Machine or Robot? Thoughts on the Legal Notion of Autonomy in the Context of Self-Driving Vehicles and Intelligent Machines

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Abstract

As machines, and namely vehicles, become increasingly independent and capable of tasks ever-growing in complexity, uncertainties rise concerning which legal framework they should be included into. Indeed, from a legal standpoint, one of the most disruptive features of these artificial agents is widely considered to be their capability of defining their course of action, in order to pursue a given task, independently from direct human control and as a consequence of the challenges and characteristics of the environment they are operating in. Aiming to provide some much-needed clarity in this area, this paper addresses the necessity of reaching a narrower legal notion of autonomy, avoiding relying solely on its technical definitions. Accordingly, this paper will: *(i)* analyze the meaning of autonomy in the context of autonomous vehicles and attempt to identify its structural characteristics; *(ii)* address the most legally challenging properties of such systems *i.e.,* "Self-Determination" and "independence from Human Control"; and *(iii)* after pointing out some overlapping aspects between the factual behavior of autonomous vehicles and clerks appointed for merely executionary tasks, attempt to strengthen the existing EU legal notion of autonomy applicable to artificial agents.

Keywords

Autonomy, legal notion, legal qualification of robot, autonomous vehicles, driverless car, autonomous vs. automated systems, Human Control, Self-Determination, principal and clerk, *preposizione*

1. Am "*I* [a] *Robot*"? Autonomy as a Definitory Scapegoat and its Elusive Nature

As the Fourth Industrial Revolution approaches,[1] Artificial Intelligence (hereinafter "AI") and its applications in physical systems such as driverless cars and robots are

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becoming part of our everyday life, bringing truly remarkable individual and collective benefits[2] as well as new social and legal challenges to overcome. As new generation's AI subverts the traditional and historical relation between humans and machines, legal scholars debate whether this nuance may pose a challenge to legal preexisting principles and paradigms as well as spawn new unprecedented questions. Among the most debated topics is the suitability of the current civil liability and insurance system to handle the specific issues brought up by the upcoming widespread use of autonomous physical systems (*e.g.*, robots) and namely autonomous vehicles (hereinafter also "AV").[3]

Thus, it is hardly surprising that a number of legal systems have already adopted or are currently working towards creating new regulatory frameworks for AV and robots in order to keep up with the pace of innovation and avoid dreaded gray zones and regulation gaps.[4] The EU is no exception: in recent years it has issued several documents expressing the need to adapt the current EU legal framework and to introduce, if necessary, new rules on the basis of which responsibility and liability are allocated with regard to the challenges of AV[5] and robots,[6] also by taking into account the set of features and *modus operandi* commonly referred to as *robot autonomy* (or just *autonomy*).

Indeed, the concept of autonomy, when applied to this new generation of machines, seems to be acquiring more and more systematic relevance as it could be used as the main criterion differentiating the latter from traditional non-autonomous (although possibly automatic/automated) physical systems.[7] Furthermore, around this very con-

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[1] See Klaus Schwab, *The Fourth Industrial Revolution* (World Economic Forum 2017).

[2] Joshua D. Borneman, *Let's Get This Show on the Road: Driverless Cars Have Arrived and It's Time to Advance the Regulatory Framework* 28(1) The Catholic University Journal of Law and Technology 57-66 (2019). Considering some possible shortcomings: Sarah J. Fox, *Planning for Density in a Driverless World* 9(1) Northeastern University Law Journal 162-174 (2016).

[3] As AV can be viewed as a *species* of robot. Aysegul Bugra, *Room for Compulsory Product Liability Insurance in the European Union for Smart Robots? Reflections on the Compelling Challenges*, in *Insurtech: A Legal and Regulatory View*, 171 (Springer 2020).

[4] Viviane Mardirossian, *Will Autonomous Cars Put an End to the Traditional Third Party Liability Insurance Coverage?* in Pierpalo Marano and Kyriaki Noussia (eds.), *Insurtech: A Legal and Regulatory View*, 277-282 (Springer 2020). See also in general Darrell M. West, *Moving Forward: Self Driving Vehicles in China, Europe, Korea, and the United States* (Center for Technology Innovation at Brookings 2016).

[5] See European Parliament, *Autonomous Driving in European Transport – European Parliament Resolution of 15 January 2019 on Autonomous Driving in European Transport (2018/2089(INI))* (2019); European Parliament, *A Common EU Approach to Liability Rules and Insurance for Connected and Autonomous Vehicles* (2018).

[6] See European Parliament, *Report with Recommendation to the Commission on Civil Law Rules on Robotics (2015/2103 (INL))* (2016) and European Parliament, *Resolution of 16 February 2017 with Recommendations to the Commission on Civil Law Rules on Robotics (2015/2013(INL))* (2017).

[7] It is important to stress that the notion of robot does not appear in any way self-evident, on the contrary the huge variety may lead to the almost impossibility of reaching an unambiguous, efficient and yet general notion of robot. In this context the notion of autonomy is to be considered a typical quality of robot. See Erica Palmerini, *Robotica e diritto: suggestioni, intersezioni, sviluppi a margine di una ricerca europea* 6 Responsabilità Civile e Previdenza 1825-1826 (2016). Accordingly, the European

cept arises the debate on whether they should be considered mere tools rather than actual agents; needless to say, the final outcome may well be a transformation of the concept of liability and responsibility itself.

Although the use of the notion of autonomy as a definitory tool intuitively makes sense, it may result in even more uncertainties as it appears to be quite complex and vague, characterized by various and often controversial meanings in different contexts/subjects.[8]

Commonly speaking, when referring to an autonomous robot we indicate a machine, thus an AI, capable of behaviors that we would deem as "intelligent" if enacted by a human being,[9] such as: understand its environment and its changes, interact/react independently and exerting some degree of discretion in the pursuit of a human given task with not completely foreseeable results. However, it should be noted that some attempts to reach a strong definition of robot autonomy have been made in the past with arguably unsatisfactory results.[10]

In 2017, a European Parliament Resolution further highlighted the concept of autonomy specifically defining it 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*'. Accordingly, '*development of certain autonomous and cognitive features*' has become a subject matter of critical importance, namely with regard to EU's system liability and legal responsibility.[11]

Parliament seems to have reached an agreement on the fact that a robot (in order to qualify as such) should be provided with the capability to understand its environment and behave accordingly, thus exerting some degree of "autonomy". See Bugra (2020), 170-171.

[8] This occurs even when the concept applies to humans, let alone when machines enter the picture: Mikolaj Firlej & Araz Taeihagh, *Regulating Human Control Over Autonomous Systems* 15 Regulation and Governance 1072 (2021). In fact, autonomy is quite a multiple-meaning concept and given the various contexts may change meaning considerably. Its etymological roots may be found in the Greek word *autonomìa* which relates to the idea of self-regulation on a political and legal level, however such notion was further extended to self-governance in the sphere of morality by modern philosophers such as Immanuel Kant. See Simon Chesterman, *Artificial Intelligence and the Problem of Autonomy* 1 Notre Dame Journal on Emerging Technologies 249 (2020). In Law the idea of autonomy is often associated with the concept of contract and the freedom (or eventually restrictions of it) of each individual to bind themselves contractually to another on the condition they agree upon; see Rodolfo Sacco, *Autonomia nel diritto privato* 1 Digesto delle discipline privatistiche (sez. Civile) 517 (1987). For an historical perspective on the topic of autonomy in law see also Francesco Calasso, *Autonomia (Storia)* 4 Enciclopedia del Diritto 349-355 (1959). Moreover, autonomy is also commonly used to indicate the behavior of an individual in accordance to her own agenda and will; again, see Chesterman, *Artificial Intelligence* (2020).

[9] See in general Jerry Kaplan, *Intelligenza Artificiale – Guida al Futuro prossimo* (Luiss University Press 2016).

[10] Tim Smithers, *Autonomy in Robots and Other Agents* 34 Brain and Cognition 88 (1997).

[11] European Parliament, *Resolution of 16 February 2017 with Recommendations to the Commission on Civil Law Rules on Robotics* (2015/2103(INL)) (2017) §AA. With this regard, see also §Z and §AB of the Resolution.

That said, some uncertainties remain: when does a machine "take decisions"? When and where does Human Control/Influence start and end? How does this translate into causal connections? Furthermore, despite the non-questionable technological nature of AVs and robots autonomy, can the notion of the latter provided by computer science suffice as a legal *criterium*?

Given its widespread use, multiple meanings,[12] and the mostly descriptive and technologically reliant nature of the current notions of autonomy; and agreeing that it should be considered the key element in bringing order and certainty to an area such as the liability and insurance models that ought to be applied to the upcoming AV market release,[13] this paper will attempt to provide a narrower legal definition.

In order to do so, for the purpose of this paper the focus will remain on AVs and their specificities (and will only incidentally include robots). The analysis will be organized as follows: *(i)* the starting point will be the technical notion of autonomy, its technological elements and the possibility of transplanting such technical definition of robot autonomy *tout court* in Law; *(ii)* as the technical notions would result to be too broad, the concepts of Human Control (and lack thereof) and Self-Determination will be addressed as key concepts; *(iii)* then, the concepts analyzed in their factual elements in the previous sections will be translated in legal terms using the discipline of clerks' supervision relationship as a conceptual conduit and a functional analogy; and (*vi*) lastly, a narrower version of the notion of autonomy provided by the EU Parliament Resolution, better suited for systematic purposes, will be attempted.

2. Can I Build Autonomy? Autonomy as a Technical Feature

From a technical standpoint, autonomy can be explained as a machine's capability of transforming data gathered from its environment and turning them in purposeful actions.[14] In an AV, this autonomy is the technical result of the interaction between three main Functions: *(i) sense/think*; *(ii) decide*; and *(iii) act*,[15] imbedded in the relevant AI.

More specifically:

(i) In order to pursue any given task 'autonomously', the system needs to gather data on the environment in which it operates as well as on itself, in other words

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[12] With regard to robot autonomy, cognitive science and philosophy provide several and sometimes conflicting notions. See in general Katherine D. Sheriff, *Defining Autonomy in the Context of Tort Liability: Is Machine Learning Indicative of Robotic Responsibility?* (2020), available at SSRN: https://ssrn.com/abstract=2735945 and Michael W. Monterossi, *Liability for the Fact of Autonomous Artificial Intelligence Agents. Things, Agencies and Legal Actors* 20(3) Global Jurist 3-4 (2020).

[13] Tracy Hresko Pearl, *Fast & Furious: The Misregulation of Driverless Cars* 73(19) New York University Annual Survey of American Law 25 (2017).

[14] David Mindell, *Our Robots, Ourselves: Robotic and the Myths of Autonomy*, 12 (Viking 2015).

[15] Vincent Boulanin & Maaike Verbruggen, *Mapping the Development of Autonomy in Weapon Systems*, 7 (SIPRI 2017).

to '*sense*'. This occurs by using various sensors and cameras such as 'lidar sensors' and GPS systems.[16] These devices allow the machine to obtain raw data on its position and surroundings and on itself, comparing it with the information at its disposal. Thus, it reaches an assessment and *thinks* of its own position and conditions as well as the ones of its relevant environment with a so-called 'sensing software', which while looking for predefined patterns can be used by the system in order to recognize and understand the result of its *sensing* activity by finding a known relation and creating a model of the world around it.[17]

(ii) Secondly, a technically autonomous system shall be able to decide a course of action in pursuit of its task, translating its *thinking* into *action*, thanks to a control system. Of course, the degree of sophistication with which a machine '*decides'* may differ quite a lot in consideration of the different systems. Therefore, two main categories of machine-acting behavior have been established: simple or model-based (*i.e*., 'reactive control systems') and goal-based or utility-based (*i.e.,* 'deliberative control system'). The former is a system which acts following a rigid set of commands applying a simple '*if-then* rule' way of reasoning, the latter, on the other hand, can make evaluations in consideration of its overall goal (with given relevant information/instructions) and is provided with a set of rules to facilitate the planning of a course of action better suited to reach it.[18] This type of system assesses the implications of various scenarios and their outcome, establishing if they may serve or hinder their overall goal and choose accordingly.[19]

(iii) Lastly, the system shall be able to enact the decision undertaken turning it into action or a series of actions. This feat in AVs is pursued via the physical and computational means of the system interacting with its surroundings, often referred to as "actuators" or "end-effectors". Thus, physical structures such as wheels and steers in an AV are connected to automated controls triggered by the AI system enacting its decisions.[20]

It should be noted that with specific regard to AV, it will necessarily be provided, in addition to the above-mentioned Functions, with an HMIs (Human-Machine

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[16] Joshua Borneman, *Let's Get This Show on the Road: Driverless Cars Have Arrived and It's Time to Advance the Regulatory Framework* 28(1) Catholic University Journal of Law and Technology, 56 (2019).

[17] Boulanin & Verbruggen, *Mapping the Development* (2017), 8-9. For further details on data collected by an AV in the context of its *sense* function, please see Michael Mattioli, *Autonomy in the Age of Autonomous Vehicles* 24 Indiana University Maurer School of Law 283-284 (2018).

[18] Boulanin & Verbruggen (2017), 9-10.

[19] Stuart J. Russel & Peter Norvig, *Artificial Intelligence: A Modern Approach*, 35-49 (Pearson Education 2014).

[20] Boulanin & Verbruggen (2017), 11.

Interface).[21] The latter would be required in order for a human driver/user to use the AV, communicate with it, provide it with relevant information on its task, and possibly take control. This system could be represented by a simple binary choice (*i.e.*, an *on-off* switch) or further operational inputs and options.[22]

To sum up, as far as technic goes, the autonomy of a system comes from: sensors it uses to sense the world, hardware and software to interpret and think about the collected data, namely sensing software and control software, and actuators allowing the system to execute its chosen actions. In light of this, autonomy can be technically described as '*the ability of a system to sense and act upon an environment and direct its activity toward achieving a given goal.*'[23]

However, the aforementioned notion does not require any specific nature of human-machine relations nor does it consider the degree of complexity of the task or the sophistication of the system itself (*e.g.*, the deliberative or reactive nature of the thinking process),[24] thus leading to quite a broad notion of autonomous systems in which rather different kinds of machine behavior would be included. The broadness of this notion, however, hinders its utility as a legal *criterium*. In fact, the very same three Functions may, with various degree, be found in either some *automated systems*, *i.e.*, AI applied in production lines or in retrieval robots,[25] *augmentation systems*, *i.e.*, driving assistance systems and last but not least what we commonly understand as truly autonomous systems (despite the fact that technically they all are),[26] such as fully autonomous AV and Weapon Systems.[27] To put it simply, the technical notion of autonomy does not allow for a proper distinction between automation and

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[21] It must be stressed that HMI, the capability of communicating with the environment and/or with other robots as well as possible Machine Learning capability, though crucially important with regard to the degree of sophistication of the system and difficulties of the tasks that can be delegated to it are to be considered merely optional and not necessary in order for a physical system to be considered technically autonomous.

[22] Dorothy J. Glancy, *Autonomous and Automated Connected Cars – Oh My: First Generation Autonomous Cars in the Legal Ecosystem* 16 Minnesota Journal of Law, Science and Technology 634-635 (2015).

[23] Boulanin & Verbruggen (2017), 11.

[24] Boulanin & Verbruggen (2017), 7.

[25] Indeed many "low tech" systems are nowadays provided with sensor and advance interactive capability which may fill the aforementioned autonomy technical requirements. Bryan Casey & Mark A. Lemley, *You Might Be a Robot* 105 Cornell Law Review 304 (2020).

[26] As all AI systems applied to robots and AV must share the capability of "*(1) communicate using natural language, (2) store information, (3) engage in automated reasoning (i.e., logic) to evaluate stored information to answer inquiries, (4) adapt to new situations and extrapolate patterns, (5) contain computer vision, and (6) include robotics functions*.". See Nancy B. Talley, *Imagining the Use of Intelligent Agents and Artificial Intelligence in Academic Law Libraries* 108(3) Law Library Journal 387 (2016).

[27] David Nersessian & Ruben Mancha, *From Automation to Autonomy: Legal and Ethical Responsibility Gaps in Artificial Intelligence Innovation* 27 Michigan Technology Law Review 64 (2020).

autonomy,[28] thus it may not suffice as a legal *criterium* as the two concepts arguably constitute at least from a legal standpoint two separate phenomena.[29]

Indeed, any system provided with the aforementioned Functions (*sense/think*, *decide* and *act*) could, broadly speaking, be considered technically autonomous notwithstanding the different, although legally much relevant, degree and manner which such "autonomy" manifests itself and disregarding the fact that it seems to '*exists across a spectrum.*'[30]

Furthermore, coherently with the European aforementioned attempt at a definition, it would appear that, '*Interesting robots…* [from a legal standpoint] *are those which are not simply autonomous in the sense of not being under real time control of a human, but autonomous in the sense that the methods selected by the robots to accomplish the human-generated goal are not predicable by the human.*'[31] In other words, when debating on the topic of autonomy of artificial systems and their impact on laws and regulation we are not actually referring to any autonomous system (as seen in this section) but mainly to one which: '*is capable of understanding higher-level intent and direction. From this understanding and its perception of its environment, such a system can take appropriate action to bring about a desired state. It is capable of deciding a course of action, from a number of alternatives, without depending on human oversight and control, although these may still be present.*'[32]

The conceptual distinction between automated and autonomous systems is also part of the legal debate since the autonomy defined in the 2017 European Parliament Resolution appears to refer to the latter, strengthening the idea that the two shall be clearly separated. In fact, not requiring Human direct Control and being able to deter-

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[28] Whereas "*automation is the ability of a system to perform well-defined tasks and to produce deterministic results, relying on a fixed set of rules and algorithms without AI technologies*". On the other hand, "*autonomy specifically refers to the ability of an AI-based autonomous system to perform specific tasks independently. They can exhibit behaviors and evolve to gain certain levels of human-like cognitive, self-executing, and adaptive abilities. They may successfully operate under some situations that are possibly not fully anticipated, and the results may not be deterministic*". Wei Xu, *From Automation to Autonomy and Autonomous Vehicles: Challenges and Opportunities for Human-Computer Interaction* 28(1) ACM Digital Library 50 (2021).

[29] Automated machines and their widespread diffusion between the XIX and the XX century were legally addressed by the introduction of strict liability systems as the human intervention concerning such assets could actually be missing. Monterossi, *Liability for the Fact of Autonomous Artificial Intelligence Agents* (2020), 5-6.

[30] Curtis E.A. Karnow, *The Application of Traditional Tort Theory to Embodied Machine Intelligence* in Ryan M. Calo and Michael A. Froomkin (eds.), *Robot Law*, 5 (Edward Elgar Publishing 2013). Indeed, we can factually divide the autonomous system in two main groups, the 'Functionally Autonomous' and the 'Discretionally Autonomous', where the former consists in all those '*systems which are capable of undertaking only predetermined or strictly limited forms of independent action*' and the latter are those able to '*substitute human decision-making processes in its domain*' Hin-Yan Liu, *Irresponsibilities, Inequalities and Injustice for Autonomous Vehicles* 19(3) Ethics and Information Technology 195-196 (2017).

[31] Karnow, *The Application* (2013), 2.

[32] Andrew P. Williams, *Defining Autonomy in Systems: Challenges and Solutions*, in *Autonomous Systems: Issues for Defence Policymakers,* 33-34 (NATO 2015).

mine the relevant course of actions to reach a desired state (non-deterministically) in a non-predictable manner (we will refer hereinafter to this capability as "Self-Determination"), the autonomous system described in the Resolution are considered '*more and more similar to agents that interact with their environment and are able to alter it significantly*.'[33]

3. All Robots are Autonomous, but Some More than Others: Human Control and Self-Determination

Traditionally speaking, referring to Human Control over a machine appears to be rather unproblematic as the machine could easily be viewed as a tool, just an extension of the human user who holds (or at least should hold) complete control over the machine's work. Furthermore, no doubt used to arise concerning the agent of the action performed by the machine as the latter could rightfully be considered merely an enabler. That being said, when autonomous systems enter the picture, the straightforward nature of this relationship changes. Indeed, as humans delegate more and more competences, an AV may actually be carrying out various degrees of driving tasks previously performed solely by the driver.[34] Therefore, Human Control over the act of driving can no longer be taken for granted.

Human Control can be divided in three main elements: performing operational actions and short-term decision making, control/oversight, and planning.

When a person drives manually, she has control over the vehicle: firstly, physically engaging in several smaller tasks such as steering, accelerating and braking, necessary for the overall act of driving in a dynamic context; secondly, she also has to constantly keep an eye on the road and their surroundings in order to detect and avoid possible threats or changes in the state of the road or itinerary, and if necessary, respond to them; thirdly, she has to plan the relevant route in order to reach her destination. As a result, any movement and action performed by the car would be directly connected to the driver. However, autonomous systems and more specifically AV may have the driver relinquish only some or part of the functions which constitute Human Control.

In the context of AV, this has often been described with the metaphor of the human being *in*, *on* and *over the loop*.

(i) The human is *in the loop*, as in the case of traditional non autonomous vehicles, when the driver is seen as in direct control of both the vehicle and the monitoring/overseeing driving operations.[35] Therefore, when the operator is *in the*

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[33] European Parliament, *Resolution of 16 February 2017 with Recommendations to the Commission on Civil Law Rules on Robotics* (2015/2103(INL)) (2017) §Z.

[34] Beatrice Panattoni, *Intelligenza artificiale: le sfide per il diritto penale nel passaggio dall'automazione tecnologica all'autonomia artificiale* 37(2) Diritto dell'Informazione e dell'Informatica 335-336 (2021).

[35] It is worth noting that what counts for a person to be *in the loop* is the direct nature of their control, not the physicality, as even the operational tasks would be carried out by an automated system

loop, we can talk of *direct control* as she is performing operational actions and short-term decision making (or at least most of it, being eventually aided but not substituted by an AI), control/oversight, as well as planning. Resultingly, in this case, a clear connection can be traced between each of the machine action and the driver command/authorization.

(ii) The human operator is *on the loop* when while she delegates to the machine the operational tasks and the short-term decision making, she still exerts oversight and surveillance over the latter's actions/decisions.[36] A clear example of this is represented by AV ranking at level 2 and 3 of SAE international level of automation.[37] Coherently, the driver will not be engaged in single tasks such as steering, braking, changing line or surpassing nor makes related short-term decisions, but would be required to monitor the actions and 'decisions' undertaken by the AV to anticipate possible threats and retake control if needed (whether or not the AV may explicitly request her to). In this case we can consider the *control* to be *indirect*.

(iii) Lastly, *over the loop* refers to when the human operator does not have direct control over the vehicle nor performs any monitoring activity over driving operations[38] such as in the case of the so called fully AV ranking at level 4 and 5 of SAE international level of automation. Needless to say, in this case we should arguably talk about 'AV user' rather than 'AV driver'. To put it simply, if the human operator does not perform any direct control or if she cannot due to lack of oversight and control but merely plans the journey choosing the destination and eventually the way of transportation (such as indicating the overall itinerary), she is being provided with a service she may have *no control* over.

To sum up, given the three components of Human Control, the driver has direct control only when performing all three, hence when she is *in the loop*. On the contrary, there is a lack in direct Human Control when the operator is *on* or *over the loop*, *i.e.*, not directly performing operational tasks and short-term and contingent decision-making. This distinction has also implication in term of causality between the command/control and machine relevant action. Whereas in the first case there is a direct and immediate causal link between human-command and machine-action, in the

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which provides nonetheless the driver with a continuous stream of force feedback (and authorizations), the fact that the driver is not mechanically driving but via automatic system which she controls directly would not exclude her from being *in the loop.* Natasha Merat *et al.*, *The 'Out-of-the-Loop' Concept in Automated Driving: Proposed Definition, Measures and Implications* 21 Cognition, Technology and Work 92-93 (2019).

[36] Merat *et al* (2019).

[37] On SAE international level of automation see *e.g.*, Pearl, *Fast & Furious* in *New York University Annual Survey of American Law*, 25, 27-28 (2017) and Glancy, *Autonomous and Automated Connected Cars,* Minnesota Journal of Law, Science and Technology 631-634 (2015).

[38] Merat *et al* (2019).

latter a direct causation link between the delegation of the task and the overall course of actions could be hard to identify as several other factors may influence the undertaking of the single action of the chain.

That said, a lack of direct Human Control would not be enough *per se* to clearly separate autonomous systems from their automated counterparts. To do so a physical system operating without direct Human Control needs to be capable of Self-Determination.

It is understood that for a system in order to be usefully delegated with relevant tasks previously performed by a human it needs, to some degree, to operate like humans would, thus not deterministically restricted to an initial state but by planning and behaving conditionally in order to pursue a final result.[39] However, a couple of premises have to be made. Firstly, it needs to be specified that in this context Self-Determination does not mean intent or free will in any way, but merely refers to the capability of a system to decide a specific action or set thereof in an open environment without further external influence. Secondly, "Self-Awareness",[40] is a necessary prerequisite of Self-Determination.

A system such as an AV does more than merely react to a given condition and choose accordingly, as it may, in pursuit of a desired state, take into account the environment in its dynamic developments, the relevant instructions it has received and the various ways to reach such desired state (conditions) and plan how to reach it by establishing the chain of 'best' actions. This occurs not only in absolute terms (possibility-impossibility) but also comparatively and conditionally, picking the action/set of actions which appears to be better in leading to the desired outcome. Furthermore, in case of any changes it may reassess the various conditions and come up with another chain of actions to pursue ultimately the same result.

That said, Self-Determination would not imply autonomy by itself nor would it pose too much of a challenge for its legal qualification if it were validated step by step by the human operator, who in a sense would maintain their direct control over any machine's action and their outcomes.

The disruptiveness of Self-Determination becomes quite self-evident when it intertwines with indirect or absent Human Control as for the first time a machine, though after a first human command and in compliance with the limitations set forth by the user or developer, may discretionally and independently choose which steps to

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[39] When a machine performs an action 'deterministically', it operates only in a preordained manner, thus doing only as it is programmed without any form of self-awareness or, in the case of functional autonomy, 'discretionarily', when pursuing a task by merely reacting to a programmed input in a strictly preordained manner. Therefore, although a deterministic system may be autonomous in a technical sense as it will react to its external environment, it will do so only in an utterly predictable manner with the sole exception being the case of malfunction.

[40] It should be noted that: '*Self-awareness (SA) is a broad concept that describes the cognitive property of an agent. In the case of artificial agents like intelligent vehicles (IVs) [1], the concept of SA is an ability to observe themselves and the surrounding environment through the various exteroceptive and proprioceptive sensors and process the sensory data to learn and maintain a contextual representation of the system'*. Divya Thekke Kanapram *et al.*, *Self-awareness in Intelligent Vehicles: Feature Based Dynamic Bayesian Models for Abnormality Detection* 134 Robotics and Autonomous Systems 1 (2020).

undertake. In this case the operator would maintain planning and overseeing functions but may be excluded from the 'lower level' decision-making process, not necessarily being able to predict what the system will do next. Indeed, the more the operator is relegated in a planner position by yielding operational tasks, the more room exists for artificial 'choice'. This may add uncertainties as malfunctioning will no longer be the sole (causal) incognita in relation to the single action performed by the system, as traditional linear causation will be substituted with nonlinear interaction.[41] Accordingly, the issue is that due to the non-deterministic nature of the system's Self-Determination and the non-linearity of its decision-making process, it may not always be easy to predict the single action undertaken by the system, their impacts and how the latter may react to changes in the environment on an operational decision-making level.

In the light of the above, legally relevant robot autonomy (and decision-makings) is to be intended solely related to the operational/executive side of the externally given task to be separated from any kind of organizational and strategic one.

4. Is the Clerk Autonomous? Aiming at a Conceptual Framework by the Italian Doctrine of '*preposizione*'

In view of the previous sections, any attempt at a legal notion of autonomy (intended as operational-discretionality) would require for the system contextually to not be under direct Human Control and to exert Self-Determination in the pursuit of its task.

In summary, this would be a system that: *(i)* receives a goal/task (such as go from point A to point B) regarding which it has no control or choice over nor engages in any overall planning aside from how to better reach its desired state (in this case being in B); *(ii)* discretionarily undertakes operational actions and decisions necessary/best to pursue its relevant task; (*iii*) is/should be under monitoring and oversight of its human operator (that is, if the system is not 'fully autonomous').[42]

This kind of factual behavior in pursuit of an externally given goal, exerting discretional choices only with regard to the operational side of the task,[43] albeit in the case at hand performed by a non-human entity, is no stranger to Law. Indeed, it would not be too far of a stretch to point out that the case of a clerk entrusted with merely

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[41] Karnow, *The Application* (2013), 5 and 15.

[42] In the latter case (*e.g.*, SAE Level 4 and 5 AV) no control or oversight over the choices and execution shall be exerted by the human operator over the machine. That being said, this category of artificial systems, and namely AV, appears to raise significantly less legal and practical issues than its semi-autonomous counterpart (*i.e.*, system requiring human oversight and control). See Thierry Bellet *et al.*, *From Semi to Fully Autonomous Vehicles: New Emerging Risks and Ethico-Legal Challenges for Human-Machine Interactions* 63 Transportation Research Part F 157-159 (2019). Concerning the issues of semi-autonomous AV, see in general Tracy Hresko Pearl, *Hands on the Wheel: A Call for Greater Regulation of Semi-Autonomous Cars* 93 Indiana Law Journal 713 (2018).

[43] On the other hand, any decision concerning for example the opportunity and purpose of the task, the relevant time and place as well as (eventually) the overall modality of pursuit of the task would be completely outside of the scope of the discretional choice of the agent.

executive and operational tasks, may share uncannily similarities on a functional level with the relationship between an AV's owner and AV. The main difference is the non-human nature (thus the lack of legal/natural capacity) of the latter and possibly the degree of complexity of the task and variables that the clerk can handle over the machine.

In fact, at least on an operational level, such clerk too will discretionarily determine, in compliance with the instructions and the task, a vast range of choices on the basis of her surroundings (environment). It is also clear that the principal, while organizing and planning the task, in the end will not be able to navigate/control each of the clerk's actions (thus, delegating), though eventually monitoring them. Additionally, despite the fact that the clerk's freedom of choice will relate only to which series of actions to undertake and how to actually perform them, and the fact that their choice will operate in an externally determined framework, the discretionality of their actions may to some degree inevitably be unpredictable for the principal (who will alone hold, as said, the organizational and planning autonomy). Resultingly, a remarkably similar lack of direct Human Control and Self-Determination on the receiving part of the task can be spotted in this relation too.

This kind of relationship under Italian Law is regulated by the discipline of clerks' supervision relationship, the so-called '*preposizione*',[44] which systemic relevance primarily concerns the allocation of liability (*i.e.*, Liability of Principals and Contractors, under Article 2049 of Italian Civil Code, hereinafter "ICC").

Though the debate on the liability system applied to AV would exceed the scope of this paper,[45] the relationship this provision implies and regulates may provide indirectly insight on a concept of operational discretionality abstractly applicable to AV autonomy (and robot's as well) as cases it regulates are not dependent on any contractual bond between the parties nor on the legal or even natural capacity of the

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[44] With this wording the Italian doctrine indicates any relationship between two parties in which one principal (*preponente*) obtain benefit or utility from the action of the other one (*preposto*) which however have not organizational and managerial autonomy but act as *nudas minister, i.e.,* merely executing the principal orders and is subjected to the latter power of direction and surveillance. If the agent's action undertaken in pursuit of the appointed task result in losses for others, Italian Law considers the principal to be liable for such occurrence as she should have better controlled (*culpa in vigilando*) or chosen (*culpa in eligendo*) the agent and in any case as the latter actions would not have occurred without the appointment of the task. Andrea Torrente *et al.*, *Manuale di Diritto Privato*, 923-925 (24th ed., Giuffrè Francis Lefebvre 2019).

[45] As mentioned, the discussion on third party liability concerning AV has become the center of a worldwide debate over the aptness of existing legal framework to properly regulate the new technological innovation's unique specificity. See *e.g.* with regard to the EU legal system Kyriaki Noussia, *Autonomous Vehicles: Legal Consideration and Dilemmas* in Pierpaolo Marano & Kyriaki Noussia (eds), *Insurtech: A Legal and Regulatory View*, 253 (Springer 2020); with regard the US legal system Jessica S. Brodsky, *Autonomous Vehicle Regulation: How an Uncertain Legal Landscape May Hit the Brakes On Self-Driving Cars* 31(2) Berkeley Technology Law Journal 851 (2016); and concerning The Italian legal system Rocco Lobianco, *Veicoli a guida autonoma e responsabilità civile: regime attuale e prospettive di riforma – I parte* 3 Responsabilità Civile e Previdenza 724 (2020) and *Id.*, *Veicoli a guida autonoma e responsabilità civile: regime attuale e prospettive di riforma – II parte* 4 Responsabilità Civile e Previdenza 1080 (2020).

clerk, or lack thereof.[46] On the contrary, what counts is the objective/factual relationship between the principal, who appoints the clerk and exerts oversight,[47] and the latter who obeys an "order" without any initiative of their own.[48] Furthermore, the relationship at hand is characterized by a weakened causal link between the appointed task and the outcomes result of the action/choice undertaken, which by all means will be performed on the principal's behalf.

The clerk's actions are included in the Article 2049 ICC discipline under several conditions:

(i) they shall be undertaken as result of a task or assignment externally established. As the principal will be appointing the task and establishing its conditions and instructions. Without such act of will by the principal the provision will not apply (*Hetero-direction*);[49]

(ii) the principal will/shall have the power of directing and overseeing the clerk's actions.[50] Moreover, for the discipline to be applied, the abstract possibility of exercising a power of control or oversight is sufficient, while actual wielding of that power is not necessary (*Oversight*);[51]

(iii) the actions and their outcome are the result of the appointed task or are enabled by it. The latter, though not necessarily being in direct causal link with the former, is the factual reason (*condicio sine qua non*) why such course of action has been undertaken in the first place.[52] Furthermore, the actions (which may result in third party loss/damages) shall be performed for purposes that are not unrelated to the interests of the principal who has entrusted the task (*Necessary Occasionality*).[53]

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[46] Guido Alpa *et al.*, *Trattato di Diritto Privato* vol. 14, 344 (UTET 2000); Riccardo Mazzon, *La Responsabilità civile – Responsabilità oggettiva e semioggettiva* in Paolo Cendon (ed), *Il diritto italiano nella giurisprudenza*, 503-504 (UTET 2012). On the same line also the Italian Supreme Court ('*Cassazione*') see *e.g.*: C. 28852/2021; C. 12283/2016 and C. 8668/1991.

[47] In fact, for the purpose of this discipline the specific role held by the clerk in the organization has little relevance. The requirement for the applicability of this provision is met whenever the relationship between principal and clerk is characterized by the execution of works or tasks and by the control, oversight and surveillance function of the principal held in relation to the clerk. On such requirements see Marco Rossetti, *Art. 2049 – Responsabilità dei padroni e dei committenti (Commento)* in Ugo Carnevali, *Commentario del Codice Civile diretto da Enrico Gabrielli – artt. 2044-2059*, 156-157 (UTET 2010).

[48] A willful act of appointment on the part of the principal is therefore necessary, whereby the clerk acts at the request and on behalf of the principal. Accordingly, there is no such relationship when there is no such act of will and the agent acts of his own accord. Anna Maria Galoppini & Augusto Baldassari, *La responsabilità dei padroni e dei committenti* in Paolo Cendon, *La responsabilità civile*, 128 (UTET 1998).

[49] Galoppini & Baldassari (1998), 128.

[50] Pier Giuseppe Monateri, *Le fonti delle obbligazioni. Vol. III – La responsabilità civile* in Rodolfo Sacco (ed), *Trattato di Diritto Civile*, 985 (UTET 1998).

[51] Paolo Cendon *et al*., *Commentario al Codice Civile*, 767-769 (Giuffrè Editore 2008).

[52] Rossetti, *Art. 2049* (2010); see also, Guido Alpa *et al*., *Trattato di Diritto Privato* (2000), 341.

[53] See *e.g.,* C. 14096/2001 and C. 2226/1990

It should be noted that the fact that only an abstract possibility of exercising the power of oversight and direction is required, further analogies this relationship to that of a user of an AV. In fact, in that case, Human Control, although always present and necessary in the abstract, may actually be lacking.[54]

In fact, the relationship underneath the provisions under Article 2049 ICC (which envisages a strict liability for the principal for any unjust loss resulting from their clerks' actions) appears to necessarily imply a degree of operational discretionality of the clerk. Indeed, the choice of applying a special liability system over the ordinary one to the principal in case of losses due to the clerk's actions appears to find its justification in the fact that although no direct-immediate causality (and responsibility) may be traced to the principal, it was her appointment of the clerk which produced a series of actions resulting in the loss (over which she may have imperfect control and may not predict completely) from which on paper she would have benefitted, "*cuius commoda eius et incommoda*".[55] It is clear that such lack of control and predictability results from the exertion of the clerk's operational autonomy, as in its absence there would be no obstacle to the application of the ordinary liability rule as ordinary causal links between the parties' action and loss could be traced. Accordingly, despite the provision would apply also in cases of a higher degree of choice and cooperation on the latter's part,[56] by default, especially the simplest and executionary form of '*preposizione'* in which the clerk behaves as merely a *longa manus* of the principal would be included as again such special liability rule.[57]

Interestingly enough, the emphasis on the concrete and objective aspects of the relationship between the commitment and the clerk has made way in other relevant jurisdictions such as the French one. Indeed, historically speaking the principles behind the aforementioned Italian provision have been heavily inspired by the French experiences.[58] Coherently, French Law provides under article 1384.5 of the Code Civil a liability system for the principal for the action enacted by her attendants in pursuit of the functions for which she has appointed them, this without even the requirement of injustice of the losses (required in the Italian norms instead). This fact, although often tempered by the case law,[59] may allow at least as far as the literal interpretation goes for even greater emphasis on the objective nature of the clerk's position without consideration for their subjective negligence or will. Moreover, comparative studies outlined that, within the Western Legal Tradition[60], Common

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[54] On the so-called "Control Dilemma" see e.g., Panattoni (2021), 336-337.

[55] Massimo Franzoni, *Commentario del Codice Civile*, 405 (Zanichelli 1993).

[56] Rossetti, *Art. 2049* (2010), 157-162.

[57] In fact, the fact of acting merely as *nudus minister* of the principal determines the applicability of the rules set forth in Article 2049 also to subjects traditionally endowed with autonomy and independence such as, in particular, the contractor, thus prevailing over different liability regimes. See Franzoni, (1993), 440.

[58] Rossetti, *Art. 2049* (2010), 153-155.

[59] Alberto Russo, *La responsabilità dei padroni e dei committenti nel contratto di somministrazione di lavoro: una comparazione tra Italia e Francia*, 4-5 (ADAPT 2021).

[60] Antonio V. Gambaro, *Western Legal Tradition* in Peter Newman, *The New Palgrave Dictionary of Economics and the Law*, 2086–2092 (Palgrave Macmillan 2002).

Law and Civil Law legal systems appear to uphold similar core elements concerning this form of vicarious liability.[61]

As a result, notwithstanding the relevance of the subjective nature of the clerk but the objective relationship of control and the unavoidable (but limited to a concrete operational level) discretionality of the latter, it could be argued that this provisions indirectly provide a normative and legal framework for an overall and more general concept of '*operational autonomy*' which could be applied to AV (and robots) autonomy as well.

5. Putting Forward a Legal Notion of Autonomy for AVs (and Robots)

As the notion of autonomy seems to be destined for an ever-growing relevance both on a conceptual level as well as for a regulatory one, it is crucial to ground it in an existing legal framework and not leave it to possible ambiguous and volatile technical notions which were not constructed with legal systematics in mind.

The issue of intelligent 'goods' which may act autonomously is not entirely new to Law as well as human and goods historically have not always been incompatible concepts. Thus, within existing legal systems, and if not within specific provisions then at least in concepts and principles, relevant pieces of data can be gathered and a general concept of operational autonomy seems to silently have been already addressed by some provisions and doctrines, which may acquire new meaning and functions with the Fourth Industrial Revolution.

In conclusion, having clarified the key elements of what constitutes autonomy in the context of AV and other autonomous physical systems and in the light of the legal framework concerning operational autonomy in pursuit of an externally given task, it could be argued, for possible future classifications and regulatory purposes, that an artificial system appointed to perform a given task is to be considered "autonomous" when if it were a human, it would be included in the discipline of Article 2049 ICC.

Therefore, the following proposal for narrowing (and strengthening) the existing legal EU notion of robot autonomy is put forward:

'[Having received an externally given task] *Robot's autonomy can be defined as the ability to take decisions* [by determining a relevant action/chain of actions and updating it from a series of alternatives on the basis of its environment] *and implement them in the outside world, independently* (1) *of* [direct] *external control or influence* (2)'.[62]

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[61] Monateri (1998), 978.

[62] Again for the original version of the notion, see European Parliament, *Resolution of 16 February 2017 with Recommendations to the Commission on Civil Law Rules on Robotics* (2015/2103(INL)) (2017) §AA.

(1) whereas '*independently*' should be intended as the fact that the decision-making in pursuit of the task process is not causally dependent on control and/or authorization/validation from the human operator being the single action undertaken is in a relation of 'necessary occasionality' with the overall task.

(2) whereas the degree of control that the human operator holds over its decision cannot exceed oversight and monitoring, though she may overtake control.[63]

[63] It is clear that as long as the human operator is exerting direct control over the system creating direct causal links between their choice and actions and the relevant machine's performance, the latter legally speaking shall lose the qualification of autonomous until the operator relinquishes control once again. Accordingly, in view of this definition AV, which merely provides assistance or in which the human operator still maintains relevant driving tasks, are not to be considered autonomous.