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Development of Autonomous Vehicles and Criminal Liability issues: key points

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Nell'ampio panorama dello sviluppo delle intelligenze artificiali, un ruolo rilevante è rivestito dai veicoli a guida autonoma. Strumenti la cui diffusione dovrebbe, secondo molti esperti, rivoluzionare il mondo dei trasporti, con importanti ricadute a livello economico, industriale e sociale. Lo sviluppo di queste tecnologie deve fare i conti con significative problematiche giuridiche, inerenti soprattutto all'allocazione delle responsabilità e, quindi, alla tutela degli interessi esposti a rischi di lesione. Il presente contributo intende affrontare tali questioni nella prospettiva del diritto penale, mettendo in rilievo i potenziali profili di responsabilità penale inerenti alla progettazione, alla costruzione e all'utilizzo di veicoli di questo tipo.

Within the development of artificial intelligence, a first sanding role is played by autonomous vehicles; these are supposed to revolutionize transports, with material economical, industrial and even social consequences. Several juridical issues are involved in this process, with particular reference to the allocation of liability, in order to provide a sufficient level of legal protection to the relevant interests at stake. This essay intends to focus the potential criminal risk related to programming, manufacturing and manning this kind of vehicles.

1. Introduction

In the opinion of several commentators and experts, autonomous vehicles (from now on, "A.V.") have the potential to revolutionize transports and to dramatically increase road safety. Indeed, it is a fact that the vast majority of injuries involving car traffic are caused by human mistakes or violations of traffic rules; the A.V. might modify the picture, being programmed to strictly fulfil

traffic laws^[1].

In many countries, vehicular traffic-related injuries might involve criminal liability, when caused by the breach of traffic laws and requirements. In Italy, deaths provoked by reckless drivers became, few years ago, a hot issue in the public debate, being the at-the-time in force punitive measures largely perceived as insufficient. Therefore, a major legislative reform occurred in 2016, and new offences of “road homicide” (“*omicidio stradale*”) and “severe road injuries” (“*lesioni personali stradali gravi o gravissime*”) were introduced in the Criminal Code, respectively at articles 589 *bis* and 590 *bis*^[2]. The new legal provisions prescribe very harsh punishments in case of injuries or deaths caused by violation of traffic laws: the more serious the infraction, the more severe the penalty. At the same time, criminal responsibility for traffic-related injuries might as well involve designers and producers, as far as the accident is caused by a technical failure of the vehicle^[3]. Eventually, even failing to provide the security conditions of the road network might entail criminal liability, of those responsible of such duties^[4].

Therefore, A.V. are expected to mitigate the overall harms caused by road accidents, cutting also the relevant economic and social costs, but we can't forget that the development of these technologies is strictly connected to the capabilities of public entities and administrations to properly promote and direct such changes.

With the present essay I intend to examine the actual statutory and regulatory frame of the matters at stake, as to understand, at a first step, what public administrations are expected to do in order to lead and encourage the A.V. development.

Then, I intend to draft which are the most relevant issues from the point of view of criminal law liability related to the introduction of A.V. on public roads.

From this point of view, I'm starting from the residual area of criminal liability for operators/passengers of an A.V., outlining, at a second time, which can be the consequences of the introduction of A.V. in terms of criminal liability of the producer or the programmer of the vehicle, in the event that the injury is caused by an error or by a lack of efficiency of the relevant manning software. The likely liability of infrastructures managing authorities or concessionaries should be also taken into account.

Finally, I'm going to formulate some brief considerations about any possible future scenario of criminal liability of the artificial intelligence, focusing especially on A.V.

2. Smart thinking: governing a technological revolution

Among of the main questions arising about the development of A.V. is whether this technology does require a collateral growth of public infrastructure suitable to sustain the relevant technology.

Several developers of artificial intelligence products bet that automated vehicles will be able, in the next future, to progress and circulate notwithstanding the quality of the infrastructure: the mission of A.V. is to interact with the surrounding world with its own instruments and capabilities^[5]. The immediate benefit of such a delivery would be to significantly cut the necessary public costs, allowing the spread of such lives-safer technologies even in poor countries; where, however, the traffic-related injuries rate is much higher than in rich countries.

Nonetheless, so far the picture is different. Legislators and public entities see the development of A.V. as strictly connected and dependant on the evolution of public infrastructures.

The Italian statutory and regulatory provisions are emblematic. A first legislative measure was adopted in 2017: article 1, section 72 of Statutory Act n. 205/2017 (so called "legge finanziaria 2018"), allocated a certain fund (of 2 Million Euros) for the digital transformation of public roads, as to permit testing A.V. prototypes^[6]. Even if the monetary assignment was not very relevant, the great merit of the provision was to establish a legal base as for the following administrative regulations of A.V.

Soon after, the Ministry of infrastructures and transports delivered on 28.2.2018 a decree – named "smart road decree" by commentators – which regulates both the implementation of digital technologies on public roads and the authorization for testing A.V. on the same. The two issues are clearly strictly dependant in the view of the legislator and of the administrative authority.

Art. 2 contains the definition of "smart road": road infrastructures subject to a digital evolution process, aimed to provide advance services to road users, road managing authorities and public administrations and to create a "technological

ecosystem” based on the interconnectivity between infrastructure and new generation vehicles.

The definition contained in the Italian regulation is coherent with the idea that autonomous driving is just a specific aspect of a wider “convergence of technologies”, which includes areas such as robotics or autonomics, sensor technology, advanced information and communication technology in general. It implies that legal analysis and assessment can be applied comprehensively and often the matters at stake have material similarities to be taken into account^[7].

The described digital “smart road” evolution is not supposed to invest all the road and transport network system equally. Art. 5 of the decree provides a classification of smart roads: priority is given to infrastructures comprised in the Trans-European Network (TEN-T) – both “core” and “comprehensive”^[8] – and to all the motorways network, even if not comprised in the TEN-T (Type I “smart roads”). Type II smart roads classification does include the infrastructures relevant to the level 1 of the National Integrated Transports System (“SNIT” for “Sistema Nazionale Integrato dei Trasporti”).

As said before, the “smart road” decree deals also with autonomous vehicles, in a comprehensive perspective.

The procedure for obtaining a licence to test A.V. on public road is set forth by article 9 and followings of the Decree and it’s quite complex, due to the obvious safety issues at stake.

It can be requested by the producer of the vehicle or by a University or a research institute, and it’s considered an advanced step of the longer process, since a minimum of 3.000 km on simulator or track-road testing are required in advance. The public administration requires a preliminary technical asseveration of all the previous testing results, and no impediment declarations from both the managing authority of the relevant public road and the producer of the vehicle are required. This last requirement has been criticized by the Italian national Antitrust Authority, since it would be an obstacle for independent developers who could be blocked by a veto from the producer of the vehicle, which is also a potential buyer of automatic driving systems realized by others^[9]. The Antitrust Authority did find this obstacle not balanced by any real need in terms of safety or liability issue. In their view, indeed it is not a matter of safety, since before the testing on public roads the A.V. must go through severe safety validations. And it

is not even a problem of civil liability since the “Smart decree” already prescribes for the tester to have an adequate civil liability insurance cover.

Notwithstanding this antitrust-related issue, for sure the Italian Authorities have adopted a strict approach to the matter and to obtain a permission to test A.V. on public roads is not an easy task: the main evidence is that to date only one authorization has been granted by the Ministry of Transport^[10]. Italy has followed the path of other European Countries, mainly of Germany where a rigorous regulation about A.V. testing process was approved in 2017, and the German Road Traffic Act was amended accordingly^[11].

Safety is provided not only by intense pre-test activities, but also by other provisions set forth by the “smart road decree”. First of all, the authorization can be granted only to those vehicles whom manual version is already fully authorized for road circulation. Also, under art. 10 a qualified supervisor has to be always on board of the vehicle, even when set in a full-auto mode. It is requested that the driver is put in condition to promptly shift from auto to manual driving mode and vice versa, as to guarantee safety circulation conditions. Pursuant to sec. 2 of article 10, the supervisor is liable for the vehicle, in both the driving modes. This is a very interesting provision, even from the point of view (which will be later deepened) of criminal liability scenario of passenger/operator of the vehicle. As far as the operator has a duty of surveillance over the A.V., then a guarantee position is on him: some commentator read the disposition as if his liability does not require any actual chance of control over the vehicle. As it will be better told in the next paragraph, this might be correct for the civil liability of the operator, where even strict liability is a valid liability measure. But when it comes to criminal liability, then the responsibility cannot be ground on the mere fact of being on board of the vehicle: this would breach the culpability requirement, which is a fundamental aspect of criminal liability.

For now, by the way, the presence of a human operator on board of the testing vehicle reflects not merely a safety measure but also a legal proper obligation. Indeed, Italy is among those countries that have undersigned and ratified the Vienna Convention, under which (at art. 5 *bis*, as it was amended by the Working Party on Road Traffic Safety of UNECE in 2014) semi-auto driver modes are allowed, as far as a surveillance operator is on board of the vehicle. Countries which are not parties of the Vienna Convention (United States, China

and the U.K., among others) have obviously less restrictions in testing and dealing with A.V.^[12]. As for the U.K., for instance, the *Automated and Electric Vehicles Act 2018* – which received the Royal Assent on July 19, 2018, but is not still in force due to the lack of a proper Commencement Order by the Secretary of State for Transport – already regulate A.V. up to Level 5 with full autonomy. A last important aspect is the overview duties pending on public administration, as to truly governing the development process and future steps. The “smart road” regulation prescribes the institution of a specific “smart road” Observatory, within the Ministry of Infrastructures and Sustainable Mobility^[13]. This Office has to monitor both the digital implementation of the road network and the testing on public roads of A.V., in order to review and amend current regulations and also to stimulate the public debate and research these issues, with reference to the most relevant ethical and legal matters involved in the development of these new technologies.

Representatives of various public entities compose the Observatory, which does not involve any member from private institutions. This decision is coherent with the need of keeping a distance from private developers of A.V., since Observatory is involved also in the procedure to obtain the authorization for testing the vehicles on public roads. At the same time, however, as far as also a technological and cultural promotion is involved, a strong cooperation with private experts might be extremely positive.

To create specialized agencies and governmental bodies is a consequence of the understanding that the development of autonomous vehicles is a major technological, legal and social challenge, to deal with adequately. We can track similar initiative almost all over the world: in 2015 the United Kingdom set up the Centre for Connected and Autonomous Vehicle (CAV), which is part of the Department for Transport and the Department for Business, Energy & Industrial Strategy^[14]. Moreover, Australia in 2018 launched an Office of Future Transport Technologies, to prepare the advent of autonomous vehicles in terms of both regulation and technological investments^[15].

In the given frame of public regulation and requirements, the aim of the legislator is to create a kind of a “riskless” road environment, with a strong trust in the ability of the artificial intelligence to avoid accidents and related harms. But the development of those technologies depends also by the capability of

jurists to resolve the problem of the liability allocation, in case something goes wrong. Investigating this aspect, I intend to start from the position of who is traditionally to blame for road injuries: the driver or operator of the vehicle.

3. Criminal liability of drivers, operators or passengers of A.V.

As for any residual area of criminal risk of driver/operator/passenger of the vehicle, much will depend on the level of automation of the future vehicles^[16].

We can say that as far as the person carried by the vehicle has not any legal duty of surveillance over the vehicle itself, nor any technical possibility to intervene on the software choices and conducts, then no ground for criminal liability is foreseeable. Indeed, under the general principles of Criminal Law, there can't be criminal liability but for an act or an omission which can be attributed to the person himself, in terms of doing something or omit to do something which is prescribed by the law. In other words, in this scenario the person is a mere passenger of the vehicle, and there can't be any liability for a third person (or a "third robot") conduct^[17].

Otherwise, if the future law will prescribe at least a duty of surveillance of the person over the vehicle, then the ordinary discipline shall find place, for which – under the culpability principle doctrine – there must be at least a negligent of unlawful behaviour in order to be liable for the more serious harm which might occur. The person, in this case, can still be considered as a proper driver or, at least, as an operator of the vehicle, and the breach of the relevant duty of care and precaution – while performing his surveillance task – might ground a criminal liability, if there is a relevant offence by negligence in the given legal system. At the same time, experts believe that a "control dilemma" would occur in case a surveillance duty is put on the shoulders of human passenger of A.V. Indeed, technological development allows the operator to be free of surveillance and control tasks, while the law still prescribes him to be in control of vehicle, as to avoid harmful event which might otherwise occur^[18]. I agree that even in the event of a persistent duty of care of the human on board over the vehicle, the scrutiny of negligence should take into due account the specific conditions of A.V. and whether there is a realistic chance of the operator to take control of it in

case of emergency. The ordinary car-accident negligence standard cannot find place in these cases, and the commentators – with the support of technical experts of A.I. – should elaborate new liability requirements and standards.

Under this aspect, the scenario is of course slightly different in common law countries, where strict liability is commonly accepted, even in Criminal Law. It means that the operator/driver might be guilty of some traffic violations or vehicular crimes, even if he did not commit any proper violation or misconduct^[19].

Though, to put on the shoulders of the human passenger of A.V. a duty of surveillance is a controversial topic. On one hand, it is hard to place a blind trust on the ability of the A.I. governing the vehicle, and to impose a duty of care over a human agent might tranquillize lawmakers and the relevant general debate. On the other hand, such a duty might frustrate many of the expected advantages related to the development of A.V. Indeed, not just more safety is at stake when it comes to A.V., but also efficiency and mobility. Indeed, these vehicles are expected to reduce the mass of unproductive hours which people spend driving, being able to do something else (especially, to work) rather than waste their time in traffic jams. At the same time, A.V. are also imagined to provide mobility capacity to people who cannot operate traditional vehicles, because of their disabilities or their age.

In the event that the law imposed a duty of surveillance, it is obvious that the passenger couldn't do any activity but to watch the vehicle, and only those who are able to perform such surveillance shall be permitted to man it. The people currently not fit for driving will not have, again, any real mobility chance. Such a duty would also frustrate – on the ground of security – the expectation on the A.V. to solve the spread phenomenon of drink-driving^[20], and a “take me home button” would not have much sense if the person is expected to have an active role while on the vehicle.

4. Criminal liability of producers and programmers of A.V.

As for any potential criminal risk of producers and programmers of A.V., we must distinguish between different possible scenarios.

A first hypothesis is that the injury is caused by a malfunction of the vehicle, in

terms of the sensors erroneously perceiving the external world, or the software failing to perform what it is programmed to; at the same time, it is possible that the programmer fails to predict some possible interactions which occurred in the real world, causing a harmful conduct by the machine which could be avoided. In all these cases, the general discipline of the criminal liability by negligence (*responsabilità colposa*) might find place. The programmer or the producer might be found criminally liable if they made an avoidable error (still a human error, then) in their relevant jobs of programming and manufacturing the vehicle, and such an error was the cause of the incident.

Even in this scenario, of course, we should consider the specificity of the matter at stake; indeed, the blameworthiness is obviously different between someone who consciously breach a road safety rule (such as running a red light, or overcoming another vehicle at a blind bend), and an engineer failing to duly programming a complicated software or manufacturing a futuristic vehicle. While a harsh punishment of reckless drivers might have a positive deterrent effect on other drivers, a similar attitude towards engineers might only discourage them to put an effort into developing new technologies and solutions, with the result of slowing down the introduction of modern machines that would make roads safer for everybody.

This consideration is commonly accepted in many common law jurisdictions, where indeed an idea of moral blameworthiness is essential when it comes to criminal liability^[21]. But still, under the Italian Law no room is given – at a substantial level – to such a distinction, and the different mentioned cases (a wilful reckless driving, on one side, and a mere technical error in manufacturing or programming the vehicle, on the other) shall be treated in the same way, but for a different and harsher penalty for the first compared to the second. Though, the problem is well known in the literature, and many authors believe that, in order to help the developing of new and positive technologies, at least a margin of tolerance should be introduced, for errors which might occur in programming or manufacturing futuristic technologies^[22].

A different scheme is the one in which the injury is caused by the A.V. as a consequence of a choice of action which is not the direct result of the original programming of the vehicle, rather the outcome of the self-learning capacity of the latter.

In these cases, between the conduct of the programmer and the action of the robot there is a wide area which is not under the control of the human “father” of the machine. What the artificial intelligence is able to develop in terms of choice of action, especially when put in connection with other machines and with the ability of learning from previous experience, is deemed as unforeseeable by the programmer and by the producer. This is one of the key points expressed in the recommendations to the Commission formulated by the European Parliament in 2017, on civil liability regime for artificial intelligence, for which *«the opacity, connectivity and autonomy of AI-systems could make it in practice very difficult or even impossible to trace back specific harmful actions of AI-systems to specific human input or to decisions in the design»*^[23].

The unforeseeability of the future action of self-learning vehicles, and of the following harms, should restrain – under the general principles of the discipline – to ground criminal liability of the human programmer, since he doesn’t have any possibility to impede it^[24].

5. Liability of the infrastructure managing entity.

As written in the introduction of this essay, liability for road and traffic related harms might also involve the managing entities of the road network system. In case they fail to provide the safety conditions of roads prescribed by the law, and in case such violation causes the accident and the harms, then an ordinary criminal liability for negligence can be grounded. This is what is happening, for instance, in one of the most known criminal case running before Italian Judiciary, related to the collapse of the “Morandi” motorway bridge in Genoa in 2018, in which 43 people lost their lives. Several qualified engineers and directors of the motorway concessionaire have been charged for multiple homicides by negligence, because of the supposed poor maintenance of the infrastructure.

As we move to the criminal law, liability of course is on the shoulders of individuals who materially committed the *actus reus* described by the law. Nevertheless, looking at the Italian scenario, we see that in 2001 a corporate criminal liability discipline has been introduced, and now companies might be sanctioned by the criminal law jurisdiction for crimes committed, for its interest and advantage, by an individual^[25]. Though, corporations are not liable for any

offence committed by its individuals, but for those explicitly indicated by the law. The catalogue of the relevant crimes is continuously enlarged by the legislator, but to date road homicide or traffic related harms are not among those. Anyway, pursuant to art. 1 of Corporate Criminal Liability Act, public administration and bodies are exonerated by such a direct “criminal” liability, which might involve only private entities.

But still, private and public bodies might be found liable for any civil damage that occurred from the offence, in case the Law prescribes a certain responsibility on it. As for traffic related damages, failing to provide safety conditions of the infrastructure is an obvious source of such a liability.

If we look at the ongoing technological transition, we understand that to develop a “smart road” means to create a digital backbone to the infrastructure, installing sensors and connection instruments able to dialog with automated vehicles. Indeed, A.V. will rely upon information originating from the digital network, collected by other vehicles and by sensors installed in the infrastructure. If the malfunctioning of the latter causes an accident, liability of the road managing authority might be grounded, since it failed to comply with safety and operational requirements set forth by the law. From this point of view, the responsibility of the concessionaire is not different – in terms of prerequisites – from what would happen if a pothole on the road surface had caused the accident.

If something goes wrong, the complexity of the digital network involves an objective difficulty in the reconstructing of the reasons and technical causes of the accident. Was it an error of a sensor installed on the road or was it a fail of the autonomous vehicle processor? In order to be able to answer the question, A.V. regulations in several countries prescribe the installation of a “black box” on board of the vehicle, similar to the one already compulsory for commercial airplanes. Looking at the German Law, we see that the Road Transportation Act, as lately amended, requires for the manufacturers to include such a tool as to collect all the data useful if an accident ever occurred. To avoid concerns related to data protection, the final version of the regulation prescribes a limitation of six months of storage of the data, unless the car is involved in an accident^[26].

Back to the Italian scenario, we see that the Italian regulation prescribes similar duties of data storage: pursuant to art. 16 of the “smart road” decree the

developer must keep all information and data related to the test of A.V. for the entire duration of the authorization and for the next 12 months; the authority that granted the authorization has free access to the data, in order to supervise the testing activities.

The complexity of the digital network involved in the autonomous vehicle “revolution” might take to the conclusion that it is simply impossible to understand if the eventual harm was caused by a malfunctioning of the vehicle software or of the relevant infrastructure support.

This conclusion took several authors, especially in the United States, to investigate the possibility to allocate the liability on the vehicle itself, and in which way this might be possible.

This is the final issue I intend to face, in the following paragraph.

6. Any room for criminal liability of Artificial Intelligence?

As far as a harmful event is caused by the choice of action of an artificial intelligence, and the same is unforeseeable by the programmer, we wonder if there is any room for criminal liability of the robot itself.

To answer this question, we could be inspired by countless movies and fictions; but the issue is not that extraneous from our reality. After all, we might say that the dogma under which only human agents can face criminal liability is already challenged; just consider various forms of corporate criminal liability, expressly recognized in several jurisdictions.

Some scholars consider the artificial intelligence compatible with criminal liability. In this perspective, the harmful fact allegedly committed by the A.I. would present both the conditions for criminal responsibility: an *actus reus* (a conduct) and, when it comes to very sophisticated and self-learning machines, a *mens rea*, in terms of expressing a proper and “personal” will of the robot, which differs from the intention of its programmer^[27]; moreover, it would be possible to apply to robots both the preventive and the punitive aims of criminal punishment.

These theories are interesting but perhaps they fail to consider that the very ground for criminal liability is consciousness (so called *suitas*). The latter is, so far, a unique characteristic of human being, not shared even by the most

advanced animals on earth. Even if the machine was able to perform some of the capabilities which help us to define consciousness (such as distinguishing, thanks to its software, what humans find to be “right” and “wrong”) it doesn’t seem enough to consider it a “free” agent, and therefore to consider it “personally” responsible for any harmful action^[28].

So far, even considering the most sophisticated A.I. that we can see at the horizon, to found a A.V. guilty for road homicide (or for any other criminal offence) seems something belonging more to fictions than to reality.

1. Worldwide are reported, each year, 1.35 million people killed in traffic related accidents; the 95 % of whom are caused by human errors. See *Global Status Report on Road Safety 2018*, by the World Health Organization.
2. In the Italian scientific literature, for a broad and detailed comment of the new mentioned crimes see A. Menghini, *L'omicidio stradale. Scelte di politica criminale e frammentazione del sistema*, Editoriale Scientifica, Napoli, 2016; G. Losappio, *Dei nuovi delitti di omicidio e lesioni “stradali”*, in www.penalecontemporaneo.it, 30th June 2016.
3. Even if not strictly related to road traffic accidents, it might be useful to remember the criminal case following the death of the Formula 1 pilot Ayrton Senna, which took place at the race track of Imola on the 1st May 1994. Among others, the chief engineers of the Williams racing team were charged for homicide by negligence, due to a technical failure of the wheel steering system of the car of Senna, which allegedly was the cause of the accident in which the brilliant Brazilian pilot lost his life.
4. We can refer to a recent case, still pending before the Criminal Tribunal of Verona, related to a dramatic accident occurred on the Milan-Trieste highway in 2017, in which a bus of tourists was involved and 11 young Hungarian students lost their lives. Among the defendants, charged for road homicide (“*omicidio stradale*”), are the driver of the bus, for reckless driving, and several high-level managers of the highway authority. Indeed, after the driver lost the control of the bus, the vehicle hit a pillar, the distance of which from the road did not fulfil the relevant law requirements.
5. See «*the rise of level 4 and level 5 autonomy*» in www.ambarella.com/blog, published on Mar. 18, 2021. Ambarella is a leading company in the field of developing artificial intelligence and autonomous vehicles.
6. For a first comment on this legislative measure see S. Scagliarini, “*Smart road*” e “*driverless cars*” nella legge di bilancio: opportunità e rischi di un’attività economica «indirizzata e coordinata a fini sociali», in *Quad. Cost.*, 2, 2018, pp. 497-500.
7. See for similar consideration E. Hilgendorf, *Automated Driving and the Law*, in E.Hilgendorf-U. Seidel (eds.), *Robotics, Autonomics and the Law*, Nomos, 2016, p. 173.
8. See Regulation (EU) No 1315/2013, under which the «*core network*» is to be completed by 2030, while the «*comprehensive network*» is to be completed by 2050.

CERIDAP

9. See decision AS1556 dated 19.12.2018, published on the Antitrust Authority Bulletin on 14.1.2019, n. 2.
10. VisLab s.r.l., an innovation company based at the University of Parma – Engineering Department. VisLab belongs to Ambarella Company – world leader on artificial intelligence systems developing, based in the Silicon Valley and listed at the N.Y. Stocks Exchange.
11. Strassenverkehrsgesetz [StVG], Mar. 5, 2003, as amended June 16, 2017, BGBL I at 1648. See F. Henkel-J. Nowak-N. Smirra, *Autonomous vehicles: the legal landscape in Germany*, in Norton Rose Fulbright, 11.8.2016.
12. Even if to date the most advanced robot-taxi service, operating from May 2021 in several specific districts of Shanghai and Beijing and run by the Chinese company Baidu, still prescribe the presence on board of the vehicle of a human supervisor, which is expected to be removed as soon as people and authorities will be confident with this new technology. See *Hyperdrive Daily: China Ramps Up its Autonomous Vehicle Development*, in *Bloomberg* 4th May 2021 and *China Give Driverless Car Services a Push with Updated Regulations*, in *CX Tech*, 2nd August 2021.
13. As it was renamed the Ministry of Infrastructures and Transport in February 2021. The composition of the Observatory is described at art. 20 of the “smart road” decree.
14. See Dep’t of Trans. et al, *New Cyber Security Standard for Self-Driving Vehicles* (Dec. 19, 2018), as well as *The Key Principles of Cybersecurity for Connected and Automated Vehicles* (Aug. 6, 2017), both on www.gov.uk.
15. See <https://www.infrastructure.gov.au/transport/land-transport-technology/office-of-future-transport-technology.aspx>.
16. Without going too deep into technical issues related to A.V., we can recall that under the definition of the North American *National Highway Traffic Safety Admin.*, there are four different levels of automation (from “no automation” to “Full Self Driving Automation”); following a different definition provided by the SAE International Corporation, there are five levels of automation, the top one being defined as High-automation, consisting in «*the full time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental condition*». See D. Glancy, *Autonomous and Automated and Connected Cars – Oh My: First Generation Autonomous Cars in the Legal Ecosystem*, 16 *Minnesota Journal of Law, Science and Technology*, 2015, p. 630.
17. See F. Douma-S.A. Polodichuk, *Criminal Liability Issues Created by Autonomous Vehicles*, 52 *Santa Clara Law Review*, 2012, p. 1160, for whom «*as long as the operator was merely acting as a passenger, negligence could not be found in the traditional sense*».
18. E. Hilgendorf, *Automated driving and the Law*, cit., 187.
19. This is happening, for instance, in the north American State of Nevada, where the local autonomous vehicle regulation makes clear that «*for the purpose of enforcing the traffic laws [...] the operator of an autonomous vehicle that is operated in autonomous mode shall be*

- deemed the driver of the autonomous vehicle regardless of whether the person is physically present in the autonomous vehicle while it is engaged»* (see Nev. Admin. Code § 482A.030(2) (2013)).
20. Under the most recent statistics, in Italy the 20-25 % of road traffic deaths involve the use of alcohol. The rate is even higher, for instance, in the USA (29%) and in Ireland (39%). See *Global Status Report on Road Safety*, 2018, by the *World Health Organization*.
 21. See for instance the statutory law of several States in the U.S.; New York, for instance, «requires serious “moral blameworthiness” on the part of an automobile driver before the driver can be criminally liable for vehicular homicide», while other statutes require, at least, gross negligence, in terms of an evident and material breaching of the relevant rule of behaving. See J.K. Gurney, *Driving into the unknown: examining the crossroads of criminal law and autonomous vehicles*, in 5 *Wake Forest Journal of Law & Policy*, p. 407.
 22. See a similar consideration in S. Gless-E. Silverman-T. Weigend, *If robots cause harm, who is to blame? Self-driving cars and criminal liability*, 19 *New Criminal Law Review*, 2016, p. 430-431.
 23. The text of the recommendations can be found on the web at https://www.europarl.europa.eu/doceo/document/A-9-2020-0178_EN.html.
 24. In equal terms, in the most recent Italian literature, P. Severino, *Intelligenza artificiale e diritto penale*, in U. Ruffolo (a cura di), *Intelligenza artificiale. Il diritto, i diritti, l'etica*, Giuffrè, 2020, p. 534, who outlines this as a starting point – and not as a conclusion – of the issue, since when it comes to safety of people, law must provide an adequate level of protection.
 25. See d.lgs. 8 giugno 2001, n. 231.
 26. See A. E. Kouroutakis, *Autonomous vehicles: regulatory challenges and the response from Germany and UK*, in *Mitchell Hamline Law Review*, 2020, vol. 46, p. 1115.
 27. See, among the most popular, G. Hallevy in various publications: *The criminal liability of artificial intelligence entities – from science fiction to legal social control*, in 4 *Akron intellectual property law*, 2010, p. 171; *I, criminal: when science fiction becomes reality: legal liability of AI robots committing criminal offense*, in 22 *Syracuse Science & Technology Law Reporter*, 2010; *Virtual Criminal Responsibility*, in 6 *Original Law Review*, 2010, p. 7. The Author proposes the establishment of three models of A.I. criminal liability, namely the (i) Perpetuation via another liability model, (ii) natural probable consequence liability model, (iii) direct liability model.
 28. In these terms S. Gless-E. Silverman-T. Weigend, *If robots cause harm*, cit., p. 417.