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Considerations regarding Artificial Intelligence and Civil Liability: the case of autonomous vehicles

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Keywords: Autonomous vehicles; Artificial Intelligence; Civil liability.

Abstract: The current paper intends to discuss the possibilities and the legal grounds of civil liability for damages caused by autonomous vehicles, meaning vehicles that operate without human intervention, under Portuguese Law. Artificial Intelligence [AI] has been evolving in such a way that allows us to assume that is rapidly approaching the time when machines like automobiles will be able to operate in a completely autonomous way, without human intervention. The automobile industry has been implementing navigation systems progressively more independent and some are already testing vehicles without driver. But who will be held liable if these vehicles cause damages to persons or goods? Who will be held liable if a mortal accident or car collision occurs? The automobile's owner, the person who is being transported, the manufacturer of the vehicle or the programmer that created the algorithms in which the vehicle based its conduct? And on which legal grounds?

On the other hand, there are several other issues that can arise regarding this matter: can we call "conduct" to the action of a driverless automobile? Will we reach a point in which the AI evolves until it is able to learn by itself and decides to cause damages? How can an autonomous agent be held liable if it doesn't have legal personality?

1. Introduction

The idea that one day machines may rise up against man and cause him harm is not new. Science fiction has always been very prodigal in creating scenarios, more or less apocalyptic, in which machines, developing a certain degree of autonomy and self-learning ability, evolve to the point of going against their creator, taking advantage of their autonomy to decide, by themselves, to cause him damage¹.

However, reality is starting to approach fiction. Today, various autonomous agents, with a greater or lesser degree of autonomy, already coexist with us. There are already computer programmes that create music without human intervention; drones programmed to learn to fly by themselves (through trial and error and using multiple sensors that allow them to avoid collisions with other objects); algorithms that collect data and make decisions (such as giving orders to buy and sell shares or other securities); cars with cruise control (which keeps the vehicle moving at a certain speed), or fitted with lane centring (which returns the vehicle to the centre of the road), assisting human

¹ Consider works such as "I, Robot" by the writer and biochemist Isaac Asimov, the inventor of the laws of robotics, which has already been adapted to cinema, or films like "Terminator" or "Matrix".

driving; mobile phone assistants such as Siri or OK Google, etc. And if we wanted to go even further, we could even discuss whether we are close to find in an entity, such as the robot Sofia, human-like learning and understanding capabilities, including truly autonomous decision-making capacity, to the point where we could rightfully speak of Artificial Intelligence (AI). The next step, naturally, if the answer comes to be positive, will be to decide to recognise them or to give them legal personality².

However, we cannot go that far - the ethical issues raised here are already extremely difficult -, although this issue eventually intersects with the purpose that made us work on this topic and that is to think who is liable and on what legal ground for damages caused by driverless cars. The fact that these autonomous vehicles [AV] are very close to being commercialized makes it urgent to discuss who will be liable for the damages they may cause when they enter circulation.

2. Autonomy and Heteronomy: the concept of autonomous vehicle

A VA is a vehicle that operates without human intervention. To do so, the vehicle needs mechanisms that enable it to gather information about its environment, analyse it and react appropriately: sensors, GPS, cameras, computer vision, navigation systems, etc.³. However, there are various degrees of autonomy to be considered. On the scale developed by the SAE - Society of Automotive Engineers - adopted by the US Highway Traffic Safety Authority, six levels of autonomy are listed: in level 0, there is no automation and the driver performs all tasks; in level 1, the vehicle is equipped with assisted driving mechanisms (such as cruise control or lane centring, although these do not operate at the same time), but it is the driver who drives the vehicle assisted by these mechanisms; in Level 2, the driving aids are more advanced, already operating in an integrated way, allowing the vehicle to control not only the acceleration/braking function but also the direction at the same time, but they only operate in certain circumstances and the driver is always required to control the driving conditions and can take control of the vehicle at any time; in level 3 the vehicle monitors the road and the environmental conditions so that the driver effectively, although sitting behind the wheel, no longer drives unless requested to do so by the vehicle; in level 4, the vehicle can operate completely autonomously, therefore the driver becomes a passenger and no longer needs to pay attention to driving and the vehicle may not even have pedals or steering wheel (however, at this level, AV can only operate in limited areas, where, for example, GPS works properly); in level 5, this limitation will no longer exist, since the AV will have mechanisms to overcome any vicissitudes it faces autonomously⁴. As you can easily see, there is already automation of driving from level 3, but the biggest problems will arise from level 4⁵, when human intervention is completely removed.

There are authors, however, who consider that the autonomy of mechanisms endowed with AI is never similar to that of human beings, since it is a “technological autonomy, founded on the potential of the algorithmic combination that is provided to the software” and that “artificial intelligence [is] based (...) on the accumulation of knowledge, being incapable of creative interpretations or judgements about what is right or wrong (...), [being] always conditioned by the programmer’s inputs”⁶. In other words, even if the AV can move by itself, without intervention from the occupants of the vehicle, the “decisions” it makes regarding the way it drives are always in some

² Another fiction film that is quite enlightening in this regard is “The Bicentennial Man”, adapted from Isaac Asimov’s work of the same name.

³ NOVAIS, PAULO/ FREITAS, PEDRO MIGUEL, «Inteligência Artificial e Regulação de Algoritmos», *Diálogos, União Europeia-Brasil*, maio, 2018, pp. 22-23 (available at http://www.sectordialogues.org/documentos/noticias/adjuntos/ef9c1b_Intelig%C3%A2ncia%20Artificial%20e%20Regula%C3%A7%C3%A3o%20de%20Algoritmos.pdf, consulted at 14/9/2020).

⁴ SOCIETY OF AUTOMOTIVE ENGINEERS, *SAE International Releases Updated Visual Chart for Its “Levels of Driving Automation” Standard for Self-Driving Vehicles*, december, 2018 (available at <https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles>, consulted at 14/9/2020).

⁵ Future autonomous taxis will be equipped with this level of autonomy. *Vide* NOVAIS, PAULO/ FREITAS, PEDRO MIGUEL, *op. cit.*, p. 24.

⁶ BARBOSA, MAFALDA MIRANDA, «O futuro da responsabilidade civil desafiada pela inteligência artificial: as dificuldades dos modelos tradicionais e caminhos de solução», *Revista de Direito Civil*, Ano V, n.º 2, 2020, p. 291.

way pre-determined by the directives given by the programmers. Hence “algorithmic autonomy cannot be confused with human autonomy”^{7/8}.

It is, however, possible that autonomous agents learn for themselves - we speak of realities such as machine learning or even deep learning, in which autonomous agents, by themselves, search for information, for example from the net or their environment - and make decisions for which they have not been programmed. This self-learning allows an autonomous agent to go beyond its programming. Although it is not yet possible to speak of self-determination or free will of autonomous agents, self-learning makes it more difficult to impute the damages caused by an AV to its programmer or producer until the legislator creates a legal regime determining the duties of one and the other in the scope of their activity⁹.

3. Damages without human intervention: who is liable?

Maybe in the future cars will be equipped with an AI¹⁰ that will allow us to consider the possibility of recognizing them as having legal personality (or something similar) and, consequently, criminal capacity. The imputability of a person depends, under Portuguese law, on that person having the capacity to understand and will the harmful act in the scope of extra-contractual civil liability, in the terms of article 488.º, n.º 1, CC (the Portuguese Civil Code; see also no. 2, which presumes that minors under seven years old do not have this capacity). Even if AI were to be recognised in the future as having this capacity of analysis and understanding, as well as the capacity of will, it would be necessary for these vehicles (like any robot) to have assets, which would be allocated to the payment of these compensations. This would imply, as we said, that they would possess something similar to legal personality and legal capacity, although limited, for example, to the functions assigned to them¹¹.

In any case, in the light of current technological development, this possibility does not yet exist¹², so the liability for damages caused by these vehicles will necessarily have to fall on other entities. In view of the lack of special legislation on this type of damage, it will be necessary to try to find, within the current legal framework, alternatives that may apply to them, while our legislator does not move forward in creating its own body of rules. In this respect, the European Commission is concerned about the possibility that each Member State could create its own legislation, jeopardising the necessary homogeneity of the European body of law and the stability of the Internal Market. In the White Paper on Artificial Intelligence, the European Commission explains the importance of moving towards the creation of unitary legislation, applicable in all Member States, in order to guarantee the confidence of economic

⁷ *Idem*, p. 282. Equally in the sense of understanding that “at the stage we are at now, (...) [there is still] a lack of generic autonomy of robots (...). The robot is still a product of human creation and manipulation (...)”, further stating that “[t]he concept of responsibility constitutes an expression of the self-determination of the human being”, ANTUNES, HENRIQUE SOUSA, «Inteligência artificial e responsabilidade civil», in: *Inteligência Artificial e Direito* (MANUEL LOPES ROCHA/ RUI SOARES PEREIRA, with the collaboration of ANA COIMBRA TRIGO), Coimbra, Almedina, 2020, p. 25.

⁸ However, scientists are already predicting that somewhere between 2030 and 2045 a state of development will be reached that will make it possible to create a computing system that is intellectually equivalent to a human being. APDSI (ASSOCIAÇÃO PARA A PROMOÇÃO E DESENVOLVIMENTO DA SOCIEDADE DA INFORMAÇÃO/GRUPO FUTUROS), *No Limiar na Autodeterminação da Inteligência Artificial?*, Printiglovers, s.d., p. 24. Despite these predictions, there are also authors who consider that the so-called HLAI - Human Level Artificial Intelligence: machine able to think and act like a human with average intelligence of university level, possessing, even so, competences in the socio-cultural emotional domains (namely, creativity and thinking “out of the box”) - will only be possible “when based on intelligent Human-Machine interfaces”, in the figure of the cyborg, something that is defended by the Transhumanism movement. *Idem*, pp. 32-35.

⁹ Considering that in the cases of deep learning, where the self-learning is done without any human control, it is “impossible to connect a possible damage that may occur to a negligent conduct of the human being” because, even if we resort to the presumptions of guilt of article 493, these may be rebutted, BARBOSA, MAFALDA MIRANDA, *op. cit.*, p. 265.

¹⁰ Something similar to KITT, from Nightrider, a US TV series, in which the protagonist’s car interacted with its driver as if it were itself an entity endowed with human-like understanding and even feelings.

¹¹ Believing that “[t]he analogy between the supposed personality of electronic persons and legal persons fails”, BARBOSA, MAFALDA MIRANDA, *op. cit.*, pp. 294-295. The author, among other arguments, explains that legal personality was given to legal persons so that certain collective or common human interests could be pursued (or could be pursued more efficiently), which would not be the case here; she adds that, even if one were to consider that the human interest at stake in this case would be the non-liability of the owner of the robot, as the robot has no assets, it would always have to be the natural person behind it who would have to bear the compensation due for damage the robot caused”.

¹² Whereas, therefore, that “[i]n an early stage of development of artificial intelligence, robots lack imputability (...) [since] the reactions that condition their behaviour are programmed, lacking (...) their own understanding and a will to act”, ANTUNES, HENRIQUE SOUSA, *op. cit.*, p. 26.

agents and an identical level of security for all European citizens. Besides considering that it is urgent to define the bases and ethical principles that should govern AI, it is also common ground that the operation of AI should always be subject, in any Member State, to respect for the fundamental rights of citizens, namely respect for human dignity and protection of privacy¹³.

Let us now explore the Portuguese legislation and consider some of the existing possibilities.

3.1. Portuguese law potentially applicable

a) Strict liability of the owner/user

A first hypothesis to consider would be the application of strict liability of the car owner. The fundamental principle here would be *ubi commodum, ibi incommodum*¹⁴: if the owner of a VA has the advantages of using it (the fact that he can travel without having to drive, being able to, for example, sleep, telephone or work in his vehicle; the fact that he is not dependent on others if he suffers from a physical handicap that prevents him from driving, or the fact that he does not know how to drive or does not have a driving licence, etc.), he should also have to bear the disadvantages. In other words, he should be liable for any damage his vehicle might cause (irrespective of whether he can subsequently transfer it to an insurance company; indeed, motor insurance will be indispensable here, and should, as is already the case with traditional cars, be compulsory). We therefore advocate the application of a risk-based liability¹⁵: using a VA will be a dangerous activity, potentially causing damages. The advantages that this activity may bring to individuals and society itself justify that it is lawful, admitted by law (even because it is estimated that the number of accidents will decrease substantially, since human error and risky behaviours adopted by many drivers are eliminated, such as driving under the influence of alcohol or speeding, since the AV is programmed to respect speed limits and other traffic rules¹⁶), but those who make use of it will have to answer for the risks inherent to its use.

This general principle seems right and reasonable to us, both legally and ethically. It is right that it should be so. However, although this solution seems to us the most appropriate, one might think that it is not supported by the letter of the law. Subjective liability is the rule in our legal system, and the principle *ubi commodum, ibi incommodum* can only be applied to cases especially foreseen in the law (cf. Article 483, n.º 2, CC). There is no general rule that determines that whoever undertakes a dangerous (but lawful) activity is liable for the damage caused in this respect¹⁷. It is therefore necessary to find a specific rule providing for strict liability in this area¹⁸.

Article 503.º CC, which is the basic rule of strict civil liability for accidents caused by vehicles, establishes that the person liable for damage arising from the risks inherent in a vehicle (even if it is not in circulation) is the person who has *effective driving* of it and uses it in his or her own interest, even if through the intermediary of a commissioner. However, by definition a AV is one that circulates on its own, without human intervention, so it could be thought that a literal interpretation of this rule would not allow its application to these cases¹⁹. However, and although the leg-

¹³ EUROPEAN COMMISSION, *White Paper on Artificial Intelligence – A European approach to excellence and trust*, p. 2 (available at https://ec.europa.eu/info/publications/white-paper-artificial-intelligence-european-approach-excellence-and-trust_en, consulted at 1/10/2020).

¹⁴ “If (...) someone, by creating for himself a possibility of profit, creates for others added risks, it is fair to make him responsible for compensating the damage caused by his profitable activities (...): *«ubi commodum, ibi incommodum»*”, PINTO, CARLOS MOTA, *Teoria Geral do Direito Civil*, 4.ª ed. actualized by ANTÓNIO PINTO MONTEIRO/PAULO MOTA PINTO, Coimbra, Coimbra Editora, 2005, p. 134.

¹⁵ As defined by COSTA, MÁRIO JÚLIO DE ALMEIDA, *Direito das Obrigações*, 12.ª ed., Coimbra, Almedina, 2009 (7.ª reimpr. 2019), p. 613.

¹⁶ “Specifically, a significant reduction in road accidents and related costs is desired, leading to lower costs associated with insurance. Autonomous vehicles are expected to increase traffic flow, provide a greater possibility of mobility for children, elderly people, people with disabilities, as travellers are relieved from driving and navigation tasks. With this type of (autonomous) driving is also expected to have a direct impact on decreasing fuel consumption, reducing parking space needs, increasing new business models for transport as a service, especially through the sharing economy”. NOVAIS, PAULO / FREITAS, PEDRO MIGUEL, *op. cit.*, p. 23.

¹⁷ In a former edition (COSTA, MÁRIO JÚLIO DE ALMEIDA, *Direito das Obrigações*, 7.ª ed., Coimbra, Almedina, 1998, p. 533), the author explained that “[r]easons of legal certainty and security prompted the legislator to specify which hazardous activities were the source of liability”. A general clause would encounter many difficulties in delimiting them (cf. paragraph 3).

¹⁸ Whereas Article 483.º, n.º 2, does not admit the analogous application of the rules relating to strict liability, LEITÃO, LUÍS MANUEL TELES DE MENEZES, *Direito das Obrigações*, 15.ª ed., Coimbra, Almedina, 2018 (reimpr. 2020), p. 374.

¹⁹ Stating that “it is debatable whether one can speak of effective driving [of the vehicle] in cases of full automation”, BARBOSA, MAFALDA MIRANDA, *op. cit.*, p. 267.

islator obviously did not consider these cases at the time the law was created, the truth is that the concept of “effective driving” cannot be interpreted as “having one’s hands on the wheel”²⁰. Portuguese authors have always considered it meant having *de facto* power over the vehicle, implying a duty to look after its good condition and functioning²¹. This means that, most of the time, it is the owner who has the effective driving, but nothing prevents that, in other cases, it can be another person, such as the usufructuary, the lessee or the borrower (at least, for a long period of time) or even someone who has stolen or robbed the vehicle²². Moreover, as the rule itself explicitly states, if the vehicle is driven by a commission agent employed by the owner, the owner is objectively liable for the vehicle’s own risks, even if he does not have his “hands on the wheel”.

This criterion allows the application of this rule to be waived in cases where someone uses a vehicle in his interest, but does not have the effective driving of it: such as the passenger, hirer or lessee of short (or very short) duration²³, etc. For example, in the future it is not unreasonable to imagine platforms such as Uber creating fleets of AVs and no longer hiring drivers. Passengers, who use the vehicle in their own interest (they are being transported), obviously will not have any power over the vehicle, nor will they be the ones obliged to ensure that it is safe to use: Uber - which, moreover, will use it to earn income from it - will have its effective driving, and will therefore be objectively liable for any damage the vehicle may cause²⁴.

As we can see, there is no need for great interpretative gymnastics to defend the application of this rule so as to make the owner of the vehicle - who has the benefit of using it (or lending it, or hiring it and deriving economic benefit from it) and the responsibility of ensuring that it operates properly - liable for the risks inherent in it. The letter of the rule perfectly accommodates this broad meaning, allowing AV to be included in its scope. Even if it is not exactly a literal interpretation, this result is certainly achieved through an extensive interpretation, since the spirit of the rule perfectly covers these cases. The question remains as to what is included in the concept of “risks specific to the vehicle”. In the case of vehicles currently on the road, for which the rule of Article 503 was created, this concept includes mechanical, electronic, or other breakdowns that may cause damage even when the vehicle is parked (such as those resulting from the explosion of the petrol tank, etc.). Damages such as those caused to persons hit by the car, collision with other vehicles or property, etc. are also compensable²⁵. Naturally, if the driver’s fault is proven (for example, for driving too fast), the regime of subjective responsibility provided in article 483.º will apply, and the limits

²⁰ “Effective driving of the vehicle is the *actual (de facto) power over the vehicle*, but it does not equate to the crude idea of having the steering wheel in your hands at the time the accident occurs”. VARELA, JOÃO DE MATOS ANTUNES, *Das Obrigações em geral*, Vol. I, 10.ª ed., Coimbra, Almedina, 2000 (16.ª reimpr. 2020), pp. 657-658.

²¹ Thus considering that “[t]he concept of effective driving could be adapted to the phenomenon of automated driving, always, however, with due caution”, FELÍCIO, MANUEL, «Responsabilidade civil extracontratual por acidente de viação causado por veículo automatizado», *Revista de Direito da Responsabilidade*, 1, 2019, p. 516.

²² Vide VARELA, JOÃO DE MATOS ANTUNES, *op. cit.*, pp. 658 and ff; COSTA, MÁRIO JÚLIO DE ALMEIDA, (2009), *cit.*, pp. 630-631; LEITÃO, LUÍS MANUEL TELES DE MENEZES, *op. cit.*, p. 374.

²³ PIRES DE LIMA/ANTUNES VARELA, *Código Civil Anotado*, Vol. I, 4.ª ed., Coimbra, Coimbra Editora, 1987, p. 514. Noting that much of the case law considers that “in the case of rental, when the vehicle is driven by the lessee, or on his orders, the vehicle is used both in the interest of the lessee and the lessor, and either of them can be said to be effectively driving the vehicle, and it should therefore be accepted that both are jointly liable for the damage”, although it disagrees with this legal interpretation, understanding that “the effective driving is in the lessee’s or lessee’s own interest”, GONZÁLEZ, JOSÉ ALBERTO, *Responsabilidade Civil*, 3.ª ed., Lisboa, Quid Juris, 2013, p. 210 (In *Idem*, *Direito da Responsabilidade Civil*, Lisboa, Quid Juris, 2017, p. 434, the author continues that “we do not see how, for example, both the lessor and the lessee should generally have an interest of their own in the use of the rented or comodated vehicle”, since “it is, instead, in the main or exclusive interest of the lessee or the comodatário”). We disagree. We believe that the two criteria should not be confused: the effective driving is one thing and the use in one’s own interest is another. The lessor has an interest (economic) in the rental; the lessee uses the vehicle he has rented in his own interest (i.e., both can fulfil the criterion of use in their own interest), but, in principle, only one of them will have the effective driving, i.e., the burden of ensuring the good condition of the vehicle. In general, this burden will belong to the lessor (owner), but may have been transferred to the lessee, by virtue of the lease being for a sufficiently long period to justify the latter carrying out the appropriate inspections and revisions of the vehicle.

²⁴ On the other hand, the criterion of “use in one’s own interest” also determines the exclusion of liability of those who use the vehicle on behalf of others, such as the commissioner, the law having made it clear that, in these cases, it is the commission principal who is liable for the risk: LEITÃO, LUÍS MANUEL TELES DE MENEZES, *op. cit.*, p. 374. The only difference is if the commissioner uses the vehicle outside the exercise of his functions as commissioner, as he is using the vehicle in his own interest, in which case he is also liable for the risk (cf. Article 503.º, n.º 3). Cf. COSTA, MÁRIO JÚLIO DE ALMEIDA, (2009), *cit.*, pp. 632-634.

²⁵ Also covered are “damages arising from the risks to which the driver is subject: sudden illness (...)”. PIRES DE LIMA/ANTUNES VARELA, *op. cit.*, pp. 514-515.

of compensation provided in article 508.º for strict liability will not²⁶. However, the situations that are of interest to us are those that are not caused by human conduct, such as loss of brakes, broken steering, or other failures in the operation of the vehicle. Although the driver may not be at fault (because he scrupulously fulfilled his duties, namely by carrying out the appropriate inspections and revisions), he will be liable under strict liability. As it is a very onerous liability, the legislator has established the aforementioned limits to compensation provided for in Article 508, that is, the injured party is only liable up to the maximum limit of the minimum capital of the compulsory motor vehicle liability insurance. It makes sense to apply this reasoning to the case of AV²⁷. If an AV runs over a person because it did not identify them as crossing the road at the zebra crossing, due to a failure of a sensor (mechanical or electronic breakdown), the damage caused to that person must be compensated under this rule. Even if the owner of the vehicle was not at fault, he should be liable, because he is the one who draws the benefits of owning and enjoying a vehicle that may suffer from this type of malfunction. Therefore, he must assume the risk that these breakdowns may cause damage, just as he would be liable in the case of a mechanical breakdown in a traditional car²⁸.

b) Strict liability of the producer

However, it may happen that the damage caused by the vehicle falls outside the normal life risk of the owner or holder of a AV²⁹. This would be the case, for example, if the accident in which the vehicle was involved was caused by a design/construction defect of the vehicle or its programming. These defects should be attributed to the manufacturer/producer (or possibly the programmer, as we shall discuss below). We therefore believe that in these cases, DL n.º 383/89, of 6th November³⁰, which establishes the legal regime of objective responsibility of the producer, should apply³¹.

It is the producer who has the (economic) advantage of placing the products he produces on the market, and he must therefore ensure that they are in good conditions, that they function properly and guarantee that they will not cause damage; otherwise he will be liable for them. It is an objective responsibility, which is justified by the fact that automated production is socially and economically useful, but carries risks, and it is often impossible to determine personal fault for the defects of the products produced in this way. Therefore, the damage must be attributed to those who have the advantages of using these means of production³².

Under the terms of Article 1 of this law, “[the] producer is liable, regardless of fault, for damage caused by defects in the products he puts into circulation”. On the other hand, the concept of producer in this legal regime is

²⁶ Also in this sense, LEITÃO, LUÍS MANUEL TELES DE MENEZES, *op. cit.*, p. 379.

²⁷ Considering that the system of strict liability of the vehicle keeper combined with the system of strict liability of the producer appears to guarantee effective protection for victims, ANTUNES, HENRIQUE SOUSA, *op. cit.*, p. 23. The author also considers that the legal regime of responsibility for traffic accidents (articles 503.º to 508.º) is much more appropriate to make the holder/user of robots liable for damages that these may cause than the subjective responsibility provided for in article 493.º, n.º 1 of the CC (duty of surveillance over thing or animal) or even the objective responsibility provided for in article 502.º of the CC (strict liability for damages caused by animals). *Idem*, pp. 28-29.

²⁸ Therefore we disagree with Manuel Felício, who considers that all damages caused by AV are part of the vehicle’s own risks (*vide* FELÍCIO, MANUEL, *op. cit.*, pp. 517-518).

²⁹ On the balance between the use of the regime of strict liability of the car owner and the use of the regime of strict liability of the producer, see the considerations of the EXPERT GROUP ON LIABILITY AND NEW TECHNOLOGIES, *Liability for Artificial Intelligence and other emerging digital technologies*, p. 35 (available at <https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupMeetingDoc&docid=36608>, consulted at 1/10/1010: “For traditional road vehicles, it used to be the individual owner (O) who was the most appropriate person to be liable, where damage was caused by the vehicle’s operation. Regardless of whether or not the damage was caused by O’s intent or negligence, it was definitely O who benefited from the operation in general, who had the highest degree of control of the risk by deciding when, where and how to use, maintain and repair the vehicle, and who was therefore also the cheapest cost avoider and taker of insurance. Where modern autonomous vehicles (AVs) are privately owned, it is still the individual owner who decides when to use the AV and puts the destination into the system, but all other decisions (route, speed etc.) are taken by algorithms provided by the producer (P) of the AV or a third party acting on P’s behalf. P is also in charge of maintaining the vehicle. P may therefore be the much more appropriate person to be liable than O”).

³⁰ In the meantime amended by DL n.º 131/2001, of 24th April.

³¹ On this regime in general, see, for all, CALVÃO DA SILVA, JOÃO, *Responsabilidade Civil do Produtor*, Coimbra, Almedina, 1990 e *Idem*, *Compra e Venda de Coisas Defeituosas (Conformidade e Segurança)*, 5.ª ed., Coimbra, Almedina, 2008, pp. 181 and ff.

³² HÖRSTER, HEINRICH EWALD / MOREIRA DA SILVA, EVA SÓNIA, *A Parte Geral do Código Civil Português*, 2.ª ed., Coimbra, Almedina, 2019, p. 86.

very broad, including all the intervening parties in the production chain, who are jointly and severally liable before the injured party (Article 6)³³.

In the path of the Directive n.º 85/374/EEC of the Council of July 25th, 1985, which was transposed in our legal system by this law, DL n.º 383/89 starts “from the existence of a safety obligation incumbent upon the manufacturer in favour of the protection of any person victim of the defective product circulating in the market”, being covered by the scope of protection of this regime all the persons injured by the defective product (and not only the consumer who bought and used it³⁴). This means that it is possible to apply this scheme to compensate, for example, a person - a third party - who is run over by a defective AV.

But what can be considered a defective AV?

Article 4.º, n.º 1, of DL n.º 383/89 states that “[a] product is defective when it does not offer the safety that can legitimately be expected, taking into account all the circumstances, namely its presentation, the use that can reasonably be made of it and the moment it came into circulation”. This is because the producer is obliged to place only safe products on the market³⁵.

A defective product³⁶, therefore, is one that is unsafe. DL n.º 69/2005 defines a safe product as “any product which, under normal or reasonably foreseeable conditions of use, including duration (...) does not present any risk or only slight risks, compatible with its use and considered to be compatible with a high level of consumer health and safety protection (...)”. To assess this high level of protection, the law requires that the characteristics of the product, its presentation, packaging, labelling, instructions for assembly/use/conservation and other warnings and information, and also the categories of consumers who are most at risk when using it (such as the elderly or children), are taken into account. In any case, the law does not require “absolute safety, zero risk: only the safety that can legitimately be counted on”, this being assessed objectively, in the light of the expectations of the public for whom the product is intended (adults, minors, young children, the elderly, etc.). Moreover, it should be noted that these expectations are not necessarily those established by law (since there may even be no legal regulation concerning the product in question) - the rule speaks of “the safety that can legitimately be counted on” and not “legally expected safety”, so that what counts here is the “state of science and technology at the time of the release of the product on the market, even if not yet laid down in law”; however, if such regulation exists, “a product that complies with the law enjoys a presumption of safety under the terms of Article 4.º, n.º 2, of DL n.º 69/2005”³⁷.

However, there are several types of defects to be considered: design defects (affecting the entire series of products produced based on these defective specifications), manufacturing defects (occurring at the next stage and generally affecting only one or some of the products in a series) and, in addition to these defects intrinsic to the product, information defects (extrinsic defects). Lack of information may result in a product which is not intrinsically defective becoming dangerous because it does not allow the consumer to use it safely³⁸. A product that does not offer security against cyber-attacks will also be defective, and the producer will also be liable if it is not possible to identify the hacker who has tampered with the programming of the product and caused damage³⁹.

³³ Unless they discharge their liability by proving that the defect in the component part which they have produced and integrated in the final product arises out of the design of this product or instructions given by its manufacturer (Article 5.º, al f)). V. MANUEL FELÍCIO, *op. cit.*, p. 506.

³⁴ CALVÃO DA SILVA, JOÃO, *Compra e Venda de Coisas Defeituosas (Conformidade e Segurança)*, *cit.*, p. 188. The author considers that this solution is explained by the primacy of respect for people’s lives, physical integrity, and health - fundamental and personality rights - which, in the light of technological and industrial development, may be endangered.

³⁵ V. Article 4.º, n.º 1, and Article 5.º of DL n.º 69/2005, which transposed the Directive n.º 92/59/EEC, on general product safety.

³⁶ Article 3 of DL n.º 383/89 defines a product as “any movable thing, even if incorporated into another movable or immovable thing”, and so the producer of that component part is also liable and not only the manufacturer of the end product. This is extremely relevant in the automobile industry, as the Brands often use parts produced by third parties (such as engine components or electronic circuits, braking systems, etc. In this respect, CALVÃO DA SILVA, JOÃO, *Compra e Venda de Coisas Defeituosas (Conformidade e Segurança)*, *cit.*, p. 194.

³⁷ CALVÃO DA SILVA, JOÃO, *Compra e Venda de Coisas Defeituosas (Conformidade e Segurança)*, *cit.*, pp. 198-199.

³⁸ On the various types of defects, *idem*, pp. 206 and ff. The author explains that the information provided must be comprehensible to the public to which it is addressed; he adds that it is possible for the producer to make up for known but ineliminable faults in the product design by providing warnings, but that these cannot operate as clauses excluding the producer’s liability for known and technically correctable design defects.

³⁹ Neste sentido, HENRIQUE SOUSA ANTUNES, *op. cit.*, p. 23.

All these types of defects can occur in our case. Let's imagine that a AV is put on the road, there is a big marketing campaign making the consumer believe that it is a safe vehicle, but it turns out that the programming on which the AV's behaviour is based was badly designed, stipulating that, in the event of a risk of colliding with another vehicle, instead of braking, the AV should swerve to the side - to protect its integrity - without taking into account that this could lead to pedestrians being hit. A pedestrian hit in this way should be compensated, but on what terms?

We think that this case is outside the vehicle's own risks and that the responsibility must lie with whoever placed on the market a AV with badly designed programming. This is a design fault, intrinsic to the whole series of AV produced based on that programming. Compensation will be available for all damage caused to individuals, whether financial damage (financial loss and/or loss of profit) or non-material damage⁴⁰.

The same will happen if the accident occurred because some of the electronic components (such as sensors, GPS, etc.) were not properly installed at the factory (manufacturing defect) and did not work properly *ab initio* (that is, it is not a case of them working perfectly initially but having malfunctioned afterwards, in which case the AV holder will be liable under the terms of article 503.º CC). Likewise, if the accident occurred because the instructions on how to operate the vehicle were unclear and mislead the holder (imagine that they do not properly explain how to connect the functionalities that need to be activated in order for the AV to drive safely by itself), in which case we are faced with an extrinsic vice (information defect), for which the producer will also be liable.

But, what if, due to one of these defects, instead of running over a pedestrian, the AV hits another vehicle, properly parked? Does the regime of strict liability of the producer allow to compensate the owner of the parked vehicle for the violation of his or her property rights?

According to Calvão da Silva, only the damages in things of the consumer that used the defective product for personal purposes (and not professional ones) are included in the producer's strict liability regime⁴¹. If so, this regime would only protect the buyer of the VA and would not be sufficient to protect the patrimony of other injured parties, especially because it is not possible to apply a regime of strict liability to analogous cases not foreseen by law; it would be urgent for the legislator to create adequate rules that contemplate the situations in which an AV causes damage to third parties' property. However, if we are talking about a design defect, a problem that is beyond the vehicle's own risks, the answer should be the same. On the other hand, if we look at the letter of the law, at article 8 of DL 383/89, which establishes which damages are compensable under this regime, we see that the law does not limit compensability to things belonging to the consumer who purchased the VA: "[Damage resulting from death or personal injury and damage to things other than the defective product are compensable, provided that they are normally intended for private use or consumption and the victim has assigned them primarily to this purpose". In other words, what the law determines is that the victim (which could perfectly well be any third party), whose things were damaged, used them mainly for his private (and not professional⁴²) use or consumption. Thus, in the event of a traffic accident caused by an AV, if another car (of private use) is hit, its owner will have the right to be compensated under the terms of this regime.

Nevertheless, it may happen that the VA defect was not detectable at the time it was marketed. We are talking about defects or development risks, which the law has excluded from the producer's liability because the state of the art and science does not allow the producer to foresee and eliminate the defect and, consequently, the damages resulting therefrom. Therefore, the moment at which the judge must assess the cognoscibility of the defect is the moment of entry into circulation and not the moment at which the damage occurs. Otherwise, the strict liability regime would be applied retroactively, which is neither reasonable nor in accordance with the law (see article 4.º, n.º 1, *in fine*, of this regime). However, it is important to keep in mind that the producer is only exempt from liability if the unknowability of the defect or the dangerousness of the product is an absolute and objective impossibility, according

⁴⁰ Including all damages in case of death or personal injury caused by a defective product, , CALVÃO DA SILVA, JOÃO, *Compra e Venda de Coisas Defeituosas (Conformidade e Segurança)*, cit., pp. 215 and ff.

⁴¹ *Idem.*, p. 221.

⁴² Thus, only non-economic damages would be excluded. Also in this sense, BARBOSA, MAFALDA MIRANDA, *op. cit.*, pp. 271-272. The author also discusses whether and in what terms the damage caused to digital content or to the hardware itself by the software put into circulation can be compensated.

to the state of science at national and international level, which is the same as saying that the producer must always keep up to date⁴³.

Let us imagine that, when the AV was placed on the market, it had not been programmed with guidelines for deciding whether to run over one person or the other if it was impossible to avoid some of them. However, the AV had been programmed to collect data from the Internet and ended up “autonomously learning” (through machine learning or even deep learning) ethical guidelines that determined that, if it had to decide between saving one person’s life or saving several, it should choose to save several people by running over only one person. Imagine now that the AV decides to follow these guidelines (because it has evolved on its own, to the point of going beyond its programming) and runs over a child to avoid running over an elderly couple. Leaving aside the ethical issues - because every human life deserves the same respect and has the same dignity - this example allows us to understand how dangerous it can be to let AI evolve by itself, without human supervision⁴⁴. Although certain defects were not known when the AV was launched on the market (and, therefore, the producer, in principle, should not be liable for damages caused by them), it should be considered that the producer has the obligation to monitor the development of the technique and the state of the art and a duty of care and vigilance over the products he has placed on the market, “under penalty of being held liable on the basis of proven fault (Article 483.º, n.º 1, CC) or presumed fault (Article 493.º, n.º 2, CC) of the average producer or on the basis of risk, having as archetype the ideal producer”⁴⁵. Under the terms of Article 6.º, n.º 1, al. b), of DL n.º 69/2005, the producer is obliged to “take appropriate measures, in accordance with the characteristics of the product supplied, to provide information on the risks that the product may present and to take any action deemed appropriate, including withdrawal from the market, warning consumers in appropriate and effective terms or recalling the product from them”. Thus, in the case of AV, a recall of the vehicle may be justified in order to correct programming that may prove to be defective or faulty in the future, or to install new guidelines or upgrades which, in the light of the development of science and the evolution that the vehicle itself has achieved, are required to guarantee the safety legitimately expected by the public. If one would not expect a VA to be able to make such decisions in the light of the programming with which it was created, but the programming allows the VA to evolve by itself and “learn” by changing its own programming, the producer must be required to monitor this evolution, to ensure that this learning and the resulting results do not turn the AV into a dangerous product⁴⁶. Non-compliance with this duty will always give rise to liability in general terms - either by proving his fault or by using the presumption of fault of Article 493.º, n.º 2, CC. However, it may be extremely difficult for a layperson to prove this, and it is therefore urgent to consider extending strict liability to these cases. In fact, at least as regards damages caused by VA that have received programming upgrades from the producer, it is perfectly defensible to consider that it is on the date that these upgrades are received that the “product” enters into circulation⁴⁷, since software falls within the concept of product for the purposes of DL n.º 383/89⁴⁸. The Expert Group on Liability and New Technologies also agrees with this when it states that “[t]he producer should be strictly liable for defects in emerging digital technologies even if said defects appear after the product was put into circulation, as long as the producer was still in control of updates to, or upgrades on, the technology. A development risk defence should not apply”⁴⁹. However, further difficulties may arise if these upgrades are carried out by another person (not the AV producer),

⁴³ CALVÃO DA SILVA, JOÃO, *Compra e Venda de Coisas Defeituosas (Conformidade e Segurança)*, cit., pp. 211 and ff.

⁴⁴ However, Manuel Felício considers that it is doubtful whether the producer should be liable for this damage, given the autonomy of the vehicle, and even wonders whether this regime has “persecutory implications”. FELÍCIO, MANUEL, *op. cit.*, pp. 508-509. The author seems to prefer the liability of the owner or user, as he is “the person who is closest to the performance of the autonomous vehicle - the source of the risk - and the one who derives most comfort from the autonomous driving system”, exploring the legal presumptions of guilt of Articles 491 and following, as well as Articles 500.º and 503.º CC. *Idem*, pp. 509 and ff.

⁴⁵ CALVÃO DA SILVA, JOÃO, *Compra e Venda de Coisas Defeituosas (Conformidade e Segurança)*, cit., pp. 210-211.

⁴⁶ In fact, we even think that the programming of these vehicles (as well as any autonomous agent that may cause harm to people and property) should not allow for unsupervised learning. It would be important that the legislator, *de lege ferenda*, create restrictions in this sense to the design and marketing of potentially dangerous products that make use of AI.

⁴⁷ Thus, we agree with BARBOSA, MAFALDA MIRANDA, *op. cit.*, pp. 300-301, who states that “[i]n practice, it is as if the producer is continually promoting the entry into the market of intangible, dematerialised products”.

⁴⁸ Cf. CALVÃO DA SILVA, JOÃO, *Responsabilidade Civil do Produtor*, cit., p. 613.

⁴⁹ EXPERT GROUP ON LIABILITY AND NEW TECHNOLOGIES, *op. cit.*, p. 42.

as it may be extremely difficult to verify whether the accident is due to the original programming or to the upgrades put into circulation in the meantime⁵⁰.

In any case, the Expert Group on Liability and New Technologies goes even further and considers that, even in cases where the damage is due to self-learning by the product (which, according to the original programming, was not defective, but became so autonomously, i.e. because the defect is due to changes made to the original algorithm by subsequent upgrades), given the need for a fair distribution of risks and benefits, the producer should not be allowed to escape liability by invoking the development risk. This is because in this case it is foreseeable that unforeseeable developments may occur⁵¹. MAFALDA MIRANDA BARBOSA considers, in fact, that this solution does not even require an amendment to the legislative framework in force, “but only the appropriate mobilisation of what is a development risk, since by producing and programming software with an unsupervised learning capability and subsequently placing it on the market, it cannot be said that it was not, according to the state of science and technology, possible to foresee that an injury would occur”⁵². As long as the legislator doesn’t create a legal solution to the problems raised by AV, we think that this interpretative solution should be embraced.

3.2 The conjugation of the two regimes to protect the injured party: proposed solution

It should be noted that we do not consider that it should always be the producer who is liable for the damages caused by AV. In the case of breakdowns, such as those we consider to be covered by the concept of “the vehicle’s own risks”, it is the vehicle’s keeper who should be liable under the terms we have already explored. Even considering that AV will be expensive vehicles, with a large electronic component, over which the owner will not be able to “have a hand”, even considering that the car industry generates many economic profits, so it could bear those costs, we must also consider the possibility that this liability, being excessive, may discourage the development or investment in this type of vehicles, losing the advantages that would be achieved with its implementation, as already mentioned (namely the reduction of road accidents). We therefore believe that it is necessary to find a balanced solution: the risks inherent in the vehicle should be borne by those who have its effective driving; risks that go beyond this field should be borne by the producer⁵³.

However, although this solution seems to us to be the most in line with the principles on which our civil liability law is based, it could be extremely hard to prove the exact cause of the damage, meaning that it would be very difficult for the car owner to escape liability, which is neither fair nor appropriate. Therefore, *de iure condendo*, it seems to us that the legislator should create a system in which strict liability should be divided equally between all parties, possibly through the prevision of the presumption that the accident was due to a manufacturing defect (including programming defects); this presumption should be rebuttable by the producer. The producer is the strongest party in this relationship, both in economic and technical terms, since it has access to all the information regarding the design and construction of the vehicle, has access to the expertise and know-how of its employees and agents (such as the programmers it hired, whether its employees or free-lance agents), and will more easily rebut this presumption than the car owner will be able to prove the opposite.

⁵⁰ BARBOSA, MAFALDA MIRANDA, *op. cit.*, pp. 274-275, where the author considers that “issues of uncertain alternative causation” may arise.

⁵¹ EXPERT GROUP ON LIABILITY AND NEW TECHNOLOGIES, *op. cit.*, p. 43.

⁵² BARBOSA, MAFALDA MIRANDA, *op. cit.*, p. 302.

⁵³ It seems to us that the considerations of the Expert Group on Liability and New Technologies also follow these thoughts, when they consider that strict liability is the most appropriate response to the risks posed by emerging digital technologies that operate in public environments and may cause significant damage and should be borne by the person who controls the risk in question and benefits from its use. In fact, a broader concept (that of ‘operator’) is used to include not only the person who uses these technologies for his own benefit (‘frontend operator’) but also the person who defines their characteristics and provides ongoing assistance (‘backend operator’); since there are two different operators, that is, two possible parties liable, the Expert Group considers that this strict liability should be borne by the operator who has greater control over the risk of the operation. Thus, in the case of damage caused by AV, the Expert Group considers that it would not be appropriate to hold the owner/holder liable, since the producer is the one who can prevent damage and is able to control the risk of accidents, especially in the case of AV with a level of autonomy of 4 or 5, where the holder of the vehicle does not control driving. To avoid uncertainty, however, the Expert Group adds that the legislator should define who is the responsible operator and in what circumstances, as well as all other matters that need legal provision/clarification. EXPERT GROUP ON LIABILITY AND NEW TECHNOLOGIES, *op. cit.*, pp. 39 and ff.

Nevertheless, producer's strict liability currently in force does not seem to consecrate this solution. The authors and the jurisprudence/case law⁵⁴ understand that it is the injured party who must prove the existence of "the defect in the product and the adequate causal link between it and the damage (Article 342.º, n.º 1, CC)"⁵⁵, in line with the option made by Directive n.º 85/374/EEC, whose Article 4 determines that "it is for the victim to prove the damage, the defect and the causal link between the defect and the damage"⁵⁶. Therefore, the general rule applies (the injured party must prove the facts which constitute his right to compensation, namely, he must prove that there is a defect, a damage, and that the damage is due to this defect). According to José Manuel Vieira Conde Rodrigues, the Directive chose, as regards producer liability in general, to "protect industry", and did not "respond to the demands of consumers, who had strongly urged that the burden of proof of the causal link be reversed"⁵⁷.

We therefore believe there is an urgent need for the legislator to create clear legal rules, conceived from scratch for the case of AV, free of doubts, which presume the existence of design, manufacturing, or information defects or to amend the legal regime of producer liability to include, at least in these cases, a presumption that reverses the burden of proof under the terms mentioned. In fact, also in this sense, the European Parliament Resolution of 23 January 2020 considers that the Directive on producer liability should be revised to accommodate the specificities that arise in the area of AI, namely in relation to the notion of product, defect and damage, and the distribution of the burden of proof should also be re-examined. The European Commission is also following this path in its considerations on this matter in the White Paper on Artificial Intelligence - A European approach to excellence and trust⁵⁸ and so does the Expert Group on Liability and New Technologies⁵⁹.

While the proposed amendments do not become a reality, an interpretation of the combination of Articles 4 and 5 of the legal regime of objective responsibility of the producer could be attempted in the sense of considering that the law would presume that the product is defective when it causes damages, as the producer would (only) not be responsible if he proved the existence of the circumstances foreseen in Article 5 - namely the one established in al. b): "taking into account the circumstances, it is reasonable to assume that the defect did not exist when the product was put into circulation"; or even, in al. e): "that the state of scientific and technical knowledge at the time he put the product into circulation was such that the existence of the defect could not be detected". However, this interpretation, although not inconceivable in the light of the letter of the law, is extremely difficult: it would be very useful (since, in the case of a traffic accident caused by an AV, the producer would always be liable unless he proved that the vehicle was not defective at the time it was put into circulation or that, even if it was, it was not possible to detect the defect at that time in the light of scientific and technical knowledge at that time), but it would not respect the legislator's options. For the sake of consistency of the legal system, if such an interpretation were to be applied in the case of AV, it would have to be applied in the other cases too, something that the European legislator did not want.

3.3 Liability of the producer *versus* liability of the programmer

Normally, programming defects are manufacturing defects (more properly, product design defects) and as such the one to be held liable for damages caused by them should be the producer. The programmer will not be very

⁵⁴ E.g., Ruling of the Supreme Court of Justice of 14-03-2019 (Lídio Sacarrão Martins), available at <http://www.dgsi.pt/jstj.nsf/954f0ce6ad-9dd8b980256b5f003fa814/70ce45ea65525375802583be0036d5c3?OpenDocument>, consulted at 1/10/2020; Ruling of the Supreme Court of Justice of 25-09-2018 (Acácio das Neves), available at <http://www.dgsi.pt/jstj.nsf/954f0ce6ad9dd8b980256b5f003fa814/4944bb00ba83133a802583200032fdd4?OpenDocument>, consulted at 1/10/2020; Ruling of the Supreme Court of Justice of 02-06-2016 (Orlando Afonso), available at <http://www.dgsi.pt/jstj.nsf/954f0ce6ad9dd8b980256b5f003fa814/5b2df3bd85c40e1880257fc70038917c?OpenDocument>, consulted at 1/10/2020.

⁵⁵ Vide, e.g., CALVÃO DA SILVA, JOÃO, *Compra e Venda de Coisas Defeituosas (Conformidade e Segurança)*, cit., p. 200; SIMÕES, FERNANDO DIAS, *Marca do distribuidor e responsabilidade por produtos*, Coimbra, Almedina, 2009, p. 87.

⁵⁶ RAPOSO, MÁRIO, *Sobre a responsabilidade civil do produtor e a garantia do seguro* (separata do BMJ n.º 413), Lisboa, 1992, p. 15.

⁵⁷ RODRIGUES, JOSÉ MANUEL VIEIRA CONDE, *A responsabilidade civil do produtor face a terceiros*, AAFDL, 1990, pp. 117-118.

⁵⁸ Vide EUROPEAN COMMISSION, *op. cit.*, p. 15.

⁵⁹ "If it is proven that an emerging digital technology has caused harm, the burden of proving defect should be reversed if there are disproportionate difficulties or costs pertaining to establishing the relevant level of safety or proving that this level of safety has not been met". EXPERT GROUP ON LIABILITY AND NEW TECHNOLOGIES, *op. cit.*, p. 42.

different from an assembly line worker, partly because there is usually not just one programmer, but a team, and it is therefore practically impossible to determine which programmer failed to program the AV code.

However, if it is possible for the AV manufacturer to determine and prove who was responsible for the faulty programming, the question arises whether he can avoid his liability towards the victims, who would then only be able to hold the programmer directly liable for the damage caused by the VA, under the terms of subjective liability. This solution would not protect the victims, since it would be difficult for the programmer to have the economic means to satisfy the right of the victims (who may be many, given the expected mass production of AV).

In this case, the general rules - which are not set aside by DL n.º 383/89, as established in its Article 13.º - work in an adequate way: if there is more than one responsible party (the programmer would be responsible under the terms of subjective liability; the producer under the terms of strict liability), both are joint and several liable and any of them may be sued by the victim (Article 497.º, n.º 1, CC). There is, afterwards, a right of recourse between the responsible in the measure of their respective faults and of the consequences resulting therefrom (Article 497.º, n.º 2, CC). Therefore, even if the cause of the accident was a programming defect and it is possible to identify who failed in the programming, the victim may choose to sue only the producer, who will answer directly to the victim, and afterwards may demand the return of his part from the programmer, if he is able to prove his fault (and, therefore, his responsibility). The Expert Group on Liability and New Technologies also considers that the various potentially applicable grounds of liability should coexist, ensuring a greater protection for the victim, who may then sue one or other of the parties responsible; these parties will afterwards call upon their rights and solve the situation among each other⁶⁰.

It may happen, however, that it is not possible to identify which of the programmers failed to create the code. In this case, the producer will not be able to claim back anything he has paid to the victim, since he will be the only one liable. One could consider the possibility of establishing, *de lege ferenda*, a joint and several liability of the team of programmers between themselves, if it were not possible to identify the faulty programmer. However, the consequences of this legislative solution would be very bad: nobody would want to programme, knowing that they could be held responsible even if they had in fact carried out their task diligently.

4. Conclusion

At this point it is already possible to outline some considerations regarding the legal regime currently applicable to AV in our legal system:

1. The AV holder must be liable for damages caused in a traffic accident that may fall within the AV's own risks under articles 503 et seq. (mechanical, electronic breakdowns, etc.);
2. The VA producer must answer for the damages arising from manufacturing defects (including programming), under the terms of DL n.º 383/89, of November 6th, and cannot be excused from his liability invoking not to be responsible for the development risk in the cases where he has placed in the market an AV with self-learning capacity.

However, this solution is not perfect as it can be extremely difficult for the victim (who can even be the owner of the vehicle) to prove that the AV is defective. Therefore, a special regime should be created which, in case of doubt, would establish the presumption that the damage caused by the AV results from defects in its production or programming, a presumption rebuttable by the producer, in which case the vehicle keeper would be liable⁶¹.

⁶⁰ EXPERT GROUP ON LIABILITY AND NEW TECHNOLOGIES, *op. cit.*, p. 36.

⁶¹ In recognition of these difficulties, the European Commission is considering adjustments to the Product Liability Directive “and of national liability regimes through appropriate EU initiatives”, EUROPEAN COMMISSION, *Report from the Commission to the European Parliament, the Council and the European Economic and Social Committee (Report on safety and liability implications of artificial intelligence, the Internet of Things and robotics)*, 19/02/2020, p. 19 (available at <https://op.europa.eu/pt/publication-detail/-/publication/4ce205b8-53d2-11ea-aece-01aa75ed71a1/language-pt>, consulted at 15/9/2020).