Robotics, artificial intelligence and autonomous vehicles

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1. Robotics and artificial intelligence

In this study we are going to attempt to provide a general overview of the current status in Europe of the so-called fourth industrial revolution, in the field of robotics and artificial intelligence, with particular reference to the so-called autonomous vehicles.

In any case, the vision we are going to offer here is intended merely as informative and generalist, without giving our potential readers the idea that the author is a specialist on the subject.

From the European perspective, on 16 February 2017, the European Parliament approved Resolution (P8_TA-PROV (2017) 0051) with recommendations to the Commission on civil law rules on robotics. This Resolution commenced with an historical-literary reflection starting from Frankenstein's monster through to Prague's Golem, with reference to the fantasising of human beings about the possibility of building intelligent machines, especially androids with human traits.

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Consequently, the Parliament considers it necessary to define the concepts of robot and of artificial intelligence, as well as to assess the impact that the development of robotics and artificial intelligence is going to make on our way of life and how we work. Likewise, it is expected that, in the short or medium term, robotics and artificial intelligence will raise levels of efficiency, savings and safety, not only in production and commerce, but also in other areas, such as transport, healthcare, rescue operations, education and agriculture.

All indications point to a situation where the development of smart and autonomous machines will not only deliver advantages of an economic nature, but will also give rise to direct and indirect effects on society overall and, consequently, the possible negative effects in the context of discrimination, due process, transparency and understandability in decision-making processes must be foreseen.

It is essential to make an ongoing analysis of the economic changes and the effects on employment that will be caused by robotics and machine learning, since their progressive implementation is going to transform the labour market, which means that we will have to reflect on the future of education, employment and social policies.

2. General principles and liability

As a starting point, and although the following affirmation may seem somewhat extravagant, the designers, manufacturers and operators of robots should keep in mind **The Three Laws of Robotics** devised in 1950 by Isaac Asimov in his novel **"I, Robot":**

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence, as long as such protection does not conflict with the First or Second Laws.

In this context, the European Union must play an essential role in establishing basic ethical principles to be respected in the development, programming and use of robots and artificial intelligence, for the purpose of shaping the technological revolution so that it is at the service of humanity.

Consequently, the European Parliament's Resolution incorporates a Charter on Robotics, which proposes a code of ethical conduct for robotics engineers, a code for research ethics committees, a licence for designers and a licence for users.

Given the level of development already being attained by robotics and artificial intelligence, it is evident that the issues relating to civil liability need to be addressed. In effect, the first issue to be resolved is going to be who can be held legally responsible for the damages caused by a robot, considering that the autonomy of a robot can be defined as the capacity to make decisions and apply them in the outside world. This autonomy is of a technological nature, and the greater the degree of sophistication with which a robot is designed for interacting with its environment, the greater will be its autonomy.

In a kind of premonitory inspiration, in the novel mentioned above and in relation to the robot, DV-5, featured in one of his stories, Asimov tells us the following: "And worked his mind over the highest functions of the robot world: the solutions of problems in judgement and ethics".

The more autonomous robots are, the less they can be considered as mere instruments in the hands of other agents (manufacturers, operators, owners, users, etc.). Whereas in the current legal framework, robots cannot be held liable for acts or omissions harming third parties, these will be attributable to a specific human agent, such as the manufacturer, the operator, the owner or the user.

The current legal framework is shaped, on the one hand, by the liability for damages caused by defective products (the manufacturer of a product is liable for its malfunction) and, on the other, by the rules that regulate liability for harmful actions (the user of a product is liable for behaviour that leads to harm to third parties). Now then, in cases where robots can make autonomous decisions, conventional rules will not suffice for generating legal liability for the damages caused by such robots, as they will not make it possible either to determine the party responsible for providing compensation or to require such party to remedy the damage caused.

Therefore, the current systems of contractual and non-contractual liability, as well as the framework provided by Directive 85/374/EEC, of 25 July 1985, with respect to product liability, would not suffice for covering the damages caused by the new generations of robots, insofar as they can be equipped with adaptive and learning abilities

entailing a certain degree of unpredictability in their behaviour. That is, a robot will be able to learn autonomously from its own experiences and interact with its environment in an unforeseeable manner specific to that robot.

Consequently, it is recommended that any legal solutions chosen in terms of liability for the damages caused by robots, in cases other than property damage, should not restrict the type or scope of the damages that could be considered for compensation, or restrict the nature of such compensation, based solely on the grounds that the damages were caused by a non-human agent.

The future legislative instrument should be based on an evaluation made by the Commission that would define whether the strict liability or the risk management approach should be applied. In any case, it would be advisable to establish a compulsory insurance scheme, similar to the existing system for automobiles, which could be based on the obligation of manufacturers or owners to take out compulsory insurance for specific categories of robots to be determined. Such compulsory insurance system should be supplemented by the creation of a compensation fund for guaranteeing the reparation of the damages caused by a robot in cases where insurance has not been arranged.

3. Common European definitions and robot register

The European Parliament has called on the Commission to propose common definitions of cyber-physical system, autonomous system, smart autonomous robot and their sub-categories, on the basis of the following characteristics of a smart robot:

- Capacity to acquire autonomy through sensors and/or through an exchange of data with its environment (inter-connectivity) and the analysis of such data.
- Capacity for self-learning from experience and by interaction.
- The form of the physical support of the robot.
- Capacity to adapt its behaviour and actions to the environment.
- Absence of life in the biological sense.

The Parliament also considers that a comprehensive system for the registration of advanced robots should be created within the internal market of the Union, together with the establishment of criteria for their classification.

A proposal has been made for the creation of a European Agency for Robotics and Artificial Intelligence, which would provide the technical, ethical and regulatory expertise necessary for supporting the work of the relevant public actors, at both Union and Member State level.

4. Autonomous means of transport

The Resolution of the European Parliament which we are analysing makes a distinction on this point between two major categories:

a) Autonomous vehicles

1.- It emphasises that autonomous transport encompasses all forms of remotely piloted, automated, connected and autonomous road, railway, waterborne and air transport, including vehicles, trains, vessels, ferries, aircraft and drones, as well as all future forms arising from developments and innovations in this sector.

2.- It notes that the automotive sector is the field in most urgent need of Union and global rules to ensure the cross-border development of autonomous and automated vehicles, with the aim of fully exploiting their economic potential and of benefitting from the positive effects of the technological trends.

3.- It highlights the fact that, in the event of an unplanned takeover of control of the vehicle, driver reaction time is of vital importance, and it calls on stakeholders to provide for realistic values determining the aspects of safety and liability.

4.- In any case, the transition to autonomous vehicles will impact on the following aspects:
- Civil responsibility (liability and insurance).
- Road safety.
- The environment.
- Protection of data.
- ICT infrastructures.
- Employment.
- Significant investments in road and energy infrastructure.

5.- It underlines the critical importance of reliable positioning and timing information, provided by the European satellite navigation programmes Galileo and EGNOS, for the implementation of autonomous vehicles.

6.- Finally, it highlights the high added value of autonomous vehicles for people with reduced mobility, since such vehicles improve their participation in individual road transport, thereby facilitating their daily lives.

b) Drones

The positive advances in drone technology are acknowledged, particularly in the area of search and rescue; underlining the importance of a European framework for the use of drones to protect the safety and the privacy of the citizens of the Union.

Likewise, the European Commission is called upon to undertake a special follow-up of the recommendations made in the European Parliament`s Resolution of 29 October 2015 on the safe use of remotely piloted aircraft systems (RPAS), commonly known as unmanned aerial vehicles (UAV), in the field of civil aviation. Particular attention is given to the safety issues becoming evident as a result of the widespread use of drones, as well as to the study of the need to introduce a mandatory tracking and identification system for the RPAS enabling verification in real time of their position in use.

5. From the connected vehicle to the autonomous vehicle

It can be said that, in general, the autonomous vehicle is the immediate future, that it is already here and that the difficulties for its implementation and its progressive generalisation are not going to be found in the technology, but rather in the legal environment and, above all, in the field of liability.

Within the framework of the different degrees of automation of a vehicle, we can envision a scale that would range from a vehicle with no degree of automation whatsoever (the driver performs the entire automation process) through to a fully automated vehicle (without the need for the driver to act, since the automated driving system would perform the entire process of driving the vehicle).

The international standard, **SAE J3016,** adopted by the U.S. Department of Transportation, defines the six levels of automation or autonomous driving:

- Level 0: No Automation
- Level 1: Driver Assistance
- Level 2: Partial Automation
- Level 3: Conditional Automation
- Level 4: High Automation
- Level 5: Full Automation

At the present time, we are entering the level 3 stage, where the intervention of the human driver is still necessary and who must be ready to intervene if the automobile so requests, foreshadowing levels 4 and 5, where the driver will no longer be necessary and will be replaced by the vehicle's system itself, whereby, once the vehicle has been started and its destination has been determined, the automobile itself will be able to drive autonomously and make its own decisions in the course of the travel.

At the present time, the vehicles being manufactured already have electronic driving aids and, with increasingly greater frequency, fully connected vehicles are being produced, that is, vehicles equipped with their own connection to the Internet, whereby they can receive and transmit data, while high-range vehicles already have automated functions capable of performing dynamic driving tasks, such as automatic parking manoeuvres.

In this context, a German high-end automobile manufacturer has just launched a vehicle with an option called "piloted driving", equipped with a "traffic jam pilot" system, that is, a **level 3 vehicle,** which performs the start-up, acceleration, steering and braking. The driver no longer needs to constantly monitor what the vehicle is doing, because the automobile performs the task of driving; therefore, drivers can take their hands off the steering wheel and, depending on the laws in each country, focus on other activities provided by the vehicle, such as watching television. The system itself takes control of the task of driving up to 60 km/h on expressways and motorways, where there is a physical barrier between the two directions of traffic and it detects a traffic situation.

As from 31 March 2018, all of the automobiles and vans manufactured in the European Union must have an emergency calling system or e-call installed. That is, they will carry a SIM card with a connection to the Internet which will enable vehicles to transmit and receive information and which, in the event of an accident, will automatically send a notice to the emergency services, indicating the location, type of vehicle, occupants and the information necessary for assistance to be provided. It is evident that this system will make it possible to significantly reduce road deaths, as well as to attenuate the seriousness of the harmful consequences for all traffic accident victims.

Consequently, we can envision a scenario where the progressive automation of motor vehicles will ultimately lead to autonomous vehicle traffic which will operate without human intervention. This circumstance will pose new challenges, together with the ensuing uncertainties and hurdles to be overcome, advantages and new risks, the first of which will no doubt be the coexistence between driver-operated vehicles and fully automated vehicles that will not need a driver to steer them.

Without pretending to be exhaustive, we can conclude these brief notes by summing up what we see as the priority issues to be addressed by European and national legislators for the imminent arrival of autonomous vehicles on the roads:

1.- Update the Vienna Convention of 8 November 1968 on road traffic, where article 8 provides that every moving vehicle or combination of moving vehicles must have a driver, who must possess the necessary physical and mental abilities and be in a fit physical and mental condition to drive, having control of the vehicle at all times.

In our internal legislation, the basic legal provisions affected would be, on the one hand, Royal Legislative Decree 6/2015, of 30 October, approving the revised text of the Traffic, Movement of Motor Vehicles and Road Safety Act. Annex I of the Decree defines a driver as the person who, in possession of the required driving permit or licence, handles the steering mechanism or is at the controls of a vehicle.

And, from the perspective of the vehicle registration obligation, Royal Decree 750/2010, of 4 June, regulating the procedures for the type-approval of motor vehicles and trailers, self-propelled or towed machines, farm vehicles, as well as systems, parts and pieces of such vehicles.

2.- Determine the criterion for imputing responsibility applicable to the civil liability of autonomous vehicles, with respect to the designer, manufacturer, importer or owner of the vehicle without, in any case, affecting the direct action against the insurer which the legislation in force recognises for injured third parties.

3.- Evaluate the advisability of establishing a special regulation in terms of civil liability and the insuring thereof or, as appropriate, amend current legislation to address the specialities arising from the movement of vehicles that are not being driven by a natural person. This latter case would involve amending the Motor Vehicle Civil Liability and Insurance Act (Royal Legislative Decree 8/2004, of 29 October), as the Act solely considers the liability of the driver of a motor vehicle and as a consequence of the risk created on the occasion of the movement of such vehicle.

4.- In any case, the maintaining of a compulsory third-party insurance system, like the one in place at the present time, together with the guarantee funds (in Spain, Consorcio de Compensación de Seguros) for covering situations of the lack of insurance or the impossibility of determining the insurance company of the vehicle causing the accident.

5.- Development of intelligent transport systems (ITS), whose framework for implementation is contained in the European Parliament and Council Directive 2010/40/EU for the road transport sector and for the interfaces with other modes of transport.

This Directive has been incorporated into Spanish law through Royal Decree 662/2012, of 13 April, establishing the framework for the implementation of intelligent transport systems (ITS) in the road transport sector and for the interfaces with other modes of transport. These are systems in which the information and communications technologies are applied in the field of road transport, including infrastructure, vehicles and users, and in the management of traffic and mobility, as well as for the interfaces with other modes of transport.

6.- Raise awareness of the consequences which the development and widespread use of autonomous vehicles is going to bring about in the insurance world, considering that safety is going to increase and, foreseeably, the number of traffic accidents will decrease as a result of the fact that the human factor in the driving of vehicles –the major factor in the occurrence of accidents- will almost disappear. Nevertheless, there is no doubt that accidents will occur as the result of a new aetiology of incidents, stemming from technological aspects, communications and infrastructure networks. New cyber risks will appear, or risks derived from the protection of personal data, which are going to be obtained by the vehicle itself.

7.- In any case, the right to respect for a person's private life and to privacy, as well as the right to the protection of personal data, must be guaranteed.

8.- As stated in the Recommendations of the European Parliament in relation to the Code of Ethical Conduct for Robotics Engineers, in the design and development stage of autonomous vehicles, such engineers must also respect the following principles:

- **Beneficence:** Robots should act in the best interests of humans.
- **Non-Maleficence Principle:** Whereby robots must not harm humans (first, do no harm).
- **Autonomy:** The capacity to make an informed, independent decision on the terms of interaction with robots.
- **Justice:** Fair distribution of the benefits associated with robotics.

9.- A significant development is that, in August of this year, the Council of Ministers of the German Government approved the first code of ethics for the manufacture and use of autonomous vehicles. A Committee of fourteen experts established the ethical grounds for the regulation of responsibilities in the event of accidents.

The report issued contains 20 theses for defining the dividing line of responsibility between man and machine, based on the idea or principle that autonomous driving is ethically justified solely if it causes fewer accidents than human or conventional driving.

Likewise, the guidelines establish that the protection of people and human life takes precedence over the protection of property. In this sense, in risk situations and when damages are inevitable, the automated driving system must be programmed to prioritise the safety of people over the concern for material damages, without establishing a classification of the possible victims based on their personal characteristics (age, sex, race and physical or mental constitution).

The fact that responsibility is a human trait not attributable to machines is emphasised. Consequently, in the event of an accident, liability will be transferred from the driver to the manufacturers and to the operators of the technical systems and the infrastructures.

Likewise, self-driving or automated vehicles must have a tangible and transportable system for the storage of the data referring to the driving of the vehicle, a black box, which will record the data of all of the operations performed. In any case, it is important to note that the use of such data by third parties will require the consent of the owner or user of the vehicle for the purpose of protecting their right to privacy.

10.- From another perspective, on 31 August 2017, the Official Journal of the European Union published the Opinion of the **European Economic and Social Committee (EESC)** on «Artificial intelligence: the consequences of artificial intelligence on the (digital) single market, production, consumption, employment and society».

This Opinion contains a number of conclusions and recommendations in relation to the advances and applications of artificial intelligence **(AI)** in all areas of society and, in respect of those aspects which are relevant to this study, we are providing the following summary:

- The EESC defends an approach to AI based on **human control** (human-in-command), in such a way that machines will continue to be machines and people will retain control over them at all times.
- The EESC calls for the preparation of an **ethical code** for the development, deployment and use of AI, which would be compatible with the principles of human dignity, integrity, freedom, privacy, cultural diversity and fundamental human rights.
- The EESC advocates the development of a **standardisation system** for the verification, validation and control of AI systems, based on a broad spectrum of rules in terms of security, transparency, intelligibility, accountability and ethical values.
- The EESC advocates a **European open-source AI infrastructure** to include learning environments that respect privacy, real life test environments and high-quality data sets for developing and training AI systems.
- Finally, the Opinion highlights the impact of AI on existing legislation and regulations. Particularly, it makes specific reference to the controversy over the issue of who is liable for the damage an artificial intelligence system could cause, especially when self-taught systems are involved that continue to learn after they have started to operate.

- In this regard, an express reference is made to the European Parliament's recommendations to the European Commission on the Civil Law rules on robotics which we have been analysing in the course of this study and, specifically, with respect to the proposal to examine the possibility of endowing robots with a **"legal personality"** (e-personality) to be able to attribute to them the civil liability for the damages they cause.
- And, in relation to such possibility, the European Economic and Social Committee has taken a firm stand, on stating that it opposes any kind of legal statute for robots or artificial intelligence systems on account of the unacceptable moral risk involved. Adding that the legislation in terms of liability has a corrective and preventive effect that could disappear as soon as the civil liability risk would no longer fall upon the person responsible, due to having been transferred to a robot or to an artificial intelligence system.

11.- Finally and from the Spanish perspective, we should mention that on 10 October 2017, the Plenary Session of the Congress of Deputies passed a **Non-Legislative Motion on the furtherance and development of autonomous vehicles (162/000451),** through which the Government of the Nation is urged to approve the legislative changes necessary for legalising the use and utilisation of autonomous vehicles and furthering the reconversion of the automotive industry in the sense of favouring the manufacture, standardisation and putting into operation of such vehicles.

The Congress of Deputies urged the Government to establish an appropriate legal framework making it possible to:

- Promote the development of autonomous vehicles by assessing the performance of the specific legislation into place and identifying possible legal improvements, fostering research and development, as well as testing prototypes.

- Further the development of the automotive industry, as well as the ecosystem of highly innovative companies and SMEs associated with the automotive sector and with the creation of quality employment, complementing all that with research, development and innovation.

- Develop measures that will strengthen the competiveness of automotive industry in Spain, making it possible its transition to the needs of autonomous vehicles, fostering specialisation and qualification of the jobs associated to the new technological needs of this industry.

- Foster actions allowing consolidating Spain as a World benchmark for testing connected, assisted and semi-autonomous vehicles at all their levels, as well as assessing the social and environmental impacts of the development of this industry.

The Explanatory Statement **defines an autonomous vehicle** as a driverless, robotic automobile, which adapts to the circumstances of the road (speed limits, pedestrians, obstacles, weather conditions, etc.).

The parliamentary debate made clear that, prior to the end of the current term of office, the General Directorate for Traffic will have to draw up a new **strategic plan for the vehicle of the 21st century** to ensure that the arrival of the self-driving car on Spanish roads, as well as the connected car, will become a reality. In any case, the debate highlighted the fact that in the nearer future, what is going to happen will be the establishment of automation level 3 with vehicles capable of autonomous driving but still under the supervision of a driver.

The conclusion is that the principal obstacles we can expect to encounter for the full implementation of autonomous vehicles will not be the technological limitations, but rather the socio-political, legal, regulatory, infrastructure-related and commitment factors to be addressed.