by automated vehicles, the focus is often on the producer of the vehicle, its owner or the user of the vehicle. The legal positions of these actors will change with the development of automated vehicles, but so does the legal position of the road authorities. In this contribution, the liability of road authorities for damage caused by automated vehicles will be explored. An example from Dutch tort law will illustrate the changing liability risks for road authorities and the influence of the type-approval on the legal position of the road authorities.

6.1 Introduction

Although automated vehicles are expected to be significantly safer than human drivers, accidents with automated vehicles will happen. This raises the question of who can be held liable for the damage caused by an automated vehicle, and thus who has to pay damages. This could be the manufacturer of the vehicle, its owner or the user of the automated vehicle, all depending on specific circumstances. This chapter, however, will explore the legal position of the road authority. An example from Dutch tort law will illustrate that, depending on the specific circumstances, the road authority can be held liable for damage caused by an automated vehicle. The type-approval of the automated vehicle plays a significant role in the legal position of the road authority. This influence of the type-approval of the automated vehicle has consequences for the road authority that greatly exceed the influence of the type-approval of a conventional vehicle on the liability risks of the road authorities. The aim of this chapter is to highlight the liability risks for road authorities and the influence of the type-approval of the automated vehicle therein.

6.2 Type-approval

Vehicles, conventional and automated, need to be approved before they are allowed to be driven down public roads within the European Union.[1] Vehicles have to meet a multitude of (technical) requirements. A particular vehicle can be granted individual approval, or a type of vehicle can be granted type-approval by an approval authority. In the future, the approval of automated vehicles could come with certain conditions. For example, the approval is only granted for use on specific roads (e.g. highways). Especially when these sort of conditions regarding use are tied to the approval, it should be recognized that the approval has been granted against the background of certain expectations of the infrastructure. This raises the question of what influence the type-approval has on the liability of the road authority when the approved automated vehicle causes damage.

6.3 The Liability of the Road Authority: a Dutch Example

6.3.1 An Example

An example: an automated vehicle has been certified by an approval authority and type-approval has been granted only for its use on highways. The automated vehicle in question needs good visible lane markings, which is known to the approval authority. Someone uses the approved automated vehicle on a highway, in

[1] Directive 2007/46/EC.

conformity with the conditions of the approval. The lane markings, however, are somewhat worn down on a part of the highway. The approved automated vehicle, that is not designed to deal with worn down lane markings, gets disoriented because of the worn down lane markings. The vehicle starts to swerve and collides with an oncoming vehicle. The user of the automated vehicle gets injured. Can the user hold the road authority liable for his damage?

6.3.2 The Liability of a Road Authority Under Dutch Tort Law

Many jurisdictions are familiar with the concept of liability of the road authority.[2] Given the length of this chapter, only Dutch tort law will be discussed here. Under art. 174 para 2 of book 6 of the Dutch Civil Code (Burgerlijk Wetboek, or BW), a road authority has to ensure that the public road is in good condition, or is liable for damage caused if the road does not meet the standards which in the given circumstances could be set for such roads. If a road does not offer the safety one is entitled to expect, the road is defective and the road authority will be liable for the damage caused by that road.[3] This is a strict liability, and as such it does not require a fault of (or knowledge of the defect by) the road authority. Which standards could be set for roads used by automated vehicles?

6.3.3 The Influence of the Type-approval

This is where the (type-)approval comes into play. The approval is granted to a vehicle that has been tried and tested. The approval authority is the authority of a Member State (Directive 2007/46/EC).[4] This gives rise to the expectation by the user of the approved vehicle that this automated vehicle can be used safely within the boundaries set by the (type-)approval. This is a justified expectation.

In the example discussed above, the approval has been granted to the automated vehicle that is unable to function properly without visible lane markings. The approval has been granted against the background of a certain infrastructure, in this case of good visible lane marking on highways. The approval has been granted for the use on highways. This approval sets the standard that could be expectedfrom the road which the vehicle has been approved for, and gives rise to the user's expectation that the automated vehicle can function safely on the approved roads. As a consequence, the

---

[2] Cees van Dam, *European Tort Law* (2nd edn, Oxford University Press 2013).

[3] Arlette JJG Schrijns, Christa PJ Wijnakker 2013. 'Aansprakelijkheid van de wegbeheerder ex art. 6:174 BW' in Cees van Dam (ed), *Aansprakelijkheid van de wegbeheerder* (ANWB, The Hague 2013).

[4] See for the Netherlands: Rijkswaterstaat, 'Wegbeheerders' <www.rijkswaterstaat.nl/kaarten/wegbeheerders.aspx> accessed 31 July 2019.

highway with the worn down lane markings does not meet the standards which in these circumstances could be set for such a highway. Therefore, the road authority can be held liable ex art. 6:174 of the Dutch Civil Code for the damage caused by the automated vehicle from the example.

6.4 Conclusion

This example from Dutch Law illustrates the effect that the type-approval will have on tort law due to the development of automated vehicles. The type-approval will set the standards for the liability of the road authority. This is a new development triggered by the development of automated vehicles. Both approval authorities and road authorities should be aware of this development and its effect on the liability risks for road authorities, which shall require special coordination between the two authorities.

Epilogue: (Type-)approval and Liability Risks

Although the focus of this research is on traffic law and tort law, the EU General Data Protection Regulation (GDPR)[1] can offer some inspiration as to how to approach liability challenges. The GDPR can serve as a model on how to approach questions of liability of the different stakeholders in automated driving. It can thereby provide more clarity on the liability risks of, for instance, public authorities, the producer of the automated vehicle, and the user of the automated vehicle.

The General Data Protection Regulation came into force in May 2018, thereby repealing Directive 95/46/EC, or Data Protection Directive.[2] The GDPR was deemed necessary in order to combat fragmentation in the way data protection was implemented and to overcome challenges posed by rapid technological developments, in order to "(…) allow the digital economy to develop across the internal market, put individuals in control of their own data and reinforce legal and practical certainty for economic operators and public authorities."[3]

The GDPR entails a number of principles on the collecting and processing of personal data and special categories of data. Personal data is defined as "any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person(…)."[4] In addition, a number of special categories of personal data are identified in Article 9 of the GDPR. One such special category of personal data is data concerning health.[5] This

---

[1] 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 (General Data Protection Regulation) [2016] OL J 119/1

[2] See on the differences between the GDPR and the Data Protection Directive: W. Gregory Voss, 'European Union Data Privacy Law Reform: General Data Protection Regulation, Privacy Shield, and the Right to Delisting' (Winter 2016-2017) 72 The Business Lawyer 221.

[3] Para I of the Explanatory Memorandum to the Proposal for a Regulation of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) COM (2012) 011 final, Recitals 6 and 7 GDPR.

[4] Article 4 (1) GDPR.

[5] Article 9 (1) GDPR.

category is of special interest in the situation described above, where cameras are tracking the physical state of the driver.[6]

The GDPR requires a data protection impact assessment "where a type of processing in particular using new technologies, and taking into account the nature, scope, context and purposes of the processing, is likely to result in a high risk to the rights and freedoms of natural persons"[7] The data protection impact assessment entails an assessment of the impact of the envisaged processing operations on the protection of personal data. The origin, nature, particularity and severity of the risk to the rights and freedom of natural persons should be evaluated in particular.[8] Based on the assessment, appropriate measures should be taken to bring the processing of personal data in conformity with the GDPR.[9] In addition, data protection by design and data protection by default are two tools to assist in reaching the appropriate level of data protection.[10] Given Article 25 (1) GDPR, data protection by design requires one to consider data protection from the very first steps of designing a system that processes (personal) data. Data protection by default entails "measures for ensuring that, by default, only personal data which are necessary for each specific purpose of the processing are processed."[11] These tools could also offer a new approach for challenges concerning liability for damage caused by an automated vehicles.

Similarly to concept of the privacy by design within the General Data Protection Regulation, almost a sort of 'liability by design' could be incorporated into the technical requirements that need to be met in order for the (type-)approval of a vehicle to be awarded, thereby taking into account liability issues within the design stages of the development of automated vehicles.[12] By clearly distinguishing the different roles held by each stakeholder, and requiring that it be technological impossible for one stakeholder to perform the role of another, or to perform their own role only partially, the requirements for the (type-)approval could provide clarity on the legal positions of the stakeholders involved. For instance, by equipping a SAE

---

[6] See on this topic: Trix Mulder, Nynke E Vellinga, 'Handing over the wheel, giving up your privacy?' (13th ITS European Congress, Eindhoven, June 2019).
[7] Article 35 (1) GDPR.
[8] Recital 84 GDPR.
[9] Recital 84, 90 GDPR.
[10] Article 25 GDPR.
[11] Article 25 (2) GDPR.
[12] This includes the UNECE Regulations to which the Community has acceded: art. 34, 35 Directive 2007/46/EC.

Level 5 vehicle with an unnecessary steering wheel, an unqualified user might try to drive the vehicle himself in an attempt to avoid an accident. If the user then causes damage, a discussion could arise on whether the user or the producer should be liable now that the vehicle was apparently in a dangerous situation and on whether the user should have interfered. Is the vehicle defective now that it has an unnecessary feature, or should the vehicle have brought itself to a safe stop? Should the vehicle authority have approved an SAE Level 5 vehicle with an unnecessary steering wheel or should the users of SAE Level 5 vehicles be qualified to drive manually? Instead, a technical requirement could be set that only vehicles of a lower level of automation need to have a steering wheel. An SAE Level 5 vehicle could then only be approved if it does not have a steering wheel but is equipped with an emergency brake, for example. The position of the user would then be comparable with the position of the passenger of, for instance, a train. There is an emergency brake for emergency situations, such as when someone gets stuck between the doors, but the user does not have to keep a lookout or take over the driving tasks from the automated driving system. It has been made physically impossible for the user to drive the vehicle himself. If damage is then caused by the vehicle, this will likely be because of a problem with the automated driving system and therefore is a matter of liability of the producer, not of the user of the vehicle.

The question of which stakeholder has a duty to prevent an automated vehicle with a safety-critical defect from driving on public roads can be resolved, in the same manner, by the technical standards set for the (type-)approval of the vehicle. Instead of confronting the user of the vehicle with the heavy burden of checking the automated vehicle for safety-critical, even invisible, defects, it should be required that an automated vehicle is equipped with a fail-safe. This fail-safe prevents the vehicle from driving when there is a safety-critical defect, or brings the vehicle to a safe stop if during the trip a safety-critical defect occurs. An automated vehicle should not be approved for use on public roads without such a fail-safe. This requirement also means that discussions on whether the user should have checked the vehicle for defects before driving off and how far this duty goes (should the user also check whether the latest software update has been installed?) are avoided. Questions on whether, if the vehicle causes damage due to a safety-critical defect, the user is liable as he did not notice the defect or whether the producer should be held liable as the vehicle is apparently unsafe, are also avoided. This illustrates how the (type-)approval can be used as a tool to provide clarity on the liability risks of stakeholders.

In addition, the data protection impact assessment of Article 35 of the GDPR also offers inspiration. As this research has shown, the legal positions of different stakeholders will change. What this change will look like will highly depend on national tort law. Therefore, it is advisable for governments to identify the consequences for the liability of the different stakeholders. Similar to the data protection impact assessment, governments could carry out a 'liability impact assessment' which would entail an assessment of the liability risks of the stakeholders involved in automated driving. This should help identify any lacunas in the applicable tort law and should clarify which legal changes are necessary on a national level in order to avoid problems in applying tort law to cases concerning this new technology. The liability risks of governmental institutions should become clear by conducting such an assessment. This assessment should, by identifying the liability risks of the various stakeholders, provide clarity on which risks should be insured. Thereby, a 'liability impact assessment' could benefit all stakeholders involved.

In addition to the GDPR as model to approach liability questions, the protection of the data gathered by the vehicle is governed by the GDPR. Data protection is becoming increasingly important to the development of automated vehicles. As these vehicles will be equipped with numerous sensors and cameras, automated vehicles are expected to collect as much as one terabyte of data per day.[13] The importance of these data has been underlined by recent developments and is especially relevant in the near future for automated vehicles of SAE Levels 2-4. Vehicles of these levels still have (at least for part of the trip) a driver within the meaning of the Geneva Convention and Vienna Convention. Volvo has recently announced it is planning to equip its vehicles with in-vehicle cameras to monitor the driver of a vehicle to in order to establish whether the driver is distracted or intoxicated.[14] If the driver is intoxicated or distracted, has ignored warnings and risks causing a serious accident, the vehicle will interfere. The vehicle will do so by, for instance, reducing its speed or

[13] Leslie Hook, 'Driverless cars: mapping the trouble ahead' (*Financial Times*, 21 February 2018) <www.ft.com/content/2a8941a4-1625-11e8-9e9c-25c814761640> accessed 4 July 2019; Stan Dmitriev, 'Autonomous cars will generate more than 300 TB of data per year' <www.tuxera.com/blog/autonomous-cars-300-tb-of-data-per-year/>accessed 4 July 2019.
[14] 'Volvo Cars targets better driving behaviour. 'Volvo Cars to deploy in-car cameras and intervention against intoxication, distraction' (23 April 2019) <www.volvocars.com/au/about/australia/i-roll-enewsletter/2019/april/volvo-cars-targets-better-driving-behaviour> accessed 3 September 2019.

even by bringing the vehicle to a safe stop.[15] It goes beyond the scope of this thesis to further explore data protection challenges for automated vehicles.

As shown above, the GDPR offers a model to approach the liability questions arising from the development of automated vehicles. Through a 'liability impact assessment' the liability risks of the stakeholders involved can be identified, whereas a 'liability by design' approach takes those liability risks into account in the design of the automated vehicle.

[15] 'Volvo Cars targets better driving behaviour. Volvo Cars to deploy in-car cameras and intervention against intoxication, distraction' (23 April 2019) <www.volvocars.com/au/about/australia/i-roll-enewsletter/2019/april/volvo-cars-targets-better-driving-behaviour> accessed 3 September 2019.

7 Conclusion

7.1 Main findings

All of the previous chapters and epilogues have contributed to answering the main research question:

Are legislative measures concerning traffic laws and civil liability needed in order to facilitate the deployment of self-driving cars on public roads within the EU, and if so, which legislative measures concerning traffic laws and civil liability should be taken?

The various chapters have revealed shortcomings in accommodating automated driving in both traffic law and civil liability. In addition, the preferred solutions for these shortcomings and the necessary steps to implement the solution have been proposed.

7.1.1 The Geneva Convention and Vienna Convention Are Not Compatible With Automated Driving

The notion of *driver* within both the 1949 Geneva Convention on Road Traffic and the 1968 Vienna Convention on Road Traffic does not accommodate automated driving (section 3.3.2). *Driver*, within the meaning of the Conventions, is a human who decides on the speed and direction of a vehicle by operating (some of) the controls of the vehicle (section 3.2.4). Therefore, an SAE Level 5 vehicle is driverless within the meaning of the Conventions. The preferred approach to overcome this problem is the *functioneel daderschap* approach (freely translated: *vicarious perpetrator* approach, section 3.8). This approach entails that the automated driving system drives the automated vehicle, and the acts of the automated driving system are regarded as being the acts of the (legal) person who has the power to dispose over the conduct of the automated driving system. The *functioneel daderschap* approach requires only one amendment to be made to each of the Conventions: the definition of driver needs to be deleted (art. 4 paragraph 1 Geneva Convention, art. 1(v) of the Vienna Convention). This can be done via the amendment procedures of both Conventions (art. 31 Geneva Convention, art. 49 Vienna Convention), whereby one of the Contracting Parties can propose an amendment. The traffic rules directed at the driver can remain as they are. If the amendment is accepted and therefore the definition of *driver* is deleted, the *functioneel daderschap* approach further enables a flexible interpretation of the notion of *driver* in both Conventions. Depending on the exact circumstances, a driver can be the automated driving system or a human (in case of a conventional vehicle). The driver can even change, for instance, in an SAE Level 4 vehicle where the driving task is performed by the automated driving system during part of the trip, and by a human during the other part. This also illustrates that the *functioneel daderschap* approach is suitable for a future where vehicles of different levels of automation share the road. In addition, the *fuctioneel daderschap* approach offers a clear framework on responsibility for the conduct of the vehicle.

7.1.2 Software should be a Product within the Meaning of the EU Product Liability Directive

Another legal instrument that is challenged by the development of automated vehicles is, as discussed in Chapter 5, the Product Liability Directive (Directive 85/374/EEC). An important discussion point in literature is whether software should be regarded to be a product within the meaning of art. 2 of the Directive (section 5.5). If software is being regarded as a product, then the producer of a software update for the automated vehicle can be held liable for damage caused by a defective software update. This is in line with the level of consumer protection offered by the Product Liability Directive.[1] The EU Court of Justice will need to decide on the status of software under the Product Liability Directive. Whether software is a product within the meaning of the Directive is a matter of interpretation, as it does not require any changes to the Directive itself.

7.1.3 Two Defences of the Producer Lead To Undesirable Results

Two of the defences that the Product Liability Directive offers to the producer lead to undesirable results when applied to scenarios related to automated driving. The outcomes are not in line with the level of consumer protection offered by the Directive.

The defence of art. 7(b) of the Product Liability Directive could lead to an undesirable result when applied to a situation such as when an automated vehicle gets a software update from the producer of the automated vehicle (long) after the vehicle has been put into circulation (section 5.7.1). The software update could turn out to be defective, when it causes damage. In this scenario, the producer of the automated vehicle could avoid liability by invoking the defence of art. 7(b) of the Directive: "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 (…)." Subsequently, the injured party would not be compensated for their damage and – depending on national tort law – and could be left without compensation entirely. This is not acceptable as this outcome is not in line with the Product Liability Directive's aim of ensuring consumer

[1] Recitals Product Liability Directive.

protection. To achieve this aim of consumer protection, the defence of art. 7(b) of the Directive should be interpreted in line with its rationale. This means that as long as a producer can exercise (substantial) influence over his product, as is the case with software updates, the producer should not be able to successfully invoke the defence of art. 7(b) of the Product Liability Directive.

The defence of art. 7(e) of the Product Liability Directive, the development risk defence, also leads to undesirable results in the context of automated driving (section 5.7.2). If the producer successfully invokes the development risk defence, then the development risk of the automated vehicle is put onto the shoulders of the random road users injured by the automated vehicle. As the development of automated vehicles should benefit society as a whole, it is not acceptable that a random victim carries the burden of the development risk. Therefore, Members States should derogate from the development risk defence of art. 7(e) of the Product Liability Directive. Article 15(1)(b) of the Directive offers Members States this possibility. This requires legislative measures by the individual Member States.[2]

7.1.4 The Influence Of The (Type-)approval Of A Vehicle On Liability Risks Will Increase

In this day and age of conventional vehicles, the (type-)approval of a (type of) vehicle has very limited, if any, influence on the liability risks of the stakeholders involved. This will change with the development of automated vehicles. Where the liability of stakeholders is affected by the justified expectations of users, the (type-)approval will have an increased influence on the liability risks of those stakeholders. This is because the (type-)approval shapes the justified expectations of the users, as shown in section 5.6 for the producer and section 6.3.3 for the road authority. The (type-)approval sets expectations for the functioning of the vehicle itself, when it has been approved for use on certain roads and under certain conditions. For instance, if the automated vehicle is approved for use during rain, this raises the justified expectation of the user that the vehicle is capable of driving fully automated during rain without a problem. If the automated vehicle then causes damage, it does not meet the justified expectations, which can contribute towards establishing whether the automated vehicle is a defective product within the meaning of art. 6 of the Product Liability Directive (section 5.6). Thereby, the (type-)approval influences the liability risks of the producer of the automated vehicle. The (type-)approval has not this great an

[2] After the completion of this thesis, the European Commission published the report 'Liability for Artificial Intelligence and other emerging digital technologies', written by the Expert Group on Liability and New Technologies - New Technologies Formation. This report underlines the findings of this thesis.

influence when it comes to conventional vehicles, as this would not entail the conditions (weather, roads, etc) under which the conventional vehicle can function. Besides, a conventional vehicle has a human driver that should act in unsafe conditions. Consequently, the (type-)approval of a conventional vehicle does not shape the expectations of the users to the extent the (type-)approval of an automated vehicle does. The increased influence of the (type-)approval of automated vehicles on the liability risks of the producer are illustrated by Table 1 and Table 2, where Table 1 shows the situation for the producer of a conventional vehicle and Table 2 the situation for the producer of an automated vehicle.

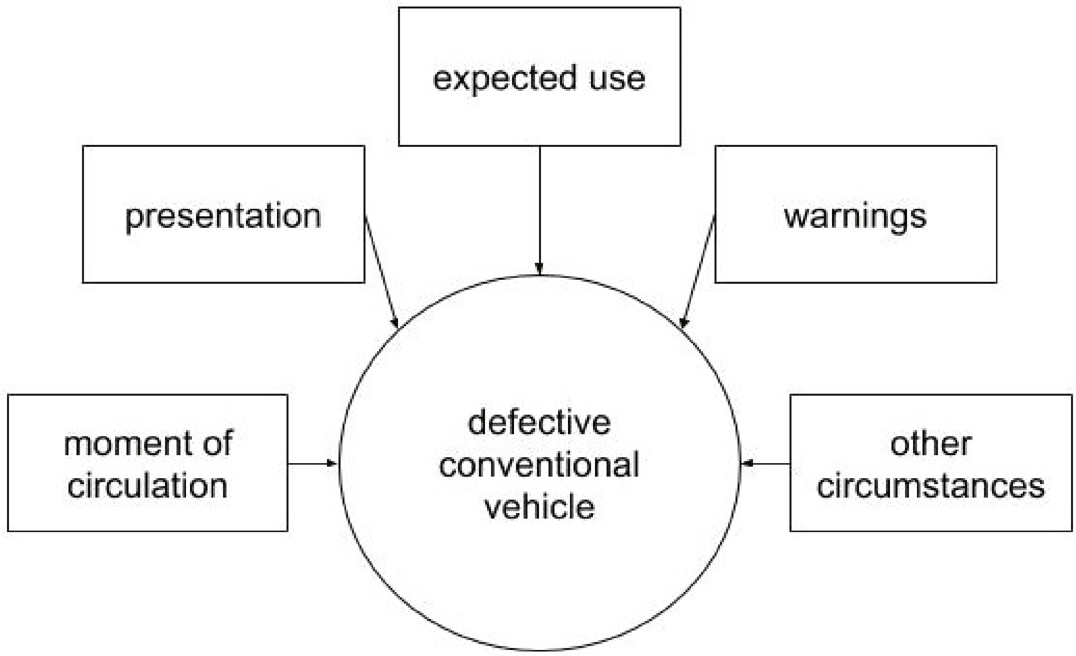

Table 1. Circumstances that can be taken into account when establishing whether a conventional vehicle is defective within the meaning of art. 6 of the Product Liability Directive.

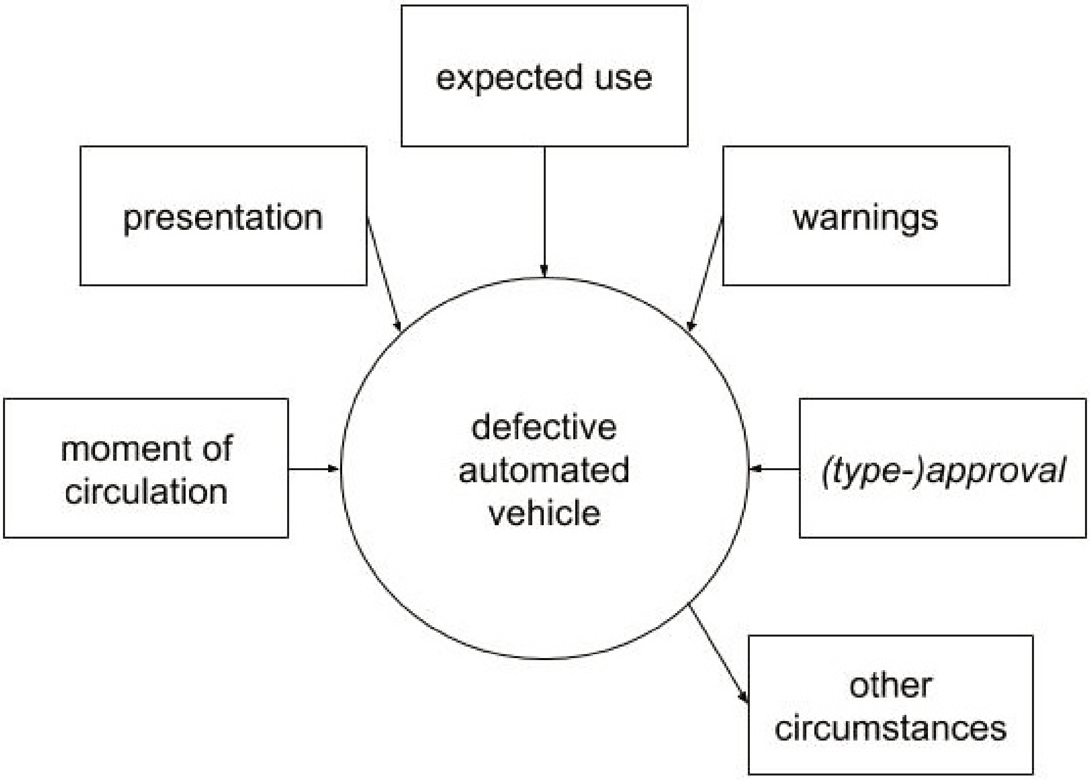

Table 2. *Circumstances that can be taken into account when establishing whether an automated vehicle is defective within the meaning of art. 6 of the Product Liability Directive.*

The influence of the (type-)approval is also relevant for the liability risks of the road authority, as the (type-)approval can also set expectations for the conditions of the infrastructure for which the vehicle has been approved, for instance, the state of maintenance of the road. If the vehicle is approved for use on a specific kind of road, this gives rise to the expectation that the road fulfils the requirements for the approved automated vehicle to function. If the road does not meet these expectations, and consequently the vehicle causes damage, then the road authority can be held liable if the justified expectations of the user of the vehicle play a part in establishing liability (as it does in the Netherlands, see section 6.3).

This illustrates how the liability risks of stakeholders, like the producer and the road authority, are influenced by the (type-)approval. This is a new development evoked by the development of automated vehicles. In addition, like with the (type-)approval of conventional vehicles, the vehicle authority could, depending on national tort law, be held liable for wrongly approving a vehicle. The influence of the (type-)approval on the liability risks of different stakeholders is illustrated by Table 3.

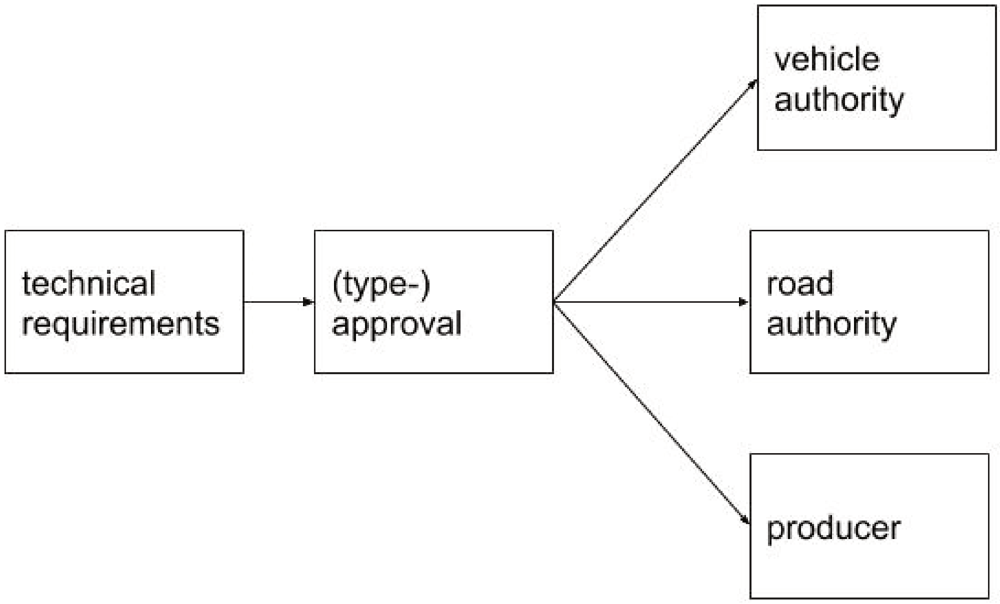

Table 3. *The relationship between the technical regulations, the (type-)approval and the liability risks of the stakeholders discussed in this thesis.*

7.2 Additional Findings

This research has also resulted in several additional findings. It brought to light the increased impact of the (type-)approval of automated vehicles on the liability risks of the stakeholders involved in automated driving, notably the producer (Chapter 5) and the road authority by means of a Dutch example (Chapter 6). In addition, the (type-)approval can also be seen as a tool to provide clarity on the roles of the stakeholders involved in automated driving. A sort of 'liability by design' could be achieved by laying down technical requirements that need to be met in order to be awarded the (type-)approval, that take away any discussions on the roles of stakeholders in liability questions (Epilogue to Chapter 6). For instance, by requiring an SAE Level 5 not to have a steering wheel, the user of the vehicle cannot interfere with the driving, thereby avoiding questions on who did what with regards to the steering of the vehicle in the moments before an accident.

In addition, a 'liability impact assessment' is advisable (Epilogue to Chapter 6). This 'liability impact assessment' should be done by governments in order to provide clarity on the liability risks of all of the stakeholders involved in automated driving, including governmental bodies. This approach is based on the data protection impact assessment from the GDPR, which entails an assessment of the impact of the envisaged processing operations on the protection of personal data. A liability impact assessment should provide clarity on the liability risks of the stakeholders and thereby on the risks that should be insured.

In the context of insurance, the notion of *driver* needs clarification (Epilogue to Chapter 3). Given art. 12 (1) of the EU Motor Insurance Directive, the mandatory motor vehicle insurance should cover liability for personal injuries to all passengers, but not the *driver*, arising out of the use of a vehicle. So, the notion of *driver* is not only of importance for the Geneva Convention and Vienna Convention, but also for the Motor Insurance Directive. If the user is the driver of the automated vehicle within the meaning of this Directive, then the user will not get their damage compensated.

7.3 Further Research: The Road Ahead

This research has shown the legislative steps concerning the 1949 Geneva Convention on Road Traffic, the 1968 Vienna Convention on Road Traffic, and the Product Liability Directive that need to be taken in order to accommodate automated driving and to provide desirable outcomes in the context of automated driving. Furthermore, the influence of the (type-)approval[3] on the liability risks should not be underestimated. Using approaches based on the General Data Protection Regulation's data protection impact assessment and privacy by design, the liability risks of the different stakeholders should be investigated and these risks should also be influenced through privacy by design, via the technical requirements automated vehicles need to meet in order to be (type-)approved. By implementing the discussed actions and approaches, the Geneva Convention, Vienna Convention and the Product Liability Directive will provide for a future with automated driving. There is, however, the need for further research.

In this thesis, the notion of *driver* in the context of the 1949 Geneva Convention on Road Traffic and the 1968 Vienna Convention on Road Traffic was studied. There is, in addition, a need to study the notion of *driver* in the context of insurance, more specifically the definition of *driver* in the EU Motor Insurance Directive. Moreover, whether a different system of insurance would lead to a more desirable result in regards to automated driving needs further research. First-party insurance, instead of third-party insurance, could avoid confronting the injured party with the question of

[3] Directive 2007/46/EC.

who is liable for the damage caused by an automated vehicle. The UK Automated and Electric Vehicles Act of 2018 underlines this need to explore first-party insurance and other systems of insurance for automated vehicles. [4]

Likewise, more research in the field of tort law is necessary. This thesis has focused on SAE Level 5 vehicles, whereas SAE Level 3 and 4 also pose challenges for liability regimes. Specifically, the situation in which the automated vehicle warns the (then) user to take over the driving tasks as an event which is unmanageable for the automated driving system nears, poses a challenge. When does the liability shift from the producer to the user/driver of the vehicle? Is this the moment the take-over request is issued, when the user puts their hands on the wheel and becomes the driver, or was the use of the automated system from the start at the user's risk? Furthermore, if it turns out that automated vehicles will depend on communication with the infrastructure, so-called V2I communication, or with other vehicles, so-called V2V communication, questions arise on the liability for damage caused by the latency of the communication network or the information that is provided.

In addition, the research on the (type-)approval should continue. This research brought to light the importance of the (type-)approval in tort law. Further research is needed to explore the feasibility and desirability of the (type-)approval as a tool to achieve 'liability by design'. Also, the outcome in the discussion on moral dilemmas – who to save in case of an unavoidable accident – could lead to new requirements being set in order for vehicles to be awarded a (type-)approval.[5] For instance, approval of a vehicle could be denied if the vehicle is programmed to always save its passengers if it is determined, following the results of the ongoing ethical discussions or given a determination from the government, that it is undesirable for it to do so. These new requirements based on the outcomes of the discussions on moral dilemmas could very well differ per country, as research has shown variations in ethics for programming automated vehicles.[6]

---

[4] See more extensively Chapter 2.

[5] See for instance Independent High-Level Expert group on Artificial Intelligence set up by the European Commission, 'Ethics Guidelines for Trustworthy AI' (8 April 2019); Ethik-Kommission, 'Automatisiertes und Vernetztes Fahren' (Bericht eingesetzt durch den Bundesminister für Verkehr und digitale Infrastruktur, Juni 2017); 'MIT Moral Machine' <http://moralmachine.mit.edu/> accessed 14 August 2019; Edmond Awad and others, 'The Moral Machine experiment' (2018) 563 Nature volume 59.

[6] Edmond Awad and others, 'The Moral Machine experiment' (2018) 563 Nature volume 59.

Table of Cases

European Court of Justice

Case C-127/04 *O'Byrne v Sanofi Pasteur MSD Ltd and Sanofi Pasteur SA* [2006] ECR I-01313

Case C203/99 *Henning Veedfald v Århus Amtskommune* [2001] ECR I-03569

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

European Court of Human Rights

Tyrer v. United Kingdom App no 5856/72 (ECtHR, 25 April 1978)

Court Benelux/Beneluxhof

Court Benelux/Beneluxhof 8 December 1994, A 93/5 (Assurance Liégeoise/Adam), NJ 1995/529

National level

<u>The Netherlands</u>

Hoge Raad (HR)

HR 16 April 1942, NJ 1942/394 (Torenbout-arrest)

HR 23 February 1954, NJ 1954/378 (ijzerdraad-arrest)

HR 2 February 1965, ECLI:NL:HR:1965:AB3467, NJ 1965/281

HR 26 January 1971, ECLI:NL:HR:AB5997, NJ 1971/208

HR 6 April 1979, NJ 1980/34, m. nt. C.J.H. Brunner

HR 1 December 1987, ECLI:NL:HR:1987:AB7814, NJ 1988/689

HR 12 June 1990, ECLI:NL:HR:1990:ZC8550, NJ 1991/29, VR 1990/158

HR 2 October 1990, ECLI:NL:HR:1990:ZC8593, NJ 1991/380

HR 14 January 1992, NJ 1992/413

HR 23 February 1999, ECLI:NL:HR:1999:ZD348, VR 2000/81

HR 21 October 2003, ECLI:NL:HR:2003:AF7938, NJ 2006/328 (drijfmestarrest) m. nt. P. Mevis

Conclusie A-G Wortel, ECLI:NL:PHR:2003:AF7938

HR 21 October 2003, ECLI:NL:HR:2003:AL3411, VR 2004/36

HR 13 August 2005, ECLI:NL:HR:2005:AT7292, NJ 2005/542

HR 11 November 2005, ECLI:NL:HR:2005:AT6018, NJ 2007/231 m.nt. Vranken

HR 7 October 2016, ECLI:NL:HR:2016:2285, JOR 2016/325 m. nt. B.M. Katan

Hof

Hof Arnhem-Leeuwarden, 31 July 2019, ECLI:NL:GHARL:2019:6122

Rechtbank

Rechtbank Roermond 19 December 1974, ECLI:NL:RROE:1974:AJ4353

Rechtbank Amsterdam 28 January 2003, ECLI:NL:RBAMS:2003:AF3616

Germany

Bundesgerichtshof (BGH)

BGH VI ZR 107/08, 16 June 2009

BGH 4 StR 592/16, 27 April 2017, ECLI:DE:BGH:2017:270417U4STR592.16.0

Table of Treaties, Instruments, and Legislation

Treaties and charters

International Civil Aviation Organization (ICAO), Convention on Civil Aviation (adopted 7 December 1944, entered into force 4 April 1947) 15 UNTS 295

Geneva Convention on Road Traffic (adopted 19 September 1949, entered into force 26 March 1952) 125 UNTS 3

UNECE Regulation No. 79. Uniform provisions concerning the approval of vehicles with regard to steering equipment (adopted 20 March 1958, entered into force 1 December 1988) 1519 UNTS 288

Vienna Convention on Road Traffic (adopted 8 November 1968, entered into force 21 May 1977) 1042 UNTS 17

Inter-Governmental Maritime Consultative Organization, 'Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)' (adopted 20 October 1972, entered into force 15 July 1977) 1050 UNTS 16

Convention on Limitation of Liability for Maritime Claims (adopted 19 November 1976, entered into force 1 December 1986) 1456 UNTS 221

United Nations Convention on the Carriage of Goods by Sea (adopted 31 March 1978, entered into force 1 November 1992) 1695 UNTS 3

EU regulations, directives and decisions

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

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

Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 on road infrastructure safety management (Directive 2008/96/EC) [2008] OJ L319/59

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 (Directive 2009/103/EG [2009] OJ L 263/11

Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor [2009] OJ L 200/1

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 (General Data Protection Regulation) [2016] OL J 119/1

Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices, amending Directive 2001/83/EC [2017] OJ L117/1

Regulation (EU) 2017/746 of the European Parliament and of the Council of 5 April 2017 on in vitro diagnostic medical devices and repealing Directive 98/79/EC and Commission Decision 2010/227/EU [2017] OJ L117/176

National level

<u>The Netherlands</u>

Burgerlijk Wetboek (BW)

Wegenverkeerswet 1994 (WVW 1994)

Besluit van 15 juni 2015 tot wijziging van het Besluit ontheffingverlening exceptionele transporten (ontwikkeling zelfrijdende auto), Staatsblad 2015/248

Besluit van 25 juni 2019, houdende vaststelling van het tijdstip van inwerkingtreding van de Wet van 26 september 2018 tot wijziging van de Wegenverkeerswet 1994 in verband met mogelijk maken van experimenten met geautomatiseerde systemen in motorrijtuigen en het Besluit van 6 december 2018 tot wijziging van het Besluit ontheffingverlening exceptioneel vervoer en het Kentekenreglement in verband met mogelijk maken van experimenten met geautomatiseerde systemen in motorrijtuigen, Staatsblad 2019/240

Tractatenblad 2008, 76

Germany

Straßenverkehrsgesetz (StVG)

Straßenverkehrsordnung (StVO)

Strafgesetzbuch (StGB)

Estonia

Estonian Law of Obligations Act

United Kingdom

Road Traffic Act 1988

Vehicle Technology and Aviation Bill HC Bill (2016-17)143

Automated and Electric Vehicles Act 2018

United States

Federal

Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act or the SELF DRIVE Act (2017-2018)

Arizona

Executive Order 2015-09

Executive Order 2018-04

California

California Vehicle Code (CVC)

California Code of Regulation (CCR)

Senate Bill 1298

Assembly Bill No. 1592, 29 September 2016

Michigan

Senate Bill 995

Senate Bill 996

Senate Bill 997

Senate Bill 998

Nevada

Nevada Administrative Code (NAC)

Texas

Senate Bill 1167

House Bill 933

House Bill 3690

House Bill 4194

Bibliography

Legislative documents, guidelines, opinions and recommendations

United Nations

United Nations Conference on Road and Motor Transport, Committee III on Road Traffic, Summary Record of the Seventeenth Meeting Held at the Palais des Nations, Geneva, on Tuesday, 6 September 1949 at 3 pm (21 November 1949) E/CONF8/CIII/SR17/Rev1

United Nations Economic Commission for Europe (UNECE) Global Forum for Road Safety (Working Party 1 or WP.1)

United Nations Economic and Social Council, 'Consistency between the Convention on Road Traffic (1949) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/1

United Nations Economic and Social Council, 'Consistency between the 1971 European Supplement to the Convention on Road Traffic (1968) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/3

United Nations Economic and Social Council, 'Consistency between the Convention on Road Traffic (1949) and Vehicle Technical Regulations' (10 January 2014) UN Doc ECE/TRANS/WP.1/2014/4

United Nations Economic and Social Council, 'A Safe System Approach' (11 July 2014) UN Doc ECE/TRANS/WP.1/2014/4/Rev.1

United Nations Economic and Social Council, 'Proposal for a new work item on the agenda of the Working Party on Road Traffic Safety' (11 July 2014) UN Doc ECE/TRANS/WP.1/2014/7

United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 April 2014) UN Doc ECE/TRANS/WP.1/145

UN Doc United Nations Economic and Social Council, 'Report of the sixty-eighth session of the Working Party on Road Traffic Safety' (17 July 2014) UN Doc ECE/TRANS/WP.1/145/Corr.1

United Nations, ‘Convention on Road Traffic Vienna, 8 November 1968, Proposal of Amendments to Articles 8 and 39 of the Convention’ (23 September 2014) <https://treaties.un.org/doc/Publication/CN/2014/CN.569.2014-Eng.pdf> accessed 7 December 2016

United Nations Economic and Social Council, ‘Automated Driving’ (28 July 2015) UN Doc ECE/TRANS/WP.1/2015/8

United Nations Economic Commission for Europe, Inland Transport Committee (70th Session), ‘Autonomous Driving Informal document No. 2’ (12 March 2015)

United Nations Economic Commission for Europe Inland Transport Committee (73rd Session) ‘Automated Driving, Informal document No. 2’ (11 July 2016)

United Nations Economic Commission for Europe Inland Transport Committee (73rd Session) ‘Automated Driving, Informal document No. 4’ (14 September 2016)

United Nations Economic and Social Council, ‘Report of the seventy–third session of the Working Party on Road Traffic Safety’ (12 October 2016) UN Doc ECE/TRANS/WP.1/155

United Nations Economic and Social Council, ‘Annotated provisional agenda for the seventy-fourth session’ (10 January 2017) UN Doc ECE/TRANS/WP.1/156

United Nations Economic Commission for Europe, Inland Transport Committee (74th Session), ‘Autonomous Driving Informal document No. 2’ (14 March 2017)

United Nations Economic and Social Council, ‘Global Forum for Road Traffic Safety: resolution on the deployment of highly and fully automated vehicles in road traffic’ (14 January 2019) UN Doc ECE/TRANS/WP.1/2018/4/Rev.3

United Nations Economic Commission for Europe Inland Transport Committee (75th Session) ‘Automated Driving, Informal document No. 8’ (4 September 2017)

United Nations Economic and Social Council, ‘Amendment proposal to Article 8 in the 1968 Convention on Road Traffic’ (9 January 2019) UN Doc ECE/TRANS/WP.1/2019/1

United Nations Economic and Social Council, ‘Discussion document for a package of article-by-article amendments to the 1968 Convention on Road Traffic to support the use of automated vehicles’ (5 July 2019) UN Doc ECE/TRANS/WP.1/2019/7

United Nations Economic and Social Council, 'Report of the seventy-eighth session' (25-29 March 2019) UN Doc ECE/TRANS/WP.1/167

United Nations Economic Commission for Europe World Forum for Harmonization of Vehicle Regulations (Working Party 29 or WP.29)United Nations Economic and Social Council, 'Proposal for the Future Certification of Automated/Autonomous Driving Systems' (19 November 2018) UN Doc ECE/TRANS/WP.29/GRVA/2019/13

United Nations Economic and Social Council, 'Framework document on automated/autonomous vehicles' (15 April 2019) UN Doc ECE/TRANS/WP.29/2019/34

EU level

European Commission, 'Answer of the Commission of the European Communities of 15 November 1988 to Written Question No 706/88 by Mr. Gijs de Vries (LDR, NL) (89/C 114/76)' [1989] OJ C144/42

European Commission, 'Towards a European road safety area: policy orientations on road safety 2011-2020' COM (2010) 389 final

European Commission, 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' (white paper) COM (2011) 144 final

European Parliament Report with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))

Declaration of Amsterdam on Cooperation in the field of connected and automated driving, 14-15 April 2016, available at <https://english.eu2016.nl/documents/publications/2016/04/14/declaration-of-amsterdam> accessed 11 April 2017 (Declaration of Amsterdam 2016)

European Commission, 'Amended proposal for a Directive of the European Parliament and of the Council on certain aspects concerning contracts for the online and other distance sales of goods, amending Regulation (EC) No 2006/2004 of the European Parliament and of the Council and Directive 2009/22/EC of the European Parliament and of the Council and repealing Directive 1999/44/EC of the European Parliament and of the Council' COM (2017) 637 final, 31 October 2017

European Commission, ‘Evaluation of 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’ (Commission Staff Working Document) SWD (2018) 157 final

European Commission, ‘Liability for emerging digital technologies’ (Commission Staff Working Document) SWD (2018) 137 final

European Commission, ‘Artificial Intelligence for Europe’ COM (2018) 237 final

European Commission, ‘Annex 1: ’Strategic Action Plan on Road Safety’ COM (17 May 2018) 293 final

European Commission, ‘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

European Commission, ‘On the road to automated mobility: An EU strategy for mobility of the future’ (Communication from the Commission) COM (2018) 283 final

EU Committee on Transport and Tourism, ‘Report on autonomous driving in European transport (2018/2089(INI))’ (European Parliament 2018) <www.europarl.europa.eu/doceo/document/A-8-2018-0425_EN.html> accessed 1 May 2019

EU Committee on Transport and Tourism, ‘Report on the proposal for a directive of the European Parliament and of the Council amending Directive 2008/96/EC on road infrastructure safety management (COM(2018)0274 – C8-0196/2018 – 2018/0129(COD))’ (11 January 2019)

Independent High-Level Expert group on Artificial Intelligence set up by the European Commission, ‘Ethics Guidelines for Trustworthy AI’ (8 April 2019)

European Commission Press Release, ‘Road safety: Commission welcomes agreement on new EU rules to help save lives’ (26 March 2019) <https://europa.eu/rapid/press-release_IP-19-1793_en.htm> accessed 10 September 2019

European Commission, ‘Guidelines on the exemption procedure for the EU approval of automated vehicles’ (5 April 2019) <https://ec.europa.eu/docsroom/documents/34802> accessed 1 May 2019

European Commission Expert Group on Liability and New Technologies - New Technologies Formation, 'Liability for Artificial Intelligence and other emerging digital technologies' (21 November 2019) <https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupMeetingDoc&docid=36608> accessed 21 November 2019

EU Legislative proposals and resolutions

Proposal for a Regulation of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) COM (2012) 011 final

European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)) [2017]

European parliament and the Council, 'Proposal for a Regulation of the European Parliament and of the Council 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/… and repealing Regulations (EC) No 78/2009, (EC) No 79/2009 and (EC) No 661/2009' COM (2018) 286 final

European Parliament resolution of 12 February 2019 on a comprehensive European industrial policy on artificial intelligence and robotics (2018/2088(INI)) [2019]

National level

<u>The Netherlands</u>

Kamerstukken II 2014/2015, 31305, 210

Kamerstukken II 2017/18, 34838, 4

Kamerstukken II 2014/15, 33009, 10

Kamerstukken II 2014/15, 31305, 212

Netherlands Ministry of Infrastructure and Water Management, ‘Draft for Internet consultation, Amendment of the Road Traffic Act 1994 in connection with the enabling of experiments with automated systems in vehicles’ (overheid.nl, July 2016) <www.internetconsultatie.nl/experimenteerwet_zelfrijdendeauto> accessed 12 January 2017

Netherlands Ministry of Infrastructure and Water Management, ‘Reacties op de internetconsultatie Experimenteerwet zelfrijdende auto’ (overhejd.nl, 7 July 2016 – 1 September 2016) <www.internetconsultatie.nl/experimenteerwet_zelfrijdendeauto> accessed 12 January 2017

France

Question N° 15677, de M. de Chazeaux Olivier, Question publiée au JO le 15/06/1998 page 3230; Réponse publiée au JO le 24/08/1998 page 4728

United Kingdom

Department for Transport, ‘The Pathway to Driverless Cars: A Code of Practice for testing’ (2015)

Centre for Connected & Autonomous Vehicles, ‘Pathway to Driverless Cars: Proposals to support advanced driver assistance systems and automated vehicle technologies’ (July 2016)

Centre for Connected & Autonomous Vehicles, ‘Pathway to Driverless Cars: Consultation on proposals to support Advanced Driver Assistance Systems and Automated Vehicles, Government Response’ (January 2017)

Law Commission (Consultation Paper No 240, 2018) and Scottish Law Commission (Discussion Paper No 166, 2018), *Automated Vehicles. A joint preliminary consultation paper*

Law Commission and Scottish Law Commission (2019), *Automated Vehicles: Analysis of Responses to the Preliminary Consultation Paper. Analysis of Responses to LCCP No 240/SLCDP No 166*

United States

Federal

National Highway Traffic Safety Administration, ‘Preliminary Statement of Policy Concerning Automated Vehicles’ (2013)

U.S. Department of Transportation/National Highway Traffic Safety Administration, ‘Federal Automated Vehicles Policy’ (September 2016) <www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016> accessed 18 April 2017

U.S. Department of Transportation/National Highway Traffic Safety Administration, ‘Fact Sheet AV Policy Section I: Vehicle Performance Guidance for Automated Vehicles’ (September 2016)

U.S. Department of Transportation/National Highway Traffic Safety Administration, ‘Fact Sheet: AV Policy Section II: Model State Policy’ (September 2016)

U.S. Department of Transportation/National Highway Traffic Safety Administration, ‘Fact Sheet: AV Policy Section III: Current Regulatory Tools’ (September 2016)

U.S. Department of Transportation/National Highway Traffic Safety Administration, ‘Fact Sheet: AV Policy Section IV: Modern Regulatory Tools’ (September 2016)

U.S. Department of Transportation/National Highway Traffic Safety Administration, ‘“DOT/NHTSA Policy Statement Concerning Automated Vehicles” 2016 Update to “Preliminary Statement of Policy Concerning Automated Vehicles”’ (2016)

Smith BW, ‘Highly Automated Vehicles Act. Reporter’s Version Release Note’ (2018)

US Department of Transportation, ‘Preparing for the Future of Transportation: Automated Vehicles 3.0’ (Policy initiative, October 2018) <www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf> accessed 1 May 2019

California

California Draft Deployment Regulations (December 2015)

California Revised Draft Deployment Regulations (September 2016)

California Department of Motor Vehicles, ‘Autonomous Vehicle Tester (ATV) Program Application for Manufacturer’s Testing Permit’<www.dmv.ca.gov/portal/wcm/connect/f8eb6c00-6039-4e4c-82b0-

2e9c4b18c38b/ol311.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=f8eb6c00-6039-4e4c-82b0-2e9c4b18c38b> accessed 20 December 2016

California Department of Motor Vehicles, ‘draft form OL311’ <www.dmv.ca.gov/portal/wcm/connect/3339d9b1-f033-44a8-8c7e-40a31e809b31/ol311draft.pdf?MOD=AJPERES> accessed 10 April 2017

California Department of Motor Vehicles ‘Application Requirements for Autonomous Vehicle Tester Program – Testing with a Driver’ (*Department of Motor Vehicles*) <www.dmv.ca.gov/portal/dmv/detail/vehindustry/ol/auton_veh_tester> accessed 12 April 2017’

California Department of Motor Vehicles, *Autonomous Vehicles Express Terms* (March 2017) <www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto> accessed 12 April 2017

<u>Australia</u>

National Transport Commission, ‘Automated Vehicle Program’ (2019)

Standards and glossaries

SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*. *Standard J3016* (revised September 2016)

SAE International, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Standard J3016* (revised June 2018)

Literature

Books

Cockcroft AN, Lameijer LNF, *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea* (Elsevier 2012)

Diederiks-Verschoor IHP, *An introduction to air law* (revised by Pablo Mendes de Leon, 9th rev ed, Wolters Kluwer 2012)

Dommering-van Rongen L, *Productaansprakelijkheid. Een rechtsvergelijkend overzicht* (Kluwer 2000)

Glancy DJ, Robert W Peterson, Kyle F Graham, *A Look at the Legal Environment for Driverless Vehicle* (Legal Research Digest 69, Transportation Research Board 2016)

Goldberg JCP, Zipursky BC, *The Oxford Introductions to U.S. Law: Torts* (Oxford University Press 2010)

Libson H, Kurman M, *Driverless: Intelligent Cars and the Road Ahead* (The MIT Press 2016)

Polly S, *EU Product Compliance, Safety and Liability: A Best Practice Guide for the Automotive Sector* (Beuth Verlag 2018)

Redeker H, *IT-Recht* (6th edition, CH Beck 2017)

Samuel G, *An Introduction to Comparative Law Theory and Method* (Hart Publishing 2014)

Schipper F, *Driving Europe: Building Europe on Roads in the Twentieth Century* (Amsterdam: Aksant 2008)

van Dam C, *European Tort Law* (2nd edn, Oxford University Press, 2013)

Vranken JBM, *Mr. C. Assers Handleiding tot de beoefening van het Nederlands Burgerlijk Recht. Algemeen Deel****. Een synthese* (Kluwer 2014)

Whittaker S, *The development of product liability* (Cambridge University Press 2010)

Zweigert K, Kötz H, *Introduction to Comparative Law. Volume 1 – The Framework* (second revised edition, Clarendon Press 1987)

Chapter contributions in edited books

Bagshaw R, 'The development of traffic liability in England and Wales' in Wolfgang Ernst (ed), *The development of traffic liability* (Volume 5, Cambridge University Press, 2010)

Dobinson I and Johns F, 'Law as Qualitative Research' in: Mike McConville, *Research Methods for Law* (Edinburgh University Press 2017)

Farwell RF, *Farwell's Rules of the Nautical Road* (United States Naval Institute 1959)

Fraedrich, Barbara Lenz, 'Societal and Individual Acceptance of Autonomous Driving' in: Maurer and others (eds), *Autonomous Driving* (Springer 2016)

Friberg S and Dufwa BW, 'The development of traffic liability in Sweden' in Wolfgang Ernst (ed), *The development of traffic liability* (Volume 5, Cambridge University Press, 2010)

Ebers M, ‘Autonomes Fahren: Produkt- und Produzenthaftung’ in Bernd H Oppermann, Jutta Stender-Vorwachs (eds), *Autonomes Fahren. Rechtsfolgen, Rechtsprobleme, technische Grundlagen* (CH Beck 2017)

Mason S, ‘The presumption that computers are ‘reliable’’ in Stephen Mason and Daniel Seng (eds), *Electronic Evidence* (fourth edition, Institute of Advanced Legal Studies for the SAS Humanities Digital Library, School of Advanced Study, University of London, 2017)

Michon, ‘A Critical View of Driver Behavior Models: What Do We Know, What Should We Do?’ in L Evans, RC Schwing (eds), *Human behaviour and traffic safety* (New York: Plenum Press, 1985)

Möhler W, Buck J, Müller C, ‘Technische Fragestellungen’ in Jochen Buck, Helmut Krumbholz (eds), *Sachverständigenbeweis im Verkehrsrecht: Unfallrekonstruktion, Biomechanik, Messtechnik, Bildidentifikation, Alkohol und Drogen* (Nomos 2013)

Schrijns AJJG, Wijnakker CPJ, ‘Aansprakelijkheid van de wegbeheerder ex art. 6:174 BW’ in Cees van Dam (ed), *Aansprakelijkheid van de wegbeheerder* (ANWB, The Hague 2013)

Smith BW, ‘A Legal Perspective on Three Misconceptions in Vehicle Automation’ in Gereon Meyer and Sven Beiker (eds), *Road Vehicle Automation, Lecture Notes in Mobility* (Springer International Publishing Switzerland 2014)

Tjong Tjin Tai E, ‘Liability for (Semi)Autonomous Systems: Robots and Algorithms’ in Vanessa Mak, Eric Tjong Tjin Tai, Anna Berlee (eds), *Research Handbook on Data Science and Law* (Edward Elgar 2018)

van Dam C, Gerrit van Maanen, ‘The development of traffic liability in the Netherlands’ in Wolfgang Ernst (ed), *The development of traffic liability* (Volume 5, Cambridge University Press, 2010)

Commentaries

Oldenhuis FT, ‘Commentaar op art. 6:174 BW’ in: C.J.J.M. Stolker (red.), *Groene Serie Onrechtmatige daad* (Wolters Kluwer 2012)

MüKoBGB/Wagner, 7. Aufl. 2017, ProdHaftG § 2

Journal Articles

– – 'Convention with Respect to the International Circulation of Motor Vehicles' (1910) 4(4) The American Journal of International Law 316

Albrecht F, '"Fährt der Fahrer oder das System?"- Anmerkungen aus rechtlicher Sicht' [2005] Straßenverkehrsrecht 373

ANWB, 'Reactie ANWB, Wetsvoorstel Verkeersongevallen' (1998) 46 Verkeersrecht 33

Awad E and others, 'The Moral Machine experiment' (2018) 563 Nature volume 59

Bakos Y, Margotta-Qurgler F, Trossen DR, 'Does Anyone Read the Fine Print? Consumer Attention to Standard-Form Contracts' (2014) 43 The Journal of Legal Studies 1-35

Buglass LJ, 'Limitation of liability from a maritime insurance viewpoint' (1978-1979) 53 Tulane Law Review 1364

De Bruyne J, Tanghe J, 'Liability for Damage Caused by Autonomous Vehicles: A Belgian Perspective' (2017) 8(3) Journal of European Tort Law 324

De Bruyne J, Werbrouck J, 'Merging self-driving cars with the law' (2018) 34(5) Computer Law & Security Review 1150

de Schrijver S, van Fraeyenhoven O, 'Self-driving cars in Belgium: a clash between innovation and liability?' <http://astrealaw.be/backend/admin/sites/default/files/wwl_tmt_2016_-_article.pdf> accessed 2 February 2017

De Vey Mestdagh CNJ, Lubbers J, '"Nee hoor, u wilt helemaal niet naar Den Haag…" Over de techniek, het recht en de toekomst van de zelfrijdende auto' (2015) 4 Ars Aequi 267

Engelhard EFD, 'Wetgever, pas op! De (vrijwel) autonome auto komt eraan' (2017) 3 Ars Aequi 230

Fagnant DJ, Kockelman K, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167

Franke U, 'Rechtsprobleme beim automatisierten Fahren - ein Überblick' (2016) 86(2) Deutsches Autorecht 61

Frenk N, Utopische wetgeving en verzekerbaarheid’ (2006) (4) Aansprakelijkheid, Verzekering & Schade (AV&S)

Frenz W, Casimir-van den Broek E, ‘Völkerrechtliche Zulässigkeit von Fahrerassistenzsystemen’ (2009) Neue Zeitschrift für Verkehrsrecht 529

Funkhouser K, ‘Paving the road ahead: autonomous vehicles, products liability, and the need for a new approach’ (2013) Utah Law Review 437

Garza AP, ‘“Look Ma, No Hands!”: Wrinkles and Wrecks in the Age of Autonomous Vehicles’ (2012) 46 New England Law Review 581

Gibson J, ‘Click To Agree’ (2013) Richmond Law Magazine 16

Gomille C, ‘Herstellerhaftung für automatisierte Fahrzeuge’ (2016) 71(2) JuristenZeitung (JZ) 76

Greenblatt JB, Shaheen S, ‘Automated Vehicles, On-Demand Mobility, and Environmental Impacts’ 2(3) Current Sustainable/Renewable Energy Reports 74-81

Grosheide FW, ‘Aansprakelijkheid voor informatie(-producten)’ (1998) 4 Tijdschrift voor Consumentenrecht en handelspraktijken 309

Gurney JK, ‘Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles’ (2013) University of Illinois Journal of Law, Technology & Policy 247

Hartlief T, ‘Van knappe koppen en hun uitvindingen’ (2018) Nederlands Juristenblad 1265

Hollander E, ‘International Traffic Law: Its Forms and Requirements’ (1923) 17(3) The American Journal of International Law 470-488

Hutchinson T, Duncan N, ‘Defining and describing what we do: doctrinal legal research’ (2012) 17(1) Deakin law review 83

Kleve P, De Mulder RV, ‘De juridische status van software’ (1989) Nederlands Juristenblad 1342

Kleve P, De Mulder RV, ‘Voor een goed begrip (weerwoord op reacties op ‘De juridische status van software’)’ (1990) Nederlands Juristenblad 283

Lehman M, ‘Produkt- und Produzentenhaftung für Software’ (1992) Neue Juristische Wochenschrift (NJW) 1721

Levy J, ‘No Need to Reinvent the Wheel: Why Existing Liability Law Does Not Need to Be Preemptively Altered to Cope with the Debut of the Driverless Car’ (2016) 9 Journal of Business, Entrepreneurship & the Law 355

Lohmann MF, 'Liability Issues Concerning Self-Driving Vehicles’ (2016) 7 European Journal of Risk Regulation 335

Lüdemann V, Sutter C, Vogelpohl K, ‘Neue Pflichten für Fahrzeugführer beim automatisierten Fahren – eine Analyse aus rechtlicher und verkehrspsychologischer Sicht’ (2018) 31 (9) Neue Zeitschrift für Verkehrsrecht 411

Lutz LS, ‘Anforderungen an Fahrerassistenzsysteme nach dem Wiener Übereinkommen über den Straßenverkehr’ (2014) Neue Zeitschrift für Verkehrsrecht 67

Lutz LS, ‘Die bevorstehende Änderung des Wiener Übereinkommens über den Straßenverkehr: Eine Hürde auf dem Weg zu (teil-) autonomen Fahrzeugen ist genommen!’ (2014) Deutsches Autorecht 446

Lutz LS, ‘Autonome Fahrzeuge als rechtliche Herausforderung’ (2015) Neue Juristische Wochenschrift 119

Lutz LS, ‘Unfälle mit dem Tesla Autopiloten: Implikationen für das automatisierte Fahren?’ (2016) Deutsches Autorecht 506

Marchant GE, Lindor RE, ‘The Coming Collision Between Autonomous Vehicles and the Liability System’ (2012) 52 Santa Clara Law Review 1321

Marshall, ‘Unmanned Aerial Systems and International Civil Aviation Organization Regulations’ (2009) 85 North Dakota Law Review 693

Obar JA, Oeldorf-Hirsch A, ‘The Biggest Lie on the Internet: Ignoring the Privacy Policies and Terms of Service Policies of Social Networking Services’ (2018) Information, Communication & Society 1

Paquay GBA, ‘Software als stoffelijk object’ (1990) Nederlands Juristenblad 283

Prins C, ‘Schadelijke beestjes’ (2017) Nederlands Juristenblad 507

Reese J, ‘Produkthaftung und Produzentenhaftung für Hard– und Software’ (1994) Deutsches Steuerrecht (DStR) 1121

Schellekens MHM, ‘Self-driving cars and the chilling effect of liability law’ (2015) 31(4) Computer Law and Security Review 506

Schellekens MHM, ‘No-fault compensation schemes for self-driving vehicles’ (2018) 10(2) Law, Innovation and Technology 314

Schirmer JE, ‘Augen auf beim automatisierten Fahren! Die StVG-Novelle ist ein Montagsstück’ (2017) 30 (6) Neue Zeitschrift für Verkehrsrecht 253

Schrader PT, ‘Haftungsrechtlicher Begriff des Fahrzeugführers bei zunehmender Automatisierung von Kraftfahrzeugen’ (2015) Neue Juristische Wochenschrift 3537

Schrader PT, Haftungsfragen für Schäden beim Einsatz automatisierter Fahrzeuge im Straßenverkehr’ (2016) 5 Deutsches Autorecht (DAR) 242

Schreuder AI, ‘Aansprakelijkheid voor ‘zelfdenkende’ apparatuur’ (2014) (5/6) Aansprakelijkheid, Verzekering en Schade (AV&S)

Schubert MN, ‘Der Automated and Electric Vehicles Act 2018. Ein (weiterer) Irrweg für das Vereinigte Königreich?’ (2019) 19 (4) Straβenverkehrsrecht 124

Smith BW, ‘Automated Vehicles Are Probably Legal in the United States’ (2014) 1 Texas A&M Law Review 411

Smith BW, ‘How Governments Can Promote Automated Driving’ (2016) New Mexico Law Review (forthcoming) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375> accessed March 2016

Solaiman SM, ‘Legal personality of robots, corporations, idols and chimpanzees: a quest for legitimacy’ (2017) 25(2) Artificial Intelligence and Law 155

Spek ACE, ‘Over toelating van autonome testvoertuigen op de weg en het onderzoek van ongevallen’ (2016) 64 Verkeersrecht 2

Stuurman C, Vandenberghe GPV, 'Softwarefouten: een 'zaak' van leven of dood?' (1988) Nederlands Juristenblad 1667

Surden H, Williams M, ‘Self-Driving Cars, Predictability, and Law’ (2016) 38 Cardozo Law Review 121

Tjong Tjin Tai TFE, Boesten S, ‘Aansprakelijkheid, zelfrijdende auto’s en andere zelfsturende objecten’ (2016) Nederlands Juristenblad 656

Tjong Tjin Tai TFE, Koops BJ, ‘Zorgplichten tegen cybercrime’ (2015) Nederlands Juristenblad 1065

Urmson C, Whittaker W, ‘Self-Driving Cars and the Urban Challenge’(2015) 23(2) IEEE Intelligent Systems 66 van Wees KAPC, 'Over intelligente voertuigen, slimme wegen en aansprakelijkheid' (2010) 58 Verkeersrecht 33

van Wees KAPC, 'Over zwarte dozen in auto's en wie er in mag kijken; verkennende beschouwingen over EDR en de exhibitieplicht' (2011) 59 Verkeersrecht 337

van Wees KAPC, 'Aansprakelijkheidsaspecten van (deels) zelfrijdende auto's' (2015) 5 Aansprakelijkheid, Verzekering & Schade 170

van Wees KAPC, 'Enkele juridische aspecten van de (deels) zelfrijdende auto' (2015) Computerrecht 313

van Wees KAPC, 'Zelfrijdende auto's, aansprakelijkheid en verzekering; over nieuwe technologie en oude discussies' (2016) 2 Tijdschrift voor Vergoeding Personenschade 29

van Wees KAPC, 'Voertuigautomatisering en productaansprakelijkheid' (2018) 4 Maandblad voor Vermogensrecht 112

Vanden Borre T, 'Kanalisatie in het debat betreffende de verzekerbaarheid van risico' (2001) (6) Aansprakelijkheid, Verzekering & Schade (AV&S) 175

Vellinga NE, 'De civielrechtelijke aansprakelijkheid voor schade veroorzaakt door een autonome auto' (2014) 62 Verkeersrecht 151

Vellinga NE, 'From the testing to the deployment of self-driving cars: Legal challenges to policymakers on the road ahead' (2017) 33(6) Computer Law & Security Review 847

Vellinga NE, 'Zelfrijdende auto's en aansprakelijkheidsrisico's voor wegbeheerders' (2019) Nederlands Juristenblad 2213

Vellinga NE, 'Automated driving and its challenges to international traffic law: which way to go?' (2019) Law, Innovation and Technology, DOI:10.1080/17579961.2019.1665798

Vellinga NE, Vellinga WH, van Wees KAPC, 'Testen van autonome of zelfrijdende auto's op de openbare weg' (2016) 64 Verkeersrecht 218

von Bodungen B, Hoffmann M, 'Belgien und Schweden schlagen vor: Das Fahrsystem soll Fahrer werden!' (2015) Neue Zeitschrift für Verkehrsrecht 521

von Bodungen B, Hoffmann M, 'Das Wienerübereinkommen über den Straßenverkehr und die Fahrzeugautomatisierung (Teil 1). Wege Aus dem Zulassungsdilemma' (2016) Straßenverkehrsrecht 41 von Bodungen B, Hoffmann M, 'Das Wienerübereinkommen über den Straßenverkehr und die Fahrzeugautomatisierung (Teil 2). Wege Aus dem Zulassungsdilemma' (2016) Straßenverkehrsrecht 93

von Kaler M, Wieser S, 'Weitere Rechtsetzungsbedarf beim automatisierten Fahren' (2018) 37 (6) Neu Zeitschrift für Verwaltungsrecht 369

Voss WG, 'European Union Data Privacy Law Reform: General Data Protection Regulation, Privacy Shield, and the Right to Delisting' (Winter 2016-2017) 72 The Business Lawyer 221

Wagner G, 'Produkthaftung für autonome Systeme' (2017) 217(6) Archiv für die civilistische Praxis 707

Wagner G, 'Robot Liability' (SSRN 19 June 2018) <https://ssrn.com/abstract=3198764> accessed 1 May 2019

Wiener JB, 'The regulation of technology, and the technology of regulation' (2004) 26 Technology in Society 483

Wu SS, 'Unmanned Vehicles and US Product Liability' (2012) 21(2) Journal of Law, Information, and Science 234

Wuyts D, 'The product liability directive: more than two decades of defective products in Europe' (2014) 5(1) Journal of European Tort Law 1-34

Inaugural lectures

Heldeweg MA, *Smart rules & regimes: publiekrechtelijk(e) ontwerpen voor privatisering en technologische innovatie*, (extended version of inaugural lecture Universiteit Twente, of 24 september 2009, Universiteit Twente 2010)

Dissertations

de Valk SN, 'Aansprakelijkheid voor leidinggevenden naar privaatrechtelijke, strafrechtelijke en bestuursrechtelijke maatstaven' (Dissertation, University of Groningen 2009)

Dommering-van Rongen L, *Produktenaansprakelijkheid. Een nieuwe Europese privaatrechtelijke regeling vergeleken met de produktenaansprakelijkheid in de Verenigde Staten* (Dissertation, University of Utrecht 1991)

Gritter E, ‘Effectiviteit en aansprakelijkheid in het economisch ordeningsrecht’ (Dissertation, University of Groningen 2003)

Hornman MJ, ‘De strafrechtelijke aansprakelijkheid van leidinggevenden van ondernemingen: Een beschouwing vanuit multidimensionaal perspectief/Criminal Liability of Corporate Executives. A Multidimensional Approach’ (Dissertation, University of Utrecht 2016)

Pape SB, *Warnings and product liability: Lessons learned from cognitive psychology and ergonomics* (Dissertation, Erasmus University Rotterdam 2011)

Simmelink JBHM, *Algemeenheden in het wegenverkeersrecht* (Dissertation, Tilburg University 1995)

Stuurman C, *Technische normen en het recht: Beschouwingen over de interactie tussen het recht en technische normalisatie op het terrein van informatietechnologie en telecommunicatie* (Dissertation, Vrije Universiteit Amsterdam 1995)

Verhoeven D, *Productveiligheid en productaansprakelijkheid* (Dissertation, Antwerp 2017)

Westerdijk RJJ, *Produktenaansprakelijkheid voor software*: *beschouwingen over de aansprakelijkheid voor informatieprodukten* (Dissertation, Vrije Universiteit Amsterdam 1995)

Working papers and conference papers

Ghena B and others, ‘Green Lights Forever: Analyzing the Security of Traffic Infrastructure’ (Proceedings of the 8th USENIX Workshop on Offensive Technologies (WOOT) 2014) <https://jhalderm.com/pub/papers/traffic-woot14.pdf> accessed 24 October 2018

Mulder T, Vellinga NE, ‘Handing over the wheel, giving up your privacy?’ (13^{th} ITS European Congress, Eindhoven, June 2019)

Vellinga NE, ‘Careless automated driving?’ (13^{th} ITS European Congress, Eindhoven, June 2019)

Vellinga NE, ‘Self-driving vehicles: preparing road traffic law for a driverless future’ (25^{th} World ITS Congress 2018, Copenhagen, 17-21 September 2018)

Verbruggen P and others, ‘Towards Harmonised Duties of Care and Diligence in Cybersecurity’ (Cyber Security Council, European Foresight Cyber Security Meeting 2016) 99 <http://ssrn.com/abstract=2814101> accessed 1 May 2019

Reports

World Health Organization (WHO)

World Health Organization, ‘World report on road traffic injury prevention’ (WHO 2004)

World Health Organization, ‘Global Status Report on Road Safety 2015’ (2015) <www.who.int/violence_injury_prevention/road_safety_status/2015/en/> accessed 18 April 2017

World Health Organization, ‘Global Status Report on Road Safety 2018’ (2018) <www.who.int/violence_injury_prevention/road_safety_status/2018/en/> accessed 1 May 2019

EU

Nevejans N, ‘European Civil Law Rules in Robotics. Study’ (Directorate-General For Internal Policies Policy Department C: Citizens’ Rights and Constitutional Affairs, Legal Affairs, 2016) <www.europarl.europa.eu/RegData/etudes/STUD/2016/571379/IPOL_STU(2016)571379_EN.pdf> accessed 20 August 2019

Engelhard EFD, de Bruin R, ‘Legal analysis of the EU common approach on the liability rules and insurance related to connected and autonomous vehicles’ in Tatjana Evas *EU Common Approach on the liability rules and insurance related to Connected and Autonomous Vehicles* (2017) (European Union 2017)

European Commission, ‘Evaluation of Council Directive 85/374/EEC on the approximation of laws, regulations and administrative provisions of the Member States concerning liability for defective products FINAL REPORT’ (January 2018)

European Commission, ‘Statistical Pocketbook 2017: EU Transport in Figures’ (2017)

National level

The Netherlands

Blokpoel A, Mulder JAG, 'Het zichtveld van bestuurders van vrachtswagens: Analyse van de problemen betreffende het zichtveld aan de rechterzijde van (rechtsafslaande) vrachtwagens - consult aan de Rijksdienst voor het Wegverkeer' (1981) <www.swov.nl/sites/default/files/publicaties/rapport/r-81-20.pdf> accessed 24 October 2018

Kiliaan APC van Wees, 'Zelfrijdende auto's en het Verdrag van Wenen inzake het wegverkeer. Een verkennende analyse' (Amsterdam Centre for Comprehensive Law, Vrije Universiteit Amsterdam, March 2015) <http://knowledgeagenda.connekt.nl/bibliotheek/> accessed 13 March 2017

SWOV, 'Road deaths in the Netherlands' (SWOV Fact sheet, 18 April 2019) <www.swov.nl/en/facts-figures/factsheet/road-deaths-netherlands> accessed 29 July 2019

Germany

Gasser TM (Projektgruppenleitung) and others, 'Bericht zum Forschungsprojekt F1100.5409013.01 des Arbeitsprogramms der Bundesanstalt für Straßenwesen: Rechtsfolgen zunehmender Fahrzeugautomatisierung' (Bundesanstalt für Straßenwesen 2012)

Ethik-Kommission, 'Automatisiertes und Vernetztes Fahren' (Bericht eingesetzt durch den Bundesminister für Verkehr und digitale Infrastruktur, Juni 2017)

United Kingdom

Department for Transport, 'The Pathway to Driverless Cars: A detailed review of regulations for automated vehicle technologies' (2015) (Review of regulations 2015)

United States

Federal

US Department of Transportation, 'Workshop on Governance of the Safety of Automated Vehicles' (Summary Report) (2016)

<www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/12837-workshop_on_governance_of_automated_vehicles_03062017_final_version-tag.pdf> accessed on 1 May 2019

National Highway Traffic Safety Administration, 'Report on Investigation PE 16-007' (2017) <https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF> accessed 9 February 2017

National Transportation Safety Board, 'Collision Between a Car Operating With Automated Vehicle Control Systems and a Tractor-Semitrailer Truck Near Williston, Florida May 7, 2016. Accident report NTSB/HAR-17/02 PB2017-102600' (National Transportation Safety Board, 12 September 2017)

California

California Department of Motor Vehicles, 'Autonomous Vehicle Disengagement Reports 2016' (2016) <www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/disengagement_report_2016> accessed 12 April 2017

California Department of Motor Vehicles, 'Report on Autonomous Mode Disengagements For Waymo Self-Driving Vehicles in California' (December 2016) <www.dmv.ca.gov/portal/wcm/connect/946b3502-c959-4e3b-b119-91319c27788f/GoogleAutoWaymo_disengage_report_2016.pdf?MOD=AJPERES> accessed 11 April 2017

Other

Anderson JM and others, 'Autonomous Vehicle Technology. A Guide for Policymakers' (RAND Corporation, 2016)

Anderson JM, Heaton P, Caroll SJ, 'The U.S. Experience with No-Fault Automobile Insurance A Retrospective' (RAND Corporation, 2010)

Blanco M and others, 'Automated Vehicle Crash Rate Comparison Using Naturalistic Data' (Virginia Tech Transportation Institute January 2016) <www.vtti.vt.edu/PDFs/Automated%20Vehicle%20Crash%20Rate%20Comparison%20Using%20Naturalistic%20Data_Final%20Report_20160107.pdf> accessed 18 April 2017

ERTRAC, ‘Connected Automated Driving Roadmap’ (Version 8, 8 March 2019)<www.ertrac.org/uploads/documentsearch/id57/ERTRAC-CAD-Roadmap-2019.pdf> accessed 1 May 2019

European Transport Safety Council, ‘Prioritising the Safety Potential of Automated Driving in Europe’ (Briefing, April 2016)

European Transport Safety Council, ‘Road deaths in the European Union – latest data’ <https://etsc.eu/euroadsafetydata/> accessed 29 July 2019

Gilbert F and Zallone R, ‘Connected cars. Recent legal developments’ (2016) <http://robots.law.miami.edu/2016/wp-content/uploads/2015/07/GILBERT-ZALLONE-Connected-Cars-REVISED_2016-03-29.pdf> accessed 3 February 2017

Hedlund J, ‘Autonomous Vehicles Meet Human Drivers: Traffic Safety Issues for States’ (Governors Highway Safety Association 2017) <http://src.bna.com/lVf> accessed 10 February 2017

International Transport Forum, Corporate Partnership Board, ‘Automated and Autonomous Driving. Regulation under uncertainty’ (OECD/ITF 2015)

Munich Reinsurance America, Inc., ‘Autonomous Vehicles. Considerations for Personal and Commercial Lines Insurers’ (2016)

Palmerini E and others, ‘Regulating Emerging Robotic Technologies in Europe: Robotics facing Law and Ethics: Guidelines on Regulating Robotics’ (Robolaw 2014) <www.robolaw.eu/RoboLaw_files/documents/robolaw_d6.2_guidelinesregulatingrobotics_20140922.pdf> accessed 6 February 2017

Schoettle B, Sivak M, ‘A Preliminary Analyses of Real-World Crashes Involving Self-Driving Vehicles’ (The University of Michigan Transportation Research Institute, Ann Arbor, October 2015) <http://umich.edu/~umtriswt/PDF/UMTRI-2015-34.pdf> accessed 18 April 2017

Singh S, ‘Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey’ (National Highway Traffic Safety Administration February 2015) <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115> accessed 1 May 2019

Sivak M, Schoettle B, ‘Road Safety with Self-Driving Vehicles: General Limitations and Road Sharing with Conventional Vehicles’ (The University of Michigan Transportation Research Institute, Ann Arbor, January 2015) <https://deepblue.lib.umich.edu/bitstream/handle/2027.42/111735/103187.pdf?sequ> accessed 1 May 2019

Verbond van Verzekeraars, ‘Toekomstvisie Automotive. Onderweg naar morgen’ (2015) <www.verzekeraars.nl/actueel/nieuwsberichten/Documents/2015/November/Onderweg%20naar%20morgen.pdf> accessed 12 April 2017

Wadud Z, ‘Self-driving cars: will they reduce energy use?’ (University of Leeds, Mobility and Energy Futures Studies) <www.its.leeds.ac.uk/fileadmin/documents/research/MobilityEnergyFutures_-_SelfDrivingCars.pdf> accessed 18 April 2017

Zmud J, Sener IN, Wagner J, ‘Consumer Acceptance and Travel Behavior Impacts of Automated Vehicles’ (Texas A&M Transportation Institute, January 2016)

Interviews

Testimony of Dr. Chris Urmson (Director, Self-Driving Cars, Google [x]) before the Senate Committee on Commerce, Science and Technology Hearing, ‘Hands Off: The Future of Self-Driving Cars’ (15 March 2016)

van den Acker, ‘Visies op de autonome auto’ (2015) 63 Verkeersrecht

News articles

– – ‘Proef met zelfrijdend busje in Scheemda wordt verlengd’ (*provinciegroningen.nl,* 13 May 2019) <www.provinciegroningen.nl/actueel/nieuwsartikel/proef-met-zelfrijdend-busje-in-scheemda-wordt-verlengd/> accessed 30 July 2019

_ _ ‘Autopilot. Kraftfahrt-Bundesamt warnt Tesla-Besitzer’ (*Der Spiegel Online*, 14 October 2016) <www.spiegel.de/auto/aktuell/tesla-autopilot-kraftfahrtbundesamt-warnt-tesla-besitzer-a-1116710.html> accessed 17 September 2019

_ _ ‘Googles autonome Autos sind nicht immer online’ (*heise online*, 16 January 2017) <www.heise.de/newsticker/meldung/Googles-autonome-Autos-sind-nicht-immer-online-3592661.html> accessed 13 January 2017

_ _ ‘Nach tödlichem Crash: Tesla verspricht Verbesserung der „Autopilot“-Funktion‘ (*Der Spiegel Online*, 12 September 2016) <www.spiegel.de/auto/aktuell/tesla-motors-verspricht-verbesserung-der-autopilot-funktion-a-1111949.html> accessed 12 January 2017

_ _ ‘Tesla soll in Deutschland nicht mehr mit “Autopilot” werben’ (*heise online*, 16 October 2016) <www.heise.de/newsticker/meldung/Tesla-soll-in-Deutschland-nicht-mehr-mit-Autopilot-werben-3351230.html> accessed 11 April 2017

_ _ ‘The future of self-driving cars is in human hands. Clear rules are instrumental to the transition towards a driverless era’ *Financial Times* (16 September 2016) <www.ft.com/content/abf1738a-7bec-11e6-ae24-f193b105145e> accessed 28 April 2016

Abent E, ‘Nissan debuts Seamless Autonomous Mobility system based on NASA tech’ (*Slashgear*, 5 January 2017) <www.slashgear.com/nissan-debuts-seamless-autonomous-mobility-system-based-on-nasa-tech-05470542/> accessed 6 January 2016

Boothman J, ‘Driverless cars can steer us into a safe and sophisticated future’ *Financial Times* (23 September 2016) <www.ft.com/content/1199ec78-7ff6-11e6-8e50-8ec15fb462f4> accessed 28 April 2017

Branman M, ‘Volvo, Google, and Mercedes-Benz will accept liability in self-driving car accidents’ (*Digital Trends*, 8 October 2015) <www.digitaltrends.com/cars/automaker-responsibility-in-self-driving-car-accidents-news/> accessed 2 February 2017

Condliffe J, ‘Semi-Autonomous Cars Could Increase Distracted Driving Deaths’ (*MIT Technology Review*, 21 September 2016) <www.technologyreview.com/s/602441/semi-autonomous-cars-could-increase-distracted-driving-deaths/> accessed 4 May 2017

Davies A, ‘The very human problem blocking the path to self-driving cars’ (*Wired*, 1 January 2017) <www.wired.com/2017/01/human-problem-blocking-path-self-driving-cars/> accessed 4 May 2017

Etherington D, ‘Waymo’s first product will be its own on-demand ride hailing service’ (*TechCrunch*, 7 November 2017) <https://techcrunch.com/2017/11/07/waymos-first-commercial-product-will-be-its-own-on-demand-ride-hailing-service/?guccounter=1> accessed 16 August 2018

Ford, ‘Ford Targets Fully Autonomous Vehicle for Ride Sharing in 2021; Invests in New Tech Companies, Doubles Silicon Valley Team’ (16 August 2016) <https://media.ford.com/content/fordmedia/fna/us/en/news/2016/08/16/ford-targets-fully-autonomous-vehicle-for-ride-sharing-in-2021.html> accessed 11 April 2017

Gillman S, ‘Hackers could blackmail owners of self-driving cars – Dr Alexander Köller, TomTom’ (*Horizon*, 16 March 2017) <https://horizon-magazine.eu/article/hackers-could-blackmail-owners-self-driving-cars-dr-alexander-kr-ller-tomtom_en.html?utm_source=HORIZON&utm_campaign=c7f3d2c038-News_Alert_20170217&utm_medium=email&utm_term=0_bdcf6f64ca-c7f3d2c038-105634345> accessed 11 April 2017

Gorzelany J, ‘Volvo Will Accept Liability For Its Self-Driving Cars’ (*Forbes*, 9 October 2015) <www.forbes.com/sites/jimgorzelany/2015/10/09/volvo-will-accept-liability-for-its-self-driving-cars/#54e7c3d43d80> accessed 2 February 2017

Greenberg A, ‘Hackers remotely kill a Jeep on the highway – with me in it’ (*Wired*, 21 July 2015) <www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/> accessed 9 March 2017

Greenemeier L, ‘Deadly Tesla Crash Exposes Confusion over Automated Driving. Amid a federal investigation, ignorance of the technology’s limitations comes into focus’ (*Scientific American*, 8 July 2016) <www.scientificamerican.com/article/deadly-tesla-crash-exposes-confusion-over-automated-driving/> accessed 4 April 2017

Halsey A, Laris M, ‘Blind man sets out alone in Google’s driverless car’ (*Washington Post online*, 13 December 2016) <www.washingtonpost.com/local/trafficandcommuting/blind-man-sets-out-alone-in-googles-driverless-car/2016/12/13/f523ef42-c13d-11e6-8422-eac61c0ef74d_story.html?noredirect=on&utm_term=.25d3bbde7b7a> accessed 30 July 2019

Hao K, ‘What is machine learning?’ (*MIT Technology Review*, 17 November 2018) <www.technologyreview.com/s/612437/what-is-machine-learning-we-drew-you-another-flowchart/> accessed 14 March 2019

Hawkins AJ, ‘The self-driving car war between Arizona and California is heating up. Arizona says human-free driving is a-okay’ (*The Verge*, 2 March 2018) <www.theverge.com/2018/3/2/17071284/arizona-self-driving-car-governor-executive-order> accessed 19 August 2019

Hook L, ‘Driverless cars: mapping the trouble ahead’ (*Financial Times*, 21 February 2018) <www.ft.com/content/2a8941a4-1625-11e8-9e9c-25c814761640> accessed 4 July 2019

Kieboom N, ‘RDW wil reactie zelfrijdende auto’s op motorfietsen testen’ (*Zelfrijdend Vervoer*, 17 December 2016) <www.zelfrijdendvervoer.nl/autopilot/2016/12/07/rdw-

wil-reactie-zelfrijdende-autos-op-motorfietsen-testen/?utm_source=newsletter&utm_medium=email&utm_campaign=Nieuwsbrief%20week%202016-49> accessed 17 September 2019.

Knight W, ‘Reinforcement Learning: 10 Breakthrough Technologies 2017’ (*MIT Technology Review*, 22 February 2017) <www.technologyreview.com/s/603501/10-breakthrough-technologies-2017-reinforcement-learning/> accessed 14 March 2019

Korosec K, ‘Michigan Just Passed the Most Permissive Self-Driving Car Laws in the Country’ (*Fortune*, 9 December 2016) <http://fortune.com/2016/12/09/michigan-self-driving-cars/> accessed 21 December 2016

Lambert F, ‘Elon Musk criticizes media on how they report on Tesla crashes’ (*electrek.co,* 14 May 2018) <electrek.co/2018/05/14/tesla-crashes-elon-musk-lashes-out-media-report/> accessed 24 October 2018

Lambert F, ‘Tesla’s software timeline for “Enhanced Autopilot” transition means “Full Self-Driving Capability” as early as next year’ (*Electrek*, 20 October 2016) <https://electrek.co/2016/10/20/tesla-enhanced-autopilot-full-self-driving-capability/> accessed 11 April 2017

Levandowski A, ‘Statement from Anthony Levandowski on Self-Driving in San Francisco’, (*Uber Newsroom*, 16 December 2016) <https://newsroom.uber.com/statement-from-anthony-levandowski-on-self-driving-in-san-francisco/> accessed 22 December 2016

Marshall A, ‘Michigan just embraced the driverless future’ (*Wired*, 9 December 2016) <www.wired.com/2016/12/michigan-just-embraced-driverless-future/> accessed 21 December 2016

Mason S, Ladkin PB, ‘Decision algorithms of driverless cars recall the trolley problem’ *Financial Times* (7 October 2017) <www.ft.com/content/3e9a8832-898c-11e6-8aa5-f79f5696c731> accessed 10 May 2017

Merrifield R, ‘Choreographing automated cars could save time, money and lives’ (*Horizon*, 14 March 2017) <https://horizon-magazine.eu/article/choreographing-automated-cars-could-save-time-money-and-lives_en.html> accessed 11 April 2017

Naughton K, ‘Ford’s Dozing Engineers Side With Google in Full Autonomy Push’ (*Bloomberg Technology*, 17 February 2017) <www.bloomberg.com/news/articles/2017-02-17/ford-s-dozing-engineers-side-with-google-in-full-autonomy-push> accessed 4 May 2017

Naughton K, 'Google's Driverless Car Czar on Taking the Human Out of the Equation. How John Krafcik went from mechanical to digital and why he thinks you have to go fully autonomous' (*Bloomberg Businessweek*, 4 August 2016) <www.bloomberg.com/features/2016-john-krafcik-interview-issue/> accessed 4 May 2017

Obama B, 'Barack Obama: Self-driving cars, yes, but also safe. New technologies and regulations will be explored at a White House conference in Pittsburgh' (*Pittsburgh Post-Gazette*, 19 September 2016) <www.post-gazette.com/opinion/Op-Ed/2016/09/19/Barack-Obama-Self-driving-yes-but-also-safe/stories/201609200027> accessed 10 April 2017

Ohnsman A, 'Musk Wants To Begin Shifting Teslas To "Full" Self-Driving Capability Within 6 Months' (*Forbes*, 24 January 2017) <www.forbes.com/sites/alanohnsman/2017/01/24/elon-musk-targets-full-self-driving-capability-for-teslas-within-6-months/#7808d76c79ee> accessed 11 April 2017

Saripalli S, 'Are self-driving cars the future of mobility for disabled people?' (*The Conversation online*, 6 October 2017) <http://theconversation.com/are-self-driving-cars-the-future-of-mobility-for-disabled-people-84037> accessed 30 July 2019

Singhvi A, Russel K, 'Inside the Self-Driving Tesla Fatal Accident' (*The New York Times,* 12 July 2016) <www.nytimes.com/interactive/2016/07/01/business/inside-tesla-accident.html?_r=0> accessed 30 March 2017

Somerville H, 'Uber removes self-driving cars from San Francisco roads' (*Reuters*, 22 December 2016) <www.reuters.com/article/us-uber-selfdriving-idUSKBN14B04Z> accessed 22 December 2016

Tesla, 'Autopilot' (Tesla.com) <www.tesla.com/model3/design?redirect=no#autopilot> (last accessed 20 March 2019)

The Guardian, 'Google's self-driving car avoids hitting woman chasing a bird – video' (*The Guardian,* 17 March 2017) <www.theguardian.com/technology/video/2017/mar/16/google-waymo-self-driving-car-video-woman-bird> accessed 1 May 2019Griggs T, Wakabayashi D, 'How a Self-Driving Uber Killed a Pedestrian in Arizona' (*New York Times*, 21 March 2018) <www.nytimes.com/interactive/2018/03/20/us/self-driving-uber-pedestrian-killed.html> accessed 9 July 2019

The Tesla Team, ‘A Tragic Loss’ (*Tesla*, 30 June 2016) <www.tesla.com/blog/tragic-loss?redirect=no> accessed 30 March 2017

The Tesla Team, ‘All Tesla Cars Being Produced Now Have Full Self-Driving Hardware’ (19 October 2016) <www.tesla.com/blog/all-tesla-cars-being-produced-now-have-full-self-driving-hardware> accessed 11 April 2017

The Tesla Team, ‘Upgrading Autopilot: Seeing the World in Radar’ (*Tesla*, 11 September 2016) <www.tesla.com/de_DE/blog/upgrading-autopilot-seeing-world-radar?redirect=no> accessed 12 January 2017

Thomas M, ‘Future with the driverless car needs careful planning’ *Financial Times* (30 September 2016) <www.ft.com/content/df918048-83ff-11e6-a29c-6e7d9515ad15> accessed 28 April 2017

Tracy S, ‘Autonomous Vehicles Will Replace Taxi Drivers, But That’s Just the Beginning’ (*Huffington Post*, updated 10 June 2016) <www.huffingtonpost.com/sam-tracy/autonomous-vehicles-will-_b_7556660.html> accessed 30 March 2017

Traufetter G, ‘Tesla-Autopilot. Unfälle? Lebensgefahr? Dem Minister offenbar egal’ *Der Spiegel* (Ausbage 41/2016. Hamburg, 7 October 2016) <www.spiegel.de/spiegel/tesla-autopilot-alexander-dobrindt-ignoriert-kritisches-gutachten-a-1115692.html> accessed 17 September 2019

Tsantilas S, ‘Motorcycle rear-ending raises questions on Tesla vehicle type approval in Europe’ (*New Atlas*, 21 October 2016) <https://newatlas.com/tesla-autopilot-fema/46045/> accessed 17 September 2019

Van den Heuvel, ‘Wetten moeten meeademen met snelheid technologie’, *Het Financiële Dagblad* (8 January 2016) <https://fd.nl/opinie/1134451/wetten-moeten-meeademen-met-snelheid-technologie> accessed 12 April 2017

Vlasic B and Boudette NE, ‘Self-Driving Tesla Was Involved in Fatal Crash, U.S. says’ (*The New York Times*, 30 June 2017) <www.nytimes.com/2016/07/01/business/self-driving-tesla-fatal-crash-investigation.html?_r=0> accessed 11 April 2017

Volvo, ‘Vera’ <www.volvotrucks.com/en-en/about-us/automation/vera.html> accessed 30 July 2019

Walker J, ‘The Self-Driving Car Timeline – Predictions from the Top 11 Global Automakers’ (*Emerj.com,* 14 May 2019) <https://emerj.com/ai-adoption-timelines/self-driving-car-timeline-themselves-top-11-automakers/> accessed 1 August 2019

Yadron D, Tynan D, 'Tesla driver dies in crash while using autopilot mode' (*The Guardian*, 1 July 2016) <www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk> accessed 30 March 2017

Ziegler C, 'A Google self-driving car caused a crash for the first time. A bad assumption led to a minor fender-bender' (*The Verge*, 29 February 2016) <www.theverge.com/2016/2/29/11134344/google-self-driving-car-crash-report> accessed 11 April 2017

Miscellaneous

– –'Open Letter to the European Commission Artificial Intelligence and Robotics'<www.robotics-openletter.eu/> accessed 9 August 2018

_ _ 'Letter from the Center For Auto Safety and Consumer Watchdog to the Federal Trade Commission' (23 May 2018) <www.autosafety.org/wp-content/uploads/2018/05/CAS-and-CW-Letter-to-FTC-on-Tesla-Deceptive-Advertising.pdf> accessed 17 September 2019

_ _ 'Letter from the Federation of European Motorcyclists' Associations (FEMA), Koninklijke Nederlandse Motorrijders Vereniging (KNMV) and Motorrijders Actie Groep (MAG) to the Dutch Vehicle Autorithy (RDW)' (14 October 2016) <www.fema-online.eu/website/wp-content/uploads/RDW_141016_EN.pdf> accessed 11 April 2017

_ _ <www.unece.org/trans/main/wp29/introduction.html> accessed 10 September 2019

_ _ <www.unece.org/trans/main/wp29/meeting_docs_grva.html> accessed 10 September 2019

'Procedure 2018/0145/COD' <https://eur-lex.europa.eu/procedure/EN/2018_145> accessed 10 September 2019

Alkim T, 'Automated Driving Roadmaps' (*Dropbox*) <www.dropbox.com/s/ji5qz5rtkkgf8jn/Overview%20Roadmaps%20Automated%20Driving_final_withoutaspect.pdf?dl=0> accessed 28 August 2019

Alkim T, 'Overview roadmaps and pilots' (*Knowledge Agenda Automated Driving*, 9 March 2017) <http://knowledgeagenda.connekt.nl/engels/2017/03/09/overview-roadmaps-and-pilots/> accessed 9 March 2017

American National Highway Traffic Safety Administration, 'NHTSA Letter to Telsa' (8 July 2016) <www.documentcloud.org/documents/2991479-NHTSA-letter-to-Tesla.html> accessed 29 November 2016

Apple Inc, 'Our Approach to Automated Driving System Safety' (February 2019) <www.apple.com/ads/ADS-Safety.pdf> accessed 21 March 2019

Arizona Department of Transportation, <www.azdot.gov/motor-vehicles/professional-services/autonomous-vehicle-notification-and-certification/overview> accessed 19 August 2019

Association of British Insurers, 'Pathway to Driverless Cars: Proposals to support advanced driver assistance systems and automated vehicle technologies. Response of the Association of British Insurers and Thatcham Research'<://www.abi.org.uk/~/media/Files/Documents/Consultation%20papers/2016/09/090916_ABI_Thatcham_response_CCAV_Automated_Driving_Consultation.pdf> accessed 10 January 2017

Attachment email from Robert Nowak, UN, to author (1 June 2017)

Automated Operation of Vehicles Act Committee <www.uniformlaws.org/committees/community-home?CommunityKey=43730d6f-013d-4883-b2b7-98e66bda3239> accessed 5 September 2019

California Department for Motor Vehicles, <www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/testing> accessed 19 August 2019

Daimler, 'Automated Driving: How do we develop trust between humans and machines?' <www.daimler.com/innovation/case/autonomous/future-insight-2.html> accessed 14 June 2019.

Department of Transportation, 'USDOT Announces New Federal Committee on Automation' (11 January 2017) <https://content.govdelivery.com/accounts/USDOT/bulletins/17fb003#.WHa9qqkV59c.twitter> accessed 13 January 2017

Dmitriev S, 'Autonomous cars will generate more than 300 TB of data per year' <www.tuxera.com/blog/autonomous-cars-300-tb-of-data-per-year/>accessed 4 July 2019

Drive.ai, <www.drive.ai/> accessed 14 June 2019

European Commission, ‘Liability of defective products’ (*ec.europa.eu*) <https://ec.europa.eu/growth/single-market/goods/free-movement-sectors/liability-defective-products_en> accessed 12 July 2019

European Commission, ‘Safety in the automotive sector’ <https://ec.europa.eu/growth/sectors/automotive/safety_en> accessed 10 September 2019

European Commission, ‘Security Assurance FramEwoRk for neTworked vEhicular teChnology’ <http://cordis.europa.eu/project/rcn/207209_en.html> accessed 28 August 2019

European Commission, ‘What We Do’ (*ec.europa.eu* 2 April 2019) <https://ec.europa.eu/transport/road_safety/what-we-do_en> accessed 2 April 2019

Ford, ‘Model T Facts’ (Ford.com) <https://media.ford.com/content/fordmedia/fna/us/en/news/2013/08/05/model-t-facts.html> accessed 1 May 2019.

Greenwheels, ‘Algemene Voorwaarden’ (*greenwheels.*com, 2018) <www.greenwheels.com/nl/sites/greenwheels.com.nl/files/content/AV/20180524%20Algemene%20Voorwaarden%20Greenwheels_NL_v1.0.pdf> accessed 18 October 2018

Greenwheels, ‘Home’ (*greenwheels.*com, 2018) <www.greenwheels.com/nl/> accessed 18 October 2018

ICAO, ‘About ICAO’ (*icao.int*) <www.icao.int/about-icao/Pages/default.aspx> accessed 10 July 2019

ICAO, ‘ICAO and the United Nations’ (*icao.int*) <www.icao.int/about-icao/History/Pages/icao-and-the-united-nations.aspx> accessed 10 July 2019

ICAO, ‘The History of ICAO and the Chicago Convention’ (*icao.int*) <www.icao.int/about-icao/History/Pages/default.aspx> accessed 10 July 2019

Insurance Information Institute, ‘Background on: No-fault auto insurance’ (*Insurance Information Institute*, 6 November 2018) <www.iii.org/issue-update/no-fault-auto-insurance> accessed 20 August 2019

Isaac L, ‘Driving Towards Driverless: a guide for government agencies’ (*WSP/Parsons Brinckerhoff*, 2016) <https://web.archive.org/web/20170323072545/http://www.wsp-pb.com/Globaln/USA/Transportation%20and%20Infrastructure/driving-towards-

driverless-WBP-Fellow-monograph-lauren-isaac-feb-24-2016.pdf> accessed 20 august 2019

Krafcik J, 'Where the next 10 million miles will take us' (*Medium* 10 October 2018) <https://medium.com/waymo/where-the-next-10-million-miles-will-take-us-de51bebb67d3> accessed 21 March 2019

Krafcik J, <https://twitter.com/johnkrafcik/status/1020343952266973186> accessed 9 July 2019

LA Times, <http://documents.latimes.com/tesla-accident-report/> accessed 3 May 2017

Massachusetts Institute of Technology, 'Moral Machine' (screenshot) <http://moralmachine.mit.edu/> accessed 19 August 2019

Massachusetts Institute of Technology, 'Moral Machine' <http://moralmachine.mit.edu/> accessed 14 August 2019

Mcity of the University of Michigan, 'Mcity Test Facility' <www.mtc.umich.edu/test-facility> accessed 28 August 2019

National Conference of State Legislatures, 'Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation' <www.ncsl.org/research/transportation/autonomous-vehicles-legislation.aspx> (accessed 22 December 2016)

National Highway Traffic Administration, 'Letter responding to a letter from Dr. Chris Urmson (Director of the Self-Driving Car Project, Google, Inc.)' (4 February 2016) <http://isearch.nhtsa.gov/files/Google%20--%20compiled%20response%20to%2012%20Nov%20%2015%20interp%20request%20--%204%20Feb%2016%20final.htm> accessed 9 August 2018

National Highway Traffic Safety Administration, 'Automated Vehicles for Safety' <www.nhtsa.gov/technology-innovation/automated-vehicles-safety> accessed 4 July 2019

Rijkswaterstaat, 'C-ITS Corridor project' <https://itscorridor.mett.nl/home+_eng/c-its+corridor_eng/default.aspx> accessed 14 June 2019

Rijkswaterstaat, 'Wegbeheerders' (*rijkswaterstaat.nl*) <www.rijkswaterstaat.nl/kaarten/wegbeheerders.aspx> accessed 31 July 2019

Smith BW, 'Human error as a cause of vehicle crashes' (*The Center for Internet and Society*, 18 December 2013) <http://cyberlaw.stanford.edu/blog/2013/12/human-error-cause-vehicle-crashes> accessed 9 March 2017

Smith BW, ‘Michigan’s automated driving bills’ (*The Center for Internet and Society*, 6 September 2016) <https://cyberlaw.stanford.edu/blog/2016/09/michigans-automated-driving-bills> accessed 7 February 2017

Smith BW, ‘Uber vs. the Law’ (*The Center for Internet and Society*, 17 December 2016) <https://cyberlaw.stanford.edu/blog/2016/12/uber-vs-law> accessed 22 December 2016

Smith BW, ‘US Department of Transportation’s Automated Driving Guidance’ (*The Center for Internet and Society*, 19 September 2016) <https://cyberlaw.stanford.edu/blog/2016/09/us-department-transportations-automated-driving-guidance> accessed 12 April 2017.

The United Nations Economic Commission for Europe (UNECE), ‘UN Transport Agreements and Conventions: Convention on Road Traffic, of 19 September 1949’ (*unece.org*) <www.unece.org/trans/maps/un-transport-agreements-and-conventions-07.html> accessed 28 June 2018.

The United Nations Economic Commission for Europe (UNECE), ‘UN Transport Agreements and Conventions: Convention on Road Traffic, of 8 November 1968’ (*unece.org*) <www.unece.org/trans/maps/un-transport-agreements-and-conventions-08.html> accessed 28 June 2018.

The United Nations Economic Commission for Europe, ‘Introduction’ (*unece.org*) <www.unece.org/trans/main/wp29/meeting_docs_wp29.html> accessed 9 July 2019

United Nations Economic Commission for Europe, ‘About us’ <www.unece.org/trans/roadsafe/rsabout.html> accessed 1 December 2016

United Nations Economic Commission for Europe, ‘List of Contracting Parties to the Convention on Road Traffic, Vienna, 8 November 1968’ (UNECE, 1 February 2007) <www.unece.org/fileadmin/DAM/trans/conventn/CP_Vienna_convention.pdf> accessed 12 April 2017

United Nations Road Safety Collaboration, ‘Decade of Action for Road Safety 2011-2020 seeks to save millions of lives’ (*World Health Organization*) <www.who.int/roadsafety/decade_of_action/en/> accessed 30 July 2019

United Nations Treaty Collection, ‘List of Contracting Parties to the Convention on Road Traffic, Geneva, 19 September 1949 <https://treaties.un.org/Pages/ViewDetailsV.aspx?src=TREATY&mtdsg_no=XI-B-1&chapter=11&Temp=mtdsg5&clang=_en> accessed 27 June 2019

United Nations Treaty Collection, 'List of Contracting Parties to the Convention on Road Traffic, Geneva, 19 September 1949' <https://treaties.un.org/doc/Publication/MTDSG/Volume%20I/Chapter%20XI/xi-b-1.en.pdf> accessed 12 April 2017

United Nations, 'Sustainable Development Goal 3' <https://sustainabledevelopment.un.org/sdg3> accessed 30 July 2019

United Nations, 'Status of the 1958 Agreement (and of the annexed regulations)' <www.unece.org/?id=25980> accessed 25 September 2019

Urmson C, 'The View from the Front Seat of the Google Self-Driving Car, Chapter 3' (*Medium*, 17 December 2015) <https://medium.com/@chris_urmson/the-view-from-the-front-seat-of-the-google-self-driving-car-chapter-3-476ea9deed9a#.wqzn8phbb> accessed 6 January 2017

Volvo, 'Vera's First Assignment' (13 June 2019) <www.volvotrucks.com/en-en/news/volvo-trucks-magazine/2019/jun/Veras-First-Assignment.html> accessed 2 August 2019

Volvo, 'Volvo Cars targets better driving behaviour. Volvo Cars to deploy in-car cameras and intervention against intoxication, distraction' (23 April 2019) <www.volvocars.com/au/about/australia/i-roll-enewsletter/2019/april/volvo-cars-targets-better-driving-behaviour> accessed 3 September 2019

Washington K, 'Meet Digit: A Smart Little Robot That Could Change the Way Self-Driving Cars Make Deliveries' (*Medium*, 22 May 2019) <https://medium.com/self-driven/meet-digit-self-driving-delivery-last-mile-solution-418d9995bb97> accessed 2 August 2019

Waymo LLC, 'Waymo Fully Self-Driving Chrysler Pacifica. Emergency Response Guide and Law Enforcement Interaction Protocol' (updated 10 September 10 2018) <https://iatranshumanisme.com/wp-content/uploads/2019/02/waymo_law_enforcement_interaction_protocol_v2.pdf> accessed 1 May 2019

Waymo, <https://waymo.com/> accessed 9 July 2019

Waymo, <https://waymo.com/ontheroad/> accessed 15 August 2018

Weiner G, Smith BW, 'Automated Driving: Legislative and Regulatory Action' (*The Centre for Internet and Society*, 27 April 2017) <cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action> accessed 12 April 2017

World Health Organization, 'Global Plan for the Decade of Action for Road Safety 2011-2020' (*World Health Organization* 2011) <www.who.int/roadsafety/decade_of_action/plan/plan_english.pdf?ua=1> accessed 30 July 2019

Summary

Fully automated vehicles, SAE Level 5, are getting closer to reality. Across the globe, countries are engaged in efforts to encourage automated driving. In numerous countries, legislative efforts have led to regulation on the testing of automated vehicles on public roads. In **Chapter 2**, three different approaches to regulating the testing of these vehicles were studied:

1. Binding regulations (California)
2. Non-binding regulations (USA and UK)
3. Permits/exemptions on a case-by-case basis (Netherlands)

This last approach is the preferred option as it can provide flexibility, in the sense that it can be adapted to changing circumstances without requiring a change in legislation, enabling it to keep up with rapid technological developments. It also provides governments with the power to set specific conditions for trials (locations, time of day, participants, precautions, exemptions from specific provisions, etc.) and to withdraw the granted permit if public safety is at risk. This approach of issuing permits on a case-by-case basis can be combined with a non-binding regulation, such as a code of practice. Thereby, those who want to test their vehicle can get an impression of what to expect and which requirements could be set, offering those parties more clarity.

In addition to exploring the legislative efforts required to make the testing of automated vehicles possible, legal challenges concerning the post-testing deployment of automated vehicles, where automated vehicles become available to the general public, were also identified. The two main challenges concern international traffic laws and liability.

The notion of *driver* was discussed extensively in **Chapter 3**. Both the 1949 Geneva Convention on Road Traffic and the 1968 Vienna Convention on Road Traffic state that every moving vehicle has to have a driver (art. 8 paragraph 1 Geneva Convention, art. 8 paragraph 1 Vienna Convention). The definition of driver given in art. 1(v) of the Vienna Convention, which is very similar to the definition given in the Geneva Convention[1], reads:

[1] Art. 4 paragraph 1 Geneva Convention.

> “ “Driver” means any person who drives a motor vehicle or other vehicle (including a cycle), or who guides cattle, singly or in herds, or flocks, or draught, pack or saddle animals on a road (…)”

This does not, however, provide much clarity on whether an automated vehicle, SAE Level 5, has a driver. Therefore, the meaning of the notion of *driver* was derived from documents pertaining to the Geneva Convention and the Vienna Convention, and the case law of Germany and the Netherlands. The study of case law and other relevant documents has led to the finding that a driver within the meaning of both Conventions is a human that decides on the speed and direction of the vehicle by operating at least some of the controls of the vehicle. None of the stakeholders in automated driving meets the requirements in order to be considered the *driver* of the automated vehicle within the meaning of the Conventions. The stakeholders are either not human (for instance, the automated driving system or the producer as a legal person) or do not decide on speed and direction of the vehicle (the user of the vehicle). An automated vehicle, SAE Level 5, is therefore truly driverless.

Four options to revise or reinterpret the Geneva Convention and the Vienna Convention in order to accommodate automated driving were discussed. These options are:

1. Revising the Conventions according to the approach used in maritime and aviation traffic law, with traffic rules directed at the vehicle instead of the driver;
2. Different interpretations of *driver* per function of the notion of *driver*;
3. Interpreting the Conventions as such that it is the user of the vehicle who operates a control by dispatching the automated vehicle and thereby becomes the driver of the automated vehicle;
4. The *functioneel daderschap* approach, meaning that the automated driving system drives the automated vehicle, and the acts of the automated driving system can be regarded to be the acts of the (legal) person who has the power to dispose over the conduct of the automated driving system.

This final option, the *functioneel daderschap* approach,[2] has proven to offer the best solution for the Geneva Convention and the Vienna Convention: without major revisions, this approach offers a clear legal framework that offers a solution for questions on responsibility in different situations. The question into responsibility is

[2] freely translated: *vicarious perpetrator* approach.

left unanswered by Options 1 and 2. Option 3 puts responsibility with the person who has barely any influence over the conduct of the automated driving system, the user, whereas the *functioneel daderschap* approach puts responsibility with the (legal) person that has the most influence over the conduct of the automated vehicle. Besides, the *functioneel daderschap* approach requires considerably less amendments to the Conventions than Options 1 and 2. The *functioneel daderschap* approach only requires the definition of driver from art. 4 Geneva Convention and art. 1(v) Vienna Convention to be deleted, so that the automated driving system can qualify as the driver. The traffic rules in the Conventions that are directed at the driver can remain as they are. The system should therefore act in conformity with all international and national traffic rules directed at the driver. If it violates such a traffic rule, the (legal) person that disposes over the conduct of the automated driving system can be held responsible. This responsible person could be the producer of the vehicle, but also the person who hacked the system and thereby made the system ignore traffic rules. This approach is also suitable for mixed traffic, where conventional vehicles and automated vehicles of different SAE Levels share the road. In a conventional vehicle, it will still be the human who drives the vehicles and who will be responsible for its conduct. The *functioneel daderschap* approach is therefore the best way forward.

In the long run, it might still be worth considering Option 1, however. The approach from maritime and aviation traffic law, where traffic rules are directed at the vessel or airplane, has proven its use. If a new Convention on road traffic were to be drafted in the future, as amending both Conventions so extensively seems unfeasible, traffic rules that are now directed at the driver should be directed at the vehicle.[3] Responsibility for the conduct of the vehicle can be assigned to a (legal) person, see Rule 2 a COLREGS 1972 and 2.3.1 Annex 2 Chicago Convention, or be established via the same reasoning as the *functioneel daderschap* approach. This approach would also be suitable for conventional vehicles driven by humans and automated vehicles of all SAE Levels. A shorter term solution, however, is it not, as this approach from maritime and aviation traffic law requires either very extensive amendments to both Conventions or an entirely new Convention on road traffic. So, the *functioneel daderschap* approach remains the best approach.

---

[3] This is not the case for all provisions directed at the driver. Some provisions are clearly written for a human driver and can therefore be left as they are.

The absence of a human driver has more implications: the roles of other stakeholders, such as the producer of the vehicle, the owner of the vehicle and the road authority, will change as well. **Chapter 4** has illustrated these changing roles and legal positions of the different stakeholders involved and its legal consequences. In this chapter, the question of who should prevent an automated vehicle with a safety-critical defect from driving down public roads was central. The roles of four different stakeholders - the user of the automated vehicle, the owner of the vehicle, the producer, and the vehicle authority responsible for approving the vehicle for use on public roads[4] - were studied. This research has shown that the government, through the approval authority, is in the best position to prevent an automated vehicle with a safety-critical defect from driving down public roads. It can do so by only approving vehicles equipped with a fail-safe that prevents the vehicle from driving if it has a safety-critical defect. A fail-safe should become a requirement for the EU (type-)approval of vehicles. The approval authority will then have the means and position to only approve vehicles equipped with such a fail-safe. Given the general interest of road safety, governments are the designated actors empowered to ensure through legislation and the (type-)approval process that automated vehicles with a safety-critical defect cannot drive on public roads and expose other road users to unnecessary risks.

However, even if all stakeholders have taken the necessary care and only automated vehicles equipped with a sufficient fail-safe are approved for use on public roads, accidents will not be eliminated entirely by automated vehicles. Humans will have no or barely any influence (perhaps only via, for instance, an emergency brake) on the driving behaviour of the automated vehicle and thereby on the accident. As a consequence, damages would most likely be claimed from the producer of the automated vehicle. Therefore, the Product Liability Directive has been studied extensively in **Chapter 5**.[5] Several shortcomings concerning automated driving were identified.

There has been an ongoing discussion in literature on the question of whether or not software, or a software update, is a product within the meaning of the Product Liability Directive. According to article 2 of the Directive, a product means all movables, with the exception of primary agricultural products and game, even when it is incorporated in a moveable or immovable. Art. 2 explicitly states electricity is also

[4] Directive 2007/46/EC.
[5] Directive 85/374/EEC.

a product. Roughly four different opinions can be identified from literature on whether (a) software (update) is covered by this definition of product:

- Software is not a product as it is not tangible;
- Only the combination of software and a tangible carrier is a product within the meaning of the Directive;
- Software is only a product within the meaning of the Directive when kept on a tangible carrier;
- Software is a product within the meaning of the Directive.

This last opinion offers the consumer protection the Product Liability Directive aims to provide.[6] Within the context of automated driving, this fourth approach would be the most desirable. Software is industrially produced and traded just like other products, therefore a producer should not be able to avoid liability for software or a software update. The software (update) in itself ought to be a product. If the software turns out to be defective and causes damage, the producer should be held liable. The carrier on which the software is supplied, whether it is provided on a usb-stick or through an over-the-air update, is in that case irrelevant. The level of consumer protection ought to be the same regardless of the (absence of a) carrier.

Software gives rise to other questions concerning the defences of the producer, listed in art. 7 of the Product Liability Directive. The defences described in art. 7(b) and art. 7(e) of the Directive proved to be of specific interest.

The defence of art. 7(b) of the Product Liability Directive can successfully be invoked by the producer if he proves 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 (…)."[7] The producer might want to invoke this defence if a self-learning error of self-learning software of his automated vehicle has caused damage. As this research showed, the producer will not be successful in this because it is a design choice to equip the vehicle with this software. This design choice was made before the vehicle was put into circulation and therefore the producer cannot successfully invoke this defence.

[6] Recitals Product Liability Directive.
[7] Art. 7(b) Product Liability Directive.

However, the defence of art. 7(b) becomes of particular importance if an automated vehicle has been put into circulation and after a certain time a safety-critical software update that influences the driving behaviour of the vehicle is provided by the producer of the automated vehicle. If such a software update turns out to be defective, and the automated vehicle has caused damage due to that update, then the producer of the automated vehicle can invoke the defence of art. 7(b) of the Directive. The producer will argue that the defect which caused the damage did not exist when he put the vehicle into circulation. After all, he provided the defective software update after the vehicle was put into circulation. This is not in line with the rationale of the defence of art. 7(b) of the Directive: only if a producer no longer has influence over his product, should he be able to invoke this defence. With the development of software updates, however, the producer can exercise influence over his product well after it has been put into circulation. Therefore, as this research has found, the producer should not be able to invoke this defence when he still has influence over his product via software updates. Consequently, the producer of an automated vehicle cannot avoid liability by only providing the necessary (update to the) self-driving software for the vehicle after the vehicle has been put into circulation.[8]

New technological developments also mean that the development risk defence of art. 7(e) of the Product Liability Directive becomes very important. The producer avoids liability if "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."[9] If an automated vehicle is equipped with self-learning software that, due to a learning error, causes damage, the producer might want to invoke this defence. The producer will have to prove that the self-learning error could not have been discovered given the state of scientific and technical knowledge at the time he put the automated vehicle with the self-learning software into circulation. If the producer succeeds and successfully invokes this development risk defence, the development risk is borne by the injured party. This means that the risks of developing automated vehicles, which ought to benefit society as a whole, are borne by a random victim that has no influence on the development risk itself. It is not

---

[8] In the European Commission, 'Evaluation of Council Directive 85/374/EEC on the approximation of laws, regulations and administrative provisions of the Member States concerning liability for defective products FINAL REPORT' (January 2018), it was underlined that "(…) there are exceptions mainly relating to the AI technology and 3D printers where it is not considered adequate to maintain (…)", among others, the defence of art. 7(b): p. 83, see also p. 38.

[9] Art. 7(e) Product Liability Directive.

desirable to put this heavy a burden on the injured party. As argued in this thesis, the development risk should lie with the producer, as the producer has the most influence over the risk itself. To achieve this, Member States could derogate from art. 7(e) of the Product Liability Directive with regards to automated vehicles (art. 15 of the Product Liability Directive).

A final issue concerning automated driving and the Product Liability Directive is the matter of establishing when the automated vehicle is defective within the meaning of art. 6 of the Directive. Article 6 states that a product is defective when it does not provide the safety which a person is entitled to expect. All circumstances should be taken into account.

In literature, a discussion is ongoing on as to what one is entitled to expect from an automated vehicle. However, the influence of the (type-)approval[10] of the automated vehicle on those justified expectations gets unjustly overlooked. As this research has shown, the (type-)approval gives rise to the expectation that the vehicle can safely be used in the way and under the circumstances it has been approved for. The approval could entail stipulations on the braking capacity, reaction speed and on the type of roads the vehicle can be used, thereby setting a minimum standard for the justified expectations of consumers. As a consequence, the (type-)approval will become of great importance for determining whether an automated vehicle is defective. Thereby, the (type-)approval gains considerably in importance for establishing the liability of the producer of an automated vehicle compared to when establishing the liability of the producer of a conventional vehicle.

The (type-)approval has further implications for the liability risks of stakeholders. Not only the liability risks of the producer are different from the situation in which only conventional, human driven, vehicles are on the road, this also applies to the liability risks of the road authority. Under Dutch law, a road authority that has to ensure that the public road is in good condition, is liable for damage caused by the road if the road does not meet the standards which in the given circumstances may be set for such roads (art. 6:174 lid 2 BW). This Dutch example from **Chapter 6** showed that, when the liability of the road authority depends on what the road user can expect, the liability risks of the road authority change. The (type-)approval of an automated vehicle can contribute to these expectations. The user of an approved automated

[10] Directive 2007/46/EC.

vehicle will expect that this automated vehicle can be used safely within the boundaries set by the type-approval, for instance, on the highway. If the road does not meet this justified expectation and damage is caused because of that, the road authority can be held liable for this damage under Dutch law. This way, the (type-)approval sets standards for the liability of the road authority. This thesis has brought to light this new development that underlines the importance of the (type-)approval for the liability risks of the stakeholders involved in automated driving.

The implementation of the solutions offered in this thesis require the efforts of legislators on a national level as well as an international level. This will inevitably take time. Therefore, it is paramount to start bringing about the necessary legal changes in order to have a good legal framework in place by the time the first automated vehicles become available to consumers.

Samenvatting

Volledig autonome voertuigen, SAE Level 5, zijn volop in ontwikkeling. Wereldwijd wordt de ontwikkeling van deze voertuigen aangemoedigd. Zo is in meerdere landen het testen van autonome voertuigen op de openbare weg in wetgeving vastgelegd. De wijze waarop het testen van die voertuigen is geregeld wordt door landen verschillend aangepakt. In **Hoofdstuk 2** zijn drie verschillende wijzen van regulering van het testen van autonome voertuigen besproken:

1. Bindende wetgeving (Californië)
2. Niet-bindende regelgeving (Verenigde Staten en het Verenigd Koninkrijk)
3. Vergunning/ontheffing per geval (Nederland)

Deze laatste benadering biedt de beste mogelijkheid tot aanpassing aan nieuwe omstandigheden, zonder dat daarvoor wetswijziging noodzakelijk is. Zo kan gelijke pas gehouden worden met de snelle technologische ontwikkelingen. Deze benadering biedt overheden ook de mogelijkheid om specifieke voorwaarden voor tests van specifieke voertuigen vast te leggen (bijvoorbeeld ten aanzien van de testlocaties, tijdstippen, deelnemers, voorzorgsmaatregelen, ontheffingen van specifieke wettelijke voorschriften, etc.). Bovendien kan de vergunning of ontheffing worden ingetrokken indien de openbare veiligheid in het geding komt. Het toekennen van vergunningen per geval kan worden gecombineerd met niet-bindende regelgeving zoals een *code of practice*. Partijen die hun autonome voertuig willen testen op de openbare weg kunnen zo een goede indruk krijgen van de voorwaarden die gelden voor het verkrijgen van een vergunning. Daardoor wordt deze partijen meer duidelijkheid verschaft.

Naast ontwikkelingen op het terrein van regelgeving van testen van autonome voertuigen op de openbare weg, is onderzocht welke juridische vragen rijzen ten aanzien van het gebruik van autonome voertuigen na de testfase. De twee belangrijkste vragen betreffen de internationale verkeerswetgeving en de civiele aansprakelijkheid voor schade veroorzaakt door autonome voertuigen.

De internationale verkeerswetgeving komt in het bijzonder aan de orde in Hoofdstuk 3. Volgens zowel het Verdrag van Genève nopens het wegverkeer van 1949 als het Verdrag van Wenen inzake het wegverkeer van 1968 dient ieder rijdend voertuig een bestuurder te hebben (art. 8 lid 1 Verdrag van Genève, art. 8 lid 1 Verdrag van Wenen). Art 1 sub (v) van het Verdrag van Wenen geeft als definitie van het begrip

bestuurder (een definitie die grote gelijkenis vertoont met de definitie uit het Verdrag van Genève[1]):

> ""Driver" means any person who drives a motor vehicle or other vehicle (including a cycle), or who guides cattle, singly or in herds, or flocks, or draught, pack or saddle animals on a road (…)"[2]

Deze definitie geeft niet voldoende duidelijkheid over de vraag of een autonoom voertuig, SAE Level 5, in de zin van de Verdragen een bestuurder heeft. Een studie van documenten afkomstig van Working Party 1, de werkgroep belast met het bijwerken van beide Verdragen, en Duitse en Nederlandse jurisprudentie met betrekking tot het bestuurdersbegrip leert dat een *bestuurder* in de zin van het Verdrag van Genève en het Verdrag van Wenen een mens is die beslist over de snelheid en de richting van het voertuig door het gebruik van een of meer bedieningsorganen. De bij het autonome voertuig (SAE Level 5) betrokken partijen zijn noch mens (de producent als rechtspersoon, het autonome systeem), noch beslissen zij over de snelheid en richting van het autonome voertuig (de gebruiker beslist slechts over de bestemming). Een autonoom voertuig, SAE Level 5, heeft daarom in de zin van het Verdrag van Genève en het Verdrag van Wenen geen *bestuurder*.

Er zijn vier opties besproken om deze Verdragen op het punt van het bestuurdersbegrip aan de komst van autonome voertuigen aan te passen, te weten:

1. Verkeersregels richten tot het voertuig in plaats van de bestuurder, zoals ook het geval is in regelingen voor maritiem verkeer en luchtvaart;
2. Uitleg van het bestuurdersbegrip naar gelang de functie die het begrip vervult;
3. De Verdragen zo uitleggen dat de gebruiker wordt aangemerkt als *bestuurder* omdat hij het voertuig in beweging stelt door het voertuig te starten;
4. Functioneel daderschap-benadering, hetgeen inhoudt dat het handelen of nalaten van het autonome systeem, dat het voertuig bestuurt, wordt aangemerkt als daad van de (rechts)persoon die erover vermocht te beschikken of de gedraging al dan niet zou plaatsvinden.

[1] Art. 4 lid 1 Verdrag van Genève.
[2] Vertaling: ""Bestuurder" is degene die een motorvoertuig of enig ander voertuig bestuurt (met inbegrip van een fiets) of die vee, hetzij enkele dieren hetzij in kudden, of trek-, last- of rijdieren op de weg onder zijn hoede heeft (…)."

Van deze vier mogelijkheden verdient de laatste, de functioneel daderschap-benadering, de voorkeur. Deze benadering biedt, zonder ingrijpende amendementen, een helder juridisch kader voor vragen rondom de verantwoordelijkheid voor het rijgedrag van de autonome auto in verschillende situaties. De eerste en de tweede optie voorzien niet in de beantwoording van vragen rondom deze verantwoordelijkheid. De derde optie legt de verantwoordelijkheid bij de persoon die nauwelijks invloed kan uitoefenen op het autonome systeem, namelijk bij de gebruiker. Dit in tegenstelling tot de functioneel daderschap-benadering. Deze legt de verantwoordelijkheid bij diegene die het meeste invloed heeft op de gedragingen van het autonome systeem. Daarnaast vereist de benadering van het functioneel daderschap aanzienlijk minder amendementen op het Verdrag van Genève en het Verdrag van Wenen dan de Opties 1 en 2. De functioneel daderschap-benadering vraagt slechts dat de definities van het bestuurdersbegrip (art. 4 Verdrag van Genève, art. 1 sub (v) Verdrag van Wenen) worden verwijderd. Het autonome systeem kan dan als *bestuurder* in de zin van de Verdragen worden aangemerkt. De gedragingen van het autonome systeem dienen in overeenstemming te zijn met de internationale en nationale verkeersregels die zich richten tot de *bestuurder* van een voertuig. Indien het autonome systeem in strijd met een verkeersregel handelt, kan de (rechts)persoon die vermocht te beschikken over de gedragingen van het systeem daarvoor juridisch verantwoordelijk worden gehouden. Deze (rechts)persoon kan bijvoorbeeld de producent van het voertuig zijn, maar ook iemand die het voertuig heeft gehackt en daardoor heeft veroorzaakt dat het autonome systeem verkeersregels negeert. In het geval van een conventioneel voertuig is er nog steeds een menselijke bestuurder die verantwoordelijk is voor zijn eigen gedragingen.

Op de lange termijn is het aan te raden ook Optie 1 in ogenschouw te nemen. Deze benadering, inhoudende dat de verkeersregels niet worden gericht tot de bestuurder maar tot het voertuig, heeft zijn waarde bewezen in het maritieme en luchtverkeer. Deze benadering vereist mogelijk wel dat er een nieuw Verdrag inzake het wegverkeer moet worden gesloten omdat het grondig wijzigen van zowel het Verdrag van Genève en het Verdrag van Wenen onhaalbaar lijkt. In een eventueel nieuw Verdrag zouden de verkeersregels die nu nog tot de *bestuurder* zijn gericht zich moeten richten tot het voertuig.[3] De verantwoordelijkheid voor de gedragingen van het autonome systeem zou vervolgens kunnen worden toegekend aan een

[3] Dit vereist niet de aanpassing van de bepalingen die zich duidelijk richten tot een menselijke bestuurder.

(rechts)persoon (zie ter illustratie Regel 2 a van het Verdrag inzake de Internationale Bepalingen ter voorkoming van aanvaringen op zee 1972[4] en 2.3.1 Annex 2 van het Verdrag inzake de internationale burgerluchtvaart[5]) of moeten worden vastgesteld via een redenering vergelijkbaar met de functioneel daderschap-benadering. De benadering ontleend aan de verkeerswetgeving betrekking hebbende op maritiem verkeer en luchtvaart zou ook geschikt zijn voor conventionele voertuigen die worden bestuurd door mensen en geautomatiseerde voertuigen van alle SAE Levels. Op de korte termijn verdient niettemin de functioneel daderschap-benadering de voorkeur, omdat deze benadering geen grote wijzigingen in de bestaande Verdragen of ene nieuw Verdrag noodzakelijk maakt.

De afwezigheid van een bestuurder van vlees en bloed heeft meer gevolgen: de rollen van de andere betrokken partijen (zoals de producent van het autonome voertuig, de eigenaar en de wegbeheerder) zullen ook veranderen. In **Hoofdstuk 4** is aandacht besteed aan zowel deze veranderende rollen van de verschillende betrokken partijen als de juridische gevolgen van deze veranderingen. Er is onderzocht wie dient te voorkomen dat een autonoom voertuig met een defect dat de (verkeers)veiligheid in gevaar brengt, op de openbare weg rijdt. Daarbij zijn de rollen van de gebruiker van het autonome voertuig, de eigenaar van het voertuig, de producent van het voertuig en de goedkeuringsinstantie[6] in ogenschouw genomen. Hierbij is gebleken dat de overheid, via de goedkeuringsinstantie die (type)goedkeuringen voor voertuigen verleent, de beste positie heeft om te voorkomen dat een autonoom voertuig met een verkeersgevaarlijk defect deelneemt aan het verkeer op de openbare weg.

Dat een dergelijk voertuig aan het verkeer deelneemt kan worden voorkomen door een zogenaamde *fail-safe* in het voertuig in te bouwen. Deze *fail-safe* voorkomt dat een voertuig met een verkeersgevaarlijk defect op de openbare weg gaat rijden. Daarom dient deze *fail-safe* verplicht te worden gesteld in de Europese (type)goedkeuringseisen voor voertuigen. De goedkeuringsinstantie krijgt daardoor de middelen en de positie om alleen voertuigen die zijn voorzien van zo’n *fail-safe* goed te keuren. Aangezien verkeersveiligheid van algemeen belang is, zijn overheden, via hun goedkeuringsinstanties, de aangewezen partij om door wetgeving en het (type)goedkeuringsproces te waarborgen dat autonome voertuigen met defecten die de verkeersveiligheid in gevaar brengen niet op de openbare weg kunnen rijden.

---

[4] Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS 1072).
[5] Convention on International Civil Aviation, 1944 (Chicago Convention).
[6] Richtlijn 2007/46/EC.

Zelfs wanneer alle betrokken partijen de nodige zorg betrachten en alleen autonome voertuigen met een *fail-safe* zijn uitgerust, zullen zich ongevallen met autonome voertuigen voordoen. Mensen hebben niet of nauwelijks (misschien via een noodrem) invloed op het rijgedrag van een autonoom voertuig en daardoor op het ontstaan van een ongeval. Het is daarom waarschijnlijk dat indien het voertuig schade veroorzaakt heeft deze bij de producent van het autonome voertuig zal worden geclaimd. Daarom is in **Hoofdstuk 5** de Europese Productaansprakelijkheidsrichtlijn bestudeerd.[7]

In de literatuur is een discussie gaande over de vraag of software, of een software update, kan worden aangemerkt als een product als bedoeld in de Productaansprakelijkheidsrichtlijn. Artikel 2 van de Richtlijn houdt in dat een product een roerende zaak is, ook nadat deze een bestanddeel is gaan vormen van een andere roerende of onroerende zaak. Artikel 2 vermeldt expliciet dat ook elektriciteit een product is in de zin van de Richtlijn. Er kunnen grofweg vier verschillende opvattingen over de vraag of (een) software (update) al dan niet een product is in de literatuur worden onderscheiden:

- Software is geen product omdat het niet een roerend zaak is, daar software niet voor menselijke beheersing vatbaar is;
- Alleen de combinatie van software en een voor menselijke beheersing vatbare drager kan worden aangemerkt als product in de zin van de Productaansprakelijkheidsrichtlijn;
- Software kan alleen als product worden aangemerkt indien het op een voor menselijke beheersing vatbare drager is opgeslagen;
- Software is een product in de zin van de Productaansprakelijkheidsrichtlijn.

Deze laatste optie biedt de consumentenbescherming die de Productaansprakelijkheidsrichtlijn nastreeft.[8] In de context van autonoom rijden is deze benadering dan ook wenselijk. Software wordt op industriële schaal geproduceerd en verhandeld, net als andere producten. Daarom zou de producent van software of van een software update aansprakelijkheid niet mogen ontlopen door te stellen dat software geen product is. Dit betekent dat de software (update) zelf dient te worden aangemerkt als product. Aldus kan de producent aansprakelijk worden gesteld indien software defect blijkt en het autonome voertuig daardoor

[7] Richtlijn 85/374/EEC.
[8] Preambule Productaansprakelijkheidsrichtlijn.

schade heeft veroorzaakt. De drager waarop software wordt verstrekt (zoals een usb-stick of door een draadloze update) dient daarbij niet relevant te zijn. Het niveau van consumentenbescherming dient gelijk te zijn, ongeacht de drager van de software.

Software doet ook vragen rijzen ten aanzien van de verweren van de producent, opgesomd in art. 7 van de Productaansprakelijkheidsrichtlijn. De verweren beschreven in art. 7 sub b en art. 7 sub e van de Richtlijn verdienen in dit verband in het bijzonder aandacht.

Op het verweer van art. 7 sub b van de Productaansprakelijkheidsrichtlijn kan door de producent met succes een beroep worden gedaan indien deze kan aantonen dat "het, gelet op de omstandigheden, aannemelijk is dat het gebrek dat de schade heeft veroorzaakt, niet bestond op het tijdstip waarop hij het produkt in het verkeer heeft gebracht, dan wel dat dit gebrek later is ontstaan; (…)."[9] De producent zou een beroep op dit verweer kunnen doen indien een leerfout van zelflerende software van het autonome voertuig aan het defect ten grondslag ligt. Zoals in dit onderzoek is besproken, zal de producent dit verweer echter niet met succes kunnen voeren omdat het in dit geval een keuze bij het ontwerp is om het voertuig met dit type software uit te rusten. Deze ontwerpkeuze is gemaakt *voordat* het voertuig in het verkeer is gebracht. Dit staat in de weg aan een succesvol beroep op het verweer van art. 7 sub b van de Productaansprakelijkheidsrichtlijn.

Het verweer van art. 7 sub b van de Richtlijn is echter in het bijzonder van belang indien een autonoom voertuig een belangrijke update krijgt enige tijd nadat het voertuig in het verkeer is gebracht. Wanneer blijkt dat zo'n software update defect is en het voertuig ten gevolge van dat gebrek schade veroorzaakt, kan de producent een beroep willen doen op het verweer van art. 7 sub b van de Productaansprakelijkheidsrichtlijn. De producent zal in dat geval aanvoeren dat het defect dat de schade heeft veroorzaakt niet bestond op het moment dat hij het voertuig in het verkeer bracht. Hij heeft de software update immers pas beschikbaar gesteld nadat het voertuig in het verkeer was gebracht. Honorering van dit verweer strookt echter niet met de ratio van het verweer van art. 7 sub b van de Productaansprakelijkheidsrichtlijn: een beroep op dit verweer zou alleen succesvol dienen te zijn wanneer een producent niet langer invloed kan uitoefenen op zijn product. Door het uitbrengen van software updates kan de producent nog lang nadat het product in het verkeer is gebracht invloed uitoefenen op het product. Dit pleit ervoor dat een beroep op het verweer van art. 7 sub b van de Richtlijn niet dient te

[9] Art. 7 sub b Productaansprakelijkheidsrichtlijn.

slagen indien de producent nog invloed heeft op zijn product via software updates. Dit betekent dat een producent van een autonoom voertuig aansprakelijkheid evenmin kan ontwijken door de voor de zelfrijdende functies noodzakelijke software pas na het in het verkeer brengen van het voertuig te verstrekken.[10]

In de context van het gebruik van autonome voertuigen is eveneens het ontwikkelingsrisicoverweer van art. 7 sub e van de Productaansprakelijkheidsrichtlijn van belang. Deze bepaling houdt in dat de producent zich succesvol kan verweren tegen aansprakelijkheid indien "het op grond van de stand van de wetenschappelijke en technische kennis op het tijdstip waarop hij het produkt in het verkeer bracht, onmogelijk was het bestaan van het gebrek te ontdekken (…)".[11] De producent van een autonoom voertuig zou een beroep op dit verweer kunnen doen indien het voertuig dat is uitgerust met zelflerende software door een fout in het zelflerende proces schade veroorzaakt. De producent zou dan kunnen aanvoeren dat de fout in het zelflerende proces, gezien de wetenschappelijk en technische kennis op het moment dat hij het voertuig met zelflerende software in het verkeer bracht, onmogelijk ontdekt had kunnen worden.

Indien het beroep van de producent op het ontwikkelingsrisicoverweer succesvol is, draagt de partij aan wie de schade is toegebracht in feite het ontwikkelingsrisico. In dit onderzoek is betoogd dat het niet wenselijk is om op de benadeelde partij zo'n zware last te leggen. Het ontwikkelingsrisico dient te liggen bij de producent, omdat de producent de meeste invloed kan uitoefenen op dit risico. Om dit te bereiken kunnen Lidstaten ten aanzien van autonome voertuigen afwijken van het ontwikkelingsrisicoverweer van art. 7 sub e van de Productaansprakelijkheidsrichtlijn (conform art. 15 Productaansprakelijkheidsrichtlijn).

In dit onderzoek is ook aandacht besteed aan het gebrekscriterium van art. 6 van de Productaansprakelijkheidsrichtlijn. Volgens art. 6 van de Richtlijn is er sprake van een gebrek indien het product niet de veiligheid biedt die men daarvan, alle omstandigheden in aanmerking dienen genomen, mag verwachten.

---

[10] In European Commission, 'Evaluation of Council Directive 85/374/EEC on the approximation of laws, regulations and administrative provisions of the Member States concerning liability for defective products FINAL REPORT' (January 2018), werd benadrukt dat "(…) there are exceptions mainly relating to the AI technology and 3D printers where it is not considered adequate to maintain (…)", onder andere, het verweer van art. 7 sub b Productaansprakelijkheidsrichtlijn: p. 83, zie ook p. 38.
[11] Art. 7 sub e Productaansprakelijkheidsrichtlijn.

In de literatuur wordt gediscussieerd over de vraag wat men mag verwachten van een autonoom voertuig. In deze discussie wordt ten onrechte niet stilgestaan bij de invloed die de (type)goedkeuring van het voertuig heeft op de inhoud van deze gerechtvaardigde verwachtingen.[12] Zoals in dit onderzoek is beschreven roept de (type)goedkeuring de verwachting op dat het voertuig veilig kan functioneren op de wijze en onder de omstandigheden waarvoor het is goedgekeurd. De goedkeuring kan bijvoorbeeld bepalingen met betrekking tot de remcapaciteit, reactiesnelheid en type wegen waarop het voertuig kan worden gebruikt omvatten. Daardoor wordt er een minimumstandaard gevormd voor de gerechtvaardigde verwachtingen van consumenten. Dit zorgt ervoor dat de (type)goedkeuring een belangrijke rol zal gaan spelen in de vaststelling of een autonoom voertuig in de zin van de Productaansprakelijkheidsrichtlijn defect is. De invloed van de (type)goedkeuring bij het vaststellen van de aansprakelijkheid van de producent neemt daarmee in vergelijking met de invloed van de (type)goedkeuring in het vaststellen van de aansprakelijkheid van de producent van een conventioneel voertuig aanzienlijk toe.

De (type)goedkeuring heeft ook anderszins invloed op de aansprakelijkheidsrisico's van de bij autonome voertuigen betrokken partijen. Naast de verandering in aansprakelijkheidsrisico's van de producent, wordt ook de wegbeheerder met nieuwe aansprakelijkheidsrisico's geconfronteerd. De wegbeheerder die moet zorgen dat de weg in goede staat verkeert, is conform Nederlands recht aansprakelijk voor schade veroorzaakt door de weg indien die weg niet voldoet aan de eisen die men daaraan in de gegeven omstandigheden mag stellen, en daardoor gevaar voor personen of zaken oplevert (art. 6:174 lid 2 BW). Dit Nederlandse voorbeeld, besproken in **Hoofdstuk 6**, laat zien dat, wanneer de aansprakelijkheid van de wegbeheerder afhangt van de verwachtingen van de weggebruiker, de aansprakelijkheidsrisico's voor de wegbeheerder veranderen met de komst van autonome voertuigen. De (type)goedkeuring kan bijdragen aan deze verwachtingen. De gebruiker van het autonome voertuig zal verwachten dat hij het voertuig veilig kan gebruiken binnen de grenzen vastgelegd in de (type)goedkeuring, bijvoorbeeld op de snelweg. Op grond van Nederlands recht kan de wegbeheerder vervolgens aansprakelijk worden gesteld wanneer de weg niet voldoet aan deze gerechtvaardigde verwachtingen en ten gevolge daarvan schade wordt veroorzaakt. Op deze manier worden door de (type)goedkeuring normen gesteld voor de aansprakelijkheid van de wegbeheerder.

---

[12] Richtlijn 2007/46/EC.

Dit onderstreept het belang van de (type)goedkeuring voor de aansprakelijkheidsrisico's van de bij autonome voertuigen betrokken partijen.

De implementatie van de in dit onderzoek voorgestelde oplossingen vereisen de inspanningen van wetgevers op zowel nationaal als internationaal niveau. Het is onvermijdelijk dat dit de nodige tijd zal gaan kosten. Het is daarom van belang om nu te beginnen de noodzakelijke wijzigingen in verdragen en nationale wetgeving door te voeren zodat er, tegen de tijd dat de eerste autonome voertuigen beschikbaar komen voor consumenten, een goed juridisch kader is gevormd voor het gebruik van en de aansprakelijkheid voor deze voertuigen.