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THE CHALLENGES THAT AUTONOMOUS VEHICLES POSE TO THE CIVIL LIABILITY OF THE PRODUCER

Master Thesis carried out in the context of the

LL.M. *Law in a European and Global Context*

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I. Acknowledgements

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II. Abstract

In today´s world it is almost impossible to keep abreast of technological and scientific development, the repercussions of which have been felt not only on the global economy but also in our daily lives. Accordingly, since the arrival of one of the most promising scientific advantages of this century - Artificial Intelligence -, several industrial sectors, namely the automobile industry, have been developing to an immeasurable rhythm. In this way, the so-called Autonomous Vehicles will soon be part of our daily lives, thus becoming preeminent for the Law to anticipate issues that may arise in the future, such as the potential civil liability of the producer of Autonomous Vehicles. Hence, this dissertation will address the suitability of the 33-year-old European Directive on producer liability in light of the challenges posed by Autonomous Vehicles. Then, based on a careful and critical analysis, it will point out the necessary changes to be performed within such legal framework.

III. Abbreviations

1. **AI** – Artificial Intelligence
2. **AV** – Autonomous Vehicle
3. **Art**. – Article
4. **CC** – Portuguese Civil Code
5. **DL** – Decree-Law no. 383/89, of 6 November
6. **Directive** – Council Directive 85/374/EEC of 25 July 1985 *on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products*
7. **E.g.** – *Exempli gratia* (for example)
8. **EU** – European Union
9. **I.e.** – That is
10. **N.B**. – *Nota bene* ("please note that")
11. **NHTSA** - National Highway Traffic Safety Administration
12. **US** – United States of America

IV. Introduction

Humanity has always been characterized by its eagerness to progress and by its will to improve its living conditions, allowing for many scientific and technological findings over the years, from gravity to the washing machine.

Accordingly, it could not have been different regarding human mobility: humans went from the first steam-powered automobile developed by *Cugnot*,[1] to the latest Tesla models equipped with autopilot. Hence, one can say that the future is much closer than we could ever have expected since, as the industry has announced, AVs will soon be present in our daily lives,[2] leading to a paradigm shift in human mobility. Thus, and even if these vehicles are still not exactly like the ones we saw in *The Jetsons,*[3] it is imperative to address these changes in human mobility,[4] especially from a legal perspective.[5]

Greeting the latest technological developments in the automobile industry, this dissertation will address the legal regime that established the civil liability of the producer of defective products regarding its suitability towards AVs. To do so, we have decided to frame this topic within the scope of the legal framework of the EU and to use the Portuguese jurisdiction as an example of the transposition of the Council Directive 85/374/EEC of 25 July 1985 *on the approximation of the laws, regulations and administrative provisions of the MSs concerning liability for defective products*.

This choice is justified due to this topic's theoretical and practical relevance, since civil liability is the legal instrument *par excellence* which ensures that victims who suffer damage(s) are duly compensated.

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[1] Encyclopedia Britannica: https://www.britannica.com/biography/nicolas-joseph-cugnot

[2] *Driven to safety, robot cars and the future of liability, timeline to robot cars,* 2017; *The disruption of transportation and the collapse of the internal-combustion vehicles and oil-industries,* 2017

[3] https://en.wikipedia.org/wiki/the_jetsons

[4] Eskandarian, Azim, *Legal issues of driver assistance systems and autonomous driving, handbook of intelligent vehicles,* 2012

[5] *Robolaw: towards a European framework for robotics regulation, 2016*

Despite having entered into forced 33 years ago, this Directive addresses a manifestly essential matter which prompts the question of whether its content is appropriate *in lieu* of the abrupt development caused by the latest technological developments.

Along these lines, we cannot fail to conclude that an analysis of the Directive in light of the challenges posed by AVs is of the utmost importance. Indeed, one must never forget that it is essential to permanently question the existing Law and to adopt an anticipatory attitude towards potential legal issues.

Additionally, this topic becomes preeminent given that it is already being discussed by the Commission, alongside the European Parliament, with the view to find the best policies for the Union. In fact, the latter issued a Resolution,[6] urging for the need to incorporate the latest technological developments, namely AI, in the existing Law. Concurrently, the former draws attention to the importance of considering the existing national legal regimes, and the initiatives carried out by non-European countries in this matter.[7]

Furthermore, we have decided to refer to the Portuguese legal regime since it has been highly praised within the Union, besides presenting general features that end up being identical to other MSs of Roman-Germanic tradition. Also, such a comparison is justified since the Directive establishes that there must be complementarity between its provisions and the corresponding national norms so that traditional means of defense continue to serve the citizen.

Having said this, we will begin by introducing AVs, so that the reader can understand their complexity and corresponding challenges. Then, we will offer an overview on civil liability, as well as an insight on consumer protection. We will proceed to a *proprio sensu* analysis of the Directive and evaluate the challenges that AVs pose to it. We will also point out the regime of civil liability of the producer applied in the US, referring to cases that have dealt with it. Finally, we will advance possible solutions for the identified problems and conclude on the exposed matter.

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[6] *Resolution of 26 February 2017 with recommendations to the Commission on civil laws on robotics,* 2015/2103

[7] E.g. US, China

We hope to contribute to the discussion of this subject, since it is our belief that it is essential to guarantee that scientific and technological progress is accompanied by efficient legal responses. Yet, we realize that the very development of the Law will have to go *hand in hand* with the progress of this technology.

V. Introducing AVs to the Legal Sphere

(i) What is an AV?

Engineering defines AVs as computer-controlled systems that, with little or no human intervention, decide essential aspects of their activity. Likewise, when faced with unpredictable change in their surrounding environments, AVs have the ability of directing their activity through a *quasi-human* process.[8]

When most decision-making depends on the driver and the AV has little or no autonomy, we face a partially AV.[9] If the vehicle can drive itself with no human intervention, being controlled by on-board computers, it is a fully AV. Moreover, partially AVs are equipped with ADAS (*Advanced Driver-Assistance Systems*), which provide for facultative technologies that – once faced with certain scenarios - automatically activate specific mechanisms without human intervention.[10] In case both the driver and the vehicle's automatic system are responsible for the decision-making, the vehicle is semi-autonomous.

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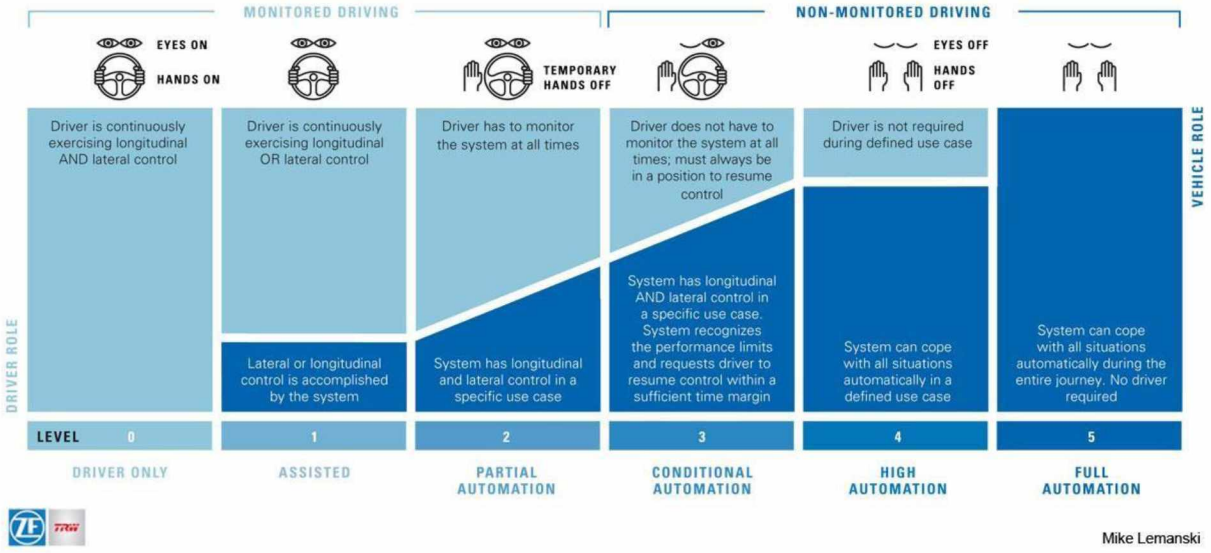
[8] Surden, Harry / Williams, Mary-Anne, *How Self Driving Cars Work,* 2016; Bin Sulaiman, Rejwan, *AI Based Autonomous Car*, 2018;

[9] E.g. self-driving tractors, Tesla's autopilot

[10] E.g. braking systems which autonomously brake when detecting the possibility of collision; automatic parking; adaptive cruise

Having said this, one of the possible classifications given to AVs is pointed out by SAE[11] and foresees 5 levels of automation:[12]



Considering the above, we will refer to fully AVs (Levels 3-5) since these represent the direction in which technology is evolving and, consequently, the one in which Law must focus.

Nevertheless, it is important to note that, at the present time, the UN Vienna Convention on Road Traffic (1968) prohibits the circulation of Level 5' AVs, despite allowing for Level 3-4' AVs. The same happens with the 1958 UNECE Agreement which contains 140 regulations with technical requirements and protocols for the approval of vehicles and corresponding components, namely the UN 79 Regulation, which refers to AVs but prohibits Level 5' AVs.

Accordingly, countries that have ratified these legal instruments (almost all MSs) are at a competitive disadvantage when compared to those not bound by them (e.g. US), even if efforts are being carried out to amend both the Convention and the Regulation.

[11] Automation levels of SAE International, Standard J3016

[12] http://pswordpress-production.s3.amazonaws.com/2016/11/auto_driving_2.jpg

(ii) A little bit of the science behind AVs

AVs understand inanimate objects such as traffic lights, stop signs, and lane marks, as well as moving objects such as automobiles, pedestrians, cyclists, and animals as they navigate complex multi-factorial environments.

To identify their location, nearby objects and trajectories, they rely on technological features and in extremely accurate data. Particularly, they resort to sensors that gather information on the surrounding environment and on the vehicle itself, sending that information to onboard computers. An example of this is the radar.[13]

Sensors are already incorporated in several objects. Thus, what distinguishes AVs is the unique interconnection that exists between these sensors, which, when coupled with the AV' onboard computers, allow for movement without human decision-making.

Moreover, many AVs use pre-built digital maps which include the expected suite of the road's geographic information with extreme precision, providing for images of roads or for detailed street-level 360-degree photographs - like *Google Maps* -, instead of overhead views. Additionally, many of these maps include information which is added to them by human map specialists. Consequently, the pre-loaded information is double-checked, which contributes to better and more accurate driving decisions.

Not to dwell on the exemplification, let us refer to these vehicle's *modus operandi,* which is based on the so-called *coordinating computer systems*, a three-stage process - *sense, plan, act* -, that repeats itself in time, determining the AV' action. Being based in what seems to be the safest, most effective and most lawful alternative, the steering of the vehicle is

[13] Which determines the location of the objects surrounding the vehicle through the emission and reflection of radio waves and observation of the angle, timing and strength of the reflected wave, which allows for the calculation of the location, speed, movement and direction of objects. Other types of sensors used are GPS, video cameras, sonar, inertial navigation systems and lidar

determined through the combination of algorithms, collected data, and processed data. More precisely, the AV:

(a) uses its sensors to detect surrounding information, the vehicle's location,[14] obstacles,[15] and the major driving features that will constrain movement;[16]
(b) transmits and analyses the collected data to the onboard computers, determining a route; and
(c) the on-board computers - considering (a) and (b) -, activate the AV' features (e.g. brakes, steering) allowing it to move to its destination

Nevertheless, this process is not linear since the task of driving is unpredictable and implies a constant adaptation to the surrounding environment, which is in permanent transformation. It would never be possible to perceive driving as an inflexible action, based in pre-defined and rigid computer standards. Accordingly, AVs rely on a technique called *Machine Learning*, that allows for constant innovation and learning abilities in the algorithms used by the vehicle, with the AV being programmed based on good and bad examples of conduct.[17]

Summarizing, fully AVs can make all major driving decisions without human intervention. the driver having a passive role. The AV' multiple and coexisting subsystems,[18] designed for the performance of driving, are capable, once combined, of deciding the vehicle's action through its operative system.[19]

[14] A process called localization, which mostly relies on GPS and lidar technology

[15] Both stationary and moving objects, whose current speed and direction must be determined, as well as their future location

[16] Levinson, Jesse, *Automatic Laser Calibration, Mapping, And Localization for AVs*, 2011

[17] The vehicle has the capacity to improve with experience, learning how to act through a consideration of outcomes in its performance. The more examples it is shown, the more accurate and similar to human decision-making the decision-making of the AV becomes

[18] E.g. the steering, lane positioning, braking and routing systems combined allow for the vehicle to stop when it perceives a red light at the traffic light

[19] Surden, Harry / Williams, Mary-Anne, *How Self Driving Cars Work*, 2016

(iii) The *pros* and *cons* of AVs

When comparing AVs with traditional vehicles, we cannot fail to point out the innumerable benefits of the former, that surpass eventual downsizes. Some of those benefits are:[20]

i) more than 90% of road accidents are caused by human error, usually created by factors such as intoxication, sleepiness or extreme speeding. Since there is no human intervention in the AV' decision making, these vehicles will probably be safer and decrease overall accidents;

ii) passengers can maximize their travel time and perform tasks other than driving, (e.g. reading or working), so long as it is not necessary for someone to drive the car;

iii) AVs have a low environmental impact when compared to traditional vehicles, since an effective combination of the data collected by the AV' sensors with its algorithms allow for speed adjustments and lowers overall consumption;

iv) AVs allow the elderly to move without having to rely on a driver, a *ratio* which can be applied to non-attributable people and to people with disabilities, i.e., to any human being who, *a priori*, is not entitled to a driving license.

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[20] Shubbak, Mahmood, *Self-Driving Cars: Legal, Social, and Ethical Aspects*, 2013; Rossi, F., *AI: Potential Benefits and Ethical Considerations*, Policy Department C: Citizens' Rights and Constitutional Affairs; Tronsor, William J., *The Omnipotent Programmer: An Ethical and Legal analysis of autonomous cars*, Rutgers J. L. & Pub., 2018

The few examples mentioned allow us to understand the extent of the benefits of AVs. Nonetheless, the market strives to perfect AVs' technology to the smallest of millimeters since there are still some issues that stand, thus creating some uncertainty in the market. Some examples are:

i) road accidents can be caused by viruses, glitches, network failures, and programming errors that afflict computer-run devices;

ii) extreme weather conditions or dense urban environments can affect the process of collecting and processing data, making it so difficult that it compromises the AV' action;

iii) the legal questions of,
   (i) creating an imposition on the driver to take control over the AV in certain cases;
   (ii) how often AVs must be inspected; and, of course,
   (iii) the civil liability of the producer of defective AVs

Besides this, AVs pose an issue related to the driver's behavior. Humans have developed an intuition that allow them to effectively move without collision when constrained to certain environments unlike most machines controlled by computers.[21] On the contrary, AVs' behavior may be hard to predict given their nature, which is in constant adaptation to a changing environment in accordance to their algorithms and to the collected and processed' data. Thus, we must not forget that the existing Law assumes that vehicles move based on the predictability of the human behavior, i.e., on a cognitive introspection and projection of movement that do not occur with AVs.

[21] Surden, Harry and Williams, Mary-Anne, *Technological Opacity, Predictability, And Self-Driving Cars*

VI. An overview on civil liability

Let us now begin with the legal analysis of the regime of civil liability, which constitutes the very origin of the liability of the producer for defective products, as we shall see.

Civil liability occurs when one must repair a damage suffered by another, henceforth the Law giving rise to an obligation in which the injured party is liable and the person liable for the damage is the debtor of that same obligation.[22] Accordingly, civil liability has underpinned the idea of patrimonial reparation of private damage because of an infringement of a legal duty which has been established in the interest of the injured party, leading to a compensation. Nevertheless, the nature of the liability in question must be clarified since the regime to be considered and applied can vary.

From a classical perspective, liability was a corollary to the principle that free men should respond for their actions. Essential for its application was the existence of guilt, which could be an intentional fact or simple negligence. However, society evolved, and it was understood that traditional compensation schemes were insufficient in complex situations such as road accidents. Thus, alongside the principle of fault-based liability, the idea of strict liability was born, so that the Law would ensure victim's compensation.

In a highly technological contemporary world, the development of multiple possibilities of human action led to the multiplication of associated risks. As MENEZES CORDEIRO writes, the Law had to accept the idea that, exceptionally, liability should be independent of fault, *maxime,* in the form of risk, so that it guarantees compensation.

[22] Almeida Costa, Mário Júlio, *Direito das Obrigações*, Almedina, 2010; Antunes Varela, João, *Das Obrigações em Geral, I*, Coimbra Editora, 2010; Sinde Monteiro, Jorge, *Rudimentos da Responsabilidade Civil*, Ver. da Fac. de Direito da UP, Coimbra Editora, 2005, Responsabilidade Civil, in RDE, IV, 1; Romano Martinez, Pedro, *Direito das Obrigações*, AADFL, 2011

For guilt-based liability, evidence of an unlawful act is necessary, provided the classic idea that the Law reproves certain conducts. [23] For risk-based liability - an exceptional institute -, liability relies on the creation or control of a source of risks or potential damages, being based on the principle of distributive justice.[24]

Accordingly, civil liability can arise from the non-compliance with contractual, unilateral agreements or legal obligations, but also from a breach of absolute rights, rules designed to protect others' interests, the abuse of the Law or from the practice of lawful acts that cause damage to third parties. Hence, civil liability can be contractual or non-contractual, even if these two types may apply simultaneously.

It is worth mentioning that, *prima facie*, the damage remains with the injured party and compensation can only be demanded from a third party through the verification of certain legal imputation criteria.

In the case of vehicles, the vehicle itself constitutes a risk since its use may cause numerous damages, creating immense opportunities for discussion in the legal field - from liability arising from road accidents to accidents caused by vehicles due to their holders. Consequently, we have decided to confine the scope of this dissertation to the civil liability of the producer of defective AVs, placed in the context of consumer protection as well.

[23] Vaz Serra, Adriano, *Culpa do Devedor ou do Agente*, BMJ, 1957

[24] Additionally, civil liability for licit facts is admitted when a subject intervenes in a situation that, in principle, enjoys absolute protection, but it does so because of a predominant interest. Thus, the subject whose legal sphere is being affected must compensate for such damage(s), because of the principle of commutative justice

VII. An insight on consumer protection

We have been witnessing major changes in the world's economy, leading to "*a change in the thinking, priorities, habits and needs of commercial and consumer agents*".[25] Indeed, many were the turning points that led to the current conceptualization of consumer Law. We moved from feudalism to capitalism between the XVII and XVIII centuries, from the substitution of mercantilism for economic liberalism based on free private enterprises. We began to perceive the concepts of commercial freedom, competition and abstention of the state in commercial relations. Also, the human being, who used to be the main production factor in the economy, became accessory to the machine. Production itself changed and the scientific and technological explosion of the XIX and XX centuries, has revolutionized international markets, leading to globalization.

Notwithstanding, a certain disproportion within this development has occurred. As such, defective products are being launched to the market and causing personal and property damages to consumers because the very technologic and scientific development extrapolates the domain of the human knowledge. Consumers themselves cannot often identify those that are the potential risks arising from the use of a given product precisely because of their complexity and sophistication, which, in turn, demonstrates their vulnerability. It was in this sense that consumer Law arose: to protect the weaker party – the consumer -, and to hold the producer accountable.

Regarding the Union, it was only in 1975 that the Council adopted a "*preliminary EC program for a consumer protection and information policy based on five fundamental rights which it has recognized: the right to protection of health and safety, economic interests, [...] compensation for damage suffered, [...] information and training and [...] representation or to be heard*". The Single Act of 1987 came next, maturing the idea of protection through the internal market' decision-making schemes, and allowing for the adoption of Directives on consumer protection. Accordingly, consumer protection in the form of the producer's civil liability arose,

[25] Coelho, Vera, *Responsabilidade Civil do Produtor*, Revista Eletrónica de Direito, N.º 2 2017

firstly, for the reparation of personal injury and then, progressively extended to material damages.[26]

The Union has, however, sought to prescribe the best policies for the protection of the victims of road traffic accidents. As such, it has established various Directives on motor vehicle traffic, bringing national legislations closer together in the field of compulsory vehicle insurance regulations, and in a broader and more rigorous regime of protection of the victims. Accordingly, Community case-law has been directed towards a greater protection of victims, particularly passengers carried in insured vehicles.[27]

[26] Trigo, Mª da Graça, *Responsabilidade Civil, Temas Especiais*, UCP, 2015

[27] Calvão da Silva, João, *Sumários de Direito Institucional da Banca, Bolsa e Seguros*, Coimbra, 2015/2016

VIII. The civil liability of the producer in the EU

Bearing in mind the abovementioned initiatives, the EU has decided to establish a specific legal instrument on the civil liability of the producer: *Council's Directive 85/374/EEC of 25 July 1985 on the approximation of the Laws, Regulations and Administrative Provisions for the Member States Concerning Liability for Defective Products.*

This Directive has enshrined an innovative principle for consumer law: the principle of the strict liability of the producer. Such novelty was justified, among others, because the modern consumer is not usually in a direct relationship with the producer. Among them intervene large distribution chains,[28] which can never be the justification for placing the consumer in a less favorable position. This is so, especially within the context of the purchase and sale of a defective product.

Therefore, this ensures that the consumer, which acquires a defective product, can act against the producer, so that today's technologies and technicalities do not debilitate the adequate protection of the victim. Thus, the Directive's Preamble refers to economic operators who are not *qua tale* producers.[29] Additionally, the Directive aims to safeguard that MSs policies do not diverge regarding the civil liability of the producer for defective products, so that there is no distortion in competition and the fundamental freedoms of the Union are not impaired.

Having said this, we will proceed to the analysis of the regime established in the Directive, as well as to its comparison - albeit in a very synthetic way –, with its transposition into the Portuguese legal order, [30] and with the Portuguese Civil Code.

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[28] Afonso, Maria / Variz, Manuel, *Da Responsabilidade civil decorrente de produtos defeituosos*, Coimbra Editora, 1991

[29] "*whereas liability without fault on the part of the producer is the sole means of adequately solving the problem, peculiar to our age of increasing technicality, of a fair apportionment of the risks inherent in modern technological production* […]".

[30] DL

Starting forthwith with the combination of Art. 1, 4 and 7 and the Directive's Preamble, we find evidence that a presumption of guilt stems from the Directive's overall spirit. This is so since the producer is obliged to plead with due diligence in his conduct to exempt himself from the obligation to pay compensation when there is a damage caused by a defective product that he has placed on the market. However, and as noted above, this does not prevent MSs from going further, as the Portuguese legislator did by expressly establishing that the producer responds independently of guilt.[31]

- *Producer*

The Directive establishes a very broad concept of producer. This is so since the producer is the only subject to whom liability for the circulation of a defective product causing damages can be directly attributed to. As a result, broadening this concept allowed for an expansion of consumer's protection, facilitating the discovery of the identity of the person who caused the defect within the distribution chain. [32]

Consequently, many are the categories of producer one can find in the Directive. Starting with the notion of real producer. It refers to the subject who manufactures the finished product,[33] i.e., the so-called assembler, the one that is limited to simply gathering or assembling, in a single product, the manufactured component parts, [34] or raw materials without being able to control the product in any way.

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[31] "*the producer is liable, regardless of fault, for damages caused by defects [...]*"

[32] Note that Portugal also opted for a broad notion. *See* Art. 2(1) of the DL

[33] Art. 2 of the directive and Art. 3(1) of the DL

[34] Component parts being those intended for the incorporation and constitution of the final product and not for the immediate and direct use by the consumer, meaning that the categorization as a component part do not depend on the function of the object

Apart from this concept we have the apparent producer.[35] I.e., the one who affixes his name, brand or other distinctive elements in the product, presenting himself as the producer, and misleading the consumer about the origin of the product by giving the appearance of being the real producer. E.g. the wholesaler, the retailer or even the distributor of a big commercial chain.

Nevertheless, the apparent producer can intervene in the development of the product, influencing its production by giving instructions as to its manufacture, design, characteristics, etc. Accordingly, not holding the apparent producer liable would not be reasonable, especially since he can always exempt himself through the indication of the real producer.

In case the injured party identifies both the real and the apparent producer, only the former can be held liable because the correct understanding to adopt is that the apparent producer correctly identifies the real producer when presenting the product to the market. E.g., if a stand that sells vehicles, namely brand *x*, and a vehicle of brand *x* has a defect and causes a damage, the producer to be held liable is not the stand but the brand.

Additionally, we have the presumed producer,[36] which can be both the subject that imports to the Union as well as the supplier of anonymous products.[37] To note, however, that the importer and the supplier are not producers *proprio sensu,* even though they are liable in the same terms as the real and the apparent producers.

There is another nuance worth mentioning, which is the fact that while the importer's liability is original, primary, principal and based on an absolute presumption, the supplier's liability is not. [38] In fact, the supplier can exempt its liability if it identifies the real producer within three months after being notified in writing by the injured party.

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[35] Art. 3(1) of the Directive and Art. 1(2) of the DL

[36] Art. 3(3) of the Directive

[37] I.e., the subject that supplies products that another subject has imported into the Union

[38] Antunes, Engrácia, *Direito dos Contratos Comerciais*, Almedina, 2009

- *Joint liability*

It follows from the combination of Art.1 and 5 that it is possible for more than one person to be jointly and severally liable for the same damage, without prejudice to national rules on the right of redress.[39] This ensures the interests of the injured party since it secures compensation from those who may be held liable.

Additionally, if a person who is held liable is insolvent or unable to fulfill its obligations, its share is proportionally divided among the others.

Joint liability is of the utmost importance pursuant to Art.1 of the Directive because it establishes the protection of the victim regardless of whether there is a contractual relationship with the producer. In other words, there will be no reimbursement from any other person other than the producer, which is of prime importance in road accidents.

This is so since during this type of casualties whoever shares the effective direction and use of the vehicle in its own interest is the one to be held liable. Thus, liability for the damages arising from the risks of the vehicle, include both defects in design and manufacturing.

In Portugal, the rule is the same.[40] Accordingly, Art. 6(2), (3) of the DL states that the judge must consider the circumstances of the concrete case and the risk created by each one of the producers, as well as the seriousness of their contribution to the damage in terms of right to redress. As follows, there is a differentiation of the real contribution of each producer to the defective product in their internal relations.

[39] Art. 3(5) of the Directive

[40] Art. 519 of the CC

- *Product*

Art. 1 of the Directive states that the producer is liable for damages arising from defective products. Complementarily, Art. 2 establishes strict liability as the rule, even if the same is confined to movable goods, except for "*primary agricultural products and game, even though incorporated into another movable or into an immovable*".

The scope of the article relates primarily to products which are movable goods whereas its final part refers to a broader category that includes consumable goods, production goods, industrial goods, or artisanal and artistic goods. Accordingly, one might have doubts to include software in the wording of the article since it is a work of the spirit externalized in a *corpus mechanicum*.

Nevertheless, as Art. 2 covers material supports in which the intellectual work is materialized, the conclusion that software is a product for the purposes of this Directive is evident.

- *Put into circulation*

The moment in which the product is put into circulation is essential for assessing the legitimate expectation of the consumer since the judge cannot restrain himself to the time of the occurrence of the damage or to the moment of the trial. [41] Hence, it is decisive to assess whether the product satisfies the public's legitimate expectations of safety once in circulation, regardless of posterior technological advances. In fact, subsequent developments do not necessarily mean that the product is unsafe when put into circulation. Nevertheless, it must be stated that the producer incurs in post-marketing surveillance duties, which are justified by the so-called development risks.[42]

[41] Art. 6(1), (c) of the Directive

[42] This will be developed further on

- *Defect*

Strict liability of the producer does not rely on its deficient conduct, but rather on the defect of the product placed in circulation.[43] Therefore, Art. 6 provides a vague notion of defect, to be concretized by the judge.

Besides the suitability of the product to achieve a certain purpose, the judge may consider factors such as the safety of the product. In this event, safety is determined based upon the level of security with which the public can legitimately count, considering not only the product's intended use but also any alternative uses.[44] To make this assessment, the judge must attend to several factors and can be aided by experts.[45] Such factors are the product's entire marketing and corresponding processes, publicity campaigns and promotion, as well as the existence or not of information, warnings or instructions. Accordingly, if there is an information defect, the case acquires other dimensions as the public expects both the external security of the product (i.e., the appearance of safety provided) as well as its internal security (i.e. the degree of safety that the product has) to be assured.[46] The judge must also consider the product´s reasonable use, which implicitly pressures the producer to anticipate any eventual product misuses, thus fulfilling general safety obligations.

Notwithstanding, it is important to clarify that there is no formal categorization of defect as the legislator did not want to determine producer's liability based on the type of defect. Nevertheless, there are some types that have been identified by the doctrine due to its frequency. Those are:[47] (i) defects of conception, when a product was defective in its conception and idealization (e.g. design or lack of observance of the state of science and technique), (ii) manufacturing defects, that occur when the product was not, in principle,

[43] Art. 1 and 6 of the Directive

[44] I.e., not base in the subjective expectations of the victim

[45] Art. 6 of the Directive

[46] The consumer counts with true, clear and complete information on the product which, *a priori*, he believes not to be defective

[47] All these categories to be further developed

defective but became unfit because of the manufacturing process, (iii) defects in information, when the product is not defective in itself but turns out to be dangerous because the producer fails to advise the consumer on the product's proper use/certain characteristics (e.g. the toxicity), and (iv) development defects, when the product is unlawfully unsafe due to risks or defects that were not known when it was launched considering the state of scientific and technological development at that time.

- *Damage*

Regarding the damage *per se*, the Directive determines that the producer must reimburse in full personal injuries which have affected the physical, psychological or moral integrity of the injured party. This includes property and non-property damages. However, as far as material damage is concerned, such compensation cannot be sought in full since damage that occur in the defective product is not subject to reimbursement. Furthermore, the goods on which compensation is payable must have been used or consumed by the injured party.

Accordingly, reimbursement faces certain limitations. Firstly, damages occurring in the defective product are not reimbursable, which is highly contested insofar as the consumer will probably want to seek such damages to be repaired. Secondly, it leads to a duplication of actions[48] in courts, contrary to the principle of procedural economy, placing an additional burden on the injured party. Lastly, and because of the second limitation, that same party will have to incur in additional costs and face legal uncertainty due to the possibility of having different legal decisions.

[48] One issued under the general scheme and intended to address the damages caused to the defective product and to the products which were not intended for private use, and another one issued underthe Directive

- *Causal link between the defect and the damage*

The Directive does not specifically regulate this matter. As such, Portugal opted for the adoption of the theory of adequate causality.

The causal link is a constituent element of the civil liability of the producer,[49] which justifies that not all damages caused by defective products lead to producer's liability.

Additionally, and observing the classic rule of *onus probandi*, the burden of proof is incumbent to the injured party based on a judgement of adequate causality, considering which, the latter must prove the existence of a damage in accordance with the general legal rules[50]. I.e., it is only necessary to prove a certain degree of probability.[51]

- *Burden of proof*

Art. 4 establishes the principle over which the burden of proof is incumbent upon the injured party.[52] Similarly, in Portugal, Art. 342 of the CC and Art. 2 of the DL (at the European level) establish this *ratio*. Ergo, the injured party must (i) bring an action against the producer for the damage caused by the defective product, (ii) prove the damage, (iii) prove the defect, (iv) prove the causal link between them, and, lastly, (v) identify the producer.

[49] Art. 1 of the Directive

[50] E.g. Art. 342 of the CC

[51] E.g. Art. 563 of the CC - "*the obligation to compensate exists only in respect of damages which the injured party would probably not have suffered if it was not for the injury*".

[52] "*the injured person shall be required to prove the damage, the defect and the causal relationship between defect and damage.*"

Full proof of the defect and the causal link are generally difficult to achieve, not rarely constituting a *diabolica probatio*. E.g. the product igniting or exploding, being destroyed, illustrate the impossible task of proving the preexistent defect.

Some authors,[53] with whom we agree, defend the position that a proof of first appearance is enough. Indeed, in situations where the car ignites or explodes, full proof of the defect of the product is only viable by sophisticated means that are not available to ordinary victims. Furthermore, Portuguese jurisprudence subscribes this understanding.

- *Exemptions*

As mentioned in the Directive's Preamble, "*a fair apportionment of risk between the injured person and the producer implies that the producer should be able to free himself from liability if he furnishes proof as to the existence of certain exonerating circumstances [...]*". This means that the Directive's strict liability is far from being absolute. In fact, in addition to the six causes of exemption highlighted in Art. 7, the Directive requires that the injured party proves the (i) defect, (ii) damage and (iii) causal relationship between them. Thus, the obligation that lies upon the producer to repair the damage can be extinguished in more scenarios than it would be desirable.

This legislative option was justified on the basis that establishing certain causes of exemption allows for a fairer relationship between the producer and the consumer. In other words, exemptions conceive a more equitable division of the risks of the product between the parties involved. However, such argument has been questioned, from the outset, by some authors such as VERA COELHO.

This is so since it is well known that the producer and the consumer are at opposite poles of the commercial relationship, being the consumer the weaker party of such relationship.

[53] Calvão da Silva, João, *Responsabilidade Civil do Produtor*, Almedina, Coimbra, 1990

Additionally, the consumer already carries out a very demanding burden of proof. On the contrary, the producer benefits from the sale of a product which can be imperfect when placed in the market and can always rely on civil liability insurance policies to cover these risks, reflecting the insurance costs in the final price of the product.

Hence, some state that this fair distribution of risks to be merely illusory. We partially agree since we believe that the extent of these risk's allocation must be weighted and its incrementation due to AVs autonomy must be considered, as we will see below.

Moving on to the abovementioned exemptions, we start with the case in which it was not the producer who put the product into circulation.[54] We refer, as the Portuguese case-law points out, to the cases in which the product was placed on the market by a third party (in default of the producer), through theft, embezzlement or any other unlawful manner. Thus, the duty of due diligence that is usually placed upon the producer must be placed on the subject that should have foreseen the damages to be caused by the defective product, when deliberately launching the product into the market.

The second exemption refers to the probable absence of the defect when the product was put into circulation.[55]

Worthy to note is that the Directive's initial version explicitly addressed the producer's liability for development risks as opposed to the final text of the Directive. The latter, which is a compromise solution, establishes that the producer is exempted when the product has an inherent risk of development. Considering this, it is crucial to understand how the defect could have been knowable at the time the product was put into circulation.

In this context, it is important to distinguish between defects of information and development defects.[56]

[54] Art. 7(a) of the Directive

[55] Art. 7(b) of the Directive

[56] Art. 7(e) of the Directive

As for defects of information, one must question whether they were attributable to the producer. Art. 7(b) proses a distribution of the burden of proof that favors the injured party, since it is only necessary to prove the existence of the alleged defect at the embryo stage of the moment the product was put into circulation.

Development risks are an extremely important cause of exemption since once verified they lead to the non-application of the strict liability regime entrenched in the Directive.

Some authors,[57] question whether this type of risks is still within the context of strict liability, insofar as the lack of science serves as the basis for setting producer liability. Some believe that this exemption alters the regime into subjective since the producer who did not apprehended certain relevant knowledge at the moment the product is put into circulation is exempt. Thus, negligence is not considered.

Conversely, CALVÃO DA SILVA believes that this legal regime foresees strict liability, even if such liability must be understood as limited and not as amounting to a business risk.[58]

On the other hand, GRAÇA TRIGO considers that the existence of an "*increased margin of responsibility*" is closer to strict liability irrespective of not covering all business risks, precisely because of the exclusion of the risk of science and technology' evolution. We agree with this opinion since development risks are not merely business risks. There are, of course, risks inherent to the way the product is manufactured or risks that derive from other productive resources, such as raw materials. It is also true that in these cases the producer will be held liable for defects, resulting in damages to consumers. As such, the producer will only be exempted from liability if he can prove that the ideal producer would not be able to master

[57] Menezes Cordeiro, António, Tratado de Direito Civil, VIII – Direito das Obrigações: Gestão de negócios, Enriquecimento sem causa, Responsabilidade civil, Almedina, Coimbra, 2014

[58] Calvão da Silva, João, Responsabilidade Civil do Produtor in Revista Portuguesa de Direito do Consumo, n. º1, jan. 1995

the defect in question, and that there is an expectation that he would have been aware of the defect in question.[59]

Regarding development risks, CALVÃO DA SILVA, who has also dwelt on this problem, has declared that what is relevant is to determine the state of art and science rather than to access the nature of the liability.

One must determine both the moment in which the product was put into circulation, and the criterion of determination to be used by the judge *per se* – e.g. the type and nature of the product, its relationship with the defect, the time that elapsed between the product entered into circulation and the damage, among others.

We agree with this position for three reasons. Firstly, since considering a different moment than the one in which the product is put into circulation would be accepting the retroactive application of the measure of liability in question at a later stage, which is unreasonable. Secondly, a consideration of the state of art and science on such a moment implies the very analysis of the figure of the *bonus pater familias* applied to the producer. Indeed, (i) it implies the observation of what would be an ideal producer, and (ii) that we are not on the realm of subjective impossibility of the knowledge of the defect at the moment of launching the product into the market. Lastly, the American experience has demonstrated that there would be a disincentive to the very development of science and technology if this exception was not consecrated and interpreted in these terms, which is an argument that must be considered.

Turning to the exemption of Art. 7(c), it refers to the production outside the scope of the professional activity and without an economic objective. Under this exemption, the producer shall not be liable if there is a cumulative demonstration that: (i) the product was not manufactured for marketing or economic purposes and (ii) the product was not produced or distributed within the framework of the producer's professional activity. Accordingly, the

[59] Conde Rodrigues, José Manuel, *A responsabilidade civil do produtor face a terceiros*, AAFDL, Lisboa, 1990

existence or inexistence of an onerous – or non-onerous but with indirect objective purposes - distribution must be assessed. In other words, the purpose of production must be determined in a subjective way. Moreover, the producer must prove that the production or distribution was not carried out within his professional activity but rather his private sphere. Nevertheless, this implies meticulous proof, always depending on the specific details of the case.

The producer may also be exempt by complying with all mandatory regulations issued by public authorities.[60] This implies, not only the conformity of the product with those regulations, but also the proof that the defect was caused by the lack of compliance with such regulations. However, this exemption is only applicable to cases where the restrictive nature of the mandatory regulation does not allow for freedom of the producer. However, this is not very common as most mandatory regulations are based on minimum safety and quality requirements, allowing for a substantial degree of variation during production.

As for the cause of the exemption established in Art. 7(f) of the Directive, it is said that the producer is not liable when the defect of the product is attributable to the design's instructions that the manufacturer provided. Accordingly, we refer to the previously mentioned design defects.

As for the present matter, the defect is attributable to the design of the product or to the instructions related to its design. Thus, it is sufficient for the producer to allege and prove that the component part was not defective and, instead, that offered the expected safety in the commercial traffic in case the defect is attributable to the design of the product. Other alternative would be to prove that the defect was caused by instructions provided by the final producer in case the defect is attributable to the instructions related to its design.

Therefore, the producer (who, in this case, will be the producer of a component part) will only be jointly and severally liable with the final producer, provided he cannot exempt himself from liability in light of development defects.

[60] Art. 7(d) of the Directive

Additionally, we find it relevant to mention Art. 7(1) of the DL, which resembles both Art. 8(2) and the Directive's Preamble. [61] We refer to the contribution of the injured party to the damage, which assumes great importance in certain jurisdictions, such as Portugal. In fact, the Portuguese general rule is that there is no competition between guilt and risk in road accidents. This legislative option can be perfectly justified since users must be careful while using products, not jeopardizing their health and then incurring in *venire contra factum proprium* as they attempt to hold the producer liable. Additionally, if the product was defective and the victim, or someone for whom the victim was responsible, contributed to the damage, the liability of the producer may be reduced or excluded. In that case, the judge will evaluate the seriousness of the victim's contribution to the damage and the existence, or not, of guilt.[62]

Another aspect which acquires special relevance is the so-called risk of assumption. It occurs when the victim knows the risk of using the product, assumes it voluntarily, and demonstrates it somehow in a conscious and visible manner.

This is an aspect of the regime of civil liability that we believe to be linked with the "terms and conditions" accepted by users of AVs before purchasing these items. To a certain extent, these terms bind the consumers and make them assume the risk of using AVs, therefore exempting the producer of the AV in certain cases. For instance, when there is a road accident caused by the AV changing its route, and such change could have been prevented if the driver had assumed the direction of the vehicle by driving it manually, the producer would be exempted.

Turning to cases which involve a third party – i.e., someone who is not the victim nor the producer -,[63] Art. 8(1) states that the negligence of third parties is not a cause of reduction or exclusion. Consequently, there is no joint liability of the producer and the third party. Considering this general rule of civil liability, we believe that the AVs do not require further adjustments, since they do not pose exceptional contours to it.

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[61] "*whereas, however, the contributory negligence of the injured person may be taken into account to reduce or disallow such liability* […]"

[62] N.B. that in cases of mere negligence or venial fault, the court may grant the total amount of compensation

[63] Such as a pedestrian run over by a car because of a defect in the vehicle's braking system

Lastly, we must not forget to mention the well-known cases of *force majeure,* even if they have not been yet pointed out as an exemption of producer's liability. These cases consist of the occurrence of an event that is unpredictable, irresistible, inevitable and external.

Even if *force majeure* is not specifically addressed in the Directive as being an exemption, it can be found both in its preparatory works and in its overall spirit. As a result, *force majeure* is an exemption justified by the fact that the victim's concurrent guilt leads to the reduction or exclusion of the producer's liability.

IX. The challenges that AVs pose to the civil liability of the producer in the European Union

(i) A closer, yet loose, look at the American perspective on the civil liability of the producer of AVs

Even though the focus of this dissertation is to assess the suitability of the Directive in relation to the challenges posed by AVs, we believe that it would not make sense to disregard the US approach to the civil liability of the producer of defective AVs. This is so because of the undeniable investment that this country is making towards the development of this technology, thus having a huge weight in the legislative decisions that will be taken regarding AVs. Additionally, many have been the efforts carried out by the NHTSA so that the development of the Law accompanies the development of AVs. As such, NHTSA understands that States must not allow the public use of AVs if there is not enough legislation.[64] In fact, despite some American States having already introduced legislation concerning the use of AVs, there is still no uniform regime regarding the civil liability system to be applied in different States in a situation of a defective AV.[65]

Nevertheless, it is possible to resort to the traditional mechanisms of civil liability to hold a producer liable for a defective AV. Also, consumers can sue manufacturers for manufacturing defects, design defects, and failures to warn,[66] which, *mutatis mutandis,* is a similar regime to the one established in the Directive, as we will briefly see. Although there is a particularity concerning design defects, the regimes are alike. In more detail, design defects are evaluated through two main tests: one that considers consumer expectations and other based on a risk-utility analysis.[67]

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[64] "*self-driving vehicle technology is not yet at the stage of sophistication or demonstrated safety capability that it should be authorized for use by members of the public for general driving purposes*"

[65] Cheh, Mary, *D.C.'s Driverless-Car Bill Is a Measure the Auto Industry Can Support*, Wash. Post, 2012; Ernst, Kurt, *California Senator Proposes Rules for Self-Driving Cars*, Bus. Insider, 2012

[66] *Watson v. Ford Motor Co.*

[67] Owen, David, *Design Defects*, Mo. L. Rev., 2008

The consumer expectation test is based on The Restatement (Second) of Torts. It defines the defect design as an unreasonable danger that goes beyond what would be expected for the consumer. Accordingly, it does not appear that the special complexity of the AV will necessarily change the perception of reasonableness for the consumer. As such, it would only be reasonably expected for the consumer to adapt that same expectation. There is a similarity to the European system as the consumer's subjective expectations are not considered.

However, most courts criticize the use of this test because they prefer to rely on the Risk-Utility Test, based on the Restatement (Third) which states that *"[a] product is defective in design if the safety benefits from altering the design as proposed by the plaintiff would have exceeded the costs of such an alteration*".[68] Hence, it is for the injured party to prove the existence of a reasonable alternative design that would have prevented the accident, which can be extremely costly for AVs and even require the need to request expert advice. Thus, we believe that this proof equates to the Directive's *diabolica probatio*.

As for the manufacturing defects, and as shown in the *Hall v. Chrysler Corp.*, it is necessary for the consumer to prove that, regardless of whether there was negligence at the time of production, the product was not in compliance with its specifications. The *onus probandi* proposed in this scenario is much less demanding than the one imposed in the European system.

Thus, there is a counterbalance with what was said above regarding design defects, even if in the US there is a major concerning manufacturing defects of AVs since courts believe nothing tangible is manufactured. Consequently, courts cease to apply the manufacturing defect doctrine to software. We agree with JEFFREY GURNEY,[69] that "*will be tricky for a plaintiff [...] if the defect is really a software error (algorithm)*", despite his later findings, through the

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[68] Owen, David, *Toward a Proper Test for Design Defectiveness: "Micro-Balancing" Costs and Benefits*, Tex L. Rev. 1997

[69] Gurney, Jeffrey, *Sue My Car Not Me: Products Liability and Accidents Involving AVs*

malfunction doctrine, that the plaintiff can prove the algorithm's defect with circumstantial evidence.[70]

On failure to warn, the American doctrine differs in almost nothing from the European one,[71] which is why we will defer from making any further consideration. There is, however, a major problem to report in the American system: expert testimony. This is so since, in any cases involving AVs liability the consumer will need - due to the complexity of the object-, expert testimony. Such testimony is of extreme importance in order to explain product safety and the very accident to the court and to the jury. As a result, most of the cases will be extremely costly, which may explain the fact why there is yet no case filed in the US in this context. *Let's see:*

Taking California as our first example, between late 2014 and mid-April 2017, thirty accidents involving AVs were reported but only two of those were caused by the AV.[72]

In 2017, in San Francisco,[73] a GM' AV collided with a motorcyclist, because of a switch lane. The victim decided not to file a product liability claim but instead sought damages based on negligence. It was thus determined that it was the AV that altered its route and crashed into the motorcyclist, which was preparing to pass the AV. At last, the parties at stake settled in less than six months after the suit was filed.

In November 2017 there was a case involving Google's first self-driving shuttle bus.[74] According to witness statements, a truck backed into the bus since the truck in front of the bus,

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[70] Restatement (Third) of Torts: Prods. Liab. § 3 cmt.; *Stackiewicz v. Nissan Motor Corp.*

[71] E.g. *Pavlides v. Galveston Yacht Basin*

[72] Graf, Rachel, *GM Hit with First-Known Suit Over Self-Driving Car* Crash, *Law 360*, 2018

[73] Vogt, RJ, *GM Settles First-Known Suit Over Self-Driving Car Crash*, *Law 360*,2018

[74] Gibbs, Sammuel, *Self-Driving bus involved in crash less than two hours after Las Vegas launch*, *The Guardian*, 2017

started to reverse its route, leading the bus to stop forward movement to avoid rear-ending the truck. In this case there were no injuries, but it was concluded that the AV may have contributed to the accident. The justification provided was that if, instead of the AV' operating system, there was a human driving the bus, such human driver would have backed up further or honked to alert the truck driver. Still, it was determined that the culprit was the driver and no lawsuit was filed.

As for cases where there were fatal accidents, they do not provide us with any sort of guidance on issues of fault since none of them lead to precedential litigation.

In May 2016 a Tesla AV, operating in autopilot mode, hit a truck crossing a highway in Florida because one of the AV' cameras did not detect the truck. That led to the death of the Tesla's driver even if the experts concluded that there was no defect in the AV. Nonetheless, the NHTSA emphasized that "*the driver was [still] responsible for maintaining [the] ultimate control of the vehicle*",[75] and failed to do so, precluding the possibility for civil litigation.

More recently, in 2018, another accident involving an Uber operating a Volvo XC90 in autopilot mode, occurred in Arizona.[76] In this case, there was no human driver inside the vehicle when the latter hit an individual who was trying to cross the street with a bicycle by hand, leading to his death. The case was settled between the parties. The Insurance Institute for Highway Safety later reported that the collision was due to Uber having disabled the Volvo's collision-avoidance technology.

In March 2018, a Tesla Model X in autopilot mode hit a broken safety barrier of a highway, leading to the death of its driver. Tesla began by stating that the accident was caused by the driver, who had no hands on the steering wheel, even after several alerts were emitted. Yet, and more recently, Tesla affirmed that "*autopilot does not prevent all accidents [...] but makes them much less likely to occur*". As a consequence of the accident, the driver's relatives

[75] Nhtsa, *Special Crash Investigations: on-site automated driver assistance system crash investigation of the 2015 Tesla Model S 70d*, 2018

[76] Kiley, David, *first death of a pedestrian struck by an AV may set tone for lawyers and liability*, *Forbes*, 2018

decided to file a wrongful death lawsuit against Tesla, which may include "*product liability, defective product design, failure to warn, breach of warranty, intentional and negligent misrepresentation, and false advertising*". Accordingly, this will probably be the first case that will serve as precedent for assessing the civil liability of the producer of AVs in the US.[77]

We can therefore conclude that, although pioneering the development of AVs' technology, and even having a similar civil liability system to the Directive, the US is not very useful example in the context of this dissertation. The reason behind it is the lack of case law addressing AVs. Nonetheless, this does not imply that this country will not have a great weight in the decisions taken about this matter in the future.

[77] Reimer, Lauren Additional family members of woman killed by self-driving Uber have hired a lawyer, azfamily.com, 2018

(ii) The European perspective in AI

Our final conclusions on the Directive consider some documents presented by the European Institutions: *The Commission Staff Working Document on the Liability for emerging digital technologies,*[78] *the Commission' Press Release on the approach that the Union must adopt to boost investment and set ethical guidelines to AI of 25 April 2018,*[79] *and the Communication from the Commission to the EP, the European Council, the Council (and others) on AI for Europe.*[80]

These documents have one feature in common. They state that AI is already part of our daily lives and that its differentiating characteristics, [81] allow us to live more comfortably and to solve problems without even realizing it.[82] Thus, AI create products and services that generate "*new systems and complex environments that significantly improve our daily life"* and open the door to investment.

The EU draws attention to the importance of establishing legal mechanisms that encourage innovation and research, but also to the necessary of changing consumers' ideals regarding "*these new products and services [which] are not inherently less [safe] than traditional products [...] already placed on the market".*

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[78] COM (2018) 237 Final, Commission Staff Working Document: Liability for Emerging Digital Technologies

(AI for Europe)

[79] European Commission – Press Release - AI: Commission Outlines a European Approach to boost investment and set ethical guidelines (Brussels, 25 April 2018)

[80] Brussels, 25.4.2018 COM (2018) 237 Final

[81] Marked by an "*Interdependence Between the Different Components and Layers",* revealed through a differentiation between the (i) tangible parts/devices, actors and hardware, (ii) different software components and applications, (iii) data itself, (iv) so-called "data services" (e.g. data processing), and (v) connectivity features

[82] "*AI is helping us to solve some of the world's biggest challenges: from treating chronic diseases or reducing fatality rates in traffic accidents to fighting climate change or anticipating cybersecurity threats*"

Thus, these documents focus on the importance of establishing appropriate, clear and effective legal regimes so that consumers do not link AI related products and services with greater risks of use.

Corroborating this *ratio*, the Commission states that there must be a three-pronged approach to AI, which increases public and private investment, prepares for socio-economic changes, and ensures an appropriate ethical and legal framework. It aims to adapt industrial capacity and AI uptake in the economy, to modernize educational systems,[83] and to ensure that there is an anticipatory approach to AI. E.g. *"[...] workers whose jobs are changing or may disappear due to automation must have every opportunity to acquire the skills and knowledge they need, to master new technology [...]."*

Accordingly, the Commission has launched a working group - GEAR 2030 – aimed at addressing the above-mentioned prongs and whose members are the automobile industry, consumer representatives, trade unions, environmental protection and road safety, as well as the following MS (represented by ministers of economy, industry or transport): Germany, France, UK, Italy, Poland, Republic Czech Republic, Romania, Spain, Slovakia, Belgium, the Netherlands and Sweden.

Ensuring that the legal system remains appropriate is a crucial target for the Union. In the Commission's own words "*includes forthcoming guidance on existing product liability rules, a detailed analysis of emerging challenges, and cooperation with stakeholders, through a European AI Alliance, for the development of AI ethics guidelines"*. Accordingly, guidance on the interpretation of the Product Liability Directive, which is being analyzed in this dissertation, will be released by mid-2019.

[83] "[…] *against the background of an ageing society, AI can provide new solutions to support more people to participate and remain in the labor market, including persons with disabilities. new jobs and tasks will emerge as a result of AI, some of which are difficult, or even impossible to predict. other jobs and tasks will be replaced. while the exact quantification of AI's impact on jobs is difficult to determine at this stage, the need for action is clear.* […]"

(iii) How can the European legal regime adapt to such challenges?

Considering that the adequacy of such an important legal instrument is an immensely demanding theoretical exercise, it becomes even harder when performed in light of the challenges posed by AVs. Hence, we have decided to look at the Directive in its generality and raise those that seem to be the most preeminent issues which link AVs with the civil liability of the producer establish thereunder. *Let us see*:

- *Is civil liability adequate?*

The first question that deserves our consideration is whether the civil liability regime, more precisely that of strict liability, can deal with situations in which there is a damage caused by a defective AV. The answer that we consider to be the most appropriate is affirmative, even if imposing strict liability on the producer appears to be too demanding, specially knowing that autonomy is an elementary characteristic of AVs.

Nevertheless, imposing a regime other than strict liability could prevent the victim from being compensated and, under no circumstance, can the injured party be placed in a less favorable position. Thus, it is always preferable to opt for a superprotective regime than going for a regime that does not guarantee the compensation of the victim that has suffered a damage. Additionally, opting for a regime such as strict liability favors the very market of AVs since it increases consumer's confidence that, in case there is a damage, such damage will be duly compensated.

On top of this, there is a presumption of liability upon the producer. That presumption can, however, be rebutted and the producer exempted, which means that, once again, the right balance prompts to the protection of the weakest party of the relationship, i.e. the consumer.

It is our understanding that it is crucial to adopt a preventive perspective in the matter of AVs, avoiding the possibility of having to resort to the producers' civil liability mechanisms to compensate a victim whose damage was caused by a defective AV. Hence, we understand that it is very important to impose the creation of agreements to be signed at the time of the

purchase of the AVs, which must include a series of duties of conduct for both the producer and the consumer, such as:

a) the duty of the consumer to:
   i) assume the direction of the vehicle when it manifestly changes its expected route;
   ii) carry out periodic inspections (to be defined in complementary Law), which should be more demanding than those existing for traditional vehicles and occur more frequently;
   iii) carry out software updates with the AV producer or with a third party accredited by the AV producer;

b) the duty of the producer to seek, for a certain period of time after the purchase of the vehicle (a period to be defined by Law), to discover changes in the state of science and technology that may be relevant and which may lead to defects in the AV (which is justified by the fact that this product is extremely susceptible to technological and scientific advancements and due to the fact that the consumer spends a large sum of money purchasing it)

Establishing such a legal instrument explicitly connects both the buyer and the seller to duties that extrapolate the *traditio* of the AV and the payment of the respective price (as traditional duties of the contract in question), which are essential to the civil liability of the producer of AVs.

Only in this way it will be acceptable to apply the Directive with the same terms for the generality of products since AVs are a product endowed with such unique characteristics that they demand complementary legislation meeting its *ad hoc* peculiarities.

An example of such complementary legislation would be a legal instrument in which the execution of the agreement abovementioned would be predicted thus, constituting a legal obligation that would act alongside the civil liability of the producer.

Nevertheless, many other issues related to the civil liability of the producer could and should be addressed in this complementary legislation, such as the need for periodic inspections by specialized technicians designated by the producer or performed by the producer himself.

This periodic inspections would ensure the suitability of the AV and the non-attributability of any defects to the producer when they have been introduced in the AV *a posteriori* by a person different from the producer. However, we believe that this matter already extrapolates the main theme of this dissertation, which leads us to briefly conclude that in cases where a third party intervenes, we must apply the terms of the Directive that refer to competition of a third party for the defect. As a conclusion, the third party must be held liable in part or in full for the damage caused, according to its contribution for the defect, that is to be assessed by the judge.

- *After all, is it a Product or a Service?*

Backing off a little, the European Commission has wondered whether, as regards to the notion of product, it is relevant to consider if the software is embedded or not in the product, since that fact may have consequences on the existence of a product or a service.

As we know, AVs are compounded by hardware, software and on-board computers, which prompts the question of whether software must be considered. We believe that dissecting these three elements removes a fundamental feature from the AV: its intrinsic autonomy. In fact, an AV is characterized by the interconnection and unique intersections existing between its three components.

Thus, if we decide not to consider software, leading to the non-categorization of AVs as products, we would not even be facing an AV, but rather a vehicle with more technology than a traditional one, which merely accelerates and locks. In this way, we put aside the Commission's question and consider, *a priori*, AVs as products.

Additionally, and within the context of this dissertation, we refer to damages caused by defective AVs, used by their owner or by an authorized subject. I.e., we refer to AVs as them being products and not as if they were used as services (e.g. Uber).

This being so, we believe AVs are products.

- *Does the concept of Producer fit the reality of AVs? And how should we differentiate Producers according to their contribution to the defect?*

The broad concept of producer provided for in the Directive includes several sub-concepts, as above mentioned. This enlarges the possibility to compensate victims who suffer damages caused by a defective product and, consequently, by a defective AV.

Nevertheless, we must ask ourselves if this broad concept makes sense within the reality of AVs. In fact, AVs are autonomous due to their very complexity, i.e., to the interconnection of software, hardware and onboard computers. Such interconnection usually arises from several component parts and raw materials, produced by different subjects and incorporated into a final product by another one. Thus, frequently there is a real producer, an apparent producer and even a presumed producer. Or several of each category.

This means that, if we only held liable a certain subject because of the production of a specific component part that caused the defect that lead to the damage, we are not considering the AV *per se* but rather one and only one of its component parts. In addition, it is up to the final producer, the one who incorporates the software, hardware and onboard computers, creating the AV, to check for any defects that may lead to damages.

It seems to us that this matter is directly related to the need to hold liable, *a priori*, all producers who, in some way, were involved in the AV' production chain, especially insofar as they can be exempt from this liability later. Hence, what must follow this approach is a very

demanding assessment, to be carried out by the judge aided by experts, to determine the contribution of each producer to the defect.

Accordingly, there is a differentiation of the real contribution of each producer to the defect of the product and an affair apportionment of the compensation to be paid by each of them, which ensures, the victim's compensation and fairness between the producers. Having said this, we believe that Art. 1 and 5 of the Directive – which address joint liability -, properly ensure this view and can be applicable to AVs without further changes.

Going further we can even say that the Directive makes more sense when applied to AVs since interconnecting these concepts and legal mechanisms is the only possible way to ensure that there is justice in the application of the Law to the concrete case of AVs. As such, all the relevant subjects who intervened in the production chain and contributed to the production of the defective AV will respond accordingly.

Notwithstanding, we call the reader's attention to what we mentioned above regarding the need of establishing an agreement between the consumer and the producer. We refer to the producer that sells the product, who can be the apparent producer (e.g. a stand). This being so, we understand that this internal distribution of liability plays a crucial role since, if only one of the subjects which has intervened in the chain of production and distribution is held liable there will be no justice in the concrete case. For instance, if the stand is the one to hold liable but the defect is due to the producer of component part *y*, it makes no sense that there is no repartition of the contribution of each producer in the payment of the compensation at stake.

- *The producer, the defect [...] do they all interconnect?*

When evaluating the very defect and allocating liability, it is our opinion that the judge must be aided by experts, due to the complexity of the matters at stake. Hence, it must pay special attention to the existence or not of information and warnings or instructions on the use of the AV.

The purchase of these vehicles is usually accompanied with documents that inform its user of the need to be aware of malfunctions, to proceed with updates to the systems, to not incur in misuse of the AV, among others, thus safeguarding the producer (and that should be considered in the agreement between the producer and the consumer that we have been mentioning) also should be considered.

Nevertheless, if there is an information defect, the case gains other contours as the public expects that the external security of the product does not fail, as well as its internal security. We are talking about products which, in addition to having a high economic value, also have a high technological complexity which, in most cases – and even if we are facing an extremely well-informed consumer -, is beyond the perception of the average user.

The producer should make a collection, as exhaustive as possible, and anticipate, as much as possible, those that will be the uses to give to the AV and the damages that may arise from that same use. In this way, its liability will be, to a certain extent, limited, and if such warnings (better said, duty of information) are complemented through the agreement that we have been referring to, and which we believe to be essential to sign when purchasing the AV, there can be a simultaneous imposition of certain legal duties on the consumer itself. E.g. surveillance duties on the AV when it has an abnormal operation based on the information provided by the producer.

Besides the duty of information, the producer must incur in the duty to inform the consumer, within a certain period, of additional information on the use of the AV. This is so since we believe that AVs are so volatile to the development of science and technology that changes may occur in short periods of time. Thus, it is important to safeguard that the user is provided with all the necessary information – which must be much more than the one provided for traditional vehicles - so that the producer is not liable for any "posterior" information defects.

Once again, this can be connected to the agreement mentioned above, which, again proves to be essential to prevent the need to resort to the extraordinary means of civil liability in case there is a defective AV.

- *Development defects and the very risk of AVs*

In addition to defects in information, it seems to us that development defects are a crucial aspect to be discussed within the scope of AVs, since we are referring to defects that were not known when the product was put into circulation considering the state of scientific and technological development at that time.

In the case of AVs, we are talking about a product endowed with such complexity and autonomy that we believe not to be possible to predict all possible misuses, all abnormal occurrences that may occur within its use, all cautions that its users must adopt, all updates that must be made to it, among others.

Development defects are some sort of intrinsic issue - risk -, that AVs necessarily imply, thus being extremely possible that they have defects when being put into circulation in the market.

In this sense, should we keep considering development risks as an exemption to the producer's civil liability when in fact they are intrinsic to the AV itself, not constituting the exception but, rather, the rule?

This is undoubtedly a matter which makes us rethink, once again, the proper distribution of risk between the consumer and the producer. However, and having already concluded this question with the proposition that it is justified to maintain the civil liability of the producer based on risk, we must rather rethink the extent to which this exemption can still be applied.

Besides, in addition to their intrinsic autonomy, AVs can "gain" even more autonomy throughout their useful life. This is so due to self-learning. Thus, we may question the extent to which the performance of an AV, when causing damages, can be expected given the foreseeable behavior of a human driver and AV' algorithms. Hence, if the autonomy of the AV is such that its decision-making extrapolates what would be a minimally expected from the AV' algorithms, thus causing damages that would never be caused in light of such expected conducts, the exemption at stake should be maintained.

We assume that, given the autonomy and the self-learning mechanisms of the AV, there is a certain degree of probability that the AV has an unexpected behavior that might cause damages for which the producer cannot be held liable for.

In such a case, it is up for the consumer to assume the risk of the product. Even provided he might not understand in full, he will always know that has an unknown potential level of autonomy. And we understand this to be so because we are of the perspective that also the consumer must accept the risks of the "dangerous" products that he decides to introduce in its daily life. Furthermore, the information duties imposed on the producer, as well as the agreement referred to above, are means that sufficiently alert the consumer to the *ad hoc* nature of the AVs.

- *Damage and force majeure*

The concept of damage raises some concerns to the Commission since some stakeholders believe that it is not necessary to distinguish between physical and material damages, but to consider infringements to privacy and cybersecurity. Hence, we agree that it is necessary to ponder special cases, such as the ones in which, using an AV, someone infringes the vehicle's owner privacy or security. This is so since we are addressing a product that is sensitive to threats that other products would never perceive as possible.

There must be a more specialized legal regime, encompassing these special cases, even if we do not believe that there is an incompatibility between these considerations and the fact that there still can be a differentiation between material and physical damages. In fact, we agree that, generally, the existence or not of any of these situations must be autonomously analyzed, generating a greater liability for the producer or not.

We understand that there is a worth noting interconnected issue. In fact, it is our understating that infringements to privacy and cybersecurity can be considered cases of *force majeure* since they are completely unpredictable, irresistible, inevitable and external events which affect the AV' operability and may cause serious damages to its operability. Thus, they constitute an inherent risk of these technologies, but they are not controllable by the consumer or by the producer, likewise a storm cannot be stopped. Therefore, such an event cannot be attributable to the producer unless there is proof that such infringement was due to a reasonably avoidable defect in the AV, such as a failure in the safety system of the AV that was due to a design error or to a defect in a component part of the vehicle.

Nevertheless, *force majeure* merely derives from the overall spirit of the Directive since it was never formally consecrated in its wording. Hence, we understand that, once again due to the peculiarities of the AVs, which are subject to unique external threats to which the other products of the global market are not exposed, the exemption of *force majeure* must be expressly foreseen in the Directive. [84]

[84] N.B. that we have disregarded a detailed approach on the causes of exemption of the producer civil liability because (i) when presenting the Directive to the reader we have already raised our preeminent concerns, (ii) we believe that *mutatis mutandis*, they apply to AVs and (iii) they are mentioned in this section when appropriate (e.g. development risks, *force majeure* and information defects)

- *What a burden [...]*

The burden of proof generates some *food for thought* in the scenario of AVs. Bearing in mind the abovementioned, we believe that the burden should continue to belong to the injured party since strict liability is established on the producer and there must be some sort of balance between the parties of any legal relationship.

Nevertheless, we do acknowledge that it may be too costly or difficult – a true *diabolica probatio* - to require from the victim that brings an action against the producer for the damage caused by the defective product to prove the damage, the defect and the causal link between them.

The only aspect mentioned in the burden of proof that we believe to be "not so hard" to identify is the subject of the producer since the Directive establishes a broad concept of producer. As such, the consumer will always know, at least, who corresponds to the figure of the apparent producer (i.e. the one who sold him the AV).

As for the proof of the damage, it seems to us that it is reasonable to require the injured party to prove it, since such subject will be the one who is in the best position to carry such task. However, it may be justified that in some cases the value of damages would be appraised by experts.

Proof of defect can be quite difficult. It is reasonable to require it to be carried out by experts in all cases, such experts being designated by the Court. Hence, a greater accuracy in the determination of the defect would be guaranteed, thus facilitating the decision and analysis to be carried out by the judge as well as reducing the burden of proof imposed on the injured party.

Moreover, proving the casual link between the damage and the defect seems to be a logical and reasonably attributable step to the consumer, bearing in mind the explanation provided and the considerations that we believe the Directive must incorporate so that it extends to the AVs.

Lastly, we believe that it makes no sense that the Directive continues to prevent the reimbursement of the damages caused in the defective product. We are of the opinion that the consumer must be compensated for the damages caused in the defective AV as well. Especially provided its high economic value.

- *Again: let's prevent!*

Even if this falls outside the scope of the Directive, we find it necessary to state that it is our understanding that requiring insurance to cover all producers of the value chain is essential. Provided that at the same extent as it happens today with traditional vehicles, AVs' insurances will be designed according to their special features and increased risks, they will be essential to promote the market and to protect the producer from strict liability which, in our view, should not cease to apply.

Additionally, the mechanism of insurance is crucial in the process of ensuring compensation to the victim of a damage caused by a defective product, Since the victim might seek payment directly from the insurance's provider or from the insurer of the would-be defendant,[85] and the case ends up in litigation, it is possible that the insurer may have to support some, or even all, of the costs incurred, considering that it is also possible that the insurers rely on risk-spreading mechanisms (e.g. reinsurance) that can assure recovery.

[85] Walker Smith, Bryant, Automated Driving and Product Liability, 2017

This question gains preeminent importance because it is possible that, in the near future, AVs will be able to operate without licensed drivers (e.g. blind or elderly people).[86] Thus, a problem arises when insurance companies will have to determine whether the human being that was inside the AV could have prevented a certain accident.

Not going any further in the development of this topic - which is worthy of another dissertation - our conclusion is that, along with an agreement in which the legal duties to be imposed on both the consumer and the producer are established, as well as this (modified) regime of strict liability of the producer, there should be adapted mechanisms of insurance to be applied to the AVs. This is due to the greater complexity of this product as well as its increased risks of use.

- *What about road traffic Laws*?

In addition to the abovementioned, we believe that it would make sense to propose an uniformization to the MSs' road traffic laws, to be implemented through Community legislative instruments.

Based on the innovative steps put forward by Germany in its proposal for an amendment of its road traffic law, some of the noteworthy points are:

- AVs must:
  (1) be able to be deactivated by the driver at any time;
  (2) recognize the necessity of the driver to take control;
  (3) signal to the driver to take control (e.g. by means of optical or acoustic warning);
  (4) incorporate black boxes that continuously record information on the vehicle; and

[86] https://Perma.Cc/T6w6-Mcfd

(5) comply with international rules (e.g. those briefly mentioned in section V-(i));

- drivers must always be ready to resume control of the AV, i.e. that they must be diligent (e.g., they can read or write but not sleep);

In this way the Union would ensure both the mitigation of eventual issues of civil liability as well as the uniformity of the circulation of AVs within the its territory. These two aspects prove to be beneficial and complementary to our other proposals, and do not constitute an intrusive measure to the MSs' fundamental policies.

X. Conclusion

Thus far, we feel bound to affirm that analyzing a legal instrument of such magnificence, either by its substance or by its context, was an extremely challenging task. This Directive has more than 33 years of existence, was enacted within the European Union and deals with an essential matter to the Law, which is the civil liability of the producer. In this way, to proceed with such an analysis, which pertains to identify and solve the challenges that the emerging reality of AVs pose to the civil liability of the producer, was both very complex and engaging.

Our analysis leads us to the conclusion that the Directive properly answers to almost all the challenges posed by AVs to the civil liability of the producer. Notwithstanding, there are issues worthy of greater detail or that should even be regulated autonomously. There is a legal vacuum which is justified by the very nature of AV since, as the name implies, they are auto-sufficient, and prone to the acquisition of more autonomy due to its ability of self-learning.

We believe it is not necessary to create a specific legal instrument - e.g. another Directive -, concerning solely AVs. We consider this to be the case since the Directive properly addresses the civil liability of the producer for defective products. Therefore, it would only be pertinent to amend it considering certain modifications imposed by the "*products of the future*". We cannot forget that the progress of technology and science is unstoppable and that products will increasingly be endowed with added autonomy and unique characteristics due to AI. Thus, the "*products of the future*" are not the same as those foreseen by the Directive, and the latter must adapt to it.

Bearing in mind the abovementioned, as well as what was duly explained throughout this dissertation, we propose an amendment to the Directive which must (i) address the exemption that consecrates development risks, determining, with the greatest degree of precision possible, where the risk is to be borne by the consumer; (ii) include *force majeure* as an exemption to the producer's liability; (iii) establish that the damages occurring on the defective product are to be compensated; (iv) ensure that injured parties are assisted by experts

appointed by the Court as a means to induce greater accuracy in the determination of the defect (v) ensure that the burden of proof imposed on the injured party is not a *diabolica probatio*; and (vi) impose that the judge is aided by experts when assessing the case, namely when determining the contribution of each producer to the defect.

Taking into account the specificities of AVs, and in order to complement the Directive, we believe that complementary legislative instruments should be emanated with a view to impose (i) insurance designed around the unique characteristics and increased risks of AVs, so that the market is promoted and the producer has guarantees in view of the strict liability regime established in the Directive; (ii) an agreement between the producer and the consumer, at the time the AV is purchased, expressly determining the duties to which such subjects are obliged to (e.g. post-sale duty of presenting additional information on the use of the AV); (iii) periodic and specific inspections to be carried out in the AV; and (iv) uniform road traffic laws within the Union's MSs.

Note that, as previously highlighted, the technology of AVs is immensely complex and interconnects many areas of science and technology (e.g. engineering and computing). Thus, we understand that it is mandatory to carry out technical studies before amending the Directive and designing such complementary legal instruments.

Regarding the role of the US, it is necessary to keep the rationale that, even if, no practical solutions have yet been pointed out, this country will have an immense impact on the development of the Law related to AVs. This is so since it is a pioneer in the development of AI, and therefore of AVs. Thus, it is important to be aware of how the corresponding Law will be addressed in the near future since the best systems of Law are built based on a close look at the neighboring experience.

As we finish this dissertation, we would like to emphasize that an anticipatory perspective is always the best policy. Only in this way can we ensure that the Law is always ready to give effective responses to the questions submitted to it, and that in no case there will be injustice by virtue of its application. Additionally, under no circumstances the safety of

victims and their right to compensation may be called into question. Nevertheless, the context in which we move is very volatile, reason why the Law will have to go hand in hand with the development of science and technology so as not to become obsolete very rapidly.

We hope to have contributed to the analysis of one of the most preeminent issues that new technologies pose to the Law, which besides bringing together various areas, allow for a constant evolution in the everyday life of the human being. Having been extremely challenging and gratifying to carry out this dissertation, the greatest conclusion to withdraw is that thinking about the future is thinking about the present. In fact, one must never forget that "*the future is now*".[87]

[87] Nam June Paik

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