The Insurance Perspective on Prevention and Compensation Issues Relating to Damage Caused by Machines

Sara Landini*

Abstract

This paper addresses the issue of automation coverage for costs in the event of damage caused by an automated decision-making process. It will consider civil liability and insurance from the point of view of problems related to the proof of a causal nexus between wrongdoing and losses. Starting from a study on causation, this paper focuses on liability and insurance in case of automation: their changing role in an automated world and various perspectives taking also into account recent European perspectives and developments.

The thesis that the paper proposes is that legal liability is not a sufficient instrument to permit effective prevention and compensation in the case of damage caused by full algorithmic automation. This is particularly so because it could be not always possible to trace back to a specific human actor, as the European Commission underscored in its recommendation on civil law rules on robotics (2015/2103(INL)). Of course, legislators can intervene by reshaping the civil liability, for instance, by eliminating the proof of causal link or introducing new forms of strict liability. We intend to propose an alternative/ complementary way considering the role of insurance system, particularly liability insurance, which is generally intended as instrument to manage and transfer risks (both private companies and public funds) in compensating victims but also in preventing losses by educating the insured machines thanks to the data acquired.

> 'I, on the other hand, am a finished product. I absorb electrical energy directly and utilize it with an almost one hundred percent efficiency. I am composed of strong metal, am continuously conscious, and can stand extremes of environment easily. These are facts which, with the self-evident proposition that no being can create another being superior to itself, smashes your silly hypothesis to nothing'.
>
> Isaac Asimov, *I, Robot*

* Associate Professor of Private Law, University of Florence.

I. Introduction

Automation is considered as a technique for reducing human error and damage.[1] We are usually oriented to consider automation only in terms of development of autonomous vehicles, but the phenomenon is much more widespread. Consider, for example: the use of automation in medicine, in particular in surgery; automation in smart contracts, (in which the parties agree the adoption of models for the adaptation of contractual contents to contingencies); smart agriculture, where the agricultural activity is guided by choices based on models capable of planning with respect to climate changeability and other occurrences; smart cities or cities that are able to direct traffic and provide information to users to improve the traffic, and quality of users' life, etc.

Automation can reduce human errors, and also damages, but cannot exclude the latter, especially when they cannot be eliminated. The question then becomes choosing which target is best to hit. The classic example is that of the autonomous vehicle that has provided a dramatic, but not avoidable alternative between killing the driver or a pedestrian walking across the street. Some countries try to find an answer by creating guidelines for these 'dilemma situations'.[2] This could be an ethical solution, but what is the consequence if the software is programmed according to these guidelines? What is the impact of that on liability? The

[1] C.-Y. Chan, 'Advancements, prospects, and impacts of automated driving systems' 6 *International Journal of Transportation Science and Technology*, 206 (2017). Among the first contributions, Id, 'Hearings on automation and technological change' *Subcommittee on Economic Stabilization of the Joint Committee on the Economic Report*, 14-28 (US Congress, October 1955); W.S. Buckingham, *Automation: Its Impact on Business and People* (New York: Harper & Brothers, 1961).

[2] In Germany an Ethics Commission on automated driving set up by Federal Minister A. Dobrindt. The Federal Ministry of Transport and Digital Infrastructure's Ethics Commission comprises fourteen academics and experts from the disciplines of ethics, law and technology. Among these are transport experts, legal experts, information scientists, engineers, philosophers, theologians, consumer protection representatives as well as representatives of associations and companies. The Ethics Commission's report comprises twenty propositions. The key elements are:

- Automated and connected driving is an ethical imperative if the systems cause fewer accidents than human drivers (positive balance of risk);
- Damage to property must take precedence over personal injury. In hazardous situations, the protection of human life must always have top priority;
- In the event of unavoidable accident situations, any distinction between individuals based on personal features (age, gender, physical or mental constitution) is impermissible;
- In every driving situation, it must be clearly regulated and apparent who is responsible for the driving task: the human or the computer; and
- It must be documented and stored who is driving (to resolve possible issues of liability, among other things).

Drivers must always be able to decide themselves whether their vehicle data are to be forwarded and used (data sovereignty).

The Ethics Commission's complete report can be found at tinyurl.com/ydc42f5a (last visited 7 July 2020).

Moreover, we have to investigate what law shall regulate AI. The national legislator even if it concerns a transnational phenomenon collecting data from a transnational network of machines? *See* E. Giorgini, 'Algorithms and Law' 5 *Italian Law Journal*, 135 (2019).

guidelines issued by the German Transport Ministry try to find solutions with regard to the issues of liability. In a report published in 2017 it stressed that, in every driving situation, it must be clearly regulated and apparent who is responsible for the driving task: the human or the computer. This information must be documented and stored who is driving in order to facilitate the victim in the proof of the dynamic of the accident.[3]

Starting from these premises, we intend to answer to a fundamental question: how to prevent and compensate damage caused autonomously by a machine? Civil liability is the basic instrument to prevent and compensate damage also with the help of liability insurance, but damage that is nor referable to a person who can be considered responsible for the wrongful act complicates this paradigm.

The above question is fundamental because effective instruments of compensation and prevention of damage caused by automation can reduce threats related to the use of automation and will permit the development of automated machines that will be safer, considering all the benefits raising from their use. Research based on SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis demonstrates the benefits of adopting automation systems in transport. The SWOT analysis (also known as the SWOT matrix) is a strategic planning tool used to evaluate strengths, weaknesses (Weaknesses), opportunities (Opportunities) and threats of a project or in a company. Regulators and policymakers are increasingly involved in making important decisions about the governance of automated vehicles (AVs). Policymakers need to design comprehensive policies to deliver the benefits of AVs and to foresee and address potential unintended consequences; however, this is not an easy task. Especially given the complexity of the technology, AVs require a sophisticated analysis: beyond the apparent safety and security issues, AVs have significant potential to impact issues related to privacy, accessibility, the environment, and land management.

The opportunities include increased road safety and lowered social costs.

[3] See point 8, at 11 of the *Report of Ethics Commission Automated and Connected Driving*, available at tinyurl.com/y9wezt45 (last visited 7 July 2020).

At the end, the report affirms that 'genuine dilemmatic decisions, such as a decision between one human life and another, depend on the actual specific situation, incorporating 'unpredictable' behavior by parties affected. They can thus not be clearly standardized, nor can they be programmed such that they are ethically unquestionable. Technological systems must be designed to avoid accidents. However, they cannot be standardized to a complex or intuitive assessment of the impacts of an accident in such a way that they can replace or anticipate the decision of a responsible driver with the moral capacity to make correct judgements. It is true that a human driver would be acting unlawfully if he killed a person in an emergency to save the lives of one or more other persons, but he would not necessarily be acting culpably. Such legal judgements, made in retrospect and taking special circumstances into account, cannot readily be transformed into abstract/general *ex ante* appraisals and thus also not into corresponding programming activities. For this reason, perhaps more than any other, it would be desirable for an independent public sector agency (for instance a Federal Bureau for the investigation of accidents involving automated transport systems or a Federal Office for safety in automated and connected transport) to systematically process the lessons learned'.

As is well known, human errors, primarily due to causes like distracted driving, speeding, reckless driving, and driving under the influence, among others are believed to be responsible for over ninety per cent of these accidents. Increased mobility and accessibility is another such opportunity, considering the fact that AVs can serve as a more convenient mode of transportation point-to-point, especially for people unable to operate a vehicle manually (including youth, people with certain disabilities, and the elderly). A third opportunity involves environmental sustainability. AVs can help to improve environmental sustainability and could reduce CO2 emissions by three hundred million tons per year also because AVs will reduce traffic congestion. Researchers have suggested that AVs may increase worker productivity by ten-fifteen per cent and save around one billion hours every day. Currently available technologies, such as Event Data Recorders (EDR), are being used by the NHTSA to investigate crashes and clarify civil liabilities earlier, which may reduce litigation costs.

In the next sections, we will try to answer the following questions, trying to find a solution to the issues of prevention and compensation in case of damage caused by machines acting autonomously with the use of algorithms. What do we mean with the term 'automated choice'? Who is liable in case of damage caused by IA autonomously? Is it civil liability the most effective solution to compensation and prevention in case of damage caused by IA? In which way can insurance represent a solution?[4]

II. What is an Automated Choice?

Before considering the above-mentioned juridical issues, it is important to define the object of our considerations.

With the use of the term 'automated choice', what is actually meant is a choice made using an algorithm? It is a choice without human factors normally influencing a choice. The Oxford English Dictionary (1989) defines automation as:

> '1) Automatic control of the manufacture of a product through a number of successive stages;
>
> 2) the application of automatic control to any branch of industry or science;
>
> 3) by extension, the use of electronic or mechanical devices to replace human labor'.

This definition needs to be read together with definition of Artificial Intelligence

[4] European Parliament and Council Directive 2009/103/EC of the relating to insurance against civil liability in respect of the use of motor vehicles, and the enforcement of the obligation to insure against such liability (2009) OJ L263/11 (Directive on motor insurance).

(AI), as proposed within the European Commission's Communication on AI1:

> 'Artificial intelligence (AI) refers to systems that display intelligent behavior by analyzing their environment and taking actions – with some degree of autonomy – to achieve specific goals.
>
> AI-based systems can be purely software-based, acting in the virtual world (eg voice assistants, image analysis software, search engines, speech and face recognition systems). AI can also be embedded in hardware devices (eg advanced robots, autonomous cars, drones or Internet of Things applications)'.

Nobel Prize winner Herbert Simon affirmed that it is not possible to predict choices through models of optimal choice, arguing that any human decision making enters necessarily in contact with psychological processes. There is no human decision only where there is a full-automated choice.

We have a case of a real automated choice in case of full automation. This involves is the technology by which a process or procedure is performed without human assistance. Automation usually implies the use of various control systems for operating with minimal or reduced human intervention, but some processes have been completely automated. As multiple examples, we can cite steering and stabilization of ships, aircraft and other applications and vehicles where different levels of automation are possible.

The above table illustrates that the SAE (Society of Automobile Engineers) international's on-road automated vehicle standards committee, along with experts from industry and government, the information report defining key concepts related to the increasing automation of on-road vehicles. Central to this report are six levels of driving automation: 0 (no automation), 1 (driver assistance), 2 (partial automation), 3 (conditional automation), 4 (high automation), and 5 (full automation).

In order to define the cause of action in case of an automated choice, it is important to consider the above-mentioned levels of automation. Generally speaking and not only with regard to vehicles we can distinguish, the levels of automation as following:

- at level one the human operator acts and turns to the computer to implement her actions;
- at level two the computer helps the human operator by determining the options;
- at level three the computer suggests options and the human operator can choose to follow the recommendation;
- at level four the computer selects the action and the human operator decides if it should be done or not;
- at level five the computer selects the action and implements it if the human

operator approves the selected action;

- at level six the computer selects the action and informs the human operator who can cancel the action;

- at level seven the computer does the action and inform the human operator;

- at level eight the computer does the action and inform the human only if the human operator asks;

- at level nine the computer does the action and informs the human operator only if the computer decides the operator should be told; and

- at level ten the computer does the action if it decides it should be done. The computer informs the human operator only if it decides the operator should be told.

Parasuraman, Sheridan, and Wickens also distinguish four models of human information processing:

1. Sensory processing, which refers to the acquisition and registration of multiple sources of information and includes the positioning and orienting of sensory receptors, sensory processing, initial pre-processing of data prior to full perception, and selective attention. This model can be translated in the function of information acquisition;

2. Perception and/or working memory, which regards conscious perception and manipulation of processed and retrieved information in working memory. It includes cognitive operations such as rehearsal, integration and inference, but these operations occur prior to the point of decision. This model can be translated in the function of information analysis;

3. Decision making, which means that a decision is based on such cognitive processing. This model can be translated in the function of decision and action selection; and

4. Response selection, which involves the implementation of a response or action consistent with the decision choice. This model can be translated in the function of decision and action implementation.

With regard to the four functions discussed above, it is possible to provide an initial categorization for types of tasks in which automation can support the human operator:

1. Information acquisition: the automation of information acquisition can be applied to the sensing and registration of input data;

2. Information analysis: the automation in this function involves cognitive functions such as working memory and inferential processes;

3. Decision and action selection. The decision and action selection involve selection from among decision alternatives; and

4. Action implementation, which refers to the actual execution of the action choice.

In accordance with the opinion of some scholars: automation should be human-centered; automation systems should be comprehensible; it should ensure

operators are not removed from command role; it should support situation awareness; it should never perform or fail silently; management automation should improve system management; designers should assume that operators will become reliant on reliable automation.

III. Civil Liability, Automation and Self-Learning Machine. Who is Liable?

As previously explained, automation can reduce human errors, but not damage, especially when damage cannot be avoided. A proper management of these problems typically requires funds to compensate victims, the implementation of effective strategies and a plan for prevention of damage. Fund-raising and prevention strategies are, therefore, key aspects.

The economic analysis of tort law assumes that a legal rule of liability will give incentives to potential parties in an accident setting for careful behavior. Thus economists tend to stress the deterrent function of tort law. On the other hand, lawyers tend to stress the '*ex post* accident' problems, where there is a victim that needs to be compensated. Lawyers focus their attention on the importance of fund raising to compensate losses. Actually, these two approaches are not that 'black and white'. Lawyers also stress the deterrent function of tort law and economists pay attention to compensation issues. It is important to find the way to deter and compensate at the same time.

It is clear that liability will give incentives for efficient prevention and will ensure compensation of damages. At the same time, civil liability aims at providing a compensation mechanism for those who have suffered harm caused by the actions of others. Terminology and the actual principles may differ between distinct jurisdictions, but the core of functions remains common: deterrence and a fair distribution of historic costs and risks. In order to cover both functions, it is important that the civil sanction is going to punish the wrongdoer, the person who takes the harmful action, intentionally or with gross negligence.

Most of the literature, and the European Institutions norms dealing with compensation for damage caused in the event of automation, have raised the question of the possible responsibility or co-responsibility of the producer and/or programmer.[5] So, most of the efforts are on the reform of the directive on manufacturer liability and on cybersecurity. Scholars have also been concerned

[5] Many authors wrote on the new challenges posed by AI in Tort law matters. See eg F.P. Hubbard, 'Sophisticated Robots: Balancing Liability, Regulation, and Innovation' 66 *Florida Law Review*, 1803 (2015); S. Chopra and L.F. White, *A Legal Theory for Autonomous Artificial Agents* (Ann Arbor: University of Michigan Press, 2011); S. Gless and K. Seelmann eds, *Intelligente Agenten und das Recht* (Baden-Baden: Nomos, 2016).

In particular, these authors have rightly placed the attention on the concept of defect in view of what may be the 'defects' in the case of artificial intelligence and of a reasonable duty of safety and care.

with reviewing the concept of guilt of the owner and/or user of the automated product, but, for example, raising the level of diligence required.[6]

Without wanting to raise any criticism to the theories that surely have seized central aspects of this theme, we intend to draw attention to aspects linked to the problem of man-machine interaction and the so-called self-learning of the machine in the case of losses highlighting how civil liability is perhaps not sufficient to compensate and above all to prevent damages.

The recommendations to the European Commission on civil law rules on robotics (2015/2103(INL) stressed this point, noting that robots are not simple toys.[7]

Our considerations become particularly current and important if we move from the field in which the attention of the doctrine is normally focused: automated vehicles, to consider other areas in which the problem of compensation and prevention of damage caused by automated machines arises, such as, medicine and agriculture. In these areas the interaction between machines and men (owner, user, producer, programmer, machine's manager, etc) are so many and complex that it becomes difficult to identify the person (s) responsible.

The recourse to solidarity between co-responsible parties, in the legal systems which know to the institute of the so-called passive solidarity, also fails to resolve the difficulties for the victim to identify the person responsible. If it is true that, in the case of solidarity between the responsible persons, the victim can recut against each of them for the entire damage, it is also true that, in a civil proceeding each potentially responsible person will try to prove that the action of the others has excluded the own responsibility. There could also be a real risk of extending the time needed to compensate the damage. Moreover, the damage is usually so huge and with domino effects that prevention, rather than compensation, becomes

[6] D.C. Vladeck, 'Machines Without Principals: Liability Rules and Artificial Intelligence' 89 *Washington Law Review*, 117, 130 (2014): 'it is useful to pause to consider whether the standard of care to be applied to driver-less cars will be different than the standard applied to cars driven by humans. There is every reason to think that the answer will be 'yes', and that fact may bear on the analysis that follows'. With regard to industry the Author consider the role played by Industry with regard to consumers expectations. 'Manufacturers, through advertising and other communications with consumers, play a key role in shaping consumer expectations. Unless the manufacturer makes inflated and unjustified representations about its product's performance, consumers are likely to expect that their products will perform in a way that is consistent with prevailing standards as articulated by the products' manufacturers, even if better and safer products are achievable at a nominal cost' (at 137).

[7] 'The more autonomous robots are, the less they can be considered to be simple tools in the hands of other actors (such as the manufacturer, the operator, the owner, the user, etc); whereas this, in turn, questions whether the ordinary rules on liability are sufficient or whether it calls for new principles and rules to provide clarity on the legal liability of various actors concerning responsibility for the acts and omissions of robots where the cause cannot be traced back to a specific human actor and whether the acts or omissions of robots which have caused harm could have been avoided': Report 27 January 2017 with recommendations to the Commission on civil law rules on robotics (2015/2103(INL)), Committee on Legal Affairs, Rapporteur: M. Delvaux, available at tinyurl.com/y4gjaujn (last visited 7 July 2020).

fundamental.

One solution can be found in special legal provisions about joint liability. This issue of the presence of a plurality of actors in the wrongdoing does not emerge if we say that all subjects involved are automatically joint tortfeasors. In this case, they are jointly liable and then it is their task to find out internally (ie within their internal relations) who owes to whom, what amount as far as internal recourse, (ie the restitution of the part of the damage paid on behalf of the other tortfeasors).[8] This solution needs legislative intervention to assign liability to all actors independently of the proof of their culpability and of the causal chain in the determination of the wrongdoing. The problem is to determine, in abstract, all the possible actors. It is possible to place objectively joint liability on the main actors (ie the actors bearing the risk of automation like the owner, the user, the manufacturer, the programmer of the automated machine/s involved). The victim could sue one of them, and, as said, they have to find out within their internal relations who owes what amount to whom, as far as internal recourse is concerned. In this case, there could also be a problem of costs sustainability, especially if we consider that insurance contracts usually don't cover joint liability. Accordingly, the actor who paid to the victim the full amount of damage will be covered by his/her insurer only with regard to his/her part of liability. Although we could discuss the unfairness of such an exclusion, insurers, however, justify it because, at the time of the conclusion of the contract, (and for the purpose of determining the premium) they assessed the risk of the insured person alone and not also of a possible co-responsible party.

Moreover, another question that arises is whether we are sure that damage in automation, cases is always caused by the owner and/or the manufacturer and/or the user?

In case of full automation, special problems regard the proof of damage causation arise. The causal link is a problem of knowledge of the origin of things and phenomena, which has accompanied the development of philosophical and scientific thought since its origins starting from the Aristotelian vision of science and principles,[9] up to a more recent period in which knowledge of the causation

[8] I've to thank Professor Á. Fuglinszky, full professor at Elte University in Budapest about these considerations.

[9] See Aristotele, *Fisica, libro I* (Milano: Mondadori, 1996), 134, at 10; F. Laudisa, *Causalità, Storia di un modello di conoscenza* (Roma: Carocci, 1999). In natural sciences, the causal nexus is considered to infer the events of the unknown future from the present ones that can be immediately perceived. In legal studies, the causal nexus is considered to identify among a plurality of events, that are potentially the efficient cause of a given phenomenon already realized, the legally relevant circumstance for the determination of the phenomenon. Accordingly, it seems that, in civil liability judgments, the decisions on the causal nexus must take place through cognitive processes of an inferential-inductive type, articulated according to counterfactual conditions. 'The process of counterfactual reasoning has three stages. The first two of these are somewhat counterintuitive and are easily ignored by analysts. But, they are essential to structuring one's counterfactual reasoning properly. First, one must establish the particular way in which the alternate possibility comes to be (ie, develop its 'back-story'). Second, one must evaluate the events that occur between

laws is due to a mediation of the empirical data.[10] The recent skepticism regarding the possibility to understand the real causation of events has not stopped scientific interest in the causal processes. New probabilistic theories postulate the possibility of replacing the search for the truth by looking for what is highly probable.[11]

The application of probabilistic judgments with regard to the identification of causal links finds a particular application in ascertaining causality in law. There, the *favor veritatis* is limited to instances of economics of judgments and legal limits to the proof of the facts that require the achievement of compromises suitable to satisfy the plurality of ends that the order intends to reach with the verification of the causal link between legally relevant facts.

In this paper we will consider only the causality in civil liability where causality could be considered, in the different legal system, as a 'variable factor'.[12]

There are many different causal theories, however, and here we will recall the ones most important. A first theory is the so-called theory of the *condicio sine qua non*: the cause of an event will be the one that constitutes the condition without which the fact would not be determined, considering the chain of antecedents that have contributed to produce the result having legal significance. This criterion has been criticized for its excessive width. The investigation should have as its object every event that even in a small part may have contributed to the cause of the fact.[13]

A second theory focuses on relevant conditions according to probabilistic criteria. Scholars have hypothesized that the adoption of a criterion that seeks

the time of the alternate possibility and the time for which one is considering its consequences. And third, one must examine the possible consequences of the alternate possibility's back-story and the events that follow it. In doing so, an analyst must connect their conclusion to the specific type of strategic assessment the counterfactual will be used to support: decision making under risk or decision making under uncertainty', see further N. Hendrickson, *Counterfactual Reasoning: a Basic Guide for Analysts, Strategists and Decision Makers* (Plymouth: Proteus Monographs, 2008), 1-2. The counterfactual reasoning represents the way to analyze possibilities, considering what would or might happen if one of the possibilities were to occur.

[10] B. Russell, 'On the Notion of Cause' 13 *Proceedings of the Aristotelian Society*, 1 (1912).

[11] P. Suppes, *A Probabilistic Theory of Causality* (Amsterdam: North-Holland Publishing Company, 1970) 41; W.C. Salmon, 'Probabilistic Causality' 61 *Pacific Philosophical Quarterly*, 50 (1980), claiming that events in the causal chain need to be considered not individually but considering their connections.

[12] V. Zeno Zencovich, 'Il nesso causale profili di diritto comparato' *Persona & Danno* (8 January 2009). He observes that the causal element is a function of three other aspects: the fault of the agent, the nature of the injured interests, the extent of the damage caused. Simplifying, we can say that the rigor in the causal rule will be inversely proportional to the gravity of the fault (or even the intent), to the hierarchical location of the protected interest (first of all, life) and to the dimensions of the damaging event. When the value attributed to one of these elements is particularly high, the judge will tend to reduce the importance of the causal rules, or to easily consider the connection.

[13] N. Godmann, 'The problem of Counterfactual Conditional' 44 *Journal of Philosophy*, 113 (1947); J.L. Mackie 'Counterfactuals and Causal Laws', in R.J. Butler ed, 1 *Analytical Philosophy: First Series*, 66 (Oxford: Oxford University Press, 1962); E. Nagel, *La struttura della Scienza* (Milano: Feltrinelli, 1968), 76.

the cause of a given event according to a judgment of a prognostic type based on probabilistic laws. A judgment, therefore, should not stop at the empirical perception of the plurality of existing conditions, but identifies the efficient cause of the phenomenon by placing as the object of the cognitive act not only what occurred, but rather what should have occurred according to a probabilistic prognosis.[14]

The use of the criterion of probability moves from the assumption that the legal causal assessment is represented by an ex post judgment given in the mind of the interpreter. If this premise is true, then the objective of the cognitive act of the jurist cannot be the identification of the true cause, but the determination of the event that turns out to be the appropriate cause of a given fact according to probabilistic laws.[15] The probabilistic theory has been developed by German scholars with some correction considering the adequate cause according to the best scientific knowledge.[16]

Considering the role of causation in civil liability and the above-mentioned theories, we must conclude that the question 'who is liable?' depends to the answer to another question 'who caused the damage?'

IV. Who Caused the Damage?

The presence of an automated choice affects the process of determining the event and the effect of the choice. As we have seen, the interaction between algorithms and human action may be present at different levels. According to the theory of probability, the human agent can be held responsible for the action if it is proved that the action was caused with high probability by the human agent. The problem is that such a vision does not take into account the interaction between man and machine in causing the event.

Let us hypothesize that a subject is acting using a semi-automated mechanism where the computer selects the action and informs the human operator, who can cancel the action, and also that the computer chooses an incorrect option and

[14] G.O. Robinson, 'Probabilistic Causation and Compensation for Tortious Risk' 14 *The Journal of Legal Studies*, 779 (1985).

[15] Probability should be considered according to the scientific evolution. *See* further G. Ponzanelli, 'Scienza, verità e diritto: il caso Bendectin. Nota a Corte Suprema USA 28 giugno 1993' *Foro italiano*, 184 (1994).

[16] See K. Engish, *Die Kausalitat als Merkmal der strafrechtlichen Tatbestande* (Tuebingen: Mohr Siebeck, 1931), 41. German scholars focus also on the necessity to consider the scope of the liability rule. *See* P. Sourlas, *Adäquanztheorie und Normzwecklehre bei der Begründung der Haftung nach Paragraph 823 Abs. 1 BGB* (Berlin: Duncker & Humblot, 1974). *See* also F. Realmonte, *Il problema del rapporto di causalità nel risarcimento del danno* (Milano: Giuffrè, 1967), 1-44; A.D. Candian, *Responsabilità civile e assicurazione* (Milano: Giuffrè, 1993), 25; G. Alpa, 'I fatti illeciti', in Pietro Rescigno ed, *Trattato di diritto privato* (Torino: UTET, 1995), 1-63; G. Calabresi, *The Cost of Accidents: A Legal and Economic Analysis* (Yale, CT: Yale University Press, 1970).

does not warn the person in time for her to be, able to intervene and avoid damage to third parties. It will not be enough to consider the probability that the computer error has caused the damage, but it will also be necessary to verify that the user, in case of correct warning from the computer, would have acted differently.

Therefore, we have a double counterfactual judgement: one with regard to the human choice and another with regard to the automated choice. If it has been proved that the cause of the accident is the automated choice, it will still be necessary to consider whether the computer error is a production error or if the option chosen by the computer is linked to the combination of algorithms and to an evolution of such a combination in a way that is autonomous from its own manufacturer. If the action or omission of the machine does not refer to a human action or omission, we must say that, regarding the causation proceeding, we are in the presence of an irresistible force that is not imputable to the user nor to the manufacturer.[17]

This is perfectly in line with the recommendations to the European Commission on civil law rules on robotics (2015/2103(INL) saying that: 'the more autonomous robots are, the less they can be considered to be simple tools in the hands of other actors'. Thus, it is important to reshape civil liability and/or find other mechanisms to prevent and compensate losses when

> 'the cause cannot be traced back to a specific human actor and (when)

[17] A problem correlated to the present is the possibility to recognize subjectivity to automated machine. See European Parliament resolution of 16 February 2017 with recommendations to the Commission on civil law rules on robotics (2015/2103(INL)):

'T. whereas Asimov's Laws must be regarded as being directed at the designers, producers and operators of robots, including robots assigned with built-in autonomy and self-learning, since those laws cannot be converted into machine code;

U. whereas a series of rules, governing in particular liability, transparency and accountability, are useful, reflecting the intrinsically European and universal humanistic values that characterise Europe's contribution to society, are necessary; whereas those rules must not affect the process of research, innovation and development in robotics;

V. whereas the Union could play an essential role in establishing basic ethical principles to be respected in the development, programming and use of robots and AI and in the incorporation of such principles into Union regulations and codes of conduct, with the aim of shaping the technological revolution so that it serves humanity and so that the benefits of advanced robotics and AI are broadly shared, while as far as possible avoiding potential pitfalls; (….)

Z. whereas, thanks to the impressive technological advances of the last decade, not only are today's robots able to perform activities which used to be typically and exclusively human, but the development of certain autonomous and cognitive features – eg the ability to learn from experience and take quasi-independent decisions – has made them more and more similar to agents that interact with their environment and are able to alter it significantly; whereas, in such a context, the legal responsibility arising through a robot's harmful action becomes a crucial issue;

AA. whereas a robot's autonomy can be defined as the ability to take decisions and implement them in the outside world, independently of external control or influence; whereas this autonomy is of a purely technological nature and its degree depends on how sophisticated a robot's interaction with its environment has been designed to be'. See G. Borges, 'Rechtliche Rahmenbedingungen für autonome Systeme' 71 *Neue Juristische Wochenschrift*, 977 (2018); S. Beck, 'Der Richtliche Status autonomer Maschinen' *Aktuelle Juristische Praxis*, 183 (2017).

the acts or omissions of robots which have caused harm could have been avoided'.[18]

The term 'force majeure' is frequently used to indicate causes that are outside the control of the parties, such as natural disasters, that could not be evaded through the exercise of due care. Force majeure is a circumstance that no human foresight could anticipate or which, if anticipated, is too strong to be controlled.[19] Depending on the legal system, such an event may relieve the parties from the obligation to compensate damage. The term 'force majeure' comes from French but with regard to the present meaning it is important to remember the German concept of '*höhere Gewalt*'. According to German jurisprudence, there is a *höhere Gewalt* if the event causing the damage has an external effect and the harm caused cannot be averted or rendered harmless by the extremely reasonable care.[20] However, it must be noted that the French force majeure is not identical with the German *höhere Gewalt*.[21] The French legal term 'force majeure' is in the narrowest sense limited to natural events, but in the broadest sense it is synonymous with the German term.

Regarding the case of automation, with the term force majeure we mean a force that is external to the actors (owner, user, manufacturer, programmer and, way not the public administration approving guidelines and conditions for the use of automation)[22] and irresistible, ie any actors cannot prevent or avoid the

[18] B. Russell, n 10 above.

[19] C. Plinii, 'Quae quum acciderint, vis major appellatur' *Secundi Historiae mundi*. Libri XXXVII, LXIX.

[20] RG VI 455/20, RGZ 101, 94, 95; RG IV 745/26, RGZ 117, 12, 13; BGH VII ZR 172/86, BGHZ 100, 185, 188.

[21] A. Blaschczok, *Gefährdungshaftung und Risikozuweisung* (Köln: C. Heymann, 1993); N. Jansen, *Die Struktur des Haftungsrechts* (Tuebingen: Mohr Siebeck, 2003). *See* also: BGH X ZR 146/11; LG Frankfurt am Mein, lexetius.com/2012, 4178 – which took into account also EU law. The European Union legislature has therefore chosen a term which, in the starting point, is similar to the criterion of force majeure (as used in Common Position (EC) no 27/2003 of 18 March 2003 OJ C 125 E/63). The legislator's consideration of the concept of force majeure, inherent in the concept of force majeure, is such that exceptional circumstances do not per se eliminate the obligation to compensate. This is only the case if the exceptional circumstances could not have been avoided even if all reasonable measures had been taken.

About the new risks related to automation H. Zech, 'Zivilrechtliche Haftung für den Einsatz von Roboten', in S. Gless and K. Seelmann eds, *Intelligente Agenten und das Recht* n 5 above, fn 163.

[22] For instance, in Italy on 28 February 2018, the Minister of Transport and Infrastructure (MIT) issued a decree which permits road testing of automatic guided vehicles.

The decreto legislativo of 28 February 2018 was implemented taking into account Regulation (EC) 377/2014 of the Parliament and of the European Council of 3 April 2014, establishing the program Copernicus and repealing Regulation (EU) 911/2010; and having regard to European Parliament and Council Directive 2010/40/EU of the of 7 July 2010, on the general framework for dissemination intelligent transport systems in the transport sector and interfaces with other modes of transport

The Act of Italian Minister of Transport reports interventions, times and types of roads involved.

automated choice, for instance because, thanks to self- learning, the machine is acting in an unpredictable way respect to the preprogrammed choice.[23]

In case of the intervention of force majeure, there is an interruption of the causal chain. So, in case of an automated choice acting like a force majeure it is not possible, according to the ordinary rules of civil liability, to put the liability

The Decree identifies functional standards to create more connected and safer roads that, thanks to new technologies introduced in road infrastructures, can dialogue with users on board vehicles, in order to provide real-time information on traffic, accidents, weather conditions, up to tourist news that characterize the different routes. They will cover newly constructed or governmental motorways or governmental sections. In particular, in a first phase, by 2025, action is taken on the Italian infrastructures belonging to the European TEN-T network, Trans European Network - Transport, and on the entire motorway and state network. Progressively, the services will be extended to the entire network of the national integrated transport system, as identified by the annex to DEF Decree 17 April 2017 'Connecting Italy'.

By 2030, we expect that further services will be activated: diversion of flows, intervention on average speeds to avoid congestion, suggestion of trajectories, dynamic management of access, parking and refueling, even electric; the installation of devices for the structural monitoring of the static nature of road works.

The interventions for the transformation in smart road have been identified after a comparison with the sector and taking into account what has already been achieved by some motorway concessionaires and by Anas (the company that manages the Italian roads).

At the same time, the decree draws the path towards the experimentation of innovative driver assistance systems on new connected infrastructures.

The Ministry of Infrastructure and Transport can authorize, on request and after a specific investigation, the testing of automatically guided vehicles on certain stretches of road, according to specific procedures and controls during the experimentation, with the aim of ensuring that it takes place in conditions of absolute security. University institutes, public and private research institutes, vehicle manufacturers equipped with automatic driving technologies may apply for authorization.

[23] Cour de Cassation, Chambre civile 2, 8 February 2018, no 16-26.198, P+B+I, '*le tiers avait poussé la victime sur les rails alors que le train redémarrait. La Haute juridiction affirme que "le comportement du tiers qui pousse un usager contre une rame alors que celle-ci redémarre n'est nullement irrésistible pour la RATP, qui dispose de moyens modernes adaptés permettant de prévenir ce type d'accident, de sorte que le fait du tiers ne présentait pas les caractéristiques de la force majeure exonératoire de la responsabilité pesant sur elle"* '; Cour de Cassacion, Chambre civile 2, 8 February 2018, no 17-10.516, P+B+I '*le tiers, souffrant de schizophrénie, avait ceinturé et entrainé la victime sur les rails, et l'enquête avait conclu à un homicide volontaire et un suicide. Le Fonds de garantie des victimes d'actes de terrorisme a indemnisé les ayants droit de la victime et s'est par la suite retourné contre la SNCF. Pour exonérer cette dernière de toute responsabilité, la Cour de cassation relève que "aucune altercation n'avait opposé les deux hommes qui ne se connaissaient pas, qu'un laps de temps très court s'était écoulé entre le début de l'agression et la collision avec le train (…) et qu'aucune mesure de surveillance ni aucune installation n'aurait permis de prévenir ou d'empêcher une telle agression, sauf à installer des façades de quai dans toutes les stations ce qui, compte tenu de l'ampleur des travaux et du fait que la SNCF n'était pas propriétaire des quais, ne pouvait être exigé de celle-ci à ce jour". Elle en déduit que c'est à bon droit que la cour d'appel a conclu à la caractérisation d'un cas de force majeure. La solution sur ce second point semble mettre un point final à la rigueur d'appréciation de la force majeure exonératoire de la responsabilité du transporteur (par exemple, Cass. 1re civ., 21 nov. 2006, n° 05-10.783, Bull. civ. I, n° 511 ; pour une appréciation de la faute de la victime non constitutive de la force majeure: Cass. ch. mixte, 28 nov. 2008, n° 06-12.307, Bull. civ. ch. mixte, n° 3), courant qui avait été amorcé en 2011 (Cass. 1re civ., 23 juin 2011, n° 10-15.811, Bull. civ. I, n° 123)*'.

on the owner/user of the machine (the owner/user of the automated vehicle, the hospital that is the owner/user of the automated machine for surgery, etc).

The term force majeure, in case of civil liability, indicates a cause of break of the causation chain such as the case of an act of God and other natural events. The defendant's liability ceases at the moment in time when the supervening inevitable condition occurs.[24] Rather than referring to contractual liability, force majeure is instead a cause justifying the breach of contract as it determines the impossibility of fulfilling the performance requested by the contract.

We must also reflect on the possibility of eliminating the relevance to the causal link in some cases through legislative provisions. The problem is that, by eliminating the relevance of the causal link, the deterrent function of civil liability would also be eliminated, or at least strongly reduced. If no liability can operate in this case, no liability insurance can operate at the same time. Civil liability is the object of coverage in case of liability insurance.

It could be possible to provide for other forms of compensation, such as the establishment of public funds financed through a specific tax paid by the owners or by the users of automated machines. Those funds would cover damage caused by totally automated machines that can give rise to cases of damage where no one claims responsibility. In European Union member states and not only with regard to vehicles, a public fund for victims of car accidents already exists.[25]

With regard to the liability in case of automated choice, we have to remember the premises of the European Parliament's Resolution on robotics.[26] There, the

[24] See, in common law, *Carslogie Steamship Co Ltd* v *Royal Norwegian Government* (1952) AC 292. The complaint's vessel was damaged by a collision with the defendant. After the collision the complaint repaired the vessel that was certified to sail for NY. On the way the vessel suffered other damage from stormy weather at sea. The Court held that the defendant from the collision, not for further damage sustained by the natural events at the sea.

[25] European Parliament and Council Directive 2009/103/EC relating to insurance against civil liability in respect of the use of motor vehicles, and the enforcement of the obligation to insure against such liability (2009) OJ L 263/11: According to the Directive 2009/103/EC, point 53: 'Where it is impossible to identify the insurer of a vehicle, it should be provided that the ultimate debtor in respect of the damages to be paid to the injured party is the guarantee fund provided for this purpose situated in the Member State where the uninsured vehicle, the use of which has caused the accident, is normally based. Where it is impossible to identify the vehicle, it should be provided that the ultimate debtor is the guarantee fund provided for this purpose situated in the Member State in which the accident occurred.'

[26] European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)), available at tinyurl.com/t5zrewh (last visited 7 July 2020): 'whereas the more autonomous robots are, the less they can be considered to be simple tools in the hands of other actors (such as the manufacturer, the operator, the owner, the user, etc); whereas this, in turn, questions whether the ordinary rules on liability are sufficient or whether it calls for new principles and rules to provide clarity on the legal liability of various actors concerning responsibility for the acts and omissions of robots where the cause cannot be traced back to a specific human actor and whether the acts or omissions of robots which have caused harm could have been avoided;

AC. whereas, ultimately, the autonomy of robots raises the question of their nature in the light of the existing legal categories or whether a new category should be created, with its own

European Parliament seems to propose a form of strict liability for users or owners of robots and does not consider the causal nexus. In the case of strict liability, the fault or the negligence of the person held responsible by the law is not relevant, but causality is a different condition in civil liability from the proof of fault or of negligence of the actors.

Moreover, even if a special normative intervention eliminates the proof of a causal link, victims, who sue for compensation of losses caused by automated choice have to face the problem of the interconnected responsibilities usually present in case of automation. Machines utilize information to make elaborate choices from different sources. Some of these sources are automated machines themselves. Automation operates in a cyberspace that is

> 'a time-dependent set of interconnected information systems and the human users that interact with these systems'.[27]

It means that it is difficult to determine who is liable in such cases.

It could be possible to anticipate liability at the moment of the 'choice on automation' putting liability not on the cause/s of the damage, but on who bears the risk of automation the manufacturer, the owner and/or the user.

V. Reshaping the Manufacturer Liability, Motor Liability and Motor Insurance

Particular attempts to find solutions to compensation issues can be found in some interventions at level of national law and of European legislation trying to reshape liability in case of motor liability and in case of manufacturer liability.

In the United States, different statutes have been enacted about the use of automated vehicles. Some States (California, Florida and Nevada) provide that

specific features and implications;

AD. whereas under the current legal framework robots cannot be held liable per se for acts or omissions that cause damage to third parties; whereas the existing rules on liability cover cases where the cause of the robot's act or omission can be traced back to a specific human agent such as the manufacturer, the operator, the owner or the user and where that agent could have foreseen and avoided the robot's harmful behavior; whereas, in addition, manufacturers, operators, owners or users could be held strictly liable for acts or omissions of a robot;

AE. whereas according to the current legal framework for product liability - where the producer of a product is liable for a malfunction- and rules governing liability for harmful actions -where the user of a product is liable for a behavior that leads to harm- apply to damages caused by robots or AI;

AF. whereas in the scenario where a robot can take autonomous decisions, the traditional rules will not suffice to give rise to legal liability for damage caused by a robot, since they would not make it possible to identify the party responsible for providing compensation and to require that party to make good the damage it has caused'.

[27] See the definition proposed by NATO Cooperative Cyber Defense Centre, available at tinyurl.com/v8cex2b (last visited 7 July 2020).

it is mandatory for drivers of automated vehicles to submit an insurance or a surety bond or to give proof of a self-insurance.[28] Moreover, Nevada's legislation does not require a licensed operator for a 'fully autonomous vehicle' if the vehicle can achieve 'a minimal risk condition' in the event of a failure.[29] A different solution has been proposed by other States, which require a human operator to be present and capable of taking over in an emergency.[30] In German law, a new § 1a *StVG* (the German law on motor liability) on 'Motor vehicles with highly or fully automated driving function'[31] has been introduced on 16 June 2017. Under German law, the liability of the car owner as in § 7 StVG, in the case of an autonomous vehicle, remains unaffected anyway, since the owner is liable for all damage that can be referred to the 'operation of a motor vehicle'. So it is just an additional liability of the motor vehicle driver. For this purpose, the new

[28] See Cal Veh Code § 38750(b) (3) (2015); Fla Stat Ann § 316.86 (2016); Nev Rev Stat Ann § 482.060 (2015).

[29] See Nev Rev Stat Ann § 482A.200.

A deep analysis of worldwide legislation on automated cars has been made by Aida Joaquin Acosta, 'What Governments Across the Globe Are Doing to Seize the Benefits of Autonomous Vehicles' available at tinyurl.com/tb2w56p (last visited 10 January 2020).

[30] B.A. Browne, 'Self-Driving Cars: On The Road to a New Regulatory Era' 8 *Journal of Law, Technology and the Internet* 1, 12 (2017).

[31] Straßenverkehrsgesetz (5 March 2003) BGBl. I S. 310, 919 (StVG):

'§ 1a Kraftfahrzeuge mit hoch- oder vollautomatisierter Fahrfunktion

(1) The operation of a motor vehicle by means of highly or fully automated driving function is permitted if the function is used as intended.

(2) Motor vehicles with highly or fully automated driving function within the meaning of this Act are those which have technical equipment,

1. To control the driving task - including longitudinal and transverse guidance - the respective motor vehicle after activation control (vehicle control),

2. which is able to comply with traffic regulations directed at vehicle guidance during highly or fully automated vehicle control,

3. which can be manually overridden or deactivated by the driver at any time,

4. can recognize the necessity of the vehicle hand control by the driver,

5. the driver can visually, acoustically, tactually or otherwise perceptibly display the requirement of the autograph vehicle control with sufficient reserve of time before the vehicle control is delivered to the driver, and

6. indicates use contrary to one of the system descriptions.

The manufacturer of such a motor vehicle must declare in the system description that the vehicle complies with the requirements of sentence 1.

(3) The preceding paragraphs shall only be applied to vehicles which are approved in accordance with § 1 (1), which comply with the requirements of paragraph 2 sentence 1 and whose highly or fully automated driving functions

1. are described in, and comply with, international regulations applicable in the scope of this Act; or

2. A type-approval pursuant to Article 20 of Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers and of systems, components and separate technical units intended for such vehicles (Framework Directive) (OJ L 263, 9.10.2007, p.

(4) Driver is also the one who activates a highly or fully automated driving function referred to in paragraph 2 and used for vehicle control, even if he does not control the vehicle in the context of the intended use of this function by hand'.

norm contained in § 1a StVG says that the user must remain receptive to be able to take control immediately.[32]

In fact, under § 1a StVG, an automated vehicle: must be able to be manually overridden or deactivated by the driver at any time; shall recognize the necessity of the vehicle hand control by the driver; and shall visually, acoustically, tactually or otherwise discernibly indicate to the vehicle driver the requirement of the vehicle hand control with sufficient time reserve before the vehicle control is delivered to the vehicle driver.

In Italy, the Minister of Transport and Infrastructure (MIT) issued a decree on February 28, 2018 which permits road testing of automatic guided vehicles. It was implemented taking into account Regulation (EU) 377/2014 of the Parliament and of the European Council of 3 April 2014, establishing the program Copernicus and repealing regulation (EU) 911/2010; and having regard to directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010, on the general framework for dissemination intelligent transport systems in the transport sector and interfaces with other modes of transport. Regarding liability in case of accidents, Art 1 letter J of the Decree says that

> 'the occupant of the vehicle, who must be always able to take control of the vehicle regardless of the degree of automation of the same, in any moment the need arises, acting on the vehicle controls with absolute precedence over automated systems and which, therefore, is the person responsible for the circulation of the vehicle'.

Insurance issues also take a relevant role in these cases.

In May 2018, the European Commission presented a proposal to amend the motor insurance directive.[33] Under these revamped rules, once adopted by the European Parliament and the Council: victims of motor vehicle accidents will be able to receive the full compensation they are due, even when the insurer is insolvent; drivers who have a previous claims history in another EU country will be treated equally to domestic policyholders, and will potentially benefit from better insurance conditions.[34] There is no special provision on automated

[32] See R. Greger, 'Haftungsfragen beim automatisierten Fahren. Zum Arbeitskreis II des Verkehrsgerichtstags' 31 *Neue Zeitschrift fuer Verkehrsrecht*, 1-5 (2018).

[33] European Commission, n 37 below.

[34] At point 7 the proposal for the Directive says that: 'Effective and efficient protection of victims of traffic accidents requires that those victims are always reimbursed for their personal injuries or for damage to their property, irrespective of whether the insurance undertaking of the party liable is solvent or not. Member States should therefore set up or appoint a body that provides initial compensation for injured parties habitually residing within their territory, and which has the right to reclaim that compensation from the body set up or appointed for the same purpose in the Member State of establishment of the insurance undertaking which issued the policy of the vehicle of the liable party. However, to avoid parallel claims being introduced, victims of traffic incidents should not be allowed to present a claim for compensation with that

car is included in the text. We also have to consider and consider the fact that, at the end of 2017, Insurance Europe (the European insurance and reinsurance federation)[35] has responded to the European Commission's REFIT consultation on the Motor Insurance Directive (MID), which should be an essential tool in the protection of road traffic accident victims and should be preserved.[36]

On 17 May 2018, the European Commission published a new communication,[37] in which it focuses on the importance of non-personal data sharing while protecting cybersecurity and on the importance of fostering vehicle connectivity for automation.[38] With regard to the safety on the roads and victims' compensation, the European Commission affirms that the motor insurer can take actions against the manufacturer.[39]

Automation also imposes the reshaping of rules on manufacturers' liability, especially with regard to the concepts both of defect an of product.[40] In 2018, the European Commission submitted the fifth report on the application of

body if they have already presented their claim or have taken legal action with the insurance undertaking concerned and that claim is still under consideration and that action is still pending'.

[35] See insuranceeurope.eu (last visited 7 July 2020).

[36] See tinyurl.com/ut3p37t (last visited 7 July 2020): Insurance Europe stressed that: 'the MID is also fit for purpose for connected and autonomous vehicles. It added that these must not be excluded from the MID's scope, as this would undermine the protection of road users. Insurance Europe noted that the success of the MID in achieving its goals is dependent on an open and competitive motor third party liability (MTPL) insurance market. As such, MTPL insurers must be able to exercise their commercial judgement freely. However, interferences - such as the standardization of claims history statements - would complicate MTPL insurers' business without bringing real added value to European drivers. Given the increasing connectivity of vehicles, an open and competitive MTPL insurance market also requires rules to be in place at European level to ensure access to in-vehicle data is independent from vehicle manufacturers. This would ensure it is European drivers that decide who can access their data, and for what purposes'.

[37] European Commission, Communication On the Road to Automated Mobility: an EU Strategy for Mobility of the Future, COM(2018)283 final, available at tinyurl.com/v7y732r (last visited 7 July 2020).

[38] See A.C. Nazzaro, 'Macchine intelligenti (*smart cars*): assicurazione e tutela della *privacy*' *Diritto del mercato assicurativo e finanziario*, 60 (2018).

[39] European Commission, n 37 above: 'On the compensation of victims, the Motor Insurance Directive already provides for a quick compensation of victims including where an automated vehicle is involved. The insurer can then take legal action against a vehicle manufacturer under the Product Liability Directive if there is a malfunction/defect of the automated driving system. The European Commission just evaluated the Product Liability Directive and as a follow-up, it will issue an interpretative guidance clarifying important concepts in the Directive including in the light of technological developments'.

[40] See tinyurl.com/wku9brt (last visited 7 July 2020).

See K. Chagal, 'Am I an Algorithm or a Product? When Products Liability Should Apply to Algorithmic Decision-Makers' (2018), 27, available at tinyurl.com/ycx7qrdb (last visited 7 July 2020). He proposes a new approach to distinguishing traditional products from 'thinking algorithms' for the determining whether products liability should apply. Instead of examining the vague concept of 'autonomy', the article analyzes the system's specific features and examines whether they promote or hinder the rationales behind the products liability legal framework. An algorithm that replaces human discretion cannot be considered a product, as information and services are not considered as to be products. At the same time damage caused by automation cannot be considered as to be 'defect of the production' when they are caused by a probability-based prediction.

Directive on product liability. The Commission carried out a formal evaluation of the Directive, assessing whether the Directive continues to be an adequate tool and continues to meet its objectives today in the light of new technological developments. The Commission launched a public consultation on the evaluation of Directive on product liability in order to collect stakeholders' feedback on the application and performance of the Directive, including considerations on challenges raised by new technological developments.

As a result of this process, the Commission issued in 2019 guidance on the Directive on product liability, as well as a report on the broader implications for, potential gaps in and orientations for, the liability and safety frameworks for artificial intelligence, the Internet of Things and robotics. With regard to new technological challenges, the European Commission's Report considers the following questions: Does the Directive adequately address the challenges of increasingly autonomous devices and cybersecurity? What about sustainability and reaching a circular economy? Does the Directive unnecessarily discourage producers from placing innovative products on the market? Or conversely, does it deter manufacturers from placing faulty and unsafe products on the market? Does it still protect injured persons in a changing world?[41]

Some gaps of the Directive on product liability are underlined by this evaluation:[42]

- The application of the Directive is problematic for products in which software and applications from different sources can be installed after purchase, that are connected to the Internet and can perform automated tasks based on algorithms and data analysis, automated tasks based on self-learning algorithms or shared

[41] European Commission, n 37 above. The Commission concluded affirming that: 'The Directive has until now covered a broad range of products and technological developments. In principle, it is a useful tool for protecting injured persons and ensuring competition in the single market, by harmonizing rules for injured persons and businesses in the aspects that it covers. It is an area where EU level rules provide a clear added value. Having EU level rules for product liability is uncontested. This does not mean that the Directive is perfect. Its effectiveness is hampered by concepts (such as 'product', 'producer', 'defect', 'damage', or the burden of proof) that could be more effective in practice. As the evaluation has also shown, there are cases where costs are not equally distributed between consumers and producers. This is especially true when the burden of proof is complex, as may be the case with some emerging digital technologies or pharmaceutical products'. Technology is going to change the concept of a defective product but also the concept of production. As correctly underlined by the Commission: 'Some of the concepts that were clear-cut in 1985, such as 'product' and 'producer' or 'defect' and 'damage' are less so today. Industry is increasingly integrated into dispersed multi-actor and global value chains with strong service components. Products can increasingly be changed, adapted and refurbished beyond the producer's control. They will also have increasing degrees of autonomy. Emerging business models disrupt traditional markets. The impact of these developments on product liability needs further reflection. At the end of the day, a producer is and needs to be responsible for the product it puts into circulation, while injured persons need to be able to prove that damage has been caused by a defect. Both producers and consumers need to know what to expect from products in terms of safety through a clear safety Framework'.

[42] See tinyurl.com/u9p8q04 (last visited 7 July 2020).

with other users through collaborative platforms;

- In case of damage caused by software, there could be a problem of proof. In case of open-source software used, for instance, in the medical field, it could be difficult to prove the damage resulting from a misdiagnosis due to a failure in the software;

- In case of interconnected products correctly attributing liability for defects can be difficult;

- A new concept of production is emerging. New technological developments such as 3D printers, which enable consumers to become manufacturers, could potentially undermine the attribution of the product that caused the damage; and

- Typical technological damage also needs to be compensated. Let us think to service failures such as downtime or loss of data.

This last point underscores the importance of considering product liability together with cybersecurity.

The European Commission considers Artificial intelligence (AI) an area of strategic importance and a key driver of economic development. At the same time, the EC addressed socio-economic, legal and ethical impacts of the AI. It expressed in all its communication a European approach to Artificial Intelligence based on three pillars:[43]

1. Being ahead of technological developments and encouraging uptake by the public and private sectors. The European Commission is increasing its annual investments ordered to connect and strengthen AI research centers across Europe. The European Commission supports the development of an 'AI-on-demand platform' that will provide access to relevant AI resources in the EU for all users and supports the development of AI applications in key sectors. On 10 April 2018, 25 European countries signed a Declaration of cooperation on Artificial Intelligence. It builds further on the achievements and investments of the European research and business community in AI;[44]

2. Preparing for socio-economic changes brought about by AI. The European Commission will support business-education partnerships to attract and keep more AI talent in Europe; it will set up dedicated training and retraining schemes for professionals; it will foresee changes in the labor market and skills mismatch; it will support digital skills and competences in science, technology, engineering, mathematics (STEM), entrepreneurship and creativity; and

3. Ensuring an appropriate ethical and legal framework, the final ethics guidelines for trustworthy artificial intelligence prepared by the High-Level European Group on artificial intelligence were published on 8 April 2019. The

[43] See tinyurl.com/y7to5ws4 (last visited 7 July 2020). See also Report of the Committee on Industry, Research and Energy of 30 January 2019 on a comprehensive European Industrial Policy on Artificial Intelligence and Robotics (2018/2088(INI), available at tinyurl.com/sufqlac (last visited 7 July 2020).

[44] See tinyurl.com/y6wd9sud (last visited 7 July 2020).

European Commission will also develop and make available guidance on the interpretation of the product liability directive.

These documents focus on new useful kinds of machine learning approach like the so called 'reinforcement learning'. In this approach, the AI system is free to make its decisions over time, and at each decision point, we provide it with a reward signal that tells it whether it was a good or a bad decision. The goal of the system is to maximize the positive reward received. This approach is used, for example, in recommender system (such as the several online recommender systems that suggest users what they might like to buy), or also in marketing.

Accordingly, at the end the group proposes a new definition of AI, which could improve the task and the liability of the manufacturer:

> 'Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behavior by analyzing how the environment is affected by their previous actions.
>
> As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search, and optimization), and robotics (which includes control, perception, sensors and actuators, as well as the integration of all other techniques into cyber-physical systems)'.

The Commission's Communication of 8 April 2019 sets out a human-centric approach. AI is seen as a tool operating in the service of humanity and the public good, which aims to increase individual and collective human well-being. Since people will only be able to confidently and fully reap the benefits of a technology that they can trust, AI's trustworthiness must be ensured. With this Communication, the European Commission welcomes the publication of guidelines on AI.

As noted above, AI HLEG presented a first draft of the guidelines in December of 2018. Following further deliberations by the group in light of discussions on the European AI alliance, a stakeholder consultation and meetings with representatives from Member States, the guidelines were revised and published in April 2019.

Based on fundamental rights and ethical principles, the guidelines published in 2019 list seven key requirements that AI systems should meet in order to be

trustworthy:

- Human agency and oversight;
- Technical robustness and safety;
- Privacy and Data governance;
- Transparency;
- Diversity, non-discrimination and fairness;
- Societal and environmental well-being; and
- Accountability.

VI. The Alternative Role of Insurance in Compensation and Prevention of Damage Caused by Automated Vehicles

Even if the use of automated machines can cause damage, it represents an important risk reduction tool.[45] At the same time, it is important to respond to the issue of compensation and prevention of damage caused by machines autonomously.

Civil liability could be considered the basic instrument to prevent and compensate damage, but may not always be appropriate in cases of damage caused by AI if it is not possible to trace back damage to a responsible person. Scholars and legislators propose to reshape civil liability in case of intervention of automation. It is possible to propose a regulatory intervention that introduces strict liability of the user and/or of the owner of automated machines, where strict liability means a responsibility that does not give relevance neither to the guilt nor to the causal link between wrongdoing and losses, but such solution risks discouraging the use of automation. This consideration is valid not only with respect to road accidents where automation can reduce human errors. Many environments exist where automated work, also increasing quality and productivity, can be the solution to operations under hazardous conditions. Moreover, such solutions seem to not play any role in preventing damage caused by machines because the only way the owner and/or the user can reduce the risk of damage cause by machines operating in full automation is to not use the full automation. Civil liability therefore needs to be reshaped together with insurance.

For example, the owner could be stimulated, from the fear of incurring responsibility, to subject the machine to an update and revision so that it is adequate to the best standards in terms of safety. However, we believe that it is preferable for the owner to be guided in the maintenance of the machine in order to make its operation as safe as possible. Moreover, the introduction of strict liability rule on the owner or on the user could discourage the use of AI in contrast with the common idea that AI represents an important instrument to reduce risks.

[45] R. Eastwood, T.P. Kelly, R.D. Alexander and E. Landre, 'Towards a Safety Case for Runtime Risk and Uncertainty Management in Safety-Critical Systems' *System Safety Conference incorporating the Cyber Security Conference*, 1–6 (2013).

In seeking a solution, perhaps we need to focus attention on the importance of compensation and prevention, which usually finds a solution in civil legal liability.

We must say that, in the event of damage that can be referred to an automated machine, prevention will be more easily guaranteed by the collection of additional data relating to cases, in which defaults of the machine have been determined, in order to improve the state of knowledge and reduce damage for the future also thanks to the 'reinforcement learning'.[46]

It therefore appears that the goals of compensation and prevention are better achieved by a system that allows the compensation of the victim and at the same time the acquisition of data relating to the claims, their processing to provide new knowledge, manage the risks of defaults in the future and prevent damage. These functions can be performed by insurance companies that could, at the time of settlement of the claim, compensate the damage, acquire data and process them. These are activities that companies have already been carrying out creating knowledge in risk management. The insurers can use the knowledge acquired to give instructions to the insured in order to make safer and safer the insured automated systems. Insurance contracts can create and update standards and guidelines, and include special conditions providing the exclusion of coverage if the insured automated system is not complaint with the standards and the guidelines. All this does not mean completely overcoming the hypotheses of civil liability and creating a completely no-fault system.[47] We believe that civil

[46] N. Bostrom, 'When Machines Outsmart Humans' 35 *Futures*, 759, 763 (2003). Artificial intelligence theorists use the term 'singularity' or 'technical singularity' to describe the moment in time, purely hypothetical at this point, when machines exceed human intelligence. He noted that it is not essential that the machine has the capacity to actually choose to break a 'rule'; it is enough that the machine's programming does not necessarily determine how the machine will act in all situations, leaving the machine to 'learn' how to make decisions when confronted with a situation not within the contemplation of the machine's programmers. See B. Rossington, 'Robots Smarter Than Humans Within 15 Years. Predicts Google's Artificial Intelligence Chief' *Mirror News* (2 February 2014), available at tinyurl.com/w8ympsq (last visited 7 July 2020). See Recommendations to the European Commission on Civil Law Rules on Robotics (2015/2103(INL)). As said, the Commission stressed on this point: 'the more autonomous robots are, the less they can be considered to be simple tools in the hands of other actors (such as the manufacturer, the operator, the owner, the user, etc); whereas this, in turn, questions whether the ordinary rules on liability are sufficient or whether it calls for new principles and rules to provide clarity on the legal liability of various actors concerning responsibility for the acts and omissions of robots where the cause cannot be traced back to a specific human actor and whether the acts or omissions of robots which have caused harm could have been avoided'.

[47] On strict liability, D.C. Vladeck, 'Machines Without Principals: Liability Rules and Artificial Intelligence', 89 *Washington Law Review*, 117, 146 (2014): 'My proposal is to construct a system of strict liability, completely uncoupled from notions of fault for this select group of cases. A strict liability regime cannot be based here on the argument that the vehicles are 'ultra-hazardous' or 'unreasonably risky' for the simple reason that driver-less vehicles are likely to be far less hazardous or risky than the products they replace. Indeed, it is precisely because these machines are so technologically advanced that we expect them not to fail. For these reasons, a true strict liability regime will be needed; one that does not resort to a risk-utility test or the re-institution of a negligence standard for the simple fact that those tests will be difficult, if not impossible,

liability can still play a relevant role in the artificial intelligence system, provided that, as noted by the doctrine,[48] the concepts on which the cases of civil responsibility are based are innovated: negligence, the defect in production, the duty not to harm.

As noted above, a first solution could be to establish by law that the owner is always liable if he/she accepts to use automation losing the control of the machine. The legislator should also provide for a mandatory insurance for the owner, in all cases of automation and not only in case of automated cars.

Moreover, the additional value of insurance in case of risks related to automation is that the insurer can create and update standards and guidelines and include in insurance contracts special conditions providing the exclusion of coverage if the automated system is not compliant with those standards and the guidelines that are under the control of the owner. It is also possible, in order to preserve the interest of the victims to be compensated, to provide for the indemnification of the victim. Even in case of damage caused by the automated machines that is working in a way that is not compliant with the standards and the guidelines imposed by contract by the insurers who, will have the right to subrogation/regress against the owner/insured). This means that the exclusion by contract will operate against the insured and not against the victim. In these terms, insurance can represent a level and a guide to the correct maintenance of the machine according to the best safety conditions. In this way, however, we create a disincentive to the use of automation, which will be burdened by insurance premium. While the automation, as said, can contribute significantly in reducing accidents.

Another solution could be the creation of a public fund to compensate victims of full automation like in case of guarantee funds for road accidents victims introduced by the Directive 84/5/CEE Art 1 para 4. The public fund could delegate to insurance companies the management of accidents (assessment and compensation). The designated insurance company would compensate the victim and it will be reimbursed by the public fund that could be financed by the producers, assuming that they are receiving the most part of economic advantages from production of automated machines. Moreover, we have to point out the role that producer can play in achieving high standard of products' safety and in maintaining such level of safety by recalling back products that need to be updated.

for the injured party to overcome'. The Author says also that: 'Lest there be any doubt, my argument is not based on notions of a 'no-fault' liability system, that is, a system that substitutes mandatory insurance and eliminates access to the judicial system. My proposal is a strict liability regime implemented by the courts. Although the idea of 'no fault' systems took hold in the 1970s and 1980s, and was expected to drive down insurance costs by limiting the transaction costs related to litigation, it is by now apparent that those systems have not worked as envisioned. It is likely, however, that the introduction of driverless cars will shift liability from the 'driver' to the manufacturer, and that shift may trigger a resurgence of interest in 'no fault' insurance regimes' (fn 91). See, eg, J.M. Anderson et al, *The US Experience with No Fault Automobile Insurance: A Retrospective* (Santa Monica: The RAND Corporation, 2010).

[48] See nn 8-9 above.

In this case, the task to create and update standards and guidelines could be over the Fund together with the delegated insurance companies. The machine algorithms will need to be updated to those standards and guidelines. In order to leave the liability on the wrongdoer and compensate the victim, it could be possible to establish, in the statute regulating the fund, that the victim, after being compensate will subrogate the fund in her/his rights against the wrongdoer who could be the producer, the owner, the user also in case of omission in updating the machine.

In this way the goals of compensation and prevention are reached without discouraging the full automation.

The interaction between human beings and machines with regard to automation of course will not only reshape civil liability but also insurance. As noted above

> 'we soon realize, however, that the insurance of the civil liability can play much broader functions than those limited to the interest of any responsible person. We soon realize that if the concept of liability has led and developed the liability insurance, this has certainly contributed to the further opening of the first, so as to represent more than a vicious circle, an upward spiral in the progress of the law. And we realize also that the function cannot be limited to the protection of the tortfeasor's exclusive interest, but it is necessary to expand the protection of the real victim, the injured third party'.[49]

VII. Conclusions

Automated choices, as discussed throughout this paper, can reduce the risk of accidents, but some damages are not avoidable. As stressed in some cases the cause of damage cannot be traced back to a specific human actor.

Given such a scenario, it is important to compensate the victims. So far, the European Commission has focused particularly on driving automated vehicles and underlined the importance of coordinating the responsibility of the user, of the owner and of the manufacturer. However, it is absolutely imperative that we also consider the different levels of automation and human-machine interaction for the purpose of proof of causal link. In case of automation, the network of actors in the process determining the damage is so complex that it could be difficult to determine what's the cause of the damage. Could it be the use of the machine? A defect of the machine? A defect of the algorithms? When putting strict liability

[49] A. Donati, *Trattato del diritto delle assicurazioni private. Il diritto del contratto di assicurazione. La disciplina delle singole specie (rami) di assicurazione* (Milano: Giuffrè, 1956), III, II, 329.

on the owner of the machine or on the producer and improving the level of diligence on the actors, it is important to determine causation that is something different from the guilt in the wrongdoing.[50]

In case of full automation, if the action or omission of the machine does not refer to any human actions or omissions we conclude that, with regards to the proceeding of causation, we are in the presence of an irresistible force that is neither imputable to the user, the owner, or the manufacturer. We have therefore evaluated two possible solutions: a) either an attempt to find another way to compensate victims, ie a way different from civil liability (eg through public funds),[51] or via a specific mandatory insurance for owners of automated machines); or b) the regulation of the use of full automated choices leaving always the final choice, and together with it the liability, to the user who must maintain the control.

As noted above, the EU Law considers automation under different perspectives. First, in May 2018, the European Commission presented a proposal to amend the motor insurance directive. That proposal stressed the importance of victims' compensation, but is does not contain any specific norms regarding automated vehicles.[52] Secondly, some gaps in EU law have been underscored by the evaluation of the directive on product liability, which considers the approximation of laws, regulations and administrative provisions of the Member States concerning liability for defective products. The evaluation report also considers typical technological damage that needs to be compensated, for instance service failures such as downtime or loss of data. Thirdly, on 17 May 2018 the European

[50] See V. Tadros, 'Causation, Culpability, and Liability', in C. Coons and M. Weber eds, *Ethics of self-defense* (Oxford: Oxford University Press, 2016), chapter 6. About the problem of 'multi-agents' in case of automation, see G. Teubner, 'Digitale Rechtssubjekte? Zum privatrechtlichen Status automoner Softwareagenten' 218 *Archiv fuer die civilistische Praxis*, 155 (2018) and Id, *Soggetti giuridici digitali? Sullo status privatistico degli agenti software antonomi* (Napoli: Edizioni Scientifiche Italiane, 2019), 120, stressing the importance to determine a financial entity able to compensate victims.

[51] As said (n 44 above), also in this case thanks to a fruitful discussion with Professor Fuglinszky, the State could be considered liable as it approved guidelines and conditions for the use of automation. Professor Fuglinzski stressed on the following points with regard to automated cars: administrative law allows AVs to take part in normal traffic, so there is an explicit permission given by administrative law; the software is preprogrammed according to the applicable ethical guidelines in the country.

[52] M. Channon, 'Autonomous Vehicles and Legal Effects: Some Considerations on Liability Issues' (according to my research: Conference: AIDA Motor Insurance Working Party Paris (instead of DIMAF), 33 (2015)). He underlines regarding EU law that: 'It is submitted that an overall EU wide approach is needed for autonomous vehicles and this should be considered as soon as possible. The Motor Insurance Directives have sought to remove any barriers to trade by harmonizing key aspects of the law of Motor Insurance to protect free movement. Differing laws on autonomous insurance and liability will almost certainly constitute a significant barrier to movement as Member States will almost certainly introduce differing laws and regulations and will almost certainly answer the above questions in relation to liability in different ways'. See also N. Bevan et al, 'University of Exeter – Written evidence (AUV0044), Driverless vehicles – where are we going wrong?' *Connected and Autonomous Vehicles: The Future?* (2017) House of Lords Report, available at tinyurl.com/s27e8lu (last visited 7 July 2020).

Commission published a communication where connections between product liability and cyber liability are underlined. Fourthly, the European Parliament's resolution of 16 February 2017 proposes a form of strict liability of users or owners of robots. We can underline three different objectives in the above-mentioned interventions: i) the protection of road victims in general; ii) the protection of consumers in case of defective product; and iii) cybersecurity.

We also note the existence of different interventions regarding different matters. The complexity of reality imposes a greater dialogue between different normative areas and a greater need for an interdisciplinary approach, even in the production of norms. Hence, only by considering the different disciplinary fields, it will be possible to arrive at regulatory innovations that reflect the multiformity of reality and contain tools to respond to the problems that such a complex reality poses.

From the analysis of the interventions at the level of EU legislation, there is a certain lack of communication between the various regulatory areas. Protection of road victims, data protection in cyberspace and producer responsibility are strongly correlated in reality. These are regulations that must be constructed as 'communicating vessels' and not as closed and self-referential areas. The national legislator and the community legislator must recover a vision that is close to the problem and at the same time coherent with the general framework of value, principles and social instances.

While we are analyzing in-depth the individual problems that the topic poses, we must not lose sight of the general framework of the principles that inform civil liability. The compensation of victims cannot be solved by eliminating obstacles to the operation of civil liability without considering the repercussions that such solutions can have on the functions of compensation and prevention of damages. Moreover, are we sure that in case of damage caused by a machine running in full automation civil liability can prevent damage thanks its deterrence function?

The insurers, covering the liability of the owner or of the producer or acting as delegate of public funds in compensating damages to victims of AI can create and update standards and guidelines in order to 'educate' machines with a relevant role in prevention of damage caused by AI thanks to tools like the 'reinforcement learning' concerning with how software agents can take actions in an environment so as to maximize some forms of cumulative reward.