

**ROBOTICS, RIGHTS AND LIABILITIES
JURIDICAL PROSPECTS OF INTELLIGENT MACHINES**

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ABSTRACT: *The idea that automated machines, that is the automata, could somehow imitate and in some cases replace human activity, found fertile ground in the literature of all time. At the same time, science, in a wide sense, was fascinated by the same suggestions, finding stimuli to deal with areas traditionally assigned to science fiction.*

From the last decades of the last century, with the emergence and evolution of electronic computing and with the development of digital planning through the production and the increasingly performing use of powerful algorithms, the robotics from the field of science fiction passed systematically to be of interest not only of the theoretical and applied research, but also of economics, law and the thus defined social systems.

Positive law, understood as a deontic rule, until recently has maintained a certain distance from automation issues, dealing solely with normative responsibility and possible damages arising from the production, trade and use of automated or technological machines, including computer devices and their necessary software.

Indeed, in the Italian legal system the issue is dealt with in different ways for what regards the attribution of liability, because there is no specific legal rule for intelligent machines. Here some questions rise that are closely related to the evolution of learning machines.

At European level, the matter is currently covered by EU Product Law and the Machinery Directive.

The European Parliament's resolution of 16 February 2017 on recommendations to the Commission on civil-law rules on robotics, indicates on the one hand that no time must be lost to legally regulate the use of robots both in industrial activities and in private life , while on the other hand it has opened a new chapter on robotics, by placing it directly in a European legal order called to legislate (de jure condendum) on essential profiles to see to what extent robotic actions affect human rights, provoking non predictable effects.

On this basis, Parliament calls the Commission to adopt one or more legislative proposals on this matter, indicating the need to address liability issues as a core issue.

The legal aspects referred to concern robot rights and the reflection on the legalization of a new legal personality: the electronic person. The areas particularly affected by robotics are eHealth, Communication, Transport, Public Administration.

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Traditional and next generation robotics do raise legal, ethical, economic and social issues for the formation and work of the new generations that require regulatory action.

KEYWORDS: *Legal informatics; eHealth; Civil rights of Robots; IoT; Robot Work; Liability.*

JEL CODE: *K00, K10*

ERC Panels: SH2_8, SH2_10, SH2_11

ITALIAN SSD IUS/20

1. INTRODUCTION

The possibility to free people from their physical workload has been considered in all epochs one of the biggest aspirations of humanity. This utopian strain has always been accompanied by constant attempts to realize ideal applications by studying and producing devices able to carry out typical human activity through automation. This means, the production of machines, at various levels of evolution, capable of autonomous movements, and able to perform work in substitution of man or to assist him.

Over time, automata have often been produced for leisure or to stir astonishment, but people were always aware to deal with devices, objects, “things”¹.

From half of the last century the issue of automatic devices powerfully enters in the imaginary collective through the production of a literature of science fiction whose protagonists are robots. Here the representation of a future society emerges, in which machines reach levels of autonomy and intelligence equal if not superior to that of man.

Even science has been moving in the fifties of the XX century, conceiving fields of research on artificial intelligence and on cybernetics in a period in which computer sciences and binary computing of information were introduced. At that point robotics started to become known beyond the small circle of scholars and specialists.

This ferment, the amazing affirmation and diffusion of computer sciences and telematics, as well as the realization of gradually more developed autonomous and intelligent devices (robots) are influencing strongly the evolutionary process of all sectors of society, not only occidental, and contribute to the activation of what we currently call the information and communication society and the society of knowledge.

In this way economics have been able to achieve global markets in which digital services join traditional commodities while the traditional *medium* of communication of the social system “economy”, the monetary system, has passed from an analogical and material state to an electronic (Sica, et al., 2005), digital and virtual one up to recent acquisitions as crypto-currency² and blockchain³, and their latest developments⁴.

¹ From a conceptual point of view, it should be noted that modern robots are designed and built with a specific purpose; generally they are used to replace or enhance manual work in all operations where there is a convenience in doing so. The automata were instead designed and built for pleasure. Although there are examples where was the money obtained from their exhibition or sale, it is clear that the main purpose of robots inventors was to fulfill a wish or desire to surprise and wonder, maybe the desire to fulfill a dream. Even from this point of view, more than ever, automata are not the ancestors of industrial robots. On the other hand, it seems significant that their time is over, almost entirely, to the nineteenth century. See (Battifoglia, 2016)

² A cryptocurrency is an equal exchange, digital decentralized the implementation of which is based on the principles of cryptography to validate transactions and currency itself generation. Like any digital currency, this makes it possible to make online payments securely. The crittovaluta best known is Bitcoin (BTC), born in January 2009, protocol-based proof-of-work, is the first criptocurrency by value, the first to be known en masse,

Technological innovation produced by the computer sciences revolution has determined the *IV industrial revolution* involving production and industry, today defined as 4.0⁵, where you find a notable use of robots.

Even law showed interest to this reflection on robotics. Over time, the doctrine and legal rulings have been assuming different positions regarding the recognition of the civil rights of robots, in particular for what regards the possible responsibility for their behaviour (ethics). A key issue is the planning and classification of the intelligent and autonomous devices whose latest legal aspects lead to the formulation of various scenarios for the recognition of their personality, subjectivity and imputability regarding the consequences of their actions.

2. CIVIL RIGHTS OF ROBOTS: QUESTIONS

In scientific literature, which has been dealing with legal problems connected with new technologies and instances of protection both of consumers and of manufactured goods produced by robotics, it is possible to individualize some fields of research useful to the description of the issue we are facing now.

In particular, the relationship between man and machine has been of interest of scholars from different disciplines, among which law. The question is to establish objective criteria useful to define what has to be protected and how this protection should be applied.

Here appear two paradigms of western culture able to meet the expectations of the protection of "things": i.e. *value* and *subjectivity*. Applied to robots this demand for protection has produced considerable consequences, improved over time, and eventually included in the *Resolution of the European Parliament* of February 16, 2017.

From the last decades of the last century, with the emergence and evolution of electronic computing and with the development of digital planning through the production and the increasingly performing use of powerful algorithms, robotics, from the field of

and to be recognized as a form of payment from different sites Internet, including those in the deep web.<https://it.wikipedia.org/wiki/Criptoaluta>. See (Capaccioli, 2015).

³ A blockchain is a distributed database, introduced by Bitcoin currency that keeps in a continuous manner a growing list of records, which refer to earlier records that exist in the same list and is resistant to tampering. The first and most popular application of blockchain technology is the public view of Bitcoin Transactions, which was inspiration for other cryptocurrency and distributed database projects. See Pische G., *Come la Blockchain può creare un'economia senza umani*, «Market Revolution» - 1 February 2016, <http://www.marketrevolution.it/blockchain-economy-of-things>.

⁴ The recent creation of a fully decentralized virtual currency called *Bitcoin Cash* (BCH), which does not respond to a central bank and does not need to trusted third parties to operate, has allowed Bitcoin to pass, a code considered obsolete by Security reasons: if the "old" Bitcoin supports blocks up to 1MB or 3 transactions per second, the new "cash" arrives at 8MB. See *La moneta virtuale si evolve: arriva il Bitcoin Cash*, in «R.it», 31 luglio 2017, http://www.repubblica.it/tecnologia/sicurezza/2017/07/31/news/la_moneta_virtuale_si_evolve_arriva_il_bitcoin_cash-172061092/.

⁵ Linearity for industrial development stages is also problematical: the historical sequence from simple manufacturing, continuing with the transition to the big factory and then Taylorism, leads to toyotism and flexible automation to finally reach the smart factory is in many ways an abstraction, useful in highlighting discontinuity but submitting to the idea that the evolution of industry is guided by a single leader. [...] The explicit goal of smart factories is to create a language chain where information is translated not only by workers but also by machines.. (Magone & Marzali, 2016).

science fiction passed systematically to be of interest not only of theoretical and applied research, but also of economics, law and the thus defined social systems.

Positive law, understood as a deontic rule⁶, until recently has maintained a certain distance from automation issues, dealing solely with legal responsibility and possible damages caused by the production, trade and use of automated machines or different technologies, including computer devices and their necessary software.

Indeed, in the Italian legal system the issue is dealt with in different ways for what regards the attribution of liability, since no specific norm exists for intelligent devices. Here some questions rise that are closely related to the evolution of *learning machines*.

It could be considered to apply to the curve of growth of artificial robotic intelligence a different division of responsibilities making them correspond with the various subjects involved: the designer, manufacturer, operator, the user-owner, the robot, third parties (inclusive other robots?). However, it could also be possible to consider responsibilities foreseen for animals in the Italian juridical arrangement as to art. 2052 c.c., to be applied to robots in the same way as to pets.

Otherwise, if a robot is considered a real subject of law, applications can be found in the articles 2047 c. c. (*Damage caused by incapable persons*), 2048 c. c. (*Responsibility of parents, guardians, preceptors*) or 2049 c.c. (*Responsibility of the owners and buyers*).

Another fundamental aspect is that of the responsibility of the robot for the damages that the same device should cause to itself or to his own user-owner (*product liability*). To the state of the art, the best choice could be to apply the discipline of art. 2050 c.c. on the exercise of dangerous activity or of art. 2051 c.c. on the responsibility for things in custody. This legislation has the particular merit to impose urgent probative obligations in charge of the subject held responsible. But they don't cover intelligent and autonomous machines .

At European level the issue is currently covered by the EU Product Law⁷ and by the Machinery Directive⁸.

The approval of the *Resolution* of the European Parliament⁹, on recommendations to the Commission regarding rules of civil law on robotics, indicates on the one hand that no time must be lost to legally regulate the use of robots both in industrial activities and in private life, while on the other hand it has opened a new chapter on robotics, by placing it directly in a European legal order *in progress*, called to legislate (*de jure condendum*) on

⁶ For a description of the deontic logic in relation to Legal Informatics see (Bertea & Porciello , 2003) e ss. *For "deontic" we have to understand the general theory of duty, that is, the concepts and the relative normative systems. The examination of such concepts, called "deontic concepts", and their relation to the concepts of the domain of being, so-called "ontic concepts", are the subject of semantics and normative language* (p. 94).

⁷ Reference rules and application procedures are condensed in the document COMMISSION NOTICE The 'Blue Guide' on the implementation of EU products rules 2016 (Text with EEA relevance) (2016/C 272/01), published on July 26, 2016 on Official Journal of the European Union, <http://ec.europa.eu/DocsRoom/documents/18027/>

⁸ *The Machinery Directive* (2006/42/EC, <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006L0042> , and Edition 2.1 (update of the 2nd edition) of the *Guide to application of the Machinery Directive 2006/42/EC* was endorsed by the Machinery Committee and issued in July 2017, <https://ec.europa.eu/docsroom/documents/24722>.

⁹ *Civil Law Rules on Robotics*, European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)), <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P8-TA-2017-0051+0+DOC+XML+V0//EN>

essential profiles to grasp to what extent robotic actions affect human rights, provoking non predictable effects.

For this reason, the European Parliament invites the Commission to adopt one or more legislative proposals in this field, indicating the need to address liability issues as a core issue.

The historical narration describes how easy it would be for man to deny identity and rights to other men only because they are different in some respects. TV series, film and specific literature show how man tends to treat his inventions as if they were naturally and independently from every other aspect, his own property. Dolores, the protagonist robot of *Westworld*¹⁰, is used as if it was an empty body on which whoever able to pay enough, could, legally, let off steam as he wished (up to barbarian forms of rape, murder and torture). Ava, on the other hand, exists with the main aim of showing the genius of her creator. In both cases, the fact to have created these beings makes man think he is obviously the owner.

The challenge of the future, if artificial intelligence will evolve to the point to become indeed intelligent, will be to accept that these machines could become something that cannot be owned by man anymore. When the moment will come – without contradicting the core values of liberal societies - we will have to be ready to question our rights to exploit intelligent robots in order to make them work in our place, to assist us in every moment, to obey to our orders.

If it is true that technology has a strong impact on the work of many companies, it is also true that, at the time, there are jobs that cannot be replaced by a machine. Therefore, the concern that robots will replace man has only a partial and limited value. According to the report realized by the McKinsey Global Institute¹¹ entitled “A Future That Works: Automation, Employment and Productivity”¹², there are five abilities considered to be irreplaceable: sensory perception, cognitive skills, the understanding of natural language, social and emotional skills and physical ability. Yet robotic technology is developing so quickly that the report states, “Over 60% of the actual jobs can achieve, already today, a 30% and more of technological automation”, and further “Half of the work activities of today could be automated within 2055.”

This scenery is because progress concerns above all sensory and cognitive abilities, *in primis* through the development of artificial intelligence. The fields in which technologies are most successful in carrying out its work are data collection and processing, besides the execution of repetitive and predictable physical activity. The impact of only these three categories is enormous, covering 51% of the total man hours in the United States and this figure stands for well 2,7 trillions of dollars of salaries. This does not mean, however, that all workers would become robots, but that most of the mechanical processes will be taking

¹⁰ See <https://watch-series.co/series/westworld-season-1-episode-8>

¹¹ See <http://datametrics.co.nz/insights/article/the-5-challenges-to-workplace-automation>

¹²

https://www.google.it/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjIraaWIPPWAhVIsBQKHc13AVkQFggnMAA&url=https%3A%2F%2Fwww.mckinsey.com%2F~%2Fmedia%2FMcKinsey%2FGlobal%2520Themes%2FDigital%2520Disruption%2FHarnessing%2520automation%2520for%2520a%2520future%2520that%2520works%2FMGI-A-future-that-works-Executive-summary.ashx&usg=AOvVaw13ZdeFhg2Hh1jfa_sdpT4N

their place. This would allow them indeed to do a more thorough job, which certainly would bring a major development to the companies.

A legislative proposal, deposited at the European Parliament, puts that “at least to the more sophisticated autonomous robots the status of *electronic person* should be given, with specific rights and duties”. This points out that the debate is gaining ground even in places well distant from science (fiction)¹³.

Despite the appearances, the European proposal doesn't target so much the protection of the robots, but rather seeks to lay the foundations for a future in which it would be legally clear who is responsible for the actions of robots and in which the technological progress would have beneficial effects on the whole society.

In any case, despite the reasons that have led to the European proposal would be mainly “human”, the recognition of the status of “person” to artificial machines would be an historical event, which would inevitably bring us to take in consideration the possibility to guarantee them access to some fundamental rights.

The legal aspects of the European Parliament Recommendations concern the civil rights of the robots and the reflection on the legalization of a new legal personality: the *electronic person*¹⁴. It is a difficult choice that affects all social sectors particularly affected by robotics such as digital healthcare, communication, transport, and public administration.

The area of interest of this reflection, therefore, introduces an increasingly meaningful enhancement, and distinguishes itself as a technological progress that, despite the diffusion of robots, goes hand in hand with a lack of appropriate legal rules. Starting from the introductory considerations of the quoted resolution of the European Parliament, it is noted how necessary it is that the legislator concretely considers the implications of the robotic innovations, though without defeating them, given the evident advantages provided by the same robotic technology (recital “B”). The appeal that emerges conducts, first of all, toward the creation of a pacific and unitary definition of robots and artificial intelligence, still missing today (recital “C”).

Some robots, nowadays more than before, in view of the development of the levels of both autonomy and cognitive and learning abilities (*deep learning*), always result to be qualified more as agents (and not only tools), who succeed in interacting with the surrounding environment, even arriving to alter it with possibly harmful actions (recital “Z”). Therefore, an organic measure on the legal liability of robots cannot longer be put off.

Indeed, if a robot can take autonomous decisions (recital “G” and “AA”) , then current legislation is not sufficient to constitute a responsibility for the damages caused by it, since it is not possible to individualize with certainty which would be the entity to charge

¹³ Signorelli A. D., *Rivoluzione Artificiale – L'uomo nell'epoca delle macchine intelligenti*, Informant, Luglio 2017, in <http://magazine.daocampus.com/58910/dovremo-concedere-i-diritti-civili-anche-ai-robot.html>

¹⁴ 59. Calls on the Commission, when carrying out an impact assessment of its future legislative instrument, to explore, analyse and consider the implications of all possible legal solutions, such as: f) *creating a specific legal status for robots in the long run, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause, and possibly applying electronic personality to cases where robots make autonomous decisions or otherwise interact with third parties independently*. European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)), *Liability*, 59 – f.

with the responsibility for the reimbursement of the perpetrated damages (especially recital “AB” and “AF”).

It is quite obvious that it will be inevitable that, in order not to be blind to a reality requiring regulation, the preparation of specific rules (AG) which regulate the characteristics of liability and the criteria for assuming it by an agent robot, in respect of universal and humanistic values which are entirely in line with intrinsically European principles (recital “U”).

The progress in the field of robotics, indeed, shall be thought and addressed in a way that best guarantees the possibility to preserve the fundamental rights of a person, as there are dignity, autonomy and self-determination (recital “O”).

This is the *focus* of the resolution of the European Parliament of last February: the civil responsibility for the possible damages caused by a robot is a fundamental matter that must be faced (also) at a European level, in order to guarantee an equilibrium in terms of efficiency and coherence.

3. RIGHT, E-HEALTH AND LEGAL RESPONSIBILITY FOR INTELLIGENT MACHINES.

The sanitary sector and all the systems of health care represent a field in which innovation robotics find more often profitable applications¹⁵. In the next future (but this is already possible today) an increasing number of people will inevitably be in close contact with medical robots. If you consider the steps you need to get a better understanding of how robots work, transition could be simpler and easier. Also in terms of law. Especially for new arisen problems that the law will face and which will have to deal with finding legal responses.

In this sense, telemedicine, or cybersurgery, commonly referred to as the technique through which the surgeon operates remotely, has become a major interest in the right, which has progressively become one of the first strategic sectors of robotics and in further development.

Indeed, the distinctive features of this practice are represented by the meaningful reduction of human error by virtue of the precision of pre-programmed mechanical movements, the least surgery invasiveness and the possibility to remotely operate. It is possible to distinguish at least three typologies of employment of the robotic system: to provide an external support to the action of the surgeon; to allow the intervention of a surgeon not present in the operating room; to manage the surgical instrumentation, often heavy and difficult to handle. From this and from other practices derive necessities concerning the allocation of responsibilities.

The release of robots in common environments which can be civil residences, the sanitary sector or commercial and financial activities, is already a phenomenon that can be observed and described from the point of view of law.

¹⁵ For a compendium of robotics developments in healthcare updated to 2014, compares *Research Report: Healthcare Robotics 2014* in «Robotics Business Review». A Division of EH Publishing, Inc. d.b.a. EH Media. All Rights Reserved, 2017, <https://www.roboticsbusinessreview.com/download/research-report-healthcare-robotics-2014/>, consulted on 30 September 2017. This report examines the companies and technologies pulling ahead in the healthcare market as well as market trends impacting the future outlook for industry stakeholders.

The actual forms of interaction man-machine vary among them - damage, contractual relationship, graft or fusion in the body . They almost immediately evoke as many partitions of the legal system. The robot designed for assistance in the house or in a clinical hospital enters in close contact with the user (often a patient or a person in fragile conditions due to age, illness or disability, or relatives and other operators of that environment), therefore inevitably creating occasions for accidents, lesions and damages (Palmerini , 2016).

An elevated sensorial ability of the robot and all the technical arrangements inserted in the design of the machine can minimize, but will never cancel the eventuality of collisions, falls, bumps of various kind, even if the available technologies may become increasingly precise and refined. Besides, the more delicate the function is that the machine has to carry out, for instance to lift a patient from the bed, the more harmful can be the consequences provoked by a malfunction, from a wrong interpretation of the environmental stimuli, from an electric breakdown.

The surgical robot allows to perform interventions of elevated precision and to operate on very small-sized locations without the difficulties of visual and manual order, that the surgeon otherwise would meet. It could though cause injuries to the same organs and the surrounding blood vases, if the operational software produces erroneously uncontrolled movements¹⁶. It becomes fundamental, in every case, that the *data set* of the robot is linked to a computational *cloud* to guarantee certified and correct information.

Law, already now, has to provide the key to understand the robotic phenomenon at least in two ways: on the one hand it should sustain the operators of the sector regarding the legal implications of their technical and experimental activities, that extend the confinements of the laboratories; on the other hand it should promote a juridical reflection on the basis of a regulation addressed to the robot market and its products in the European legal field (Palmerini , 2016). To these traditional appeals one can add the necessity that law starts to equip itself for dealing with risk, with responsibilities and with ethical and civil consequences. An advanced artificial Intelligence applied to robots could make them autonomous and intelligent: able to make decisions.

Lately the world press sends messages now alarming now reassuring about the various damages or benefits that robots can produce in the field of work, of production, of education, of information and of medicine. Namely, how robots daily interact or can interact with man. This representation of society, that already records the presence of robot and androids endowed with an autonomous artificial intelligence, is going to will be the normal everyday life in the social fabric. This requires that the attention should move towards the protection of all those personal data that such “intelligent machines” will be able to treat.

A first reference to the protection of personal data is already found in ‘recital N and O’ of the European Parliament *Resolution* of 2017, where the European regulation 679/2016

¹⁶ Starting from the American Case for Damage to Surgery of the Surgical Robot, we identify the peculiar profiles of the producer's responsibility to understand with which techniques the legal order balances technological uncertainty with the value of innovation. The CD. The "technology chilling effect" of the rules of liability could, in fact, adversely affect the development of a competitive market, composed of few protagonists. Ad hoc regulatory measures could increase competition, for example by allowing new devices to emerge at a competitive price, or by improving the quality of the product and service offered. For this, limiting manufacturers' assumptions of liability also becomes a strategic choice. (Guerra , 2017).

is explicitly recalled. The GDPR¹⁷, which on May 25th 2018 will be fully applicable, establishes a legal framework to protect personal data, though leaving the door open to the possibility that other aspects, inherent to such circle, could have to be faced in the future, since new worries, demands or doubts could rise on *data protection* within the IoT-robotics-automation of processes (namely those solutions of completely automated data processing, without human intervention, i.e. in the field of communication *machine-to-machine*).

In the hypothesis of traditional robots it is necessary to guarantee and to respect the key principles of data protection, as there are *privacy by design and by default*, data minimisation and limitation of the finalities, as well as all the rights of the party and the various mechanisms of access, control and correction of the personal data. In this hypothesis, a clear risk appears regarding the fact that those androids / humanoids can immediately become data banks of unbelievable value thanks to the accumulated personal data in their possession, which could attract the attention and the interest of possible hackers.

What is more, the rights set out by the articles 7 and 8 of the Charter of Fundamental Rights of the EU (respect for private and family life and protection of personal data) as well as by the art. 16 of the TFUE, are applied to all the areas of robotics and therefore the whole EU legislative framework for data protection must be fully respected.

If a robot is going to be created having autonomy and intelligence and able to take decisions, then the possibility becomes real for androids to have an own legal personality (recital AA - AI of the Resolution of the European Parliament): in such case it would be necessary to make things clear on who would be the holder of the personal data collected by the legal robot-person and the consequent imputability for the civil and penal responsibility regarding the processing of the collected personal data.

In this regard, some solutions are already issue for study and the proposals are heading toward the necessity to trace the decisional processes of the machines in case of accidents and possible damages to people or things, hypothesizing the constitution of a fund incurred by the robot manufacturing companies or by firms that use robots in their industrial processes. This appropriate Fund would collect the benefit accumulated from the savings derived from the non-use of human resources.

4. ROBOTICS CLASSIFICATION¹⁸

The traditional and new generation robotics do raise some issues, also ethical ones, for the formation and the work of the new generations that require attention.

One of the recommendations advanced by the European document on robot civil rights concern the indication to proceed to a classification of intelligent machines in order to precisely individualize the typologies of attributable responsibilities. In this sense it is useful to recall summarily how robots currently are classified.

¹⁷ See <http://eur-lex.europa.eu/legal-content/IT/TXT/?uri=CELEX%3A32016R0679>

¹⁸ Roboethics (robot ethics) is the area of study concerned with what rules should be created for robots to ensure their ethical behaviour and how to design ethical robots. The purpose of roboethics is ensuring that machines with artificial intelligence (AI) behave in ways that prioritize human safety above their assigned tasks and their own safety and that are also in accordance with accepted precepts of human morality.

The general classification of the robots, seen as machines, involves a distinction among:

- Industrial robots
- Autonomous and intelligent robots

The typology of the so-called “industrial robots” is defined on the basis of various references. The definition proposed by the ISO (International Organization For Standardization) is the following: a robot is a multifunctional, reprogrammable manipulator with a continuous control of position (closed-loop control), multi-axled, able to move material, pieces, utensils, through programmed operations for a variety of assignments.

Industrial robots are also classified in base to the degree of mobility and liberty.

It is possible to explain this in other words. Any point in the space possesses three degrees of liberty. This means that three movements are sufficient (three degrees of mobility), opportunely selected and individualized, for instance, through three Cartesian axes, to reach any point. Nevertheless, with only three movements a point would be reached only with a robot having the same orientation, with a pliers, for instance, always prepared in the same way.

To allow to reach a point with any orientation, other axes (axes of the wrist) are added to the three principal ones (axes of the body) so to increase the degree of mobility of the system. These further axes, in function of the necessity, can be one, two, three and also more, having thus robots with four, five, six and more axes.

Here one should keep in mind that the degree of mobility, i.e. the number of movements that the joints complete, can be superior to the degree of liberty of the system: in this case one speaks of redundant systems. Increasing the number of the axes, and therefore the degree of the systems’ mobility, there is an increase of the number of errors of their positioning due to them, and cumulated errors could lead to a diminution of the precision and the repeatability of the robot. Therefore one prefers to limit the number of axes to those strictly necessary.

A robot with six axes (six degrees of mobility) is normally able to reach any point of the space, within the volume of the work, with a terminal reaching any angle (six degrees of liberty). The most employed configurations to realize the movements of the wrist are the following:

1. Rotation around a first horizontal axis (axis y), perpendicular to the precedent (pitching).
2. Rotation around a second axis perpendicular to the precedent (axis z) and positioned in a vertical plan (yaw).
3. Rotation around an axis perpendicular to the other two (axis x) so to be able to direct any piece around its axis of rotation (rolling).
4. A seventh axis is added when it is necessary to widen the field of the work, and so forth and so on. A further classification can be individualized in two categories: a “not autonomous” robot and an “autonomous” robot.

Industrial robots generally belong to the category of “not autonomous” robots because they have a well-defined purpose and assignment and are realized or with the help of man or through control systems, based on infinite loop algorithms.

“Autonomous” robots are instead characterized by the fact that they operate in total autonomy and independent from human intervention. They are able to take decisions even

in the face of unexpected events. These robots are usually programmed with algorithms that recall techniques of artificial intelligence: genetic algorithms, *fuzzy logic*¹⁹, *machine learning*, neural networks. Autonomous robots are suitable for carrying out assignments in environments not known in advance.

A classification often used is the temporal one that individualizes the generations of robot in a chronological way :

1. Robots of the *first generation*: the sixties and following
2. Robots of the *second generation*: the seventies and following
3. Robots of the *third generation*: the eighties and following
4. Robots of the *fourth generation*: equipped with artificial Intelligence

In the category autonomous robots one places their same evolution: the autonomous and intelligent robots.

The enclosure to the Resolution of the European Parliament of February 16, 2017, concerning recommendations to the Commission on civil law rules for robotics (2015/2103 (INL) finds it necessary to establish a common European definition of intelligent autonomous robots, possibly inclusive the definition of its subcategories, keeping in mind the following characteristics:

1. the ability to acquire autonomy thanks to sensors and/or through the exchange of data with its own environment (interconnectivity) and the analysis of such data;
2. the ability of learning through experience and interaction;
3. the form of physical support of the robot;
4. the ability to adjust its behaviour and its actions in favour of the environment.

The same *Resolution* underlines the need to record the “intelligent robots” for their traceability, postponing this operation to the *criteria of robot classification*, currently very random.

Before the *Resolution* of 16/2/2017 , intelligent robots were a specific typology of industrial robots. In the text of the European Parliament appear some typologies of “intelligent” robots:

1. Autonomous vehicles
2. Robots employed for assistance .
3. Medical robots
4. Robots for restorative and enhancing interventions on the human body
5. Drones (RPAS).

But this is a functional classification for the individualization of the responsibilities and risks by type of employment. That means that it individualizes a classification related to specific functions, while the existence of a clean dichotomy is evident between intelligent and autonomous robots, and robots not endowed with autonomy, even though intelligent, and robots endowed with autonomy but with limited and controlled intelligence.

In the *Introduction* of the EU document, the *Resolution* of 16/2/2017, among the various *Recitals*, it is possible to clarify the intentions of the European Parliament. There is a need to create a generally approved definition of what is a robot and what is artificial intelligence. This definition should be flexible and should not hinder innovation, while it

¹⁹ See (Kosko , 1992); ID, *Fuzzy Thinking: The New Science of Fuzzy Logic*, Hyperion, New York, 1993.

becomes essential that law takes in consideration the implications and the legal and ethical consequences.

The European Parliament invites the Commission to propose common European definitions of cyber-physical systems, of autonomous systems, of intelligent autonomous robots and of their subcategories, taking in consideration the characteristics of an intelligent robot, including already the addition of the fundamental requisite of absence of life in biological terms. The realization of intelligent and autonomous robots universally presupposes a connected digital infrastructure, with guarantees of access to the ultra-wide band or to major possibilities to convey information, also with mobile systems. This should happen through networks 5G, or superior, in the respect of the principles of safety and protection of the personal data, in an open environment, interoperable and technologically neutral. Starting from these presuppositions, currently there are no classifications of intelligent and autonomous robots, but it is possible to try to advance some proposal in this direction.

Independently from the physical and aesthetical aspect of the machines, it is possible to argue on the basis of some presuppositions. If we wanted to face the problem in analogy with the degrees of liberty of movement of industrial robots, we could speak of a *classification of levels of autonomy*, departing from a thin basic level to an apical level, provisionally the most advanced.

The observatory IRIA²⁰, within a research on *Internet of Things and Robotics* of March 2017, has intervened to propose a classification of intelligent and autonomous robots, in phase of further close examination. It sets, though, the presuppositions for a progressive classification of robots, based on the process of empowerment entirely in synthetic form:

1. Basic level
2. Level of access to information: online - locally
3. Level of the collaborations with man and with other intelligent machines, having at disposal hierarchical levels of access to information
4. Level of the development of autonomy limited only by the hardware capacities
5. Level of cognitive learning
6. Level to know how to understand, to choose, to act, to express itself
7. Level of the directing of choices and the updating of behaviour
8. Level of the ethical evolution and physical reproduction
9. Level of the total autonomy – the formulation of complex thoughts - self-control.

Every level includes and adds the characteristics of the previous degree in the list and represents an evolutionary level.

On this hypothesis, a comparison is open, without excluding others. Clearly, every reported point needs to be rendered explicit in a more analytical way and has to be supported by accredited and punctual references. But in this phase of reflection, since the

²⁰ The Observatory *Internet delle cose – Robotica – Intelligenza artificiale* (IRIA) was established at the National School of Digital Administration (SNAD) of the University of Rome Unitema Sapienza on July 3, 2017. IRIA's creator is prof. Donato Limone while Prof. Irene Sigismondi is the Coordinator. <https://www.unitelmasapienza.it/it/contenuti/novita/osservatorio-iria>

research is situated in the field of the innovative eidetic production, every contribution is fundamental.

To the thresholds of this description, the European Resolution approved last February deals with the issue of civil responsibility deriving from infringement caused by actions of robots, and underlines the impact of robotics on the labour market.

For the damages produced by machine's negligence an obligatory insurance is proposed that covers risks (actual example the *drivelesscar*) as well as a subsidiary fund in case of not insurance, recalling the *peculium* of the Roman slaves.

For what regards the effects on the work, on the one hand one should pay attention to the forecast of the Commission according to which, within 2020, Europe could have to face a lack of "digital" professionals up to 825.000 people and, on the other hand, it should be noted that robotization could engrave negatively on occupation in general, with possible strong losses of workplaces.

In this respect, the initial proposal required the introduction of a tax named Robotax, related to the incomes from "digital" entrances. This tax aims to constitute a fund for the protection and further training of those workers that are dismissed because of digital technology. Currently the approved text cancels this hypothesis because, as sustained equally by the International Federation of Robotics, it would result excessively harmful for the digital industry. It rather invites the state members to develop systems of education and formation to increase digital skills, favouring both the consumption of digital products and the occupation in the robotics industry²¹.

5. CONCLUSIONS

It was on February 16th 2017 that the motion was addressed to the European Commission by Mady Delveaux, member of the European Parliament (S&D, LU), regarding the creation of a "Code of ethical behaviour" and of the "Agency for Robotics and the Artificial Intelligence". These are tools able to face, at a European level, the increasing juridical challenges deriving from the rapid advancement of the technologies NBIC (Nanotechnology, Biotechnology, Technology of the information, Cognitive Sciences).

The questions that rise around this issue can be synthesized in two opposite lines: is a such intervention from the European organisms necessary in a sector that, even though in constant development, could not have found a space yet so to raise concerns at an ethical and juridical level, or, is there a strong delay in the regulation of an issue that risks to escape the control of law and politics?

For what regards other aspects, one can assume that the already existing body of law could also be extended to the challenges deriving from "smart autonomous robots", as for example within the intellectual ownership: it would not be necessary to rewrite a whole legislation on the case in which a robot is the author of an intellectual job. It would be enough to adapt the existing regulation to meet the new needs of robotics. Or, would the irruption of intelligent and autonomous robots, endowed with the ability of choice and deep learning, capable to create ex novo original solutions and to produce new forms of

²¹ See Taddei Elmi G., *Robotica e lavoro umano*, in «Colombaria oggi», 26/05/2017, <http://www.colombaria.it/rivistaonline/archives/276>.

art and intellectual products, not ask instead for a profound rethinking of the specific legislation in force?

It will be other fields of law that would raise major perplexities, as for instance the issue of civil responsibility. It is not easy to understand to whom one could attribute the responsibility for damages, in the case in which the author (robot) has reached such a degree of autonomy and independence as not to leave any trace of human error. This matter probably deserves to be faced in advance with legal means. Even if until today the number and the diffusion of smart autonomous robots has not reached a level such as to raise immediate worries. Vehicles endowed with automatic guide can lift and indeed do lift ethical and juridical questions. It will be difficult to find solutions with the existing legal tools at disposal.

Besides specific fields of law in which an Agency of this type could effectively intervene, there is another problem that needs to be tackled. It is in the nature of western culture to have a “negative” vision of robots and artificial intelligence in general. Since the times of the myth of Golem up to the most recent dystopic and science fiction works, the artificial creature has been drawn as a being able to acquire such a level of conscience and knowledge as to overcome and, at a certain point, to oppose its same creator.

Taking in consideration the point of view of the leading Italian experts on this subject, the IIT in Genoa, it will be clear that these worries at the time are meant to stay confined to film, books and comic strips. Other visionaries and qualified people of the world of technology, as Elon Musk, Bill Gates and Stephen Hawking, sustain however that a scenery of this type would be possible, if not already in phase of realization.

From the present projections, it is rather easy to imagine that in the next years to date the NBIC technologies will advance even more rapidly compared to that vision. A scenery in which men will cohabit, work, share the space in the house or even fall in love and entertain relationships with highly sophisticated machines, is absolutely not far-fetched. The European Parliament, in the Recitals and in the body of the text, often recalls both the consumers and the designers to pay attention on the possible dangerous implications of affectivity that particularly fragile subjects can develop towards assisting humanoid robots.

Independently from what will be the advancement and the development of these technologies, a reflection must be made. To establish with certainty, at a European level, a common definition of smart autonomous robots, rules of responsibility for damages, also ethical, as well as all the aspects related to the living with robots, could represent the next great challenge of law, currently only faced in South Korea with the *Intelligent robots development and distribution promotion Act of 2016*²².

On the basis of the treated matters the most original path to go - and probably with most probabilities of success - would be the significant institution of a specific legal status, at a European level, at least for the more sophisticated and autonomous robots . In

²² Statute of the Republic of Korea, *Intelligent Robots Development and Distribution Promotion Act*, 2016. “Article 1 (Purpose) - The purpose of this Act is to contribute to enhancing the quality of life of citizens and the national economy by establishing and promoting a policy on the sustainable development of the intelligent robot industry to facilitate the development and distribution of intelligent robots and lay down the foundation therefor”. http://elaw.klri.re.kr/eng_service/lawTwoView.do?hseq=39153.

answer to a *responsibility gap*, indeed, the creation of a new legal personality for robots, with the purpose to make them (as centres of imputation of actions and legal effects) directly responsible for the caused damages with regard to third parties. This would represent - with the opportune formalities - the most courageous solution but, at the same time, perhaps, the most correct one.

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