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# The Horseless Age

The arrival of autonomous vehicles and the challenges facing EU liability regulation

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# Summary

In the vehicle industry, as well as rest of society, efficiency and automatization is increasingly important. For the vehicle industry, the next big step in vehicle evolution is automated vehicles, AVs. AVs are predicted not only to make transportation easier but also safer. This thesis will further examine the present EU legislation in product liability, how the presentation of AVs will be affected by said legislation and what challenges that might occur when this new type of product arrives.

The thesis will present different levels of automatization in vehicle's and what the characteristics are. The thesis will further examine if the Product Liability Directive is sufficient for the challenges ahead or if additional legislation will be needed on a Union level.

# Sammanfattning

I fordonsindustrin, likväl som i resten av samhället, ökar vikten av effektivitet och automatisering. Nästa steg i utvecklingen och evolutionen av fordonsindustrin är självkörande bilar, AVs (Automated Vehicles). Självkörnade bilar förväntas inte bara göra transport lättare och mer effektivt, utan även säkrare. Denna uppsats kommer granska den nuvarande EU lagstiftningen inom produktansvar, hur denna påverkar introduktionen av AVs och vilka utmaningar som kan uppstå när denna nya typ av produkt lanseras.

Denna uppsats kommer att presentera olika nivåer av automation inom fordon och dess olika karaktärsdrag. Uppsatsen kommer vidare granska huruvida gällande EU-lagstiftning (Product liablity Directive) är tillräcklig för kommande utmaningar eller om ytterligare lagstiftning kommer krävas på Union nivå.

# Preface

This thesis would not be what it is today without the support of my loved one Liza Svärdh, I owe you the world. I would like to thank my father Michael and my mother Ulrika for the support throughout my life, thank you for always being there for me. I would also want to give a special "thank you" to my grandmother Ulla for opening my eyes to the written word and encouraging me to read.

Lastly, I would like to thank my supervisor Valentin Jeutner for his feedback and ideas throughout the work of this thesis.

# Abbreviations

| | |
|---|---|
| EU | European Union |
| PLD | Product Liability Directive |
| MID | Motor Incurrence Directive |
| AV | Automated Vehicle |
| AI | Artificial Intelligence |
| The ECJ | The European Court of Justice |
| FAV | Fully Automated Vehicle |
| SaaP | Software as a Product |
| SaaS | Software as a Service |
| V2X | Vehicle to everything |
| TT | Tracing Technology |

# 1. Introduction

The automobile industry is one of the biggest industries worldwide, both employment-wise and financially, with the four biggest consortiums having a combined revenue of over 900 billion US dollars (Volkswagen, Toyota, Daimler and Ford) in 2018.[1] The industry now faces a new challenge with the development of Artificial Intelligence (AI) and the introduction of autonomous vehicles. Autonomous cars are, according to many, the future of the automobile industry. The challenges for the sector are vast when a new type of product is developed. Changes may come and according to Aston Martin's chief executive Andy Palmer billions of dollars need to be invested to develop and connect autonomous vehicles which might force existing brands to merge or sell to rivals.[2]

The development of these kinds of vehicles is viewed as the next natural step in the automotive lifecycle. The positive effects of the transition into more autonomous vehicles is, amongst others, a prediction that around 90% of traffic fatalities could be prevented by the use of autonomous vehicles.[3] The use of autonomous vehicles is also expected to have an impact on the transport sector, especially in transportation from A to B. To be able to programme a truck's AI to go on a pre-decided course with cargo can heavily reduce cost on, for example, labour and ancillary costs.

The new challenges not only arise from a technical and financial standpoint, but most importantly for this thesis, a legal one. Liability in cars and other motor vehicles are regulated on the Europen Union level by the Motor

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1 Statista, *Revenue of leading automotive manufacturers worldwide in 2018.*
2 Saigol, Lina. *"Daimler holds the keys to any future Aston Martin deals"*. MarketWatch16/4 2109.
3 Loeffler, John. *New training model helps autonomous cars see A.I's blindspot*. Interesting engineering. 28/1 2019.

insurance directive (MID 2009/103/EC) and the Product Liability Directive (PLD 85/374/EEC). These laws regulate the coherence between the driver or owner of the vehicle and incidents including the vehicle and the consumer and the manufacturer. With the development of a more automated car where the AI gradually takes control over the vehicle the question arises whether the current legal framework is sufficient enough to take on the challenges ahead.

## 1.2 Issue at hand

How will the introduction of independent and autonomous cars affect the development of EU liability legislation and the perception of who, consumers or producers, will be liable for damages?

## 1.3 Purpose

The purpose of this thesis is to further examine if the development of new types of vehicles and their attributes is consistent with current EU legislation or will additional legislation be necessary.

## 1.4 Research questions

- Will the PLD be applicable on stage 3 vehicles and onward in the Society of Automotive Engineers scale?
- Will the PLD be applicable to all elements on an AV?

## 1.5 Methodology

For this paper to answer the research question in the most efficient way an EU legal method will be used to examine EU law from a teleological perspective.[4] The research question is a complex question where not only the legal text of the Product Liability Directive (85/374/EEC) will be used

[4] . Hettne, Jörgen & Otoken Eriksson, Ida. *EU-rättslig metod-Teori och genomslag i svensk rättstillämpning*, Norstedts juridik andra upplagan 2011, p. 168.

but also different EU-law in light of the objectives of The EU as well as the EU-courts. This thesis will apply a teleological interpretation, which is primarily used when the context of a legislation is unclear, to help fill the gaps when the texts of the treaties or directives do not suffice. Due to this thesis researching the current legislation covers the challenges awaiting the vehicle industry the current legislation will be of importance, but also literature and articles examining the impact of AVs on said legislation.

# 2. Autonomus vehicels

To know what challenges the PLD will face with the development of AVs, one must first know what characteristic make an AV and the different levels of AVs. This chapter will further examine and explain what an AV is and how it differs from more conventional vehicles.

Autonomous vehicles (AVs) are expected to be the next level in the evolution of vehicles. The development and use of AVs expected to have a great impact on the characteristics of cars and how they are used. The extended use of AVs is assumed to have the potential to aid motoring and motorists in many ways, with for example saving human lives, decrease congestion and negative impacts on the environment, help minimise the financial impact of accidents and increase productivity.[5]

## 2.1 The horseless wagon

An American organisation called the Society of Automotive Engineers, or SAE International, has published a 6 level scale to distinguish the different levels of driving automation and the standard for Self-Driving vehicles.[6] These levels describe vehicles driving automatization systems that perform various parts of the Dynamic Driving Task (DDT) on a sustained basis.[7]

The SAE International, previously known as Society of Automotive Engineers, is an American organization with roots and history back to the early days of the automobile. In 1902 a man named Peter Heldt of the magazine *The Horseless Age* wrote an editorial where he stated "*Now there is a noticeable tendency for automobile manufacturers to follow certain*

[5] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* European Parliamentary Research Service. February 2018. Page 7.
[6] SAE International, SAE J3016 Levels of driving Automation.
[7] Ibid.

*accepted lines of construction, technical questions constantly arise which seek solution from the cooperation of the technical men connected with the industry. These questions could best be dealt with by a technical society. The field of activity for this society would be the purely technical side of automobiles".*[8] Out of these ideas the SAE was founded and Mr Heldt was one of the early members. According to the SAE one of their earlier members even created the term Automotive by combining the greek word Autos (Self) and the latin word Motivus (of motion) to describe a form of self-powered vehicle.[9] Today the SAE has subsidiaries in countries across the globe and work on an informative and proactive basis to inform and create interest in the automotive sector.

The SAE has, as previously mentioned, graded a 5 level (6 including zero) scale to describe a vehicle's level of automation. These classifications were later accepted by the US National Highway Traffic Safety Administration[10] and is also used as a guideline classification in other countries as well as the automotive industry.

At level 0 the car has no automotive features and driving aids. Most cars older than 20 years are level 0 cars. Here steering, throttle and braking is all controlled by the driver with no aid given. A car at level 0 might have warning systems like blind-spot pointers to alert the driver of vehicles emerging from the blind-spot but it is up to the driver to make use of this information, the vehicle itself will not react or interfere.

The SAE level 1gives the driver of the vehicle some technological aids but nevertheless the human driver is still operating the vehicle and is in control. Here some of the features a driver of a modern car takes for granted are presented. Both Steering and acceleration/deceleration gets technologies help and assistance. This assistance is however in fixed situations and is not

[8] SAE International. About SAE, History.
[9] Ibid.
[10] Vineet Chatterjee, SAE levels of Autonomy. Automotive Electronics

featured in everyday driving without the human driver actively engaging these functions. Examples like cruise-control that assists a car with maintaining a certain speed without the driver holding his foot on the throttle or lane-assist that keeps the vehicle between the lines on a road without the human driver holding onto the steering wheel is considered to be Level 1 of on the SAE scale. Adaptive cruise-control which is an extension of cruise-control and a bit more technologically assisted that also falls under Level 1. Adaptive cruise-control uses sensors and cameras to measure the distance between vehicle A and B and then adapts vehicle A's speed to that of vehicle B. When vehicle B brakes in front of vehicle A, vehicle A automatically brakes to keep the distance and when vehicle B accelerates vehicle A does the same, up to a certain speed.

What is typical for a Level 1 vehicle is that these functions, assisted steering or acceleration, rarely are used at the same time.

At SAE Level 2 the vehicle assists the human driver in more situations and may take over control in both steering and acceleration, but only in certain fixed situations. The human driver is at all times in control over the vehicle and can only use these systems as aid to the driving. Here the adaptive cruise-control and steering aid, such as lane-assist, might work together to help the vehicle and its driver to avoid other cars in traffic or change lanes when appropriate.[11] Even with these systems engaged the human driver is expected to be in charge of all remaining aspects of the DDT. The type of parking assistance that some modern cars have where the driver chooses a parking location, for example when parallel parking, and the vehicle run the throttle, brakes and the steering to park the vehicle is considered to be part of Level 2 automation.

Multiple car manufacturers offer these levels of autonomy in their cars that are available on the market today. One of the most prime and well known is

[11] Vineet Chatterjee, *SAE levels of Autonomy*, Automotive Electronics.

the Tesla Enhanced Autopilot but also Volvo Pilot Assist 2[12] offers these aids and features to the driver. The Tesla enhanced autopilot has been involved in some accidents, even with fatal outcomes. Some of these accidents have highlighted the shortcomings in the AI on level 2 and why it is important that the driver of the vehicle is supervising the drive and is alert. In 2016 a Tesla crashed which led to the first death of the driver operating the vehicle. A Tesla Model S was driving on an American freeway when the trailer in front of the vehicle changed lanes and the Tesla sensors failed to detect this.[13] According to Tesla this accident might have occurred because the sensors of the car mapping and reading the environment surrounding the car failed to detect the white paint of the trailer changing lanes and mistook it for the sky.[14] This shows that the systems on a level 2 car are developed and supposed to be used as an aid to the driver, for easier tasks but under the drivers' supervisions.

Moving from Level 2 to Level 3 of the SAE scale is where the development is at the moment. But what may look like an easy transaction in development has turned to cause debate and controversy both in public and amongst manufacturers.

A Level 3 vehicle can by itself drive around in a mapped environment and control all features required to drive a vehicle without assistance from the driver. Important to point out is that this does not make it a completely autonomous vehicle in the eyes of the SAE, or in the eyes of the law. At level 3 the key word is assistance. All the systems exist to assist the driver, but the driver is the ultimate failsafe. If the conditions on the road or environment surrounding the vehicle changes it is up to the driver to monitor these changes and adjust the drive. In terms of liability this is a significant and important difference.

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[12] Ibid.

[13] Cohen, Wayne & Schneider, Nicole. *Self driving cars and liability*. Cohen and Cohen.

[14] Cohen, Wayne & Schneider, Nicole. *Self driving cars and liability*. Cohen and Cohen.

## 2.2 SAE levels 3 and onward

Up to Level 2 on the SAE scale the question on liability has been quite straight forward. In the EU, liability between producer and consumer is directed by the PLD (Product Liability Directive 85/374/EEC). The PLD is a general liability directive for *liability without fault* between a producer and the consumer. The PLD is applicable on industrially produced goods and movables (PLD Art 2). And since a vehicle is an industrially produced movable it falls under the scope of the PLD.

The next article in the PLD is one that causes some of the debate regarding the future of the PLD and its applicability on AVs. As it is today a producer in the eyes of the PLD "'*Producer' means the manufacturer of a finished product, the producer of any raw material or the manufacturer of a component part and any person who, by putting his name, trademark or other distinguishing feature on the product presents himself as its producer*".[15] Rather uncomplicated. A producer of a vehicle, for example a car manufacturer, is liable for the product they release onto the market for consumers. It is the next part of the article that causes an issue. A car manufacturer seldom produces all parts for a vehicle in-house but uses subcontractors to supply them with different parts for the finished products. However, if any part of a vehicle is defective, the producer who put the product on the market is still liable. In an AV many of the moving parts will be the same as in a regular car. There will be a propulsion system moving the vehicle and even though most future cars at this moment look to be electrical rather than petrol based mechanical components will not cease to exist in AVs. The subcontractors supplying manufacturers with raw material and components will keep doing that. With the arrival of AVs a new major player will be entering, the software developer. When AI more and more gains control over the driving of a vehicle the demand on the software developers to produce software/AI that is up to the task increases.

[15] PLD 85/374/EEC, Article 3.

It is not only small parts of the vehicle that are produced or developed by other parties than the manufacturer of the car. It is not uncommon that a brand buys engines from another brand that is not a direct competitor. A recent example is the British Aston Martin buying their V8 engines from the German Mercedes-Benz.[16] This is to cut the process of developing an entirely new engine from scratch which is a costly and time-consuming project. However, when an Aston Martin is then sold to consumers the engine is fitted into an Aston Martin car and with an Aston Martin logo on it. In accordance with Art. 3 PLD when a company puts its name or trademark on the product it also takes over the responsibility of liability. So even if the engine in an Aston Martin can be built in a Mercedes-Benz plant, if any problems occur, Aston Martin will be liable to the consumer.

When an engine is installed in a car it stays there, one might switch out faulty parts or do some slight modifications but overall the engine stays in its dock. The software in a car is however changed, modified and updated to the extent that it has very little resemblance to the original product after a few years. Modern Level 2 vehicles rely on software in many of the vehicle's features, to control the sensors of the adaptive cruise control or the guide the vehicle when using park-assist. These systems require a well-developed software that would to some level resemble the one that would be used on Level 3 and onward. So the software is already there, and in today's cars the manufacturer of the car is still liable for any fault that might occur to the vehicle due to problems in relation to the software. Just like an engine, when installed it falls under the liability of the manufacturer of the car. It has their logo on it. So why would this change?

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16 Saigol, Lina. *"Daimler holds the keys to any future Aston Martin deals"*. MarketWatch16/4 2109.

## 2.3 Not only horseless, but driverless

The transition from level 2 to level 3 (also known as conditional driving assistance) on the SAE scale offers small challenges on the question of liability. For consumers the gap between level 2 and 3 automation might seem subtle, a few extra features to help improve the ride. But technological wise the change is substantial.[17] One of the biggest differences in vehicles between these levels is the vehicle's perception of the environment surrounding said vehicle. In a level 2 car the vehicle uses sensors and cameras to monitor the direct exterior surrounding the car but does not take any active decisions by itself or plan further ahead. The vehicle's AI has a passive role and does not take any decisions but rather react to situations that occur. A level 3 vehicle and its AI takes a more active role in the driving of the vehicle. A level 3 vehicle has a what is referred to as an "environmental detection"[18] that can, contrary to level 2, allow the vehicle to make informed decisions by itself. However, the technological difference between these levels might be a big leap but the legal standards remain the same. Ultimately, according to the PLD and the SAE,[19] the driver is the failsafe and must be able to intervene if any problem would occur. The systems offered are there to assist the driver but not to take over the drive completely. Therefore, the driver is responsible at all times, and liable for accidents that might occur that are not contributed to a hardware problem.

Moving to level 4, the automation of vehicles increases. A level 4 vehicle differs in one major way from a level 3, the ability to act on its own. A level 4 vehicle composes the ability to act and intervene if things go wrong or if a systems failure would occur.[20] This feature grants the driver the freedom of lacking control, to not pay attention. These cars can be operated in a complete self-driving mode where the driver can enjoy the ride as a passenger. Most of the level 4 vehicles that are in use today are operated in a

[17] Synopsys, *Dude where's my autonomous car?.*
[18] Ibid.
[19] SAE International, SAE J3016 Levels of driving Automation.
[20] Synopsys, *Dude where's my autonomous car?.*

mapped environment where the vehicles never go faster than 30mph (approx. 48 km/h).[21] The vehicles on level 4 may or may not be equipped with typical driving features such as a steering wheel and pedals. [22]

Then there is the final level, level 5. A level 5 car possesses the same features as a level 4 car, automated driving features and will not have the requirement for the driver to be able to take over control. The AI of the car will be able to drive the vehicle under all conditions and will most likely miss today's standard features such as steering wheel and pedals,[23] simply because there will be no need for them. Even though the "driver" will act as a passenger on this stage, there will still be need to hold someone liable for the operating part of the vehicle. The question is who that should be, and will it be legal?

Out of the 28 member states (this including The UK) 23 member states have signed the Vienna convention on Road Traffic of 1968 which states that "*Every moving vehicle or combination of vehicles shall have a driver*",[24] according to many interpreted as requiring that all road vehicles must have a human "driver".[25] This would obviously rule out Level 4 and 5 vehicles from entering the internal market. To allow FAVs (Fully Automated Vehicles) the suggestion is to reinterpret the term "Driver" to allow AI to remote control the vehicle, this trough a further amendment of the Vienna Convention.[26]

For automakers as well as consumers the importance of knowing beforehand what is to be expected of one another in terms of liability in controlling and driving a vehicle is crucial. For the industry to start

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[21] Ibid.
[22] SAE International, SAE J3016 Levels of driving Automation
[23] Ibid.
[24] Art 8(1), *19 Convention on Road Traffic*, United Nations. Vienna. 8 November 1968.
[25] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* Annex 2. *Socio-Economic analysis of the. EU common approach on liability rules and insurance related to connected and autonomous vehicles*. p. 144.
[26] Ibid.

producing and selling automated vehicles the legislators, both European as well as globally, must produce a clear rulebook on which party can be held liable in any given situation.

With further knowledge on the different levels of AVs and their characteristics the question concerning present liability regulation and applicability arises, which the next chapter will examine further.

# 3. Liability

The current EU liability legislation is designed to cover a vast area of products and potential damages. This chapter will explain the outline of EU regulatory acts regarding liability and the impact of AVs.

## 3.1 Liability and the EU

The question on whether the PLD needs to be revised or if the current form is suitable for the next generation of cars is a complex one. The PLD has been sufficient enough to cover a vast area of products due to its comprehensive outline. The PLD is in no way designed with a specific product in mind but rather to cover an overall area of products. With the arrival of next generation cars where a range of the features offered might not fall under the scope of the PLD there is reason to examine which actions might be subtle to take on a union level. In a report published by the European Parliament[27] four possible solutions to move forward were presented.
The first one is a status quo, to keep the legislation as it is today (1), the second one is to revise or reform the PLD (2), the third one to reform the MID (3) and the fourth one to would be to introduce a new EU legislation that sets up a no-fault insurance framework for accidents or damages that occur because of a AV.[28] Out of these four, the second one or the last one is the most likely to actually be put into practice.

The PLD is a directive that is designed to cover liability in a wide range of products. The PLD covers products that are produced in or imported to the European economic area. This is obviously a broad scope containing

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[27] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* European Parliamentary Research Service. February 2018.
[28] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p.6

products with different characteristics and utility areas. A legislation that covers all these areas cannot be too precise or specific, it cannot state different objectives or specifics that expels a product or a category. The PLD is fairly undetailed for a reason, to give the opportunity to cover a wide range. If legislators would revise the PLD to make it more focused on certain aspects, such as AI in general, software or even AVs the legislation would lose a lot of its applicability.

There is no question that the PLD is, and still would be, applicable on damages and faults on vehicles even when autonomous. The vehicle in itself is still a product with a producer that is liable. When it comes to defects that the PLD can not foresee or regulate, an additional legislation rather than a revised current one can be favourable.

In addition to the PLD the Motor Insurance Directive (MID 2009/103/EC) governs EU liability in questions connected to civil liability. The MID does not regulate the relation between manufacturer and consumer but rather between users of vehicles and the surrounding environment.[29] The MDI sets out harmonized minimum standards for the EU member states to ensure that all vehicles within the union and in traffic are insured.[30] This standard is as mentioned a minimum standard for all EU member states to give a certainty for people and vehicles traveling and transporting goods within the internal market that they have a minimum protection despite which country or state that they are driving in or through. The MID covers an important sector but this thesis will rather look at the liability without fault between manufacturer and consumer so therefore the MID will not be examined closely except for when needed.

[29] MID 2009/103/EC Art 1.

[30] MID 2009/103/EC Art 3.

## 3.2 The product and its expectation

There is no question that the PLD is, and still would be, applicable on damages and faults on vehicles even when autonomous. The vehicle in itself is still a product with a producer that is liable. When it comes to defects not relating to the vehicles ability to drive and make decisions and the damages caused by it the PLD will still be the legislation that is applicable. Caselaw regarding from the PLD, views that The European Court of Justice (ECJ) does not only examine what a product actually does, but what it can be expected to perform.

There is no specific caselaw on vehicles and PLD but one can view the ECJ's standpoint by interpreting the cases analogical.

### 3.2.1 Boston Scientific

In joint cases C-503/13 and C-504/13 between *Boston Scientific Medizintechnic GmBH (B.S)* and *AOK Sachsen-Anhalt (503)* and *Betriebskrankenkasse RWE (504)* the ECJ examine the liability regarding defectiveness in pacemakers. Boston Scientific is a US producer of medicinal products, such as pacemakers. B.S. then exported these pacemakers (Guidant Pulsar 470 and Guidant Meridian 976) and sold them on the German market.

In 2005 B.S sent a letter to treating physicians using their products that, inter alia, a component used to hermetically seal the pacemakers may experience a gradual degradation and therefore recommended replacing such pacemakers.[31] These recommendations were followed and the pacemakers in question were replaced.[32] Replacing said pacemakers came with an price for the physicians making the surgery, which they sought compensation for. The question from the national court to the ECJ that is of

[31] Judgement of The Court in joint cases C-503/13 and C-504/13, Point 14.
[32] Judgement of The Court in joint cases C-503/13 and C-504/13, Point 13.

importance for this thesis is if a product or product series can be found to be defective without the need for the product in itself to be defective, but rather if it is enough that a product belongs to the same group or form a part of the same production series. This is of interest due to safety aspects, propose one AV is involved in a severe accident where the cause of the accident is unclear and needs to be further examined. Can owners of that car model or similar one's demand compensation for replacing or say rent another vehicle while the cause is investigated?

In the combined cases involving Boston Scientific the ECJ brought the question forward. According to article 6(1) of the PLD product can been viewed as defect if it does not provide the safety which a person or consumer is entitled to expect. In this reasoning some requisitions are required: for example the presentation of the product, to what use the product could reasonably be expected to be put to and the time the product was put into circulation.[33] The phrasing "*expected*" is of importance when it comes to liability and AV's. In accordance with the sixth recital of the preamble to the PLD, the assessment on the level of safety of the product must be carried out with regard to reasonable expectations of the public.

So, when asking and answering a question regarding liability at fault one must not simply look at relevant legislation but also at what the consumer and the public is expecting from the product. This means that the safety which the public is entitled to expect must be assessed by taking into account, inter alia, the intended purpose of the product, the objective characteristics of the product and if there is any specific requirements for the group of users who the product is intended for.[34]

In this instance the ECJ found that if a product belongs to a group or form a part of the same production series as a defective product where there is a

[33] Judgement of The Court in joint cases C-503/13 and C-504/13, Point 37.
[34] Judgement of The Court in joint cases C-503/13 and C-504/13, Point 38.

risk of injury or damage it can be classified as defective without need to show that the product in question is defective. [35]

For this verdict to be applicable and interesting when it comes to AI and AVs one needs to look at the possible connections and redefections this could have in a situation similar to the one involving *Boston Scientific.* The two most important points of this verdict to focus on is the reasonable expectations of the public and the possibility of a product being defective just by being part of the same production series.

## 3.3 The expectations of an AV

The Public's expectation on what an AV can and will perform is uncertain, as with any new product. The car itself has been around for over a century and is a well-defined product. The public has a way to quickly adopt new changes and get accustomed to new features to any product. One can just look at the many aids a modern car has with park-assist, rear-view camera and lane-assist. Standard in most premium cars today and a rare exclusivity ten years ago. So, the public perception on what can be expected is everchanging. When first launching an AV the expectations might differ from person to person depending on the level of basic knowledge in for example programming or road-safety. This makes the assessment of expected product safety procedural requirements challenging. Here the ECJ needs to examine the cases individually (as they always do) to clarify and examine what can be expected in different situations.

Examples on different expectations between producer and customer is the previously mentioned Tesla incident. Tesla´s autopilot is used as an aid to drivers in fixed situations, for example when cruising the freeway. But it is just that, an aid and not designed to completely take control over the vehicle without any assistants or intervention from the driver. The incidents

[35] Judgement of The Court in joint cases C-503/13 and C-504/13, Point 56.

involving Tesla and its autopilot can be viewed as "crash" between expectation and product reality. When examining if the autopilot is faulty The Court further examines how the product was designed, what is written in the instructions and how the instructions are formed. With this as a premise the ECJ then examine what the reasonable expectations on the product might be.

The second part of the judgment that is of interest is the Court's reasoning over faulty products in a production series. When it comes to vehicles moving in high speeds and where a potential system failure could be lethal, having complete faith in the system in charge of one's life is crucial. For consumers and people traveling by AVs, where no control lies with the driver, it is important to be able to trust the vehicle and its ability to make the right informed decisions.

## 3.4 An AV out in the wild

An AV is designed to make millions of decisions every second to ensure safe travel for its passengers and the surroundings.[36] Suppose that the car manufacturing company A produces a four-door saloon for the European market, they call the model 4E. They also have the SUV 4X on the market, which is a Level 4 car on the SAE scale. The 4X have some reported incidents involving their sensors malfunctioning leading to accidents, the latest one causing damage to both person and material. The 4X is as mentioned a Level 4 car, which means that it has a steering wheel, ultimately leaving the driver in charge of the vehicle. However, the same type of sensors with the same type software is used in the 4E, a completely autonomous level 5 car. Customers of the 4E have expressed their worries about the same type of faulty sensors being used on the 4X also being used on 4E, and on the 4E there is no driver to act as a failsafe. Multiple customers have reached out to A and asked to have their sensors replaced

[36] Synopsys," Dude *where's my autonomous car*?"

with new ones because of fear for their safety. To support their claim, they cited Article 6(1) of Directive 85/374 (PLD) that a product is defective when it does not provide the safety which a person is entitled to expect.

The Boston Scientific case gives some guidance on how to interpret Article 6(1) of the PLD. In Advocate General Bot´s Opinion on the combined cases he gives guideline that can be valuable in an analogue interpretation. When examining the objectives set out in the second recital of the preamble to PLD of adequately solving the problem of fair apportionment of risk in modern technology such as AI "*That concept must be understood to refer to a product that poses risks jeopardising the safety of its user and having an abnormal, unreasonable character exceeding the normal risks inherent in its use*".[37] A product being dangerous or unsafe in itself is not a safety aspect, the danger does not stem from the product itself or the use of it, but rather from abnormal potential for damage that the product can cause the user or any surrounding property. A product, say a chainsaw, is in itself dangerous and unsafe. However, when using a chainsaw, the adequate level of caution and safety is required, and expected, of the user. One does not run around with the chainsaw on, trip, get a cut in the leg and claim the product is defect. Risk is calculated with the characteristics and intended use of the product in mind.

If customers of A 4E request their sensors to be replaced due to concerns for their and the surroundings safety, it is important to examine both the actual potential damage of the faulty sensors but additionally whether the defect is rigours enough that it affects the legitimate expectations to the product concerning safety. In this case, examining AG Mr Bot's opinion, it is the writer's opinion that when it comes to AV's that the expectations are still somewhat unclear on some features. It is however of great importance that consumers and users feel comfortable and safe using an AV, not only for the sake of the consumer but for the sales and development of AVs. If a feature

[37] Opinion of AG Mr Bot, *Joined Cases C-503/13 & C-504/13 Boston Scientific Medizintechnik.* Point 30.

of the vehicle fails to operate according to the standards expected it is of great importance that this is viewed as defect even if only occurring in some vehicles. AG Mr Bot further clarifies this in Point 37[38] of his opinion of the combined cases. In situations like the one described above or similar ones involving AV the PLD will most certain apply as it does to other products when it comes to hardware.

When reviewing AVs, the hardware is only a small part of the product, what distinguishes an AV from a traditional car is not to some great extent the hardware but rather the software controlling the vehicle. Here lie the great challenges for the legislators and the industry to come to terms.

As one can see, the current legislation will cover defects in hardware as with any other product, the challenge for legislators concerns the vehicles brain, the software. The next chapter will clarify the difference between the two and how that might affect the scope of the legislation.

[38] Opinion of AG Mr Bot, *Joined Cases C-503/13 & C-504/13 Boston Scientific Medizintecknik.* Point 37.

# 4. Software, the brain of the vehicle

In an AV on Level 3 and onwards on the SAE scale the software plays a crucial role in how the vehicle is driven. This chapter will look at some of the challenges AV are facing in light of the software and this may be affected by current or future legislation.

## 4.1 Hardware vs Software

As mentioned earlier, there might be a difference between hardware and software in vehicles in terms of product liability when reaching level 3 and onwards. This, in the opinion of the writer of this thesis, depends on whether software should be viewed as part of the vehicle or a product on its own. As it is today software is a part of the vehicle's integrated systems, not a separate product. The software in a car today, say on level 2, is a pre-installed program that falls under the liability of the vehicle manufacturer as part of the vehicle itself. As it is today software and AI are a big part of the vehicle, which can be shown easily by the fact that an average Ford Auto produced in 2010 already back then contained more code than a Boeing Dreamliner Aircraft[39] and that is in a car with significantly less AI interference than a car on the level we are on today. When the AI in an AV regains most of the control over the vehicle, the expectations and the pressure for it to work smoothly increases, it is after all in charge of human lives.

A shift in product liability from manufacturer to software developer is an extension of the question if software should be considered a product on its

[39] *Connected Vehicles: How Soon Will They Hit the Road?,* WHARTON SCHOOL (Aug. 1, 2017), https://pvmi.wharton.upenn.edu/news/driverless-connected-vehicles/.

own or incorporated in the vehicle. If software is considered a product of its own, the software can be liable under the PLD and the software developer could be forced to bear the cost to failure in an AV related to the software.

Suppose that the software controlling the AV is considered a product, the question arises if the software can still fall under the PLDs "defectiveness"" standard.[40] Proving software is defect, or even arguing that software is defect, can cause a substantial problem compared to more established products. If the software is considered to fall under the PLD, the right to compensation in respect to the PLD still depends on the reason of failure. For a risk or a defect to be covered by the PLD, this defect needs to be able to be scientifically discovered before any vehicle is put into production and leaves the factory to be delivered to the customer.[41] Risks that emerge or are discovered after the production are not covered. To be able to hold either the car manufacturer or the software producer liable, the defect or risk need to be there from the start. To prove that a product is defect from start can raise some challenges, especially if continuously updates are offered and the product (software) is evolving and changing. To offer a solution, consumers might be able to use circumstantial evidence to prove a defect. As mentioned earlier in the thesis, a product is defective if it lacks the safety a person is entitled to expect (Art 6(1) PLD), by extension, a product is defect if it differs from products of similar kind. Art 4 PLD states that the injured person is required to provide prove of damage. By providing circumstantial evidence, the consumer would have to provide evidence that the product malfunctioned, this occurred during proper use and the product had not been altered with or misused in a way that could cause this malfunction. By the principle of *res ipsa loquitur,* used in common law, the sheer nature of an accident can be proven negligence in the absence of direct evidence, if there

[40] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 25.
[41] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 25.

were no negligence the accident would not occur.[42] This principle has been put to use at least once in involving a vehicle and AI. In 2013, a court found that Toyota was liable when one of their cars allegedly suddenly accelerated, even though there was a lack of actual evidence.[43]

Any product containing software is dependent on many things, updates is one of them. Take for example a modern smartphone or GPS. Both the apps in the phone as well as the software on the phone is updated regularly to offer new solutions or fix bugs. The same thing would, and is, happening with the software used in cars. When updating software, a new line of code replaces the old/current one in the product, being a phone or a car. Whether this code updates or replaces the current one is of importance. Superimpose that a vehicle is updated with new software, containing new road maps with updated speed regulation and traffic safety. The AV accepts this information, process it and start driving by the information given. After two days the vehicle is traveling 90 km/h on a 70 km/h road due to a bug in the updated software. Naturally, there is a speed-camera on this road capturing the vehicle speeding. The driver of the vehicle did not speed, the vehicle itself did. The line of code monitoring the speed limit was defect, therefore the product was defect. To prevent uncertainty from both the producer and users in situations like this the European commission suggest different methods to ensure that software updates in AVs can be properly risk analysed, including but not limited to, hardware in the loop tests and in-service conformity rules.[44] To ensure that AVs that are sold as used vehicles have risk protection the same report suggest that software updates in aftermarket cars gets a sort of EU-type approval.[45]

[42] Dictionary.law.com, *Res ipsa loquitur.* https://dictionary.law.com/Default.aspx?selected=1823
[43] Kim, Sunghyo. "*Crashed software: assessing product liability for software defects in automated vehicle*s" Duke Law & Technology review. Volume 16. 2018. P. 305.
[44] GEAR 2030, "*High level group on the competitiveness and sustainable growth of the automobile industry in the European Union*" DG Grow, Internal Market, Industry. 2017. P 46.
[45] Ibid.

## 4.2 Edge cases

Determining to what extent the manufacturer of the vehicle or the software developer writing the algorithm is liable when risk occurring is challenging. When AVs become more evolved and closer to production, one of the most crucial parts is the software to ensure that the vehicle can drive itself safely. However, the software is only as good as its developer and those who design the program. Therefore, some argue that software and its designer should most certainly be considered a product of their own. One of the predicted problems with using software to actually drive a vehicle is that the algorithms that is used to predict and control the behaviour of the car are all start of as ideas of humans. Engineers and programmers think up 1000's of ideas with possible things that can go wrong, they then try to implement failsafe to prevent them from happening.[46] To further prevent the possibility of accidents and to prepare the vehicle for as many events as possible the software controlling the AI are put through extensive virtual simulations.[47] Still, scenarios that are impossible to predict, the perfect storm, exists. These are referred to as *Edge Cases*. Edge cases are low probability events, where the event should not happen according to probability, but still might happen in the real world.[48] The kind of event that neither programmer or nor simulation/machine learning processor might think of. This is of course a risk that needs to be taken seriously. The help prevent this, Microsoft and The Massachusetts Institute of Technology (MIT) are helping manufacturers and developers of AI with a different kind of system. Microsoft and MIT use two different techniques to develop this system.[49]

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[46] Kim, Sunghyo. "*Crashed software: assessing product liability for software defects in automated vehicle*s" Duke Law & Technology review. Volume 16. 2018. P. 310.
[47] Massachusetts Institute of Technology. "*Self-driving cars, robots: Identifying AI 'blind spots'*." ScienceDaily. ScienceDaily, 25 January 2019.
[48] Loeffler, John. "*New training model help autonomous cars see AI's blind spots",.* Interesting engineering. January 28 2019.
[49] Massachusetts Institute of Technology. "*Self-driving cars, robots: Identifying AI 'blind spots'*." ScienceDaily. ScienceDaily, 25 January 2019.

- The first one is letting the AI run through simulations, but letting a human supervisor closely monitor the simulation and provide feedback on how a human would react in any given situation.
- The second one is letting the AI work as a "passenger" on drives conducted by human drivers, to let the AI monitor how human drivers interact and behave in traffic and compare that to how the AI wold react.

Both these techniques are developed to help AI interact in traffic with humans and let the AI experience as many scenarios as possible and be prepared for as any given situation. However, the key characteristic with an Edge case is just that, it can't be predicted. This endeavour by MIT and Microsoft will must certainly help minimize the risk of Edge cases, but unfortunately not erase them. Regardless of who will be held liable, the car manufacturer or the software developer, both will probably argue that it would be impossible to be held liable for the entire decision-making capability of the vehicle. Both would probably argue that Edge cases should be treated as unforeseeable and unpredictable risks of harm. Article 7 in PLD does not explicitly rule out unforeseeable events from liability, however when assessing who will be held liable, this must be taken into account.

Regulating these edge cases differs from member state to member state depending on their civil law. In an extreme case where a vehicle forces to make a choice between two evils, the core question comes down to: Who shall the vehicle protect and who can be deemed "less important". This is not for Union law to regulate and every member state has the right to separately cover this area. However, for the sake of consumers and producers common EU guidelines on the matter would be preferable. There is a risk, even if a small one, that an accident would occur when a vehicle is crossing a border between states with different domestic legislation and the vehicle fail to comply with the current legislation due a to slow update or similar circumstances. This is like an edge case, not likely but still not impossible. So for the sake of the consumer some guidelines on the core questions regarding a vehicles ability to make an decision and a choice would be preferable.

## 4.3 Programming choices

An extension in the debate on liability in Edge cases is programming choices. Whereas an Edge case is an unforeseeable event occurring outside the control of the software of the vehicle, the programming choice is just what it sounds like, a choice made in the software. A programming choice is what makes the vehicle to what it does in any given situation. In this part the central question is under what conditions the manufacturer of the AV is liable for the programming choices made.[50] Can the choices that are made by the car, purposely, be considered a defect? If pre-programmed, the defect would rather be that the AV departs from the programmed pattern, then sticking to it. This is a very complex legal issue, an issue where the current PLD legislation is not designed to give answers. Under the current framework, the producer of an AV would be held liable for any damages or fault relating from the software, network and programming only if these were attributed to the production process. Any fault or malfunction that might occur in the product, specifically the software or the network connectivity, would have to be proven to have been there at the time the vehicle left the production line.[51] Hence the problem with programming choices, and also in extent, the question if the software in itself is a separate product.

To prove a part of a vehicle defect due to hardware failure is troublesome as it is, and with the introduction of AVs and their software aid and the importance of a secure network the uncertainty in assessing liability grows.

[50] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 26.
[51] Ibid.

## 4.4 SaaP Vs SaaS, the brain of the vehicle

In determining if the software of the car is a product in itself, one must first determine if the software is a product at all. There are different types of software that are regarded as products or services. In the same way that streaming music from for example iTunes or Spotify in favour of actually owning copies of the music, using software as a service is growing increasingly popular for companies.

### 4.4.1 SaaP

The traditional way of using software as an product, known as SaaP (Software as a Product), requires the user to purchase a license and the host the solution on your device yourself.[52] A SaaP solution is a "one-time purchase", in the cases of AVs included in the purchase of the vehicle. In general, one would need an internet connection to run SaaP, but one can typically also use it offline or with an internal connection.[53] To keep the software up to date, updates would be required. Even though the SaaP works offline, the vehicle would be have to be online at least for updates to be installed, and preferably more often than that.

### 4.4.2 SaaS

Software as a service works in another manner. Instead of having the software installed on a host device, the vehicle, the software will be presented as service that is stored in a "cloud", a central hub for information storage, and then delivered back and forth over an internet connection by the provider.[54] This type of solution is used by most streaming services such as

[52] Schutz, Mike. *"Software as a Service Vs Software as a Product"*. August 2018. https://www.bynder.com/en/blog/software-as-a-product-vs-software-as-a-service/.
28 Schutz, Mike. *"Software as a Service Vs Software as a Product"*. August 2018. https://www.bynder.com/en/blog/software-as-a-product-vs-software-as-a-service/
[53] Ibid
[54] Ibid.

Netflix and Spotify and seen as the future of providing software solutions. However, this type usually requires an internet connection.

### 4.4.3 Software solution for AVs

In order to establish if the software of an AV would be regulated by the PLD, the nature of said software needs to be determined. Depending on if AVs on Level 4 and 5 will use SaaP or SaaS solutions the question on which type of regulatory acts will be applicable changes. For the PLD to be applicable obviously an SaaP solution has to be used, one cannot use legislation relating to product on a service.

The type of software that will be used by Level 4 and 5 will have to be sophisticated and interact with the driving aids of the vehicle, such as the sensors mapping the surroundings. With SaaP losing market shares to SaaS and SaaS becoming increasingly popular, a reasonable expectation would be that AVs of the future will use SaaS. However, AVs on Level 4 and 5 rely on the software constantly making decisions for the vehicle, life or death can depend on it. Therefore, the loss of an internet connection can be crucial for the vehicle and its decision-making process. In the opinion of the writer, who is in no way an engineer or an expert in the area, a combination of the two will be the best solution for an AV, with the key feature being SaaP.

AVs usually use a satellite connection or a cellular connection for internet connection.[55] However, when driving in rural areas, such as northern Sweden, connection through 4G or 5G can be unreliable. Therefore, a satellite connection can be more reliable, but also more expensive. And even a satellite connection has blind spots. More on network and connectivity later in the thesis.

[55] GEAR 2030, "*High level group on the competitiveness and sustainable growth of the automobile industry in the European Union*" DG Grow, Internal Market, Industry. 2017. P 41.

As stated above the vehicle will, with high probability, as some point lose its internet connection. Having a software that is located in the vehicle and working, even limited, when going offline and helping the vehicle manoeuvre and steer is of importance.

## 4.5 Regulating the brain

Regardless which system the industry and the manufacturers implement into the vehicle, it is of great importance that the regulatory acts regarding liability are clear for both the producer and, most importantly, the consumer. When a consumer purchases a vehicle, they expect to get possession of a product. A single product. Especially when paying the amount of money that a vehicle cost. For the benefit of the consumer, all the different systems and components; from engine to software to the seats, ought to be considered one product.

Dividing the vehicle into more components and products for the consumer to keep track off and may risk having a negative effect on the industry. With the current PLD, more than 85% of the respondents in a survey claims the Directive is beneficial to consumers as well as producers due to the fact that consumers can enjoy the same level of protection across the union.[56] To keep this level of satisfactory from the public it is of importance that AVs keep this level of consumer and producer protection on a Union level, and to establish clear for all what can be expected from said product. So for consumer protection and certainty, software ought to be viewed as a product and furthermore as a part of the vehicle rather than an product of its own.

Like most things consisting of software, AVs will need a network connection to make the product function at its fullest. While this chapter

[56] Commission staff working document. *Evaluation of council directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrate provisions of the Member States concerning liability for defective products*. Brussels 7.5.2018. P. 29.

viewed the software in itself, the next chapter will view the need for a network connection and the challenge arising with this.

# 5. Connecting People (Vehicles)

Like most modern things AVs will require a network connection to function at its fullest. This chapter will explore the different types of connections and how this will be integrated in the vehicle**.**

**The challenges regarding connectivity and hacking**

As mentioned earlier in this thesis the importance of the vehicle having an internet connection. This is referred to as V2X (Vehicle to everything).[57] This is a connection that AVs will depend on heavily, but not exclusively. Regarding the discussion between SaaP and SaaS, some of the driving aids will be handled by the vehicle, even when offline. The basic safety features as well as levels of autonomy will be managed by the on-board software, such as sensors, cameras and radar.[58] V2X will be used to support these features and then be more essential with other features, such as the communication between different vehicles and mapping. This thesis will not focus much on the technical point of view but rather the legal questions arising.

## 5.1 Network as a product

Once again, the question on what to be included in the product "AV" arises. The hardware is the product, the software ought to be considered as a part of the product, but is the network-connection part of the product? If the vehicle manufacturer offers a network connection as part of the provided product there is little to argue about. If being connected is part of the supplied product any network problems that might occur is liable under

[57] GEAR 2030, "*High level group on the competitiveness and sustainable growth of the automobile industry in the European Union*" DG Grow, Internal Market, Industry. 2017. P 45.

[58] Ibid.

PLD.[59] As with other questions relating to damages and the PLD, the proof of defects, the court will apply the reasonable expectation test and other defences and then decide the outcome.[60] As with any defect, it must be proven that the vehicles defect is in relation to a problem already existing when the vehicle left the production line.

However, if the network connection is not part of the sold product the network provider can arguably be considered liable if there is damage related to a loss of network or network failure. The risk of network failure increases as mentioned previously in rural areas which generally suffer from lack of cell reception. Here the AV will have to rely on the sensors and radar as well as a satellite connection. Therefor it's hard to imagine that a network provider will be held liable for network connection when they cannot, and probably will not, guarantee that the vehicle have an constant connection. The right to compensation due to network failure will also differ between member states. A problem may arise when an AV crosses the border between different members states. As anybody who has travelled knows your phone will connect to a domestic network provider when arriving in a new country. This will happen with the AV as well. It is important to make sure that this gap is filled and that the vehicle can support these moments lacking connection by itself.

## 5.2 Uninvited guests

With the increased use of software and AI the risk of hacking from a third party arises. Both information contained in the vehicle as well as control of the vehicle itself can be subject to hacking. Regarding the information contained in the vehicle about the passengers and any personal or otherwise related information, this is covered by the GDPR (The General Data

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[59] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 25.
[60] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 25

Protection Regulation (EU) 2016/697) and will not be examined further by this essay, but rather the liability of the breach of security.

The risk of hacking and cyberattacks in AVs poses a serious threat. Not only the information onboard is in danger, but sabotage or outside control of a vehicle by a third party can cause serious damages to the passengers of the vehicle or the surroundings. Unfortunately, Europe has seen an increase in Acts of Terror where vehicles have been used as a weapon, for example in Stockholm, London and Nice. When vehicles can be driven and controlled by an AI (Level 4 & 5), the risk of outside operators gaining control of the vehicle increases. To prevent this, producers will need to make sure that the safety-measures in the vehicle's software are sophisticated and strong enough to withstand an attempt to breach from attacks and malware. In case of hacking and cybercrime, general civil liability rules are not harmonised in the EU.[61] Producers can be held liable under the GDPR, but only if they fail to take appropriate measures to prevent a breach, and they still have to be deemed as a *controller of data* within the meaning of GDPR.[62] If the cyberattack is intended to gain control over the vehicle rather then the information within it, national civil liability rules can help regulate but the driver/operator of the vehicle can use The PLD to claim damages from the producer if they argue that the software breach is linked to fault in the product. They will however have to be able to prove that the fault was there when the vehicle left the production line.

The operator/owner of an AV can be held responsible for an cyberattack on risk-based liability if the operator fails to comply in updating or installing required updates and security software on the vehicle.[63] This is however governed by national law and not by Union Law.[64]

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[61] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 26.
[62] Ibid.
[63]n Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 120.
[64] Ibid.

All this considered, how should the EU position itself regarding AVs and liability?

# 6. Racing towards the next level

What distinguishes the internal market from many other types of unions in the world is the free movement. EU thrives toward creating a harmonised internal market in the name of free movement, and a harmonised legislation is one part of that. The PLD is created to ensure the right of consumers in case of defective products and to create a set of harmonised rules on strict liability within the Union.[65]

An issue with the PLD has proven to be the burden of proof, particularly in cases involving complex products.[66] Consumers find it challenging to prove causality between defect and damage.[67] AVs do most certainly fall under the scope of "complex products" and for a consumer to prove what caused a damage can be problematic. Recent incidents involving Tesla Cars where the drivers and the producers view of what caused the crash differs shows that this area can be problematic.

## 6.1 Tracing Technology

To solve that certain measures are suggested. AVs use software and hardware to store and process information and data. To use this data and store it further vehicles will be fitted with "black boxes", or *event data recorders*, similar to the ones used in aviation.[68] These will help to record information about incidents and events and what lead up to them. The group GEAR 2030, who examines the future of the European automobile,

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[65] Commission staff working document. *Evaluation of council directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrate provisions of the Member States concerning liability for defective products*. Brussels 7.5.2018. P. 21.
[66] Ibid.
[67] Commission staff working document. *Evaluation of council directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrate provisions of the Member States concerning liability for defective products*. Brussels 7.5.2018. P. 29.
[68] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 86.

recommends that these types of *event data recorders* should be required in a sort of Type-approval legislation recommended for AVs.[69] This will help to asses liability in cases of damages. In addition to storing this information, using V2X to share this information with other vehicles and road users will help not only establishing liability but also help prevent additional damages and accidents.[70] This *Tracing Technology* (TT) will in terms of liability include: Logged vehicle and driving behaviour data that will aid with determining the exact cause for damage, who or what that was at fault and who or what may be held responsible.[71] This will to great extent help with questions regarding liability and separate human control from vehicle control when those situations arise. Outside the scope of this essay, this type of V2X communication sharing will hopefully also help prevent accidents and collisions by in real-time by letting surrounding vehicles know the whereabouts and potential problems of other AVs.[72] Naturally there will be limitations on what type of information that will be shared trough Tracing Technology and V2X, but technical data such as motor behaviour, fuel use and actuator data fall outside the scope of The GDPR and can be shared.[73] Due to GDPR the information shared between vehicles need to be limited and encrypted to make sure that information that is personal is not shared with others.

## 6.2 The core issues

This thesis has shown that the PLD is a sufficient legislation in many aspects. It is a general legislation covering vast type of products and due to that it will also cover a lot of the aspects and concerns relating to AVs.

[69] GEAR 2030, "*High level group on the competitiveness and sustainable growth of the automobile industry in the European Union*" DG Grow, Internal Market, Industry. 2017. p.44.
[70] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 86.
[71] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 120.
[72] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 86.
[73] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 120.

However, even if comprehensive, there are still areas where the PLD lacks regulatory power and additional legislation will be necessary. Four of the key areas have been discussed in this thesis:

- Risk of failure to operate software
- Risk relating to network failure
- Risk relating to hacking and cybercrime
- Risks relating to programming choices

These risks fall outside the scope of the PLD and will therefore need additional legislation to clarify the legal matter both for consumers and producers.[74]

All this could be handed down to be controlled by national legislation in every Member State. However, as mentioned earlier a key aspect of The EU is continuity. The internal market works due to the coherence between national law and union law, with the objective of a harmonized internal market.

### 6.2.1 Question 1

To answer the question presented in the beginning of the thesis:

- Will the PLD be applicable on stage 3 vehicles and onward in the SAE?

In short, yes and no. As presented in chapter 3, many of the characteristics of a present-day vehicle will be part of the AV as well. The AV will still be a product that falls under the scope of the PLD on a Union level. Due to the PLD being designed to be comprehensive and cover a vast area of products,[75] the AV will be deemed a product, manufactured by a producer and then sold to a consumer. However, certain characteristics and features of the AV will need additional legislation as presents in chapter 4 and 5, for example the four risks mentioned in the paragraph above:

[74] [74] Evas, Tatjana. *A common EU approach to liability rules and insurance for connected and autonomous vehicles.* p. 25.
[75] Also mentioned in chapter 3

- Risk of failure to operate software
- Risk relating to network failure
- Risk relating to hacking and cybercrime
- Risks relating to programming choices

Additional type-approval legislation for AVs consisting of for example *trace technology* will help determine if damages occur out of defect under the scope of the PLD or the new additional legislation that will be needed.

**6.2.2 Question 2**

- Will the PLD be applicable to all elements on an AV?

As it is today, no. The writer sees no need to change the PLD so that it covers all elements of a AVs and instead recommend additional customised legislation that focus on the aspects and elements of AVs falling outside of the scope of the PLD. Legislators will also need to clarify certain aspects, such as SaaP vs SaaS so that both consumers and producers will know what to expect in terms of liability and software.

In conclusion, the arrival of completely autonomous cars is getting closer by the day and all the major producers are in competition to be the first one to release a self-driving car to the public. But as in most cases, regulation and laws struggle to keep the same pace as technological progress. To protect both the consumer and the producer a framework of rules needs to be in place before the product is released onto the market.

The development and introduction of AVs to the public market is a logical next step in the evolution of vehicles and how we use them. The introduction is expected to not only simplify transportation but also increase road-and public safety. However, to make the transaction into this next chapter as smooth as possible the EU and its member states will need to make sure that the market is ready for it, this by providing a comprehensive legislation on the next chapter of the vehicle.

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