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THE LEGAL ISSUES REGARDING THE REGULATION OF AUTONOMOUS VEHICLES IN THE EUROPEAN UNION

Bachelor Thesis

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I hereby declare that I am the sole author
of this Bachelor Thesis and it has
not been presented to any other
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Introduction

Life nowadays is dependent on technology since it makes life easier and more comfortable, saves time and simplifies communication. Innovation has always been valued for its potential of increasing the economy´s competitiveness on the international market, hence it can be seen as the driving force in order to introduce new developments and advancements.[1] Recent advancements have introduced vehicles that include highly sophisticated hardware and software.[2] Thus, the driver could share control over the driving with the vehicle or these vehicles could operate fully independently. All these improvements are leading to autonomous vehicles. States could incorporate technological developments into laws or find a way how existing legislation could be applied to new technology. However, current laws do not include specifically autonomous vehicles and do not regulate them. Technological advancements in vehicle automation will change the legal framework and lead to significant legal developments.[3] Therefore, the legislation needs to be updated and renewed so that it would not inhibit development. The legislation should clearly define what is an autonomous vehicle, how it can operate in traffic, who is then considered to be the driver or operator and who is responsible if the vehicle actually drives itself. In addition, laws should lay down safety requirements for security and privacy, and determine how to deal with liability issues.

Road traffic is a highly regulated area on the international and national level since it involves people and their lives, and bears a risk for all traffic users. Roads are filled with vehicles and every year more and more vehicles appear on public roads. Consequently, the absence of road rules would cause many accidents, causing injuries to people and damage to vehicles. Road traffic laws are intended to protect people and therefore these laws should be clear, understandable and coherent. Failing to follow the laws will result in liability and punishment.

The European Union values innovation and therefore aims to improve the innovation performance and strives toward creating a friendly environment for innovation and for ideas that can be turned into various products and services which are needed for growing the European

[1] Stanculescu, E. European Union: Innovation Activity and Competitiveness. Realities and Perspectives. Global Economic Observer 2015, 3(1), pp 4-9, p 8.
[2] Lohmann, Melinda F. Special Issue on the Man and the Machine - Liability Issues Concerning Self-Driving Vehicles. European Journal of Risk Regulation 2016, 7 (2), pp 335-340, p 335.
[3] Kohler, William J. Colbert-Taylor, A. Current Law and Potential Legal Issues Pertaining to Automated, Autonomous and Connected Vehicles. Santa Clara High Technology Law Journal 2015, 31(1), pp 99-138, p 101.

economy, jobs and for ensuring that Europe is globally competitive.[4] With regard to innovation, the EU Member States are divided into groups. The first group called the innovation leaders includes Sweden and the second group whose innovation is also noticeable includes Estonia.[5] Sweden is the leading innovator in the EU according to the European Innovation Scoreboard 2015[6] and therefore Sweden is interested in developing its technology including autonomous vehicles.

It has been proposed that vehicle automation could change the transportation system by improving road and transport safety, offering more comfort and mobility, and being more environmentally friendly.[7] Many manufacturers are currently developing their technology to introduce autonomous vehicles. Google is perhaps the most known manufacturer who has started to test its driverless vehicles on public roads. These vehicles are an excellent example of innovation and technology development. Fully autonomous vehicles should be able to drive completely themselves without needing someone to control and operate the vehicle and therefore the issue is whether the driver needs to monitor the vehicle continually or just react to the alerts by the vehicle if it is necessary for the driver to take control of a malfunctioning vehicle.[8] Autonomous vehicles are intended to make critical decisions themselves while driving and that places a huge burden on policymakers and lawmakers to adopt and change public policies, laws and technical standards to prepare courts and the public for autonomous vehicles and issues along with them.[9] A coherent, appropriate and strategic legal framework at the international level would be the best solution to provide the needed balance between promoting innovation, managing liability issues and protecting the public.[10]

The concept of an autonomous vehicle is in contrast with the Vienna Convention on Road Traffic from 1968. Autonomous vehicles should be able to drive themselves, but the Vienna Convention includes the word driver and lays down that every moving vehicle or combination of

[4] Stanculescu, *supra* nota 1, p 6.
[5] *Ibid*, p 5.
[6] European Commission. European Innovation Scoreboard. ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en (29.01.2017).
[7] Fagnant, D., Kockelman, K. Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations. Transportation Research Part A: Policy & Practice 2015, 77, pp 167-181, p 167.
[8] Douma, F., Palodichuk, Sarah A. Criminal Liability Issues Created by Autonomous Vehicles. Santa Clara Law Review 2012, 52(4), pp 1157-1170, p 1161.
[9] Beiker, Sven A. Legal Aspects of Autonomous Driving. Santa Clara Law Review 2012, 52(4), pp 1145-1156, p 1146.
[10] Holder, C. *et al*. Robotics and law: Key legal and regulatory implications of the robotics age (Part I of II). Computer Law & Security Review 2016, 32 (3), pp 383-402, p 388.

vehicles shall have a driver.[11] In addition, the Convention requires that the driver must be able to control the vehicle at all times.[12] However, the Convention is contrary to the aim of autonomous vehicles. Autonomous vehicles should, in theory, be able to drive completely themselves without any human intervention and therefore eliminating the need for an actual driver. Currently, autonomous vehicles still require a human driver who can control the vehicle and therefore these vehicles are allowed to do the test driving on roads. However, the aim of autonomous vehicles embodies the vehicle´s ability to drive without any intervention of a human driver. In order to introduce fully autonomous vehicles onto public roads, the Vienna Convention should apply to autonomous vehicles and allow them to operate without requiring a driver.

The hypothesis of the thesis is following: **The regulation of autonomous vehicles in the EU is currently problematic and has many legal issues due to the absence of a supranational legal framework.** The author evaluates the hypothesis based on three research questions. **What are the legal issues concerning autonomous vehicles? Why is the current legislation regarding vehicles on the international level and in the European Union problematic? How are vehicles and autonomous vehicles regulated in Sweden and Estonia?**

The goal of this thesis is to analyse the legal issues concerning autonomous vehicles, including privacy, security and especially liability in more detail in order to come to a conclusion whether autonomous vehicles face challenges and whether the regulation of these vehicles is problematic. The aim of the author is to assess the hypothesis based on the research questions and conclude whether the regulation of autonomous vehicles in the European Union is currently problematic. In addition, the thesis examines how the current legislation regulates vehicles in the European Union and why autonomous vehicles present difficulties for legislators. Furthermore, the thesis examines how Sweden and Estonia regulate vehicles and whether they are willing to allow autonomous vehicles on their public roads.

The thesis is based on qualitative research method. The main sources of this thesis are peer-reviewed articles about autonomous vehicles, the essence of them, their development and their legal issues including liability and security problems. In addition, the author uses the legislation of the European Union, international legislation and the laws of two Member States to analyse the regulation of autonomous vehicles. The regulation of autonomous vehicles in Sweden and

[11] The United Nations, Vienna Convention on Road Traffic, 1968, article 8, p 1.
[12] *Ibid*, article 8, p 5.

Estonia is examined and compared. The thesis includes court cases which will be discussed and analysed. In addition, relevant and current news are used to discuss the regulation and issues of autonomous vehicles.

The author will firstly introduce the concept, essence, and development of autonomous vehicles. What are autonomous vehicles? What are the different types of autonomous vehicles? How have autonomous vehicles developed? Secondly, the thesis will explore the legal issues concerning autonomous vehicles, discussing liability and security in more detail. The third chapter examines the legislation concerning the regulation of vehicles concentrating on the Vienna Convention on Road Traffic and the European Union Product Liability Directive[13] and discusses why the regulation of autonomous vehicles is problematic. The fourth chapter concentrates on two of the European Union Member States and the way these States regulate autonomous vehicles. Since Sweden has issued a proposal of a new law regarding autonomous vehicles, the thesis examines how Sweden regulates the issue of autonomous vehicles. In addition, Estonia is also one of the Member States whose law is examined, since Estonia recently allowed test drives of autonomous vehicles on public roads provided that the vehicle has a driver who can take over control when needed.

[13] Council Directive of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (85/374/EEC), OJ 1985 No L210, 7 August 1985.

1. The development and purpose of autonomous vehicles

1.1 The essence of autonomous vehicles

Humans have used cars and other vehicles for a long time. The history reaches back to 1886 when Karl Benz invented the first automobile vehicle and since then various vehicle concepts have evolved.[14] The automobile was a transformative invention that affected every level of modern society and shaped the modern industrialized societies.[15] Since the technology is constantly developing, new and improved vehicles are being introduced to the world. Especially the computer science and information communication technology are becoming more advanced and therefore it has a major influence on road transport vehicles and on the benefits for society.[16] Advancements have led to vehicles that ultimately should be capable of operating independently. Due to the potential of autonomous vehicles to improve safety, efficiency, and mobility, they are currently one of the most intensively researched and debated technologies.[17]

Autonomous vehicles are road vehicles which can sense the environment and control movements without actually requiring a human driver and are also known as driverless, self-driving or robotic vehicles.[18] The term autonomous is currently more widespread since the ultimate goal is to develop vehicles capable of acting alone or independently, however, the term automated is more accurate since most vehicles use navigation and communication systems, but cannot select destinations or routes and operate independently and require a human driver.[19] The technology in the autonomous vehicle has preprogrammed scenarios of situations happening in the traffic and hence the vehicle is able to react the same way in the actual traffic situation.

Vehicles can be divided into different categories based on their level of automation. Non-automated vehicles presume that the human controls the vehicle completely and solely at all times, however, this category includes also vehicles which are equipped with warning systems that assist the driver thus provide necessary information to the driver and warn the driver in the

[14] Maurer, M. *et al*. (eds.) Autonomous Driving - Technical, Legal and Social Aspects. Ladenburg, Springer-Verlag Berlin Heidelberg 2016, p 255.
[15] Brodsky, Jessica S. Autonomous vehicle regulation: how an uncertain legal landscape may hit the brakes on self-driving cars. Berkeley Technology Law Journal 2016, 31, pp 851-877, p 851.
[16] Tettamanti, T. *et al*. Impacts of Autonomous Cars from a Traffic Engineering Perspective. Periodica Polytechnica: Transportation Engineering 2016, 44(4), pp 244-250, p 244.
[17] Beiker, *supra* nota 9, p 1146.
[18] Tettamanti, *supra* nota 16, p 245.
[19] Wood, Stephen P. *et al*. The Potential Regulatory Challenges Of Increasingly Autonomous Motor Vehicles. Santa Clara Law Review 2012, 52 (4), pp 1423-1502, p 1425.

case of situations which require attention.[20] First vehicles with driver assistance systems included sensors such as cameras, lasers, GPS that were able to determine the environment and location of the vehicle and therefore provide warnings to the driver.[21] In addition, communication systems enabling connection with other vehicles or infrastructure are useful for autonomous vehicles since the system is capable of connecting with the pedestrian´s mobile phone which transmits GPS based location through Wi-Fi network to all surrounding road vehicles.[22] The benefit of these systems is to warn vehicles and therefore prevent an accident.

A step further is monitored automation which is the first to share the driving responsibility with the driver, nevertheless, the driver should be able to take control at all times since the technology allows the vehicle to drive autonomously only when the conditions permit it.[23] One step from full automation is conditional automation which permits the driver to completely hand over the driving responsibility to the vehicle under certain circumstances, however, differs from the previous one since the driver is not expected to assume control over the vehicle immediately, the vehicle should be able to warn the driver of a condition needing attention in advance, allowing the driver safely and timely take control of the vehicle.[24]

The last category is the ultimate goal for autonomous vehicles. Full automation allows the vehicle to operate automatically and independently in all driving tasks and all driving scenarios, additionally, the vehicle is responsible for all driving decisions and actions made during driving.[25] The full automation takes control from a human driver and hands it completely over to the vehicle meaning that a human driver is no longer required. The long-term vision should allow the driver to choose whether to drive the vehicle himself or allow the vehicle to circulate autonomously in the traffic.[26]

Currently, many driver assistance systems such as parking assist or lane keep assist systems are included in numerous vehicles, all leading to fully automated vehicles that are capable of driving without a driver.[27] Nevertheless, these systems are capable of handling particular driving

[20] *Ibid*, p 1429.
[21] Beiker, *supra* nota 9, p 1147.
[22] Tettamanti, *supra* nota 16, p 245.
[23] Wood, *supra* nota 19, p 1431.
[24] *Ibid*.
[25] *Ibid*, p 1432.
[26] Beiker, *supra* nota 9, p 1149.
[27] Lohmann, *supra* nota 2, p 335.

operations or driving only in certain environments.[28] Therefore, the transition from regular vehicles to autonomous vehicles should occur gradually. Firstly, drivers should give more driving tasks to automated systems and take over control when necessary which would then lead to fully autonomous systems allowing completely driverless vehicle on public roads.[29] The transition will certainly take time and effort since fully autonomous vehicles are introduced to the market and allowed onto the public roads only when they drive more safely than a human driver does.[30]

Presently, many car manufacturers including Audi, BWM, Ford, Mercedes, Toyota and in addition companies like Apple and Google are actively working on the improvement of their technology and introducing new developments in autonomous vehicles.[31] Manufacturers and other interested parties like Google are cooperating to achieve a better and more favorable regulatory environment in order to test the autonomous vehicle technology.[32] Google has developed its autonomous vehicle technology and is continuously improving this technology.[33] The software used can sense anything near the vehicle and allow the vehicle to make decisions that usually human drivers do.[34] Currently, Google´s technology needs a person in the driver´s seat and allows the driver to take control of the vehicle anytime desired and needed.[35] Furthermore, before autonomous vehicles are allowed onto the roads and into the traffic, states need to test the way these vehicles drive and whether all systems and functions work properly. Test drives are also necessary to develop appropriate and up to date laws and regulations. Many states are already prepared and allow test drives of autonomous vehicles on public roads.[36] For instance, Google´s driverless vehicles have done many test drives on public roads for many years and have completed hundreds of thousands of miles of driving covering different traffic conditions.[37] Although these vehicles still have a human in the driver´s seat, the human has no

[28] Glancy, Dorothy J. Autonomous and Automated and Connected Cars - Oh My: First Generation Autonomous Cars in the Legal Ecosystem. Minnesota Journal of Law, Science and Technology 2015, 16(2), pp 619-692, p 628.
[29] Tettamanti, *supra* nota 16, p 245.
[30] Hevelke, A., Nida-Rümelin, J. Responsibility for Crashes of Autonomous Vehicles: An Ethical Analysis. Science & Engineering Ethics 2015, 21 (3), pp 619-630, p 624.
[31] Tettamanti, *supra* nota 16, p 248.
[32] Maurer, *supra* nota 14, p 150-151.
[33] Bogue, R. Robot ethics and law. Industrial Robot: An International Journal 2014, Vol. 41 (5) pp 398-402, p 400.
[34]Markoff, J. Google Cars Drive Themselves, in Traffic, 2010. www.nytimes.com/2010/10/10/science/10google.html (24.02.2017)
[35] Vladeck, David C. Machines Without Principals: Liability Rules And Artificial Intelligence. Washington Law Review 2014, 89 (1), pp 117-150, p 129.
[36] Schroll, C. Splitting The Bill: Creating A National Car Insurance Fund To Pay For Accidents In Autonomous Vehicles. Northwestern University Law Review 2015, 109 (3), pp 803-833, p 803.
[37]Urmson, C. The self-driving car logs more miles on new wheels, 2012. googleblog.blogspot.com.ee/2012/08/the-self-driving-car-logs-more-miles-on.html (19.02.2017)

purpose or task in the actual driving.[38] Additionally, Estonia recently allowed the test drives of autonomous vehicles on public roads as well.

1.2 The benefits and advantages of autonomous vehicles

Every manufacturer and producer desire its products to be beneficial for the public. Autonomous vehicles are expected to have many advantages and benefits for everyone. The most important and ambitious benefit of autonomous vehicles is safety. These vehicles are considered to be much safer since they rely extremely minimally on humans for their operation.[39]

Currently, the human is the main cause of accidents and therefore the main advantage of autonomous vehicles is the elimination of human drivers and consequently the elimination of human errors in transportation.[40] Human error is linked closely to accidents in traffic since human drivers tend to be more inattentive and furthermore alcohol, drugs, fatigue, speeding or distraction can cause more accidents.[41] Autonomous vehicles are better at maintaining a steady speed, observing and monitoring other drivers or pedestrians, making rapid adjustments without getting distracted or falling asleep.[42] Since autonomous vehicles share data with other vehicles in real time, they have an advantage over human drivers due to their knowledge of dangerous situations.[43] Moreover, these vehicles could help the driver to drive more safely by notifying the driver to pull over or take a break when the driver shows signs of tiredness and is not sufficiently alert.[44] Texting, calling and using the phone while driving is definitely one of the reasons for accidents and therefore autonomous vehicles create possibilities to answer calls and text while driving, hence improving safety.[45] Additionally, autonomous vehicles create the possibility of eliminating intoxicated drivers from the roads by allowing the vehicle to drive itself and not needing an actual driver, however, this creates a challenge for lawmakers to decide whether the laws would actually allow an intoxicated person into the vehicle.[46]

[38] Vladeck, *supra* nota 35, p 126.
[39] Schroll, *supra* nota 36, p 805.
[40] Tettamanti, *supra* nota 16, p 248.
[41] Fagnant, *supra* nota 7, p 169.
[42]Collingwood, L. Privacy implications and liability issues of autonomous vehicles. Information & Communications Technology Law 2017, 26 (1), pp 32-45, p 34.
[43] Schroll, *supra* nota 36, p 809.
[44] Hevelke, *supra* nota 30, p 625.
[45] Douma, *supra* nota 8, p 1162.
[46] *Ibid*, p 1163.

Since traffic safety is highly valued, car companies are striving toward the development of autonomous vehicles which could hopefully reduce the number of deaths and increase safety in driving.[47] Although, before allowing autonomous vehicles into the traffic and onto public roads, it is crucial to test how these vehicles manage on roads and whether they need to be improved further. Autonomous vehicles are expected to increase safety by making safety critical operations and therefore test driving is crucial for autonomous vehicles since these vehicles are not yet completely viable since they are incapable of navigating through all these different scenarios that might arise in the traffic.[48]

Moreover, autonomous vehicles have many social advantages. Autonomous vehicles are capable of circulating without an actual human driver and therefore these vehicles can pick up the passenger from anywhere and take him anywhere, serve the purpose of a taxi or circulate on fixed routes for the purpose of a public bus, consequently extending the benefits to all sectors of society allowing them more opportunity for mobility.[49] They offer benefits for elderly, disabled people and people underage who may not have the opportunity to drive themselves. Ordinary vehicles need drivers and according to the law, drivers need to be at a certain age and obtain a driving license in order to qualify as a driver. Since autonomous vehicles can drive themselves, it reduces the actual need for drivers and even people without a driving license could be able to manage the vehicle and reach their destination safely.[50] In addition, autonomous vehicles may help new drivers acquire driving skills in order to become safe and experienced drivers without causing serious accidents and minimizing the risk of accidents.[51] Unfortunately, in these situations where the driver needs to take control, underage or elderly people can face difficulties since they may not be able to control the vehicle. In addition, if states decide that even the passenger in the vehicle needs a driving license to take control of the vehicle, autonomous vehicles could possibly become unusable for underage people. Furthermore, autonomous vehicles provide comfort for the driver and passengers since they are not required to constantly pay attention to traffic which allows them more free time and the possibility to relax.[52] Driving becomes more comfortable with possibilities to eat, use the phone and sleep or simply rest while driving.

[47] Schroll, *supra* nota 36, p 804.
[48] Wood, *supra* nota 19, p 1426.
[49] Tettamanti, *supra* nota 16, p 249.
[50] *Ibid*.
[51] Beiker, *supra* nota 9, p 1151.
[52] Lohmann, *supra* nota 2, p 335.

1.3 The challenges of autonomous vehicles

In spite of introducing numerous safety advantages as well as social and environmental benefits, the development of autonomous vehicles is not straightforward and faces several challenges. Autonomous vehicles are programmed to act in a certain way and therefore difficulties arise when a situation occurs which the vehicle is not prepared for. These vehicles rely on route data that has been programmed into their systems and therefore in unexpected situations or extreme weather conditions these vehicles may behave differently or not drive at all.[53] Detecting human and other objects on the roads or facing poor weather conditions, such as fog and snow, or rain and ice may be more difficult for autonomous vehicles.[54] Moreover, the sensors in autonomous vehicles may fail to recognise and respond to potential hazards or detect and respond to nonexistent incidents.[55] In dangerous and unexpected circumstances, the autonomous vehicle should be designed to notify the driver that in these conditions the vehicle cannot drive itself and driver must take control of the vehicle.[56]

Before autonomous vehicles are allowed on to public roads, they need to be tested. Test driving is crucial since autonomous vehicles may still cause accidents and if these vehicles have more or simply more severe accidents, then such vehicles will not be allowed onto public roads and they will not be legally eligible for widespread use.[57] It is a challenge for manufacturers to develop vehicles that do well on test drives without actually needing a human driver in order to place these vehicles into circulation. This technology will definitely become more widespread over the years, hence increasing the possibility of damage caused by autonomous vehicles.[58]

Although autonomous vehicles have great benefits, policymakers, manufacturers, and drivers are concerned about the security of the system.[59] Since autonomous vehicles are able to connect and communicate with other vehicles while performing autonomous driving functions, they share and receive data.[60] Relying on technology makes autonomous vehicles vulnerable to hacking and

[53] Cohen, Roy A. Self-Driving Technology and Autonomous Vehicles: A Whole New World for Potential Product Liability Discussion. Defense Counsel Journal 2015, 82 (3), pp 328-334, p 329.
[54] Fagnant, *supra* nota 7, p 169.
[55] Watzenig, D. *et al*. (eds) Automated Driving - Safer and More Efficient Future Driving. Switzerland, Springer 2017, p 10.
[56]NPR. Google Asks, Why Should A Car Need A Driver? www.npr.org/templates/story/story.php?storyId=130492972 (9.02.2017)
[57] Marchant, Gary E. , Lindor, Rachel A. The coming collision between autonomous vehicles and the liability system. Santa Clara Law Review 2012, 52 (4), pp 1321-1340, p 1321.
[58] Holder, *supra* nota 10, p 386.
[59] Fagnant, *supra* nota 7, p 177.
[60] Wood, *supra* nota 19, p 1432.

data that is collected by these vehicles creates issues of privacy. In addition, autonomous vehicles store and use information, make decisions, act on their own and therefore can cause actual damage independently of manufacturers, owners or users which consequently creates issues of liability.[61]

Furthermore, autonomous vehicles raise ethical and moral issues. Ethical issues regarding autonomous vehicles are concerned with the absence of a human driver who makes moral decisions in extreme and difficult situations, for example deciding whether to hit another car or drive off the road to avoid hitting a pedestrian.[62] Additionally, morality questions concern whether the liability should be imposed based on the human´s duty to pay attention to the road and traffic and in order to avoid accidents, intervene and take control of the vehicle.[63]

[61] Holder, *supra* nota 10, p 386.
[62] *Ibid*, p 387.
[63] Hevelke, *supra* nota 30, p 619.

2. Legal issues regarding autonomous vehicles

2.1 Issues created by the introduction of autonomous vehicles

International and national laws regulate conventional vehicles and road traffic. The technological world is developing continuously, unfortunately, laws are quite slow to deal with technological developments and moreover, all improvements need proper legislation, but the creation of good, solid and understandable laws requires time.[64] The introduction of autonomous vehicles creates a challenge since current laws do not regulate these vehicles yet coherent and appropriate legislation is needed before autonomous vehicles are allowed onto public roads. Legislators around the world are considering how autonomous vehicles will affect existing laws and are struggling to grasp and solve the legal, regulatory and ethical issues concerning autonomous vehicles.[65]

Laws and regulations form a crucial part of the development of autonomous vehicles, although legal issues surrounding autonomous vehicles are complex and difficult and therefore may even hinder the development of autonomous vehicles.[66] Even though autonomous vehicles have advantages and bring along many benefits, legal aspects remain unclear and therefore impose great challenges for lawmakers and manufacturers since the issues of legality, liability, responsibility and insurance, privacy and cyber security of autonomous vehicles need to be dealt with and clarified.[67] Without proper laws, it is currently unclear how courts should deal with issues involving autonomous vehicles.[68]

Presently, autonomous vehicles raise many questions regarding driving licenses. Currently, it is required to have a valid driving license for all drivers in order to drive and control the vehicle. Consequently, it needs to be decided what type of license if any at all should be required to operate an autonomous vehicle, whether a license should be required for fully autonomous vehicles in which the human does not control the vehicle, what prerequisites and training are needed to obtain a license to operate an autonomous vehicle.[69] Therefore legislators need to determine whether their laws still require the operator or the passenger of the vehicle to obtain a driving license in cases where the operator needs to take control, furthermore, if laws require a

[64] Holder, *supra* nota 10, p 384.
[65] *Ibid*, p 386.
[66] Tettamanti, *supra* nota 16, p 250.
[67] Bogue, *supra* nota 33, p 400.
[68] Beiker, *supra* nota 9, p 1152.
[69] Holder, *supra* nota 10, p 387.

driving license for the operator, then it needs to be determined whether that person has criminal responsibility for failing to manage malfunctions and avoid accidents.[70]

In addition, autonomous vehicles cause legal issues with current traffic rules and laws. Since autonomous vehicles can circulate on an autopilot mode, each state should decide whether their laws will regulate passenger or autopilot modes and then clearly define the word operate since current laws consider that the operator controls the vehicle, but in the case of autonomous vehicles, the operator can simply be a passenger having no control over the vehicle.[71] In addition, some of the existing driving rules need to be examined, since for example, current rules prohibit the use of mobile phone while driving which would be irrelevant in the case of autonomous vehicles.[72]

2.2 Liability issues concerning autonomous vehicles

Even though autonomous vehicles are considered to be safer than conventional vehicles, accidents will still happen, however, due to the autonomous technology, the human error will be eliminated.[73] Accidents always create the question of liability and in the case of conventional vehicles, the liability can be decided more easily. A central legal question of autonomous vehicles concerns responsibility and liability since fully autonomous vehicles should, in theory, be able to drive without any human intervention, hence problems arise when driving fails and an accident occurs.[74]

In order for autonomous vehicles to operate, certain situations and scenarios are already programmed in the system of these vehicles, however, the difficulty occurs when something happens that the system is not prepared for.[75] For example, if a deer jumps suddenly on the road, then the autonomous vehicle needs to decide whether to hit the deer or drive off the road and in addition, the decision of a vehicle can change if instead of the deer another vehicle, bicyclist or a pedestrian occurs in front of the vehicle.[76] This will be the decision of the vehicle and vehicle should be held liable for consequences. However, developers and manufacturers program the vehicle to act accordingly in the traffic and react to situations in a specific manner. This is

[70] Douma, *supra* nota 8, p 1163.
[71] *Ibid*, p 1162.
[72] Holder, *supra* nota 10, p 387.
[73] Schroll, *supra* nota 36, p 805.
[74] Douma, *supra* nota 8, p 1160.
[75] Tettamanti, *supra* nota 16, p 247.
[76] Fagnant, *supra* nota 7, p 177.

simply an unexpected event that was not foreseen and therefore not programmed. This leads to the question of responsibility.

At present, autonomous vehicles are not capable of handling all driving conditions and therefore the driver needs to be alert to quickly react and take control in order to avoid dangerous situations.[77] Therefore, the liability system could put the responsibility on the users of autonomous vehicles which is then based on the user´s duty to pay attention to the road and traffic and to intervene in the case of an accident.[78] In this case, while determining responsibility, the human interaction with the autonomous vehicle is crucial and needs to be evaluated.[79] The user´s duty to intervene could help autonomous vehicles to develop gradually allowing the transition from semi-autonomous vehicles to fully autonomous vehicles, however, this alternative would decrease the usefulness and purpose of autonomous vehicles since it would not be possible for the vehicle to drive itself or drive a passenger to the destination and in addition, the vehicle could not be used by disabled, elderly or underage people.[80]

Currently, the vehicles are at most still semi-autonomous and therefore the human who is making decisions is responsible for wrongful acts committed by the vehicle since autonomous vehicles do not have a legal personhood.[81] Consequently, in the case of fully autonomous vehicles, states should consider whether or not afford some formal legal status to these vehicles and therefore make them legally responsible for actions and decisions.[82] Laws regulating autonomous vehicles could designate some form of legal personality to these vehicles and therefore recognize that they can cause damage and be fully liable for that which would avoid difficulties on how to determine the responsibility.[83]

Issues of liability for any damage caused by autonomous vehicles will definitely have impacts on the insurance system since the system needs to embrace the increased responsibility of manufacturers, owners, developers and others involved in autonomous vehicles.[84] For insurance industry, it is important to know who is liable for accidents since then the question who should

[77] Wood, *supra* nota 19, p 1473.
[78] Hevelke, *supra* nota 30, p 623.
[79] Glancy, *supra* nota 28, p 634.
[80] Hevelke, *supra* nota 30, p 624.
[81] Vladeck, *supra* nota 35, p 121.
[82] *Ibid*, p 124.
[83] Holder, *supra* nota 10, p 387.
[84] *Ibid*, p 387.

bear the costs occurs.[85] Moreover, insurance compensates people and therefore a vehicle insurance is mandatory, however, it is unclear whether autonomous vehicles need to have an insurance since these vehicles do not have a driver.[86] A possible solution to the insurance issue could be found in the current system in Sweden whereby the victims are compensated by insurance and then the insurance decides whether to proceed with the product liability claim against manufacturers, however, this system is extremely reliant on state funding and therefore may face challenges in other jurisdictions.[87] Legislators need to draft and pass laws that would provide a framework for insurance issues and insurance industry needs to develop their guidelines to deal with liability and insurance problems.[88]

Before autonomous vehicles are allowed into the traffic, the issues regarding who is responsible for accidents need to be dealt with and laid down properly.[89] Laws must define and lay down the functions of drivers, operators, and owners.[90] Since fully autonomous vehicles can drive completely themselves or simply have a passenger, the laws should also determine whether the owner of the vehicle is liable for the actions of its autonomous vehicle and perhaps also of the actions of the passenger or driver.[91] Furthermore, courts should have a clear idea of how to determine liability.[92]

2.2.1 Liability shift from human drivers to manufacturers

A conventional vehicle crash has usually three possible causes - the driver, a vehicle defect or malfunction, or natural conditions.[93] Currently, laws presume that a driver is in control of the vehicle and therefore responsible for accidents and damage caused.[94] Autonomous vehicles eliminate the need for drivers, hence excluding driver´s fault in the case of an accident. Expectedly autonomous vehicles should minimize the number of accidents due to human drivers while creating new failures attributable to the vehicle.[95] The decrease of

[85] Vladeck, *supra* nota 35, p 129.
[86] Glancy, *supra* nota 28, p 667.
[87] Holder, *supra* nota 10, p 387.
[88] Bogue, *supra* nota 33, p 400.
[89] Hevelke, *supra* nota 30, p 619.
[90] Douma, *supra* nota 8, p 1168.
[91] *Ibid*, p 1159.
[92] Herd, A. R2dford: Autonomous Vehicles And The Legal Implications Of Varying Liability structures. Faulkner Law Review 2013, 5 (1), pp 29-58, p 58.
[93] Marchant, *supra* nota 57, p 1326.
[94] Bose, U. The black box solution to autonomous liability. Washington University Law Review 2015, 92 (5), pp 1325-1351, p 1337.
[95] Marchant, *supra* nota 57, p 1339.

human-caused accidents will, unfortunately, affect manufacturers since the use of autonomous vehicles will increase the number of accidents caused by defects and malfunctions.[96] Partially autonomous vehicles shift the liability from the driver to the vehicle to a certain extent, whereas the introduction of fully autonomous vehicles shifts the responsibility for avoiding accidents and therefore the liability completely to the vehicle.[97] As a result, manufacturers can be held liable for the actions of the vehicle.

Manufacturers should be held liable since they are responsible for the autonomous vehicle and the system managing the vehicle.[98] Manufacturers have the duty to disclose any possible malfunctions or defects in the autonomous vehicle technology and instruct the owner how to operate the vehicle safely.[99] Additionally, manufacturers are in the best position to improve and secure the technology and prevent malfunctions.[100] Working together with designers and software engineers enables to design the autonomous system in a way that would react to all situations and minimize the risk of accidents.[101] Laws regulating simple traffic issues such as speeding and traffic signs should require manufacturers to program autonomous vehicles to comply with all rules and regulations in traffic, even when the vehicle is in a passenger mode, hence any violation thereof would be a malfunction of the vehicle and liability would shift from a human driver to the autonomous vehicle.[102] However, if the driver decided to turn on the autonomous system and made the decision negligently, the distribution of liability between the vehicle and the driver may be more difficult, for example, if the instruction manual required the driver not to use the autonomous system in bad weather conditions and the driver did so anyway, the driver may be partly responsible and liable.[103]

On the other hand, autonomous vehicles will have many parties related to the vehicle. Since there are different parties who can be held liable, manufacturers of autonomous vehicles desire laws and measures that would decrease their liability.[104] If the driver is not liable anymore, the

[96] Schroll, *supra* nota 36, p 805.
[97] Marchant, *supra* nota 57, p 1326.
[98] Hevelke, *supra* nota 30, p 620.
[99] Gurney, J. K. Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles. University of Illinois Journal of Law, Technology & Policy 2013, 2013 (2), pp 247-277, p 264.
[100] Scott, Michael D. Tort Liability for Vendors of Insecure Software: Has the Time Finally Come? Maryland Law Review 2008, 67 (2), pp 426-484, p 469.
[101] Marchant, *supra* nota 57, p 1334.
[102] Douma, *supra* nota 8, p 1160.
[103] Marchant, *supra* nota 57, p 1327.
[104] Wallach, W. From Robots to Techno Sapiens: Ethics, Law and Public Policy in the Development of Robotics and Neurotechnologies. Law, Innovation and Technology 2011, 3 (2), pp 185-207, p 194.

liability for an accident caused by an autonomous vehicle can be placed on the vehicle manufacturer, the manufacturer of a component in the system, the software engineer responsible for the programmed code, and the vehicle designer.[105] However, laws regarding autonomous vehicles need to be developed since manufacturers must know which laws their vehicles must follow.[106] Since autonomous vehicles rely on technology and in order for the vehicle to function properly it needs to be maintained and monitored, drivers could be held responsible for vehicle maintenance.[107] Accidents caused by the failure to take care of the vehicle could result in a driver´s liability.

Due to the lack of the regulatory and legal framework regarding liability issues, the developers and manufacturers of autonomous vehicles are left to face a problem that could possibly hinder innovation and development.[108] Unfortunately, laws that would place the burden of responsibility and liability on manufacturers could severely diminish or even eliminate any incentive for manufacturers to innovate, develop and produce autonomous vehicles, and improve the safety in order to prevent liability claims.[109] The decrease in deaths and accidents is a strong moral reason to promote the development and improvement of autonomous vehicles and therefore legislators should frame manufacturers liability laws in a way that would still encourage manufacturers to develop and improve their vehicles.[110] The liability system must be balanced so it would not place extremely strict liability on manufacturers which could have a harmful effect on innovation and manufacturers incentive to develop and improve their technology, while still preserving the functions of liability law which is to prevent accidents and compensate victims of accidents.[111] In conclusion, laws regulating liability need to be drafted carefully and rules should take into account all aspects of autonomous vehicles.

[105] Marchant, *supra* nota 57, p 1328.
[106] Brodsky, *supra* nota 15, p 874.
[107] Bose, *supra* nota 94, p 1338.
[108] Bogue, *supra* nota 33, p 398.
[109] Marchant, *supra* nota 57, p 1337.
[110] Hevelke, *supra* nota 30, p 623.
[111] Robolaw. Regulating Emerging Robotic Technologies in Europe, Guidelines on Regulating Robotics 2014. www.robolaw.eu/RoboLaw_files/documents/robolaw_d6.2_guidelinesregulatingrobotics_20140922.pdf (23.02.2017), p 63.

2.3 Cybersecurity issues created by autonomous vehicles

Technology in general causes cyber security issues and autonomous vehicle technology is not an exception. Due to depending heavily on technology, concerns regarding third party involvement, hacking, and even terrorism may arise.[112] Autonomous vehicles enable hackers to use the vulnerabilities and execute malicious attacks which may cause the driver or the vehicle to lose control.[113] It is crucial for autonomous vehicles to be safe from hacks, viruses and malicious software since only one severe incident could be enough to startle manufacturers and consumers, and prevent autonomous vehicles from driving on the roads.[114]

Unfortunately, autonomous vehicles increase the potential for misuse which in turn generates new types of crimes.[115] The connectivity between cars and personal items creates possibilities for third parties to have access to personal data and hence cause accidents intentionally.[116] Hacking into autonomous vehicle sensors and systems could be a danger to the vehicle´s security since attackers can program the vehicle to increase the speed which could end with an accident or attack the system with so many signals that the vehicle becomes confused.[117] In addition, the problem could occur with the ability to use the vehicle to commit crimes, since the vehicle is able to operate remotely, by itself and therefore the vehicle can be for example for drug trafficking.[118] This raises a question of who is responsible, is it the owner of the vehicle that delivered drugs or the hacker who compromised the vehicle for drugs. Therefore, newly emerged cyber crimes related to autonomous vehicles should be included in cyber crime laws and therefore criminalized.

[112] Douma, *supra* nota 8, p 1159.
[113] Watzenig, *supra* nota 55, p 11.
[114] *Ibid*, p 18.
[115] Glancy, *supra* nota 28, p 664.
[116] Cohen, *supra* nota 53, p 331.
[117]Harris, M. Researcher Hacks Self-driving Car Sensors, 2015. spectrum.ieee.org/cars-that-think/transportation/self-driving/researcher-hacks-selfdriving-car-sensors (22.02.2017)
[118] Douma, *supra* nota 8, p 1165.

2.4 Privacy issues created by autonomous vehicles

Privacy issues arise since vehicle automation requires communications between vehicles or between vehicles and infrastructure.[119] Autonomous vehicles are designed to share information and communicate with other vehicles thus creating and processing data, and therefore it is important to ensure that all vehicles are in accordance with privacy requirements to protect any sensitive data.[120] Collected and shared data raises questions including for what reasons the data will be used, how it will be used, who should control the data, what types of data should be stored, who will have access to the data and how long is reasonable to keep the data.[121]

On the other hand, collecting data could be beneficial since the data from the autonomous vehicle could be used in the case of an accident to provide the location of the vehicle, information about the speed and passengers.[122] However, information and data about the vehicle, driving, travel details need appropriate safeguards otherwise, this data could be used by governments to track individuals, by law enforcement for surveillance or by hackers to control the vehicles and even cause accidents.[123] The collected data could be beneficial if it is sufficiently and appropriately protected. The software and technology of autonomous vehicles could include encryption measures in order to protect the personal data it generates and collects.[124] However, this would require a court order in order to oblige the data holder to disclose the information for investigation or detection of illegal activity.[125]

Since autonomous vehicles introduce crimes that can be committed through the vehicle, tracking the GPS in the vehicle could be beneficial and crucial for investigation. However, surveillance creates issues of privacy and is contrary to the right to respect for private life. On the other hand, as crimes are a threat to public security, the surveillance and tracking of possible crimes would probably prove to be necessary. This issue was discussed in a case that was initiated due to a surveillance via GPS that was committed for a criminal investigation. The applicant claimed that the surveillance and the use of data constituted a violation to the right to respect for private and family life under Article 8 of the European Convention on Human Rights. The European Court

[119] Kohler, *supra* nota 3, p 101.
[120]Tettamanti, *supra* nota 16, p 248.
[121]Collingwood, *supra* nota 42, p 37.
[122] Holder, *supra* nota 10, p 391.
[123] Fagnant, *supra* nota 7, p 178.
[124] Pagallo, U., Durante, M. The Pros and Cons of Legal Automation and Its Goverance. European Journal of Risk Regulation 2016, 7 (2), pp 323-334, p 325.
[125] Collingwood, *supra* nota 42, p 37.

of Human Rights decided in the case Uzun v. Germany[126] that surveillance via GPS and the use of data obtained from the GPS does not constitute a violation of the right to respect for private life. The proceedings had a legitimate aim that was to protect national security, public safety and prevent crime. Additionally, it was proportionate since the GPS surveillance had been done only when the less intrusive methods appeared to be insufficient and the surveillance was carried out for a short period. Hence, the surveillance by GPS and the processing and use of data were necessary. Therefore, surveillance of GPS in autonomous vehicles is acceptable if a serious crime is suspected. The surveillance could be helpful in determining where the vehicle drives and what operations the vehicle performs in crime cases.

Concerns regarding how to apply and enforce the data protection legislation will emerge when autonomous vehicles become data controllers and they will be responsible for compliance with data protection laws.[127] The European Union´s Data Protection Directive[128] concerning the protection of personal data lays down the principles and requirements of data protection and data processing. Therefore, systems that process data gathered from autonomous vehicles must comply with the currently applicable Data Protection Directive. Furthermore, the processing must comply with the requirements of the General Data Protection Regulation which will enter into force on the 25 of May 2018.

The public will accept autonomous vehicles only when it is certain that they are safe, reliable and protect the privacy of drivers.[129] It is crucial for the adoption of autonomous vehicles to clarify what the technology can and cannot do with the user data.[130] Manufacturers and designers need to find a way to make systems secure so that unauthorized people will not be able to access and modify these systems.[131] This difficult task will hopefully create trust between the public and autonomous vehicle technology hence increasing the possibility that these vehicles will soon be allowed onto public roads.

Since autonomous vehicles collect, store and share data, they must comply with data protection requirements laid down in the DPD. Pursuant to Article 6(1)(b) of the Data Protection Directive

[126] ECHR 2.9.2010, 35623/05, Uzun vs. Germany.
[127] Holder, *supra* nota 10, p 395.
[128] Directive 95/46/EC OF the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, OJ 1995 No L 281, 23 November 1995.
[129] Wood, *supra* nota 19, p 1448.
[130] Collingwood, *supra* nota 42, p 38.
[131] Wood, *supra* nota 19, p 1466.

autonomous vehicles must collect data to the extent that it is necessary to achieve a specific and legitimate purpose.[132] For example, the data could be collected only for arriving at a certain destination or used for an accident investigation purposes. Moreover, Article 6(1)(e) lays down that data collected must not be stored for longer than is necessary to achieve the purpose the data was collected for.[133] In addition, the collection and use of personal information should rely on the consent of the users of autonomous vehicles.[134]

[132] Directive 95/46/EC OF the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, *supra* nota 128.
[133] *Ibid*.
[134] Glancy, Dorothy J. Privacy in Autonomous Vehicles. Santa Clara Law Review 2012, 52 (4), pp 1171- 1239, p 1200.

3. The current international and the European Union legislation concerning vehicles

3.1 Legislation on the regulation of autonomous vehicles

Basic traffic rules are regulated on the international level. Therefore, autonomous vehicles should be regulated by conventions or treaties on the international level as well. In addition, the European Union has adopted its laws regulating traffic and vehicles. States should adopt similar legislation regarding autonomous vehicles to make these vehicles successful.[135] Some countries have already started to adopt and amend their existing laws to regulate autonomous vehicles.[136] The legislation of autonomous vehicles is a mixture of different laws across the world.[137] Every country tries to regulate autonomous vehicles in the way they see necessary and appropriate. In addition, countries are bound by international instruments regulating vehicles and when the European Union adopts laws concerning autonomous vehicles, states need to incorporate these into their national laws.

In order to adopt laws regulating autonomous vehicle, lawmakers need to conduct studies to deal with the issues of definitions, standards, and liability for autonomous vehicles.[138] Policies and legislation must be established to create an appropriate legal framework that allows safe and continuous innovation of autonomous vehicles.[139] A coherent, appropriate and strategic legal framework at the international level would be the best solution to provide the needed balance between promoting innovation, managing liability issues and protecting the public.[140]

3.2 Vienna convention on Road Traffic

Currently, traffic with human drivers is regulated by traffic rules on the national and international level.[141] International agreements help to facilitate the international traffic by providing harmonized road traffic rules. On the international level, basic traffic rules are defined by an international treaty under the authority of the United Nations, called the Vienna Convention on Road Traffic, which aims to enhance road safety and facilitate international road

[135] Herd, *supra* nota 92, p 32.
[136] *Ibid*, p 58.
[137] Bogue, *supra* nota 33, p 401.
[138] Beiker, *supra* nota 9, p 1153.
[139] *Ibid*, p 1154.
[140] Holder, *supra* nota 10, p 388.
[141] Vanholme, B. *et al*. Highly Automated Driving on Highways Based on Legal Safety. IEEE Transactions on Intelligent Transportation Systems 2013, 14 (1), pp 333-347, p 333.

traffic.[142] The Convention is ratified by all of the European Union Member States, except the United Kingdom and Spain.[143]

Since vehicles are complex and traffic needs to be accurately regulated, the United Nations Economic Commission for Europe established the Working Party on Road Traffic Safety in 1988 on the prevention of road accidents and improvement of road safety which primary function is to supervise the legal instruments adopted to harmonize traffic rules.[144] The United Nations adopted the Geneva Convention on Road Traffic in 1949 and the Vienna Convention on Road Traffic in 1968. The Vienna Convention replaced the previous Geneva Convention and is currently applicable. It regulates rules of the road, conditions for the admission of vehicles to traffic and requirements for the drivers of vehicles.

The requirement that every vehicle shall have a driver and that the driver must be able to control the vehicle at all times was already included in the Geneva Convention on Road Traffic from 1949.[145] The Vienna Convention demands the same. Chapter 2 deals with rules of the road and article 8 lays down requirements for drivers. According to Article 8 point 1, each moving vehicle shall have a driver and according to point 5 the vehicle must be controlled by the driver at all times.[146]

If autonomous vehicles are allowed onto roads, adaptations and amendments to the Convention are needed.[147] For example, the United Kingdom has an advantage regarding the regulation of autonomous vehicles since they have not ratified the Vienna Convention on Road Traffic and therefore the government of the United Kingdom is currently focusing on adopting the legislative and regulatory framework in order to allow autonomous vehicles on the roads while some other countries in Europe, who have ratified the Vienna Convention, have proposed to amend the Convention to allow autonomous vehicles on the roads.[148] However, actions to soften the

[142] *Ibid*, p 334.
[143]European Parliament. Automated vehicles in the EU 2016. www.europarl.europa.eu/RegData/etudes/BRIE/2016/573902/EPRS_BRI(2016)573902_EN.pdf (23.04.2017), p 6.
[144] The United Nations Economic Commission for Europe. http://www.unece.org/trans/roadsafe/rsabout.html (2.03.2017).
[145] The United Nations, Geneva Convention on Road Traffic, 1949, article 8, p 1, p 5.
[146] The United Nations, Vienna Convention on Road Traffic, 1968.
[147] Vanholme, *supra* nota 141, p 335.
[148] Bogue, *supra* nota 33, p 401.

requirement about an actual driver have not reached far. Adopting an international agreement would be a move towards fully autonomous vehicles.[149]

The governments of Germany, Italy, France, Belgium and Austria proposed an amendment in May 2014 that the United Nations Working Party on Road Traffic Safety agreed to and which could simplify the conditions for research and development of autonomous vehicles in numerous countries.[150] Therefore a major step towards the deployment of autonomous vehicle technologies was made on 23 March 2016 when the amendments to the Vienna Convention on Road Traffic entered into force, allowing autonomous vehicles in traffic, however, only on a condition that these technologies are in conformity with the United Nation´s vehicle regulations or the driver can take control over the driving.[151] According to the report of the sixty-eighth session of the Working Party on Road Traffic Safety, the amendment to Article 8 of the Vienna Convention will include a new paragraph.[152] Consequently, autonomous vehicles are allowed to have a driver who is not involved in the actual driving and may remove hands from the wheel, however, the driver must be prepared to take over the driving any time necessary.[153]

3.3 The European Union legislation on the regulation of vehicles

3.3.1 The European Union Product Liability Directive

National laws may regulate product liability issues differently which consequently may be a challenge for consumers and a burden on manufacturers due to the EU internal market which allows people to buy products across the EU and therefore the European Union is determined to harmonize the product liability laws in the Member States.[154] The Directive 85/374/EEC on liability for defective products, which was adopted in 1985, lays down the framework for the harmonized system.[155] Even though product liability is strongly harmonised in the European Union, there is no harmonised framework on liability for damages that are caused by accidents involving motor vehicles and therefore the regulation of liability of the vehicle holder or the

[149] Holder, *supra* nota 10, p 387.
[150] Maurer, *supra* nota 14, p 159.
[151] The United Nations Economic Commission for Europe. UNECE paves the way for automated driving by updating UN international convention 2016. www.unece.org/info/media/presscurrent-press-h/transport/2016/unece-paves-the-way-for-automated-driving-by-updating-un-international-convention/doc.html (24.03.2017)
[152] The United Nations. Economic and Social Council. Report of the sixty-eighth session of the Working Party on Road Traffic Safety 2014. www.unece.org/fileadmin/DAM/trans/doc/2014/wp1/ECE-TRANS-WP1-145e.pdf (24.03.2017), p 9.
[153] European Parliament, *supra* nota 143, p 7.
[154] Tulibacka, M., Howells, Professor G. Product Liability Law in Transition: A Central European Perspective. Surrey, Ashgate Publishing 2009, p 5.
[155] Council Directive of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products, *supra* nota 13.

vehicle driver is different in the Member States.[156] Since autonomous vehicles are capable of shifting the liability from holders or drivers to manufacturers, the Product Liability Directive becomes applicable.

Robotics is developing and nowadays growing into the next transformative technology.[157] Many companies are using robots and replacing human jobs with robots to increase productivity. However, robotic systems are not fully flawless and may cause accidents. A few years ago a worker was killed by a robot which raised concerns about the effects and consequences that automation may have.[158] Robotic systems have issues and may fail to operate due to defects and malfunctions. Hence, robotic technologies are not completely secure and therefore raise concerns of safety and affect liability issues. Accordingly, any damage caused by robots would create liability and additionally product liability questions.

In a case where an autonomous vehicle is involved in an accident, the reason is considered to be a defect or malfunction and therefore liability issues arise. It is argued that autonomous vehicles will shift the liability from drivers to manufacturers. Therefore, an autonomous vehicle which causes an accident due to a defect would give rise to a product liability matter. Article 1 of the Directive establishes that the producer is liable for damage caused by a defect in the product.[159] According to the Directive, a product is defective when it does not provide the safety a person is entitled to expect.[160] Users of autonomous vehicles expect that the vehicle is safe and is capable of driving itself without causing accidents and damage. Defects usually cause damage and damage within the meaning of Article 9 of the Directive is any damage caused by death or by personal injury, and any damage caused to private property.[161] An autonomous vehicle causing an accident due to a defect will likely give rise to damage claims. Article 2 determines the meaning of products and lays down that the term „product" means all movables, hence including vehicles.[162] Autonomous vehicles depend on technology and therefore software is a crucial part of the vehicle system. The final product manufacturers are distinguished from producers of

[156] European Parliament, *supra* nota 143, p 10.
[157] Calo, R. Robotics and the Lessons of Cyberlaw. California Law Review 2015, 103(3), pp 513-563, p 515.
[158] Dockterman, E. Robot Kills Man at Volkswagen Plant 2015. time.com/3944181/robot-kills-man-volkswagen-plant/ (19.04.2017).
[159] Council Directive of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products, *supra* nota 13.
[160] *Ibid*, article 6, point 1.
[161] Council Directive of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products, *supra* nota 13.
[162] *Ibid*.

software. Autonomous vehicles will probably cause accidents due to malfunctioning software. Even though a product has a broad meaning, it was considered whether the software is a product and whether a consumer whose vehicle causes an accident due to malfunctioning defect may bring a claim against the producer of the software under the Directive.[163] The European Commission has declared that the Directive applies to software.[164] Hence, software producers could be held liable for malfunctioning software in the autonomous vehicle.

Since autonomous vehicles eliminate the need for drivers, they may place a greater liability on manufacturers who will be responsible for accidents that happen due to a defect. The Directive states that the producer is liable for damage caused by a defect in the product, yet provides defenses for the producer under which the producer will not he held liable if these defenses can be proven. Therefore, the purpose of the Product Liability Directive is, on one hand, to protect the consumers against damage caused by a defective product and on the other hand to protect the producers from too burdensome liability. In conclusion, the purpose of the Directive could be the fair distribution the of the risk and liability between manufacturers and consumers. Product liability cases are examined and decided in national courts under national laws.[165] The European Court of Justice decided that the purpose of the Directive 85/374/EEC is to afford a balanced protection to manufacturers and consumers and therefore a national law cannot afford greater protection than it is provided by the Directive.[166] Hence, national laws must not place too heavy liability on producers. The introduction of autonomous vehicles, however, will place the liability solely on manufacturers, since accidents probably occur due to defects. Although, manufacturers have a possibility to rely on defenses to escape liability.[167]

The Directive lays down that the injured party has the burden of proof and has the obligation to prove the actual damage, a defect in the product and a causal link between the damage and the defect.[168] However, the victim does not need to prove the negligence of the producer. In the case of vehicles, if the victim consideres that the accident happened due to a defect, the manufacturer

[163] Wuyts, D. The Product Liability Directive – More than two Decades of Defective Products in Europe. Journal of European Tort Law 2014, 5(1), pp 1-34, p 5.
[164] Written Question No 706/88 by Mr Gijs de Vries to the Commission of the European Communities: Product liability for computer programs, OJ 1989 No C 114, 8.5.1989, p 42.
[165] Delaney, R., Zande, Rene v d. A Guide to the EU Directive Concerning Liability for Defective Products (Product Liability Directive) 2001. gsi.nist.gov/global/docs/EUGuide_ProductLiability.pdf (16.04.2017), p 1.
[166] CJEU, 25.04.2002, C-183/00, Maria Victoria González Sanchez and Medicina Asturiana SA.
Council Directive of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products, *supra* nota 15, article 7.
[168] *Ibid*, article 4.

can be sued for a defect in the vehicle. Hence, the victim is required to prove the damage and the defect. Since autonomous vehicles should not, in theory, require a driver, the accidents occur as a result of a defect or a malfunction and the manufacturer is considered to be liable. Therefore, there should be no need to prove the fault since it is assumed that the manufacturer is liable.

According to the Directive, a producer is not only the manufacturer of a finished product but also the producer of any raw material or of a component part and any person who places a name, trademark or a distinguishing mark on the product and therefore present himself as a producer.[169] Consequently, the Directive imposes joint liability on all parties involved in the production of the vehicle. Vehicles frequently have components that originate from a different manufacturer. In a case of an accident, the manufacturer of the component part is also considered to be a producer and can be held liable if the part was defective. However, the distribution of liability between the manufacturer of a finished product and the producer is a component part is a problematic area of product liability law.[170] The consumer should always have the possibility to sue the manufacturer of the finished product. Hence, in the case of a defect, the consumer firstly sues the manufacturer and the manufacturer has the opportunity to sue other parties who were involved in the production.[171] Autonomous vehicles operating independently and causing an accident, grant the injured party a right to sue the manufacturer since the accident is assumed to be caused by a defect and consequently the manufacturer can sue its suppliers or producers of component parts. Therefore, the manufacturer of the final product and the other producers of component parts are jointly liable, however, the manufacturer of the final product is responsible for the product that is placed on the market.

The Product Liability Directive determines that in the case of a defect in the vehicle, the manufacturer is responsible. Autonomous vehicles are able to operate without needing a human driver which places a huge responsibility on manufacturers. Currently, there is no legislation that would regulate the issue of liability regarding autonomous vehicles. Since the European Union has no contemporary legal framework for autonomous vehicles, courts cannot give a judgment regarding autonomous vehicles and therefore there is a lack of court cases regarding liability.

[169] *Ibid*, article 3, point 1.
[170] Ross, K. Manufacturers versus Component Part and Raw Material Suppliers: How to Prevent Liability. www.productliabilityprevention.com/images/2-ManufacturerversusComponentPartandRawMaterialSuppliersHowtoPreventLiability.pdf (19.04.2017), p 1.
[171] *Ibid.*

However, the USA is a front runner in autonomous vehicle technology and the autonomous cars developed can be examined. Google and Tesla have developed self-driving cars for a long time and their cars have been undergoing test drives for years. Although autonomous vehicles should be safer than human drivers, there are many accidents involving autonomous vehicles. These vehicles have an autopilot which means that the car is capable of driving independently, however, requiring a driver who is able to take control when necessary. These vehicles are not fully autonomous and cannot operate independently. The cases concerning self-driving cars in the USA could enlighten the liability issues.

Since Google has been developing its autonomous vehicle technology for a long time, their autonomous cars have had a couple of accidents. Google cars undergoing test drives that operated on an autopilot were in an accident that was caused by a human error while Google announced that not once have their self-driving cars been the cause of the accident.[172] Since these cars still need a human to control the vehicle when necessary, the liability for the accident is on the human for not being able to pay attention and take control of the vehicle to avoid the accident. Therefore, if autonomous cars that need a person in the driver´s seat are released, the liability would probably still fall on the human.

Additionally, Tesla´s cars have had a number of accidents. In 2016, a Tesla car which had the Autopilot, a self-driving software, activated was involved in a crash that resulted in a death of the driver.[173] Tesla´s cars are designed in a way that requires the driver to keep hands on the wheel and maintain control of the vehicle, hence according to Tesla, the driver is ultimately responsible for the actions of the vehicle and therefore liable in the case of an accident.[174] Since the Autopilot in Tesla´s car requires the driver to be fully engaged at all times, the driver was held liable for the accident for not paying attention to the road, additionally the investigation concluded that the system performed as it was designed and intended without having any defects and therefore the Autopilot did not cause the accident.[175] In the same year, a Chinese driver was killed in an accident that involved a car using Autopilot and a court case was initiated against Tesla China and the dealership that sold the car, however, Tesla denies that the Autopilot was at

[172] Los Angeles Times. Humans at fault in self-driving car crashes 2015. www.latimes.com/business/la-fi-self-driving-accidents-20150512-story.html (9.04.2017).
[173] Golson, J. Tesla driver killed in crash with Autopilot active, NHTSA investigating 2016. www.theverge.com/2016/6/30/12072408/tesla-autopilot-car-crash-death-autonomous-model-s (13.04.2017).
[174] *Ibid.*
[175] Boudette, Neal E. Tesla's Self-Driving System Cleared in Deadly Crash 2017. www.nytimes.com/2017/01/19/business/tesla-model-s-autopilot-fatal-crash.html?_r=0 (13.04.2017).

fault and the driver had the responsible for maintaining control of the vehicle.[176] The Autopilot was allowed to operate only with the driver controlling the vehicle.

Consequently, if the car is on the autopilot and causes an accident, the driver is responsible and could be held liable for the accident. These vehicles are partly automated and require a human driver who must be alert, take control when necessary and drive the vehicle. Therefore, partly autonomous vehicles which operate on an autopilot or rely on certain automated functions, place the responsibility and liability for accidents on the driver. Nevertheless, Volvo has announced that they will take full liability for all cars operating in fully autonomous mode.[177] Thus, manufacturer´s liability can occur in the case of a fully autonomous vehicle. Nowadays, autonomous vehicles are at most party autonomous and require a driver to control the vehicle.

[176] South China Morning Post. Father of Chinese man killed in Tesla crash files lawsuit over Autopilot system 2016. www.scmp.com/business/companies/article/2021356/father-chinese-man-killed-tesla-crash-files-lawsuit-over (13.04.2017).
[177] Golson, *supra* nota 173.

4. The current regulation of vehicles in two of the European Union Member States

4.1 The regulation of autonomous vehicles in Estonia

Estonia is considered to be a highly networked country that values innovation and therefore has many innovative ideas and achievements.[178] Since innovation is valued, technology is developing in Estonia. Autonomous driving technologies are supported and autonomous vehicles are a passionately debated issue. For example, Estonian inventors have developed Starship Technologies which were launched in 2014 with the aim of improving the local delivery by making it faster, smarter and more cost-efficient.[179] These technologies introduce small package delivery robots that are capable of delivering packages and groceries to a client autonomously via a mobile app while being secure, having a gentle speed and navigating through obstacles.[180] In addition to these robots, Estonia is currently debating about autonomous vehicles and whether to allow the test drives of these vehicles.

Autonomous vehicles are an issue on the international level since vehicles require a driver, but the aim of these vehicles is to be driverless. In Estonia, the Estonian Traffic Act[181] regulates the traffic on the roads of Estonia and lays down traffic rules, the principles and basic requirements for ensuring road traffic safety. According to the Traffic Act, a driver is a person who drives a vehicle and therefore Estonian law requires a vehicle to have an actual driver. [182] The Traffic Act also lays down the traffic rules for the driver. However, autonomous vehicles are intended to drive themselves without needing a driver. Currently, vehicles require a driver, hence the Traffic Act lays down the general duties of the driver.[183] These requirements use the word driving which assumes that the driver is in control of the vehicle and does the actual driving. In addition, the driver must pay attention to other road users including pedestrians and cyclists and avoid causing them harm. This implies that the driver must be in control of the vehicle and pay attention to the traffic.

[178] European Commission. Estonia, highly networked and highly innovative 2012. https://ec.europa.eu/digital-single-market/en/news/estonia-highly-networked-and-highly-innovative (24.03.2017).
[179] Starship Technologies 2016. www.starship.xyz/about-us/ (24.03.2017).
[180] *Ibid.*
[181] Traffic Act, RT I 2010, 44, 261.
[182] *Ibid*, §2.
[183] *Ibid*, §33.

According to the Traffic Act, drivers are prohibited from doing certain activities while driving a vehicle.[184] These include the prohibition of activities that hinder the ability to drive or danger the comprehension of the traffic environment and the prohibition of driving a vehicle in the state of intoxication. Using a telephone and holding a telephone in hand while the vehicle is moving is strictly prohibited. However, in the case of autonomous vehicles, this prohibition is irrelevant. Autonomous vehicles are intended to drive themselves without an actual driver, therefore the use of a telephone while the vehicle is driving should be allowed since the driver has no driving responsibility. Furthermore, it has been argued that one benefit of autonomous vehicles is that intoxicated people could be transported home safely in these vehicles. Currently, it is prohibited for intoxicated people to drive the vehicle, therefore an intoxicated driver is not allowed in the vehicle. Autonomous vehicles remove the driving responsibility from the driver, hence, in theory, allowing an intoxicated person into the vehicle. In addition, the same prohibition applies in the case of a state of health that could be hazardous to traffic safety. Autonomous vehicles could bring a benefit for people who are injured or hurt and need to go to the hospital by themselves. However, currently, the laws require a driver and the person cannot drive the vehicle in this state of health.

In addition, current laws require a valid driving license for every driver who drives a vehicle. §88 of the Traffic Act lays out documents that are required from the driver of the vehicle, including a driving license or another document certifying the driver´s right to drive.[185] The debate over autonomous vehicles involves also driving license and whether they should be demanded when autonomous vehicles drive themselves without a human intervention. In theory, autonomous vehicles eliminate the need for human drivers and consequently the need for driving licenses. Therefore, laws should clearly lay down whether the person within the vehicle still need to obtain and carry a valid driving license even if the person does not control the vehicle. Furthermore, laws should determine whether a license is required if the driver suddenly has a necessity to take control of the vehicle.

Currently, drivers are responsible for accidents and held liable for any damages. Estonian court convicted a driver of a vehicle who caused a car accident for not following the traffic requirements and ordered the driver to pay damages.[186] The driver of the vehicle failed to

[184] *Ibid.*
[185] Traffic Act, *supra* nota 191, §88.
[186] TlnRnKo 1-07-14992

ascertain that the maneuvers are safe by not considering the weather conditions that complicated the maneuvers and not observing the speed limit. The driver violated the traffic rules which resulted in an accident that caused a severe health damage to the other party. The injured party claimed compensation for damages. The case concerned personal injury and damage to property claims. Both are rather common claims in car accidents.

In spite of the issues with current laws and autonomous vehicles, Estonia has taken a step to introduce autonomous vehicles to the public and test them on roads. The Estonian Ministry of Economic Affairs and Communications announced on the 2nd of March 2017 that the test driving of autonomous cars is allowed on the streets and roads of Estonia, however, the car must have a driver who is able to take control of the car any time needed, additionally the driver can sit within the vehicle or act remotely, but is still responsible for the vehicle and must take control of the vehicle if it is necessary.[187] It is an excellent opportunity for Estonia to demonstrate its desire for innovation and development, and to test the vehicles and assess the acceptance of autonomous cars by the public. In addition, a group of experts is working on issues surrounding autonomous vehicles including responsibilities, insurance, privacy, and ethics.[188]

4.2 The regulation of autonomous vehicles in Sweden

Sweden is a contracting party to the Vienna Convention on Road Traffic and therefore is bound by the requirement that vehicles must have a driver at all times who must be able to take control of the vehicle. Consequently, a barrier that should be considered when allowing autonomous vehicles in the Swedish traffic system is current laws and regulations.[189] Since Sweden wishes to enhance its innovative technologies, legislative changes have been proposed which should be passed into a law on 1st of May 2017 and are necessary for autonomous vehicle trials.[190] The proposal suggests that Swedish Transport Agency should be responsible for granting permits to carry out trials while stating that permit holders will be held criminally liable when vehicles are

[187] Republic of Estonia. Ministry of Economic Affairs and Communications. Estonia Allowing a Number of Self-Driving Cars on the Streets Starting Today 2017. www.mkm.ee/en/news/estonia-allowing-number-self-driving-cars-streets-starting-today (24.03.2017).
[188] *Ibid*.
[189] Bohm, F., Häger, K. Introduction of Autonomous Vehicles in the Swedish Traffic System – Effects and Changes Due to the New Self-Driving Car Technology. Uppsala University 2015. https://uu.diva-portal.org/smash/get/diva2:816899/FULLTEXT01.pdf (14.04.2017), p 39.
[190] Drive Sweden. Sweden proposes a progressive legislation for autonomous vehicle trials 2016. www.drivesweden.net/en/smart-mobility-news-and-comments/sweden-proposes-progressive-legislation-autonomous-vehicle-trials (14.04.2017).

in the self-driving mode, however, drivers will be held liable when the vehicle operates at lower levels of automation.[191]

Sweden has always been interested in technological advancements and developments. Since Sweden is considered to be an early pioneer of self-driving technology, the Swedish Government allowed its citizens to use self-driving cars on roads and started a project which is a collaboration between the Swedish government and Volvo and is the first project with an aim to test autonomous vehicles on a larger scale with citizens.[192] The cooperation between the government and Volvo is crucial and can contribute to the understanding of legislative questions regarding autonomous vehicle technology and facilitate the adoption of necessary policies.[193] The project is called „Drive me – self-driving cars for sustainable mobility" which involves 100 self-driving Volvo cars that should drive on public roads in Gothenburg in 2017.[194] The project includes highly autonomous vehicles which imply that the driver is not obliged to monitor the vehicle at all times and can cede control, however, the driver must be alert and able to take control of the vehicle if needed.[195] The focus is on a number of areas such as social and economic benefits of autonomous vehicles, infrastructure requirements for autonomous driving, usual traffic situations suitable for autonomous driving, people´s trust in autonomous vehicles.[196]

[191] *Ibid*.
[192] Maurer, *supra* nota 14, p 162.
[193] *Ibid*, p 163.
[194]Lindholmen Science Park. Drive Me - self-driving cars at Lindholmen 2014. www.lindholmen.se/en/news/drive-me-self-driving-cars-lindholmen (3.04.2017).
[195] Bohm, *supra* nota 189, p 3-4.
[196] Fourtané, S. Sweden's Self-Driving Cars for Sustainable Mobility 2014. www.eetimes.com/document.asp?doc_id=1324383 (14.04.2017).

Conclusion

The vehicle industry is developing quickly and therefore autonomous vehicles are being introduced to the world. However, due to issues and challenges, autonomous vehicles have created many debates and discussions. Since fully autonomous vehicles are able to drive themselves without any human intervention, these vehicles should reduce accidents that occur due to human drivers. In addition, autonomous vehicles increase mobility for elderly and disabled people, and for underage people. However, there are many legal and moral issues surrounding autonomous vehicles which are great and yet lack any concrete solution. The emphasis in the thesis was on legal issues regarding autonomous vehicles and the regulation of these vehicles. Even though autonomous vehicles increase road safety, enhance mobility, improve comfort while driving, decrease harm to the environment, they create challenges for manufacturers, policymakers, and legislators. Since liability issues arise, manufacturers need to find technical solutions for different traffic situations and manage defect problems.

The author analysed three main research questions in the thesis. What are the legal issues concerning autonomous vehicles? Why is the current legislation regarding vehicles on the international level and in the European Union problematic? How are vehicles and autonomous vehicles regulated in Sweden and Estonia?

The first chapter concentrated on the concept of autonomous vehicles along with the levels of automation, their benefits, and challenges. Autonomous vehicles can be divided into categories based on their automation. Currently, vehicles are at most partly autonomous and are able to drive independently, however, requiring a human who is able to control the vehicle and take over control when necessary. The ultimate goal is fully autonomous vehicles that are capable of operating completely autonomously without any human intervention. There can be a person in the vehicle as a passenger or the vehicle can circulate on the roads itself. The thesis analysed the benefits and challenges that autonomous vehicles present.

Since the use of traffic places people´s lives in danger, the most significant benefit of autonomous vehicles is improved safety. Elimination of human drivers and therefore human errors is expected to increase safety in road traffic and hence the introduction of autonomous vehicles is welcomed. Nowadays, many accidents occur due to the inattention of drivers. A huge problem and a cause of accidents are texting, calling or simply using the phone while driving.

Autonomous vehicles intend to be beneficial as vehicle users could use their phones since driving is completed by the vehicle. However, autonomous vehicles require test drives before it is decided whether these vehicles are viable and suitable on roads and whether further improvements are crucial. Hence, amendments to the Convention and national laws are necessary even for test drives. The benefits of autonomous vehicles extend beyond safety. Being able to circulate independently, these vehicles offer greater mobility and create opportunities for elderly, disabled and underage people to reach their destinations. On the other hand, autonomous vehicles present challenges for lawmakers, manufacturers, and owners of the vehicle. Defects in the vehicle create liability issues for manufacturers, unsolved questions of security, privacy, and regulation of vehicles are problematic to lawmakers and owners.

In the second chapter, the author analysed the legal issues of autonomous vehicles. The main focus was on liability issues regarding human drivers and manufacturers. The adoption of autonomous vehicles will probably shift the liability from a human driver to the manufacturer. Currently, the human is responsible for accidents since human error is considered to be the cause of accidents. Consequently, since autonomous vehicles no longer require a human driver, the accidents occur due to a defect or malfunction which is attributable to the manufacturer and therefore the manufacturer will be held liable. Even though the introduction of autonomous vehicles should place great liability on manufacturers, these vehicles are nowadays at most partly autonomous and require a person in the vehicle who is required to override the vehicle when necessary. Hence, currently, drivers are still liable for accidents. Cases with Google and Tesla´ s self-driving cars indicate that the driver is clearly at fault for failing to control the vehicle and therefore causing an accident.

Moreover, conventional vehicles require a driver who has a valid driving license. Laws impose on drivers the obligation to obtain and possess a valid driving license while driving. Since autonomous vehicles do not require a driver, the issue of driving licenses emerges. Therefore, current laws are a restriction to the introduction of autonomous vehicles and should be amended or adjusted to regulate the issue of licenses. States and lawmakers are confronting a decision whether or not to require a driving license to operate an autonomous vehicle and whether passengers should possess a license to drive in the vehicle. Moreover, issues concern whether a driving license is required if the passenger must take control and avoid a potential accident. However, an autonomous vehicle that operates in the traffic independently, is responsible for avoiding any accidents and therefore does not require a human who should take control. Hence,

the introduction of autonomous vehicles creates issues of driving licenses that should be solved in order to proceed with this technological achievement.

In addition, this chapter explained why privacy is considered to be an issue. Since autonomous vehicles rely on technology, data is collected and stored. Hence, the EU privacy laws come to play. Data must be processed lawfully, not stored longer than is necessary for the purpose achieved. Additionally, autonomous vehicles leave data vulnerable for third parties who may gain unauthorised access to the vehicle and therefore to the data stored in the system. The EU Data Protection Directive should apply to autonomous vehicles also and the systems need to be in accordance with the Directive and have appropriate safeguards.

The author examined cybersecurity issues created by autonomous vehicles. Autonomous vehicles depend on technology in order to operate and therefore create cyber security concerns. Technology allows hacking and third party involvement. Autonomous vehicles may provide hackers with a possibility to cause accidents, hijack vehicles and commit crimes. Technology is not flawless and all vulnerabilities are potential risks since hackers may execute malicious attacks. Cyber crime laws regulate crimes committed through the Internet and other computer networks, however, technology in autonomous vehicles creates opportunities for committing crimes using this technology. Therefore, cyber crime laws should recognise new crimes created by autonomous vehicles and consequently these crimes should be penalised by including them in cyber crime legislation.

The third chapter concentrated on the international legislation regulating vehicles and on the European Union Product Liability Directive. The author analysed the regulation of autonomous vehicles based on the Vienna Convention on Road Traffic. According to the Convention, all vehicles must have a driver and the driver must be able to control the vehicle at all times. Consequently, the Convention restricts the adoption of autonomous vehicles. Currently, the Convention does not allow autonomous vehicles on roads since having a driver is obligatory. Hence, in order for autonomous vehicles to operate on roads, amendments to the Convention are necessary. Consequently, amendments to the Vienna Convention entered into force and therefore the Vienna Convention allows autonomous vehicles in traffic provided that the driver can override the system and take control of the vehicle. Therefore, test drives should be allowed and partly autonomous vehicles are allowed onto roads. It is an immense step towards fully autonomous vehicles.

Conventional vehicles have a driver who controls and operates the vehicle. As a result, drivers are responsible for accidents and will be held liable for damages. Court cases have shown that currently human drivers bear the liability for an accident. Autonomous vehicles raise an issue of liability due to the absence of a human driver. Moreover, the elimination of drivers shifts the liability on manufacturers since accidents will most likely occur due to a defect or a malfunction. However, the liability may be too burdensome on manufacturers. Laws should balance the liability between manufacturers and other parties involved in the production.

The European Union aims to harmonise the product liability laws in the Member States to prevent the distortion of competition and to maintain a balance between the interests of producers and consumer. Hence, the EU has adopted a Product Liability Directive concerning liability for defective products which determines that the producer is liable for any damage caused by a defect in the product produced. The author examined how the Directive would regulate the liability of autonomous vehicles. According to the Directive, producers are liable for defects in their products. Autonomous vehicles increase the possibility of defects and malfunctions, hence placing liability on manufacturers of these vehicles. However, manufacturers of the finished product and producers of a component part are jointly liable for defects. Therefore, the consumer can sue both parties for defects in the vehicle or in the system of the vehicle. Nevertheless, in the case of an accident, the victim will most likely sue the manufacturer of the finished vehicle which grants the manufacturer the possibility of suing other parties if the accident occurred due to a defect in a component part.

The fourth chapter examined two of the EU Member States. The author had chosen Estonia and Sweden. Both Member States are bound by the Vienna Convention and therefore the introduction of autonomous vehicles is restricted in Estonia and Sweden. In addition, Estonian Traffic Act defines a driver as a person who controls the vehicle. Moreover, the actions of the driver are regulated. Drivers must not use a telephone while driving, must not drive the vehicle in an intoxicated state or in a state of health that could be hazardous to traffic safety. All these restrictions in the law hinder the introduction of autonomous vehicles. However, being a state interested in innovation and technological developments, Estonia recently allowed test drives of self-driving cars. Although the cars are allowed to drive independently, they require a driver who must take control any time necessary. Furthermore, Sweden has proposed legislative changes to allow the test drives of autonomous vehicles. Additionally, a project between the Swedish government and Volvo was initiated which aims to test autonomous vehicles with drivers on

public roads. Although the project allows the driver to grant the driving to the vehicle, the driver must be alert at all times and is responsible for taking control when necessary. Despite that fully autonomous vehicles still appear to be quite far in the future and the adoption of fully autonomous vehicles is considerably difficult and restricted, test drives in both states are definitely a great step towards autonomous vehicles.

The hypothesis of the thesis was following - The regulation of autonomous vehicles in the EU is currently problematic and has many legal issues due to the absence of a legal framework. Like the author pointed out, the regulation of autonomous vehicles in the European Union is problematic and involves many legal problems. Most Member States of the European Union are bound by the Vienna Convention and therefore face a restriction that vehicles must have a driver. The author concentrated on Estonia and Sweden, and described the situation regarding autonomous vehicles. Although Estonia and Sweden have both allowed test drives, the legislation is not yet regulating autonomous vehicles. In addition, issues including liability, privacy, and security emerge and remain unsolved in the European Union. Even though the European Union regulates product liability, autonomous vehicles increase the liability of manufacturers which therefore may be too burdensome. The Directive is meant for all Member States and theoretically product liability should be regulated harmoniously, however, the Directive allows some derogations which imply that the liability for defective vehicles may be regulated differently and hence manufacturers are left in uncertainty about their liability. Furthermore, current traffic rules determine that driving a vehicle while being intoxicated is prohibited and using a phone is not allowed. Even these rules are a restriction to autonomous vehicles which are aimed to allow the person in the vehicle to use a phone, text and call freely. Since the human does not drive the vehicle, being intoxicated in the vehicle would not be such an enormous problem. On the other hand, it raises ethical issues and states face a concern whether to allow an intoxicated person in the vehicle at all. Since autonomous vehicles which are going through test drives and hence require a driver, should obey the traffic rules. The issue arises when fully autonomous vehicles are ready to circulate on the roads and these traffic rules are not amended.

The author confirmed that the regulation of autonomous vehicles in the European Union is problematic and involves many legal issues since the European Union lacks a supranational legal framework. The thesis explored a relatively modern technological achievement that could be beneficial for the society, however, the absence of comprehensive and coherent laws regulating

all aspects of autonomous vehicles creates issues. The EU law does not regulate autonomous vehicles and therefore all issues and problems of autonomous vehicles remain unsolved and create difficulties. Although some states allow test drives, the issues of autonomous vehicles are still present. In order for autonomous vehicles to enter onto roads, legislators should incorporate autonomous vehicles into current laws by considering whether existing legislation could regulate this new technology or develop completely new laws that would be up to date, contemporary and would regulate the issues of autonomous vehicles understandably and harmoniously.

Juriidilised probleemid seoses autonoomsete sõidukite reguleerimisega Euroopa Liidus
Resümee

Liiklus on ülimalt reguleeritud valdkond nii rahvusvahelisel kui ka riiklikul tasandil, kuna see hõlmab inimesi ja inimelusid ning kujutab riski kõigile liikluses osalejatele. Seetõttu on oluline, et seadused kehtestaksid selged ning arusaadavad liiklusreeglid, mida on kohustuslik kõigil järgida. Kuna tehnoloogia areneb kiiresti, siis seadusandlus ei suuda järge hoida ning ei suuda kõiki arenguid ja uuendusi seadusega kooskõlastada ning luua vastavaid seadusi, mis neid tehnoloogia arenguid reguleeriks. Seetõttu on tänapäeval probleemiks, et seadusandlus ei reguleeri autonoomseid sõidukeid. Sõidukite automatiseerimine võib parandada liiklus- ning transpordiohutust, pakkuda rohkem mugavust ning liikuvust inimestele ja muuta sõidukid keskkonnasõbralikumaks. Paljud tootjad on alustanud tehnoloogia arendamist, et luua autonoomseid sõidukeid. Üheks tuntuimaks näiteks on Google, kes on juba alustanud isejuhtivate autode testmist teedel ning tänavatel. Seetõttu on oluline, et seadused peaksid arusaadavalt defineerima autonoomse sõiduki; inimese, kes juhib või opereerib sõidukit; reguleerima sõidukite liiklemist; määratlema vastutuse juhul, kui sõiduk tõepoolest iseseisvalt liikleb ning kehtestama vastutuse õnnetusjuhtumite korral.

Lõputöö põhineb kvalitatiivsel uurimismeetodil, mille põhilisteks allikateks on teaduslikud artiklid. Lisaks sellele kasutab autor lõputöös nii Euroopa Liidu kui ka rahvusvahelist seadusandlust analüüsimaks autonoomsete sõidukite reguleerimist. Autor uurib, kuidas Eesti ja Rootsi reguleerivad autonoomseid sõidukeid. Lõputöö eesmärk on analüüsida juriidilisi küsimusi seoses autonoomsete sõidukitega, kaasates privaatsuse, turvalisuse ning vastutuse aspekte, et jõuda järeldusele, kas autonoomsete sõidukitega kaasneb probleeme ning kas nende reguleerimine on problemaatiline. Lisaks sellele on eesmärgiks uurida, milline on Euroopa Liidu seadusandlus ning kas autonoomsed sõidukid kujutavad raskusi seadusandjatele. Kuna Rootsi võttis vastu ettepaneku seaduse muudatuseks seoses autonoomsete sõidukitega ning Eesti lubas hiljuti isesõitvate autode testimist teedel ja tänavatel, on autor valinud just need liikmesriigid, et analüüsida nende seadusi ning kuidas ja kas need riigid on valmis lubama autonoomseid sõidukeid teedele. Lõputöö hüpotees on järgnev: Autonoomsete sõidukite reguleerimine Euroopa Liidus on hetkel problemaatiline ning kujutab endast palju juriidilisi probleeme õigusliku raamistiku puudumise tõttu. Autor analüüsib hüpoteesi põhinedes kolmele uurimisküsimusele. Millised on juriidilised probleemid seoses autonoomsete sõidukitega? Miks on hetkel kehtiv

rahvusvaheline ning Euroopa Liidu sõidukite seadusandlus probleemne? Kuidas on sõidukid ja autonoomsed sõidukid reguleeritud Eestis ja Rootsis?

Autonoomsed sõidukid on vastuolus 1968 aastal vastuvõetud Viini teeliikluse konventsiooniga, mille kohaselt peab igal liikuval sõidukil olema juht, kes on võimeline igal ajal sõidukit kontrollima. Selleks, et võimaldada autonoomsetel sõidukitel sõita iseseisvalt teedel, oleks vaja muuta Viini konventsiooni lisades sinna autonoomsed sõidukid ning lubada mingil määral sõidukeid, mis on võimelised sõitma ilma juhita. Lisaks sellele, toovad autonoomsed sõidukid kaasa palju juriidilisi probleeme, millest kõige mõjukam on vastutus õnnetuste ning kahju eest, mis on tekitatud autonoomse sõidukiga. Kuna autonoomsed sõidukid peaksid teoorias sõitma täiesti iseseisvalt, siis pole sõidukil juhti, kes oleks vastutav. Hetkel on seadustes selgelt kirjas, et sõidukil peab olema juht, kes kontrollib sõidukit pidevalt ning seetõttu on kogu vastutus sõiduki juhtimise eest juhil ning õnnetuste ja kahju tekitamise korral on juht vastutav. Õnnetused autonoomsete autodega näitavad, et kuna auto vaja veel siiski juhti, on õnnetuse korral süüdi ning vastutav juht. Õnnetused viitavad lisaks veel sellele, et autonoomsed sõidukid ei ole täiesti usaldusväärsed ning toimivad. Lisaks vastutusele on autonoomsete sõidukite puhul probleemiks ka privaatsus ning turvalisus. Autonoomsed sõidukid sõltuvad suuresti tehnoloogiast, mistõttu loovad need sõidukid võimalusi kolmandade osapoolte sekkumiseks, häkkimiseks ning pahatahtlikeks rünnakuteks. Sõidukid kasutavad tehnoloogiat ja on ühenduses teiste sõidukitega ning seetõttu toimub andmete kogumine, jagamine ning töötlemine. See kujutab riski privaatsusele, kuna kolmandatel osapooltel on võimalik nendele andmetele ligi pääseda.

Autonoomsed sõidukid elimineerivad vajaduse juhi järele ning seetõttu mõjutavad rohkem tootjaid, kuna suurem osa õnnetustest juhtub tehnoloogia, defektide ja rikete tõttu. Autonoomsed sõidukid nihutavad vastutuse juhilt tootjale ning tootja on vastutav õnnetuste eest, mis juhtuvad autonoomsete sõidukitega. Euroopa Liidu tootjavastutuse direktiiv kehtestab vastutuse defektsete toodete korral. Selle kohaselt vastutab tootja kahju eest, mille põhjustab tema toote puudus. Tooja tähendab nii valmistoote valmistajat kui ka mis tahes tooraine tootjat või koostisosa valmistajat. Kuna autonoomsete sõidukite tõttu elimineeritakse vajadus juhi järele, siis on tootjatel suurem vastutus. Direktiivi kohaselt on sellisel juhul võrdväärselt süüdi nii valmistoote valmistaja kui ka tooraine või koostisosa valmistaja. Tarbijal on õigus kaevata esitada nõue mõlema vastu, kuigi arvatavasti esitatakse nõue kõigepealt valmistoote tootja vastu ning temal on õigus siis nõuda kahju hüvitamist tooraine või koostisaine valmistajalt, kui nende toodetud osa oli defektne ning põhjustas õnnetuse.

Kokkuvõttes on autonoomsete sõidukite reguleerimine Euroopa Liidus küllaltki problemaatiline. Autonoomsed sõidukid on vastuolus Viini teeliikluse konventsiooniga ning lisaks põhjustavad sellised sõidukid palju küsimusi seoses turvalisusega, privaatsusega ning vastutusega. Tootjatele langeb suurem vastutus ning Euroopa Liidu direktiivi kohaselt tootjad vastutavad defektide ja puuduste eest.

List of the reference materials

Books

1. Maurer, M. *et al*. (eds.) Autonomous Driving - Technical, Legal and Social Aspects. Ladenburg, Springer-Verlag Berlin Heidelberg 2016.

2. Tulibacka, M. Product Liability Law in Transition: A Central European Perspective. Surrey, Ashgate Publishing 2009.

3. Watzenig, D. *et al*. (eds) Automated Driving - Safer and More Efficient Future Driving. Switzerland, Springer International Publishing 2017.

Articles

4. Beiker, Sven A. Legal Aspects of Autonomous Driving. Santa Clara Law Review 2012, 52(4), pp 1145-1156.

5. Bogue, R. Robot ethics and law. Industrial Robot: An International Journal 2014, Vol. 41(5) pp 398-402.

6. Bose, U. The black box solution to autonomous liability. Washington University Law Review 2015, 92(5), pp 1325-1351.

7. Brodsky, Jessica S. Autonomous vehicle regulation: How an uncertain legal landscape may hit the brakes on self-driving cars. Berkeley Technology Law Journal 2016, 31, pp 851-877.

8. Calo, R. Robotics and the Lessons of Cyberlaw. California Law Review 2015, 103(3), pp 513-563.

9. Cohen, Roy A. Self-Driving Technology and Autonomous Vehicles: A Whole New World for Potential Product Liability Discussion. Defense Counsel Journal 2015, 82(3), pp 328-334.

10. Collingwood, L. Privacy implications and liability issues of autonomous vehicles. Information & Communications Technology Law 2017, 26(1), pp 32-45.

11. Douma, F., Palodichuk, Sarah A. Criminal Liability Issues Created by Autonomous Vehicles. Santa Clara Law Review 2012, 52(4), pp 1157-1170.

12. Fagnant, D., Kockelman, K. Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations. Transportation Research Part A: Policy & Practice 2015, 77, pp 167-181.

13. Glancy, Dorothy J. Autonomous and Automated and Connected Cars - Oh My: First Generation Autonomous Cars in the Legal Ecosystem. Minnesota Journal of Law, Science and Technology 2015, 16(2), pp 619-692.

14. Glancy, Dorothy J. Privacy in Autonomous Vehicles. Santa Clara Law Review 2012, 52(4), pp 1171- 1239.

15. Gurney, J. K. Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles. University of Illinois Journal of Law, Technology & Policy 2013, 2013(2), pp 247-277.

16. Herd, A. R2dford: Autonomous Vehicles And The Legal Implications Of Varying Liability structures. Faulkner Law Review 2013, 5(1), pp 29-58.

17. Hevelke, A., Nida-Rümelin, J. Responsibility for Crashes of Autonomous Vehicles: An Ethical Analysis. Science & Engineering Ethics 2015, 21(3), pp 619-630.

18. Holder, C. *et al.* Robotics and law: Key legal and regulatory implications of the robotics age (Part I of II). Computer Law & Security Review 2016, 32(3), pp 383-402.

19. Kohler, William J., Colbert-Taylor, A. Current Law and Potential Legal Issues Pertaining to Automated, Autonomous and Connected Vehicles. Santa Clara High Technology Law Journal 2015, 31(1), pp 99-138.

20. Lohmann, Melinda F. Special Issue on the Man and the Machine - Liability Issues Concerning Self-Driving Vehicles. European Journal of Risk Regulation 2016, 7, pp 335-340.

21. Marchant, Gary E. , Lindor, Rachel A. The coming collision between autonomous vehicles and the liability system. Santa Clara Law Review 2012, 52(4), pp 1321-1340.

22. Pagallo, U., Durante, M. The Pros and Cons of Legal Automation and Its Goverance. European Journal of Risk Regulation 2016, 7(2), pp 323-334.

23. Schellekens, M. Self-driving cars and the chilling effect of liability law. Computer Law & Security Review 2015, 31(4), pp 506-517.

24. Schroll, C. Splitting The Bill: Creating A National Car Insurance Fund To Pay For Accidents In Autonomous Vehicles. Northwestern University Law Review 2015, 109(3), pp 803-833.

25. Scott, Michael D. Tort Liability for Vendors of Insecure Software: Has the Time Finally Come? Maryland Law Review 2008, 67(2), pp 426-484, p 469.

26. Stanculescu, E. European Union: Innovation Activity and Competitiveness. Realities and Perspectives. Global Economic Observer 2015, 3(1), pp 4-9.

27. Tettamanti, T. *et al*. Impacts of Autonomous Cars from a Traffic Engineering Perspective. Periodica Polytechnica: Transportation Engineering 2016, 44(4), pp 244-250.

28. Vanholme, B. *et al*. Highly Automated Driving on Highways Based on Legal Safety. IEEE Transactions on Intelligent Transportation Systems 2013, 14(1), pp 333-347.

29. Vladeck, David C. Machines Without Principals: Liability Rules And Artificial Intelligence. Washington Law Review 2014, 89(1), pp 117-150.

30. Wallach, W. From Robots to Techno Sapiens: Ethics, Law and Public Policy in the Development of Robotics and Neurotechnologies. Law, Innovation and Technology 2011, 3(2), pp 185-207.

31. Wood, Stephen P. *et al*. The Potential Regulatory Challenges Of Increasingly Autonomous Motor Vehicles. Santa Clara Law Review 2012, 52(4), pp 1423-1502.

32. Wuyts, D. The Product Liability Directive – More than two Decades of Defective Products in Europe. Journal of European Tort Law 2014, 5(1), pp 1-34.

Conventions

33. The United Nations, Geneva Convention on Road Traffic, 1949.

34. The United Nations, Vienna Convention on Road Traffic, 1968.

Directives

35. Council Directive of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (85/374/EEC), OJ 1985 No L210, 7.08.1985.

36. Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, OJ 1995 No L 281, 23.11.1995.

Written questions to the Commission

37. Written Question No 706/88 by Mr Gijs de Vries to the Commission of the European Communities: Product liability for computer programs, OJ 1989 No C 114, 8.5.1989.

National law

38. Traffic Act, RT I, 03.01.2017, 18.

Case law

39. CJEU, 25.04.2002, C-183/00, Maria Victoria González Sanchez and Medicina Asturiana SA.

40. TlnRnKo 1-07-14992.

41. ECHR 2.9.2010, 35623/05, Uzun vs. Germany.

Web pages

42. Bohm, F., Häger, K. Introduction of Autonomous Vehicles in the Swedish Traffic System – Effects and Changes Due to the New Self-Driving Car Technology. Uppsala University 2015. https://uu.diva-portal.org/smash/get/diva2:816899/FULLTEXT01.pdf (14.04.2017).

43. Boudette, Neal E. Tesla's Self-Driving System Cleared in Deadly Crash 2017. www.nytimes.com/2017/01/19/business/tesla-model-s-autopilot-fatal-crash.html?_r=0 (13.04.2017).

44. Delaney, R., Rene van de Zande. A Guide to the EU Directive Concerning Liability for Defective Products (Product Liability Directive) 2001. gsi.nist.gov/global/docs/EUGuide_ProductLiability.pdf (16.04.2017).

45. Dockterman, E. Robot Kills Man at Volkswagen Plant 2015. time.com/3944181/robot-kills-man-volkswagen-plant/ (19.04.2017).

46. Drive Sweden. Sweden proposes a progressive legislation for autonomous vehicle trials 2016. www.drivesweden.net/en/smart-mobility-news-and-comments/sweden-proposes-progressive-legislation-autonomous-vehicle-trials (14.04.2017).

47. European Commission. European Innovation Scoreboard.

ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en (29.01.2017).

48. European Commission. Estonia, highly networked and highly innovative 2012. ec.europa.eu/digital-single-market/en/news/estonia-highly-networked-and-highly-innovative (24.03.2017).

49. European Parliament. Automated vehicles in the EU 2016. www.europarl.europa.eu/RegData/etudes/BRIE/2016/573902/EPRS_BRI(2016)573902_EN.pdf (23.04.2017)

50. Fourtané, S. Sweden's Self-Driving Cars for Sustainable Mobility 2014. www.eetimes.com/document.asp?doc_id=1324383 (14.04.2017).

51. Golson, J. Tesla driver killed in crash with Autopilot active, NHTSA investigating 2016. www.theverge.com/2016/6/30/12072408/tesla-autopilot-car-crash-death-autonomous-model-s (13.04.2017).

52. Harris, M. Researcher Hacks Self-driving Car Sensors, 2015. spectrum.ieee.org/cars-that-think/transportation/self-driving/researcher-hacks-selfdriving-car-sensors (22.02.2017).

53. Lindholmen Science Park. Drive Me - self-driving cars at Lindholmen 2014. www.lindholmen.se/en/news/drive-me-self-driving-cars-lindholmen (3.04.2017).

54. Los Angeles Times. Humans at fault in self-driving car crashes 2015. www.latimes.com/business/la-fi-self-driving-accidents-20150512-story.html (9.04.2017).

55. Markoff, J. Google Cars Drive Themselves, in Traffic, 2010. www.nytimes.com/2010/10/10/science/10google.html (24.02.2017)

56. NPR. Google Asks, Why Should A Car Need A Driver? www.npr.org/templates/story/story.php?storyId=130492972 (9.02.2017).

57. Republic of Estonia. Ministry of Economic Affairs and Communications. Estonia Allowing a Number of Self-Driving Cars on the Streets Starting Today 2017. www.mkm.ee/en/news/estonia-allowing-number-self-driving-cars-streets-starting-today (24.03.2017).

58. Robolaw. Regulating Emerging Robotic Technologies in Europe, Guidelines on Regulating Robotics 2014.

www.robolaw.eu/RoboLaw_files/documents/robolaw_d6.2_guidelinesregulatingrobotics_20140922.pdf (23.02.2017).

59. Ross, K. Manufacturers versus Component Part and Raw Material Suppliers: How to Prevent Liability 2008. http://www.productliabilityprevention.com/images/2-ManufacturerversusComponentPartandRawMaterialSuppliersHowtoPreventLiability.pdf (19.04.2017).

60. Starship Technologies 2016. www.starship.xyz/about-us/ (24.03.2017).

61. South China Morning Post. Father of Chinese man killed in Tesla crash files lawsuit over Autopilot system 2016. www.scmp.com/business/companies/article/2021356/father-chinese-man-killed-tesla-crash-files-lawsuit-over (13.04.2017).

62. The United Nations Economic Commission for Europe. http://www.unece.org/trans/roadsafe/rsabout.html (2.03.2017).

63. The United Nations Economic Commission for Europe. UNECE paves the way for automated driving by updating UN international convention 2016. www.unece.org/info/media/presscurrent-press-h/transport/2016/unece-paves-the-way-for-automated-driving-by-updating-un-international-convention/doc.html (24.03.2017).

64. The United Nations Economic and Social Council. Report of the sixty-eighth session of the Working Party on Road Traffic Safety 2014. www.unece.org/fileadmin/DAM/trans/doc/2014/wp1/ECE-TRANS-WP1-145e.pdf (24.03.2017).

65. Urmson, C. The self-driving car logs more miles on new wheels, 2012. googleblog.blogspot.com.ee/2012/08/the-self-driving-car-logs-more-miles-on.html (19.02.2017).