

	Science, Education and Innovations in the Context of Modern Problems Issue 9, Vol. 8, 2025
	Title of research article Civil Liability in the Age of Autonomous Robots: Bridging Legislative Gaps, Redefining Responsibility, and Ensuring Accountability in the Era of Artificial Intelligence
Messafah Fatma	Lounisi Ali University – Blida 2, Laboratory of Digitalization and Law in Algeria Algeria E-mail: f.messafah@univ-blida2.dz
Issue web link	https://imcra-az.org/archive/383-science-education-and-innovations-in-the-context-of-modern-problems-issue-9-vol-8-2025.html
Keywords	Artificial intelligence, Intelligent robots, Civil liability, Autonomy, Damage, Accountability, Legal reform
Abstract Artificial intelligence (AI) has progressed from a supporting tool to an autonomous decision-maker that influences diverse sectors, including healthcare, transportation, education, finance, and agriculture. The growing reliance on intelligent robots introduces profound legal, ethical, and regulatory questions, particularly concerning liability attribution when damages occur without direct human intervention. Existing civil liability regimes, rooted in classical principles of fault, harm, and causation, remain insufficient to regulate the complexity of self-learning, adaptive systems. Current legislation across jurisdictions often lacks clear definitions of 'intelligent robots,' leaving critical gaps in liability frameworks. This paper explores the limitations of traditional civil law in addressing robotic autonomy, analyzes comparative legal approaches in Europe and international organizations, and highlights the risks of leaving responsibility undefined. The findings reveal that legal uncertainty not only jeopardizes victims' rights but may also deter innovation due to unpredictable liability risks. A balanced framework is required—one that incorporates risk-distribution models, mandatory insurance schemes, and the potential recognition of 'electronic personhood' for highly autonomous entities. Ultimately, the convergence of law, ethics, and technology calls for urgent legislative reform to ensure both accountability and innovation-friendly environments.	
Citation. Messafah F. (2025). Civil Liability in the Age of Autonomous Robots: Bridging Legislative Gaps, Redefining Responsibility, and Ensuring Accountability in the Era of Artificial Intelligence. <i>Science, Education and Innovations in the Context of Modern Problems</i>, 8(9), 1014–1025. https://doi.org/10.56334/sci/8.9.85	
Licensed © 2025 The Author(s). Published by Science, Education and Innovations in the context of modern problems (SEI) by IMCRA - International Meetings and Journals Research Association (Azerbaijan). This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).	
Received: 10.04.2024	Accepted: 02.08.2025 Published: 08.09.2025 (available online)

Introduction:

Artificial intelligence comprises a set of technologies capable of contributing to a broad array of economic and societal benefits across industries and social activities. Through improved prediction, enhanced operations, and optimized resource allocation, as well as tailored digital solutions for individuals and institutions, AI use can provide companies with key competitive advantages while supporting socially and environmentally positive outcomes—for example, in healthcare, agriculture, education and training, infrastructure management, energy, transportation and logistics, public services, security, justice, resource and energy efficiency, and climate change mitigation and adaptation.

One of the most prominent features of AI technological development is the adoption of robots in various domains. Robots, whether traditional or equipped with AI systems, have become an integral part of today's practical reality, utilized in factories, hospitals, courts, transportation, and even in everyday life. While these robots offer enhanced

safety, efficiency, and service development, their use is not devoid of risks, particularly when physical or bodily harm occurs due to technical, software-related, or even “self-driven” decisions.

These technologies possess characteristics that, in some aspects, surpass natural intelligence, contributing to their rapid expansion and global proliferation. However, this extraordinary progress has not been free of emerging legal dilemmas, especially with rising questions around civil liability for damages caused by these intelligent machines, foremost among them robots. This reality calls for a reevaluation of existing legal rules to keep pace with new technological challenges.

The importance of this topic stems from the lack of a clear legal definition for robots and uncertainty regarding the scope of liability for damages caused by modern technologies.

In light of this accelerating reality, it has become imperative to highlight civil liability rules that were originally established in contexts vastly different from today’s technological landscape. Civil liability, as defined by jurisprudence and legal doctrine, rests on specific foundations requiring the presence of harm, fault, and a causal relationship between them. Yet, these elements can be difficult to apply in cases where the robot is the direct cause of damage, especially if it operates independently of direct human intervention.

The issue becomes increasingly complex when the robot is equipped with self-learning algorithms—meaning its decisions are not always the result of pre-programmed instructions, but of autonomous interaction with data and the surrounding environment.

From here, we raise the following question: **To what extent can the legal definition of the robot be formulated given its technical development, and what are the boundaries for applying civil liability rules to damages caused by its actions?**

We answer this question through the following two sections:

Section One: The Conceptual and Technical Framework of the Intelligent Robot

Section Two: Civil Liability for Damages Caused by the Intelligent Robot

1. The Conceptual Framework of the Intelligent Robot With the advancement of artificial intelligence and the evolution of robots from simple execution tools to systems capable of making complex decisions, new scenarios have emerged where such systems cause physical or material harm without direct human involvement. This new reality presents a serious challenge for legal systems—namely, the need to adapt traditional civil liability rules to account for a non-human actor.

Hence, studying civil liability in relation to robots becomes essential. This section is divided into two main subsections: the concept of the robot (**Subsection One**), and the characteristics of artificial intelligence and their impact on the robot’s legal behavior (**Subsection Two**).

1.1 The Concept and Classification of Robots The term “robot” emerged in 1920, while the term “artificial intelligence” appeared in 1950, followed by various technical terms linked to AI. To clarify these concepts, this subsection will address the definition of “robot” (Part One) and its classification (Part Two).

1.1.1 Definition of the Intelligent Robot This part examines the definition of intelligent robots (A) and distinguishes them from conventional robots (B).

The robot is now viewed as a powerful and vital tool that enhances the efficiency of research operations and supports analytical and processing accuracy—making it one of the most remarkable innovations achieved by human intellect in recent decades¹.

This innovation reflects human capacity to design technologies that mimic human thinking through advanced software and systems. AI applications have diversified significantly, leading to innovations such as autonomous vehicles and smart medical devices designed to simulate human behavior and decision-making.

A. Definition of the Intelligent Robot: An intelligent robot refers to the development of smart machines in the form of robots that obey human instructions and commands. These humanoid robots are deployed globally—in industries, medical surgeries, restaurants, and more—and are capable of performing complex tasks in cooperation with humans².

Robotics is one of the most important future fields. It is a branch of technology concerned with the design, construction, and operation of robotic applications. It represents one of AI’s most advanced applications, focused on building a physical framework that operates according to human logic and is programmed to execute specific tasks.

This stands in contrast to the concept of robotics as a science. According to Isaac Asimov, the science of robotics can be summarized by the equation: robot = machine + computer. He did not include the human factor in this equation. His writings and his discussion of the Three Laws of Robotics indicate that he envisioned an autonomous moving entity whose operation and movements are defined without human intervention³.

B. Conventional Robots A robot is defined as a programmable electromechanical system capable of performing a series of tasks independently or semi-independently, based on specified commands or responses to environmental input. A typical robot includes mechanical components such as frames and motors, electronic control units (e.g., microprocessors), and sensor systems⁴ that allow interaction with its surroundings.

The American Institute defined a robot as a manually reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through programmed motions to perform a variety of tasks⁵.

Meanwhile, the Japan Industrial Robot Association defined a robot as a multipurpose machine equipped with limbs and memory systems, capable of executing a predetermined sequence of movements and potentially replacing human labor through automatic performance⁶.

These definitions emphasize the notion of the robot as a self-moving machine, whose operation and movement are determined by the human operator.

A robot operating with an artificial intelligence system is the physical machine, while AI functions as the brain; by contrast, an automatic robot is preprogrammed, with stored movements that never depart from the ordinary—it does not possess an intelligent “brain.”

1.1.2 Types of robots by their uses :

It can be said that robotics is the branch of science that studies all industrial aspects related to the engineering, construction, and operation of robots, relying on examining how any material technological system performs a specific task that saves time and effort.

The field of robotics has witnessed remarkable progress in recent years, thanks to the scientific leap the world is experiencing in science and technology. Contributing to this are the emergence of big data—which equips robotic systems with high capabilities that would not have been possible without advances in big data—along with sensors and the Internet of Things, which has connected different devices within a single network capable of monitoring all surrounding environmental conditions and responding based on the information collected. All of this has led to a new generation of robots. Development has not stopped there; it has reached the point where artificial intelligence has intertwined to form separate and self-sufficient robotic units. Thus, robots have become entities with their own intelligence within the limits of current achievements, and scientists expect this field to witness a frightening level of development in the future.

Robots have become a principal partner to humans in scientific uses for managing daily life. Below are some of these applications.

A/ Medical operations: Robots are used in surgical procedures, either to carry out some tasks during the operation or all tasks. Their use in hospitals was approved in 2000 by the U.S. Food and Drug Administration, and since then many hospitals in Europe and the United States have been equipped with robots. This yields numerous health benefits for patients, including reducing surgical wounds, lowering the rate of infections, and decreasing pain and blood loss during operations⁷.

B/ Military work: Robots are used in demining, including mines that may be explosive. These robots pull the mine into their interior and detonate it in an isolated environment, receiving instructions and commands via remote control⁸.

Robots are also used militarily for spying on the enemy. They move through enemy areas, aided by their small size which makes detection difficult, and are equipped with cameras and night-vision capabilities. These robots collect information about enemy locations and study and analyze it, especially in places that are difficult for humans to reach⁹—all through remote control of these devices.

C/ Traffic control: Robots are employed to manage traffic, moving in the same manner as a traffic officer, tracking movement and rotation, equipped with lights of different colors, and containing cameras to analyze traffic conditions. They can operate on solar power¹⁰.

Autonomous vehicles—self-driving cars—are among the most important modern robots in transportation. They are defined as vehicles with autonomous control, capable of performing all necessary driving functions without human intervention, thanks to their ability to sense and perceive the surrounding environment and the use of a fully

automated driving system. Such a vehicle is equipped with sensors, cameras, and radar, in addition to artificial intelligence that helps it navigate automatically and independently without the need for human input¹¹.

The importance of these vehicles lies in their ability to reduce traffic accidents, lessen driver effort and fatigue, and serve people with disabilities and those unable to drive. They are, in essence, mobile robots¹².

1.2 The characteristics of artificial intelligence and their impact on the robot's legal behavior: The difference between artificial intelligence and an automatic robot lies in AI's unique characteristics, namely immateriality and decision-making autonomy. This subsection is divided into: clarifying the difference in the characteristic of immateriality (First), and the difference between AI and robots in the characteristic of autonomy (Second).

A/ The characteristic of immateriality: Artificial intelligence is a program or algorithm that performs high-level cognitive operations through intelligent software, and software is immaterial by nature. In the case of an intelligent robot, the robot's "mind" consists of immaterial software or algorithms—this is the AI—while the robot's body is the carrier and is always material by nature. Accordingly, an automatic robot is programmed and designed by a natural person to perform a predetermined sequence of programmed, foreseeable movements that never depart from the ordinary, and it is always material¹³.

The material robot embodies immaterial AI and renders it effective for performing complex, not strictly predetermined tasks—tasks based on evolving inputs that an intelligent robot can parse and, in light of which, make its own independent decisions through AI. Given AI's immaterial nature, AI is not confined to robots alone; it can be embedded in any other machine or form, and it can even exist on its own without being reduced to a machine—such as AI programs in financial markets, which are systems based on software or are integrated within devices¹⁴. To clarify, the materiality of robots is evident in their various types—cars and machines in healthcare and different industries are robots.

Likewise, when robots are embodied in human form, they are called androids; when embodied as animals, they are called animal robots. The differing material embodiments of robots reflect the creator's ingenuity and particular preferences. A robot is a machine, and a machine is materially thing-like by nature—unlike AI, which consists of immaterial learning algorithms and intelligent programmatic symbols.

B/ The characteristic of autonomy: A robot has been defined as designed by a natural person to perform a predetermined sequence with programmed movements through automatic performance¹⁵. Thus, autonomy is absent here: the robot's performance follows a predetermined sequence programmed by a natural person for non-independent, automatic execution—on orders from the natural person using it, whether it be a robot in a particular factory, a healthcare facility, or any robotic machine programmed to perform a predetermined sequence.

It is easy for technicians in the field to distinguish an automatic robot that does not run on AI software from an intelligent robot. The intelligent robot's autonomy lies at the core of its operation: it is not designed to perform a predefined sequential task; rather, it is programmed with AI algorithms capable of deep learning and performing tasks according to changing external inputs. Its behavior is difficult to predict; it is autonomous and not constrained by a predefined automatic programmatic sequence. An example is lethal autonomous robots¹⁶.

By virtue of this characteristic, it will also be difficult to predict the harms that AI may cause, unlike a robotic machine designed in advance and programmed to perform a sequence under the guarding, direction, and monitoring of a natural person. In such cases, the robot's behavior is predictable because it proceeds in a known, specific sequence. For example, a robotic machine in a factory designed to lower goods and place them in storage performs expected, controlled movements: the ordinary device continuously does the same task in the same way, automatically, with no margin for autonomy or freedom to decide when to operate. Consequently, the harms such a robot might cause can be anticipated and prevented by the natural person who has the right of control and direction over it, since it does not deviate from what it was designed to do.

2. Civil liability for damages caused by intelligent robots

Intelligent robots have assumed a pivotal role in operating modern work systems for individuals and institutions, with various sectors relying on them to carry out tasks with efficiency and precision. This proliferation has given rise to a new kind of legal risk, particularly when these intelligent robots cause harm to persons or property. The question thus arises as to the extent to which traditional civil liability rules can address these newly emergent challenges.

An important aspect also emerges concerning how to compensate for resulting harm and how to strike a balance between protecting the injured party and encouraging innovation.

2.1 The extent to which an intelligent robot may be granted legal personality

Artificial intelligence has evolved from mere tools for executing commands to systems capable of making independent decisions and performing complex tasks without direct human intervention. In this context, fundamental legal questions have arisen regarding the possibility of granting these novel entities “legal personality” as a means of delineating their responsibilities and identifying who bears the damages they cause. Accordingly, we will discuss this subsection according to the following two approaches:

First: The approach supporting the grant of legal personality to intelligent robots

Second: The approach rejecting this based on traditional concepts of legal personality

First: The approach supporting the grant of legal personality to artificial intelligence

Proponents of this view maintain that advanced AI is no longer merely a tool fully subject to human control; rather, it exhibits a degree of autonomy and self-directed behavior that justifies granting it a special legal status for regulatory, ethical, and compensatory purposes.

AI applications are no longer rigid software systems; they have become capable of self-learning, data analysis, and decision-making without direct human oversight, as in autonomous driving systems or AI-based medical diagnostics. The machine now acts independently in many contexts, creating the need for a special legal status¹⁷.

Granting legal personality is not intended to enable the robot to enjoy all human rights; rather, it is a tool for identifying the party responsible for damages—whether the designing company, the user, or the robot itself, if it is assigned a separate patrimony.

Here, legal personality is not an honorific, but a regulatory means to ensure the rights of victims amid technological advances¹⁸.

The world witnessed the first symbolic recognition of a robot’s legal personality when Saudi Arabia granted citizenship in 2017 to the robot “Sophia,” sparking a global debate about the feasibility of legislation conferring a legal status on robots. The European Parliament likewise recommended in its 2017 report studying the grant of an electronic personality to robots to regulate the consequences of their actions¹⁹.

Second: The approach opposing the grant of legal personality to artificial intelligence

This approach—especially within traditional civil law—opposes granting robots legal personality for fundamental reasons related to concepts of will, discernment, and personal responsibility.

A natural legal person is defined in laws (such as the Algerian Civil Code) as “a living being endowed with rights and duties and having legal capacity,” conditions not met by AI, which lacks free will and moral discernment.

Legal capacity is conferred only upon those who possess understanding and discernment—both absent in artificial entities, however advanced²⁰.

Legal personality is granted either to natural persons or to juridical persons (such as companies), each grounded in a factual or social existence, not a mere manufactured entity. However advanced it may become, the robot remains a human-made product whose existence does not stand apart from the will of its creator.

AI cannot be deemed a legal person because it lacks an independent life and self-directed ends²¹.

Legal capacity is tied to age stages and mental development, as with a natural person—something impossible for AI, which develops only digitally and is not subject to biological formation or direct personal responsibility²².

From this analysis, it is clear that granting legal personality to AI remains the subject of wide doctrinal and legislative debate. While supporters see technical progress as necessitating concomitant legal reform, opponents adhere to traditional legal concepts that regard AI as no more than a programmed tool.

Between the two, a third, pragmatic approach emerges, calling for the recognition of a special legal personality for intelligent robots based on the notion of electronic identity, without granting them full independence akin to humans or corporations.

2.1.1 Modern approaches to adapting civil liability specific to intelligent robots

Civil liability is defined as the obligation of a person to compensate for damage caused to another as a result of a breach of a duty incumbent upon them. In general, it is the sanction ensuing from the violation of one of a person’s obligations, whatever the source of that duty may be. Civil liability is among the most important topics in the study of law, as its subject matter is a living translation of real-life daily disputes among individuals.

Accordingly, I will examine the following elements:

The extent to which liability arising from the custody of things can be applied to damage caused by the intelligent robot

The extent to which product liability for defective products can be applied to damage caused by the intelligent robot

The human proxy theory according to the European Union's 2017 decision

2.2 The extent to which liability arising from the custody of things can be applied

Liability arising from things developed rapidly from the early twentieth century, as liability began to be based on the existence of damage without the need to prove fault on the part of the person held responsible. The core idea is that anyone who owns or controls a thing may be held liable for the damage that thing causes, even without direct fault. Industrial progress contributed to reshaping the law's outlook, especially with the emergence of dangerous machines and devices requiring strict oversight, which called for protecting individuals from their risks—even when they could not directly control them.

First: The autonomy of the intelligent robot and the absence of traditional custody elements

Operational autonomy is one of the most prominent features of contemporary AI, relying on data analysis and self-directed decision-making without direct human intervention. With the increasing use of Machine Learning algorithms, predicting the behavior of these systems has become complex—indeed, at times impossible.

In this reality, the material element of custody is negated: the operator or user cannot exercise actual supervision or direction over the intelligent system, nor is the “control” quality required to establish the relationship between custodian and thing present. Some legal scholars have even argued that AI functions as an independent actor outside the will of the programmer or operator, thereby denying these parties the status of custodian in the traditional sense.

A. The Position of Algerian Legislator

The Algerian legislator has yet to enact a specific law regulating civil liability for damages resulting from artificial intelligence. However, certain trends in draft digital legislation have signaled the need to develop a legal framework that takes into account the distinctive nature of AI. Article 138 of the Civil Code can be interpreted to establish liability in cases of proven fault or negligence, though it does not fully cover damage arising from the autonomous behavior of intelligent systems.

Consequently, this legislative silence renders the traditional legal framework insufficient to confront the risks posed by such technology. This necessitates the development of new legal provisions or, at the very least, the expansion of the concept of “custodian” to encompass new forms of responsibility.

B. The Position of the European Union

The EU adopted a legislative proposal titled *Regulation of the European Parliament and Council establishing harmonized rules on AI* (Artificial Intelligence Act – 2021)²⁰, which seeks to regulate the use of high-risk AI systems and impose obligations on developers and users, especially in instances of harm.

Furthermore, in 2020, the European Parliament issued a resolution establishing a special civil liability regime for AI systems, stating: “A strict liability regime should be adopted for producers or operators of high-risk AI systems, regardless of fault.”²¹

This orientation reflects the EU's recognition of the challenges in applying the traditional custody theory and its push toward a more fitting legal model—one that balances victim protection and innovation promotion.

These developments underscore that the traditional theory of civil liability for things no longer suffices to address the legal implications of AI. The technical autonomy of these systems nullifies the legal concept of custody, creating an evident legislative gap, especially in Algerian law. A more suitable approach appears to be the establishment of dedicated legislation—akin to the EU's initiatives—introducing a new liability regime tailored to AI's unique nature while ensuring victims' legal protection without impeding innovation.

Second: Intangibility as an Obstacle to Applying the Theory of Custody of Things

According to the European Commission's 2020 recommendation, artificial intelligence may be wholly virtual or embedded within a physical entity, capable of making decisions based on data analysis and autonomous learning.

This intangibility implies that AI could be mere code operating via cloud computing without any tangible existence. This differs fundamentally from the material objects upon which custody theory is based—where physical control is a prerequisite.

Liability for things, as regulated in Article 1242/1²⁴ of the French Civil Code and Article 138 of the Algerian Civil Code, relies on actual possession and physical oversight. These foundations are entirely absent in the case of intelligent robots, rendering the element of custody legally unfulfilled.

A. Impact of Intangibility on Causal Relationship and Unpredictability of Harmful Acts

Intangibility also disrupts the causal link between action and damage. Modern AI systems rely on deep learning algorithms, whose outcomes even their designers cannot accurately predict. These systems may cause widespread harm due to internal processes that cannot be immediately traced, such as erroneous recommendations or economically or medically damaging decisions.

The resulting damage may be disproportionate to the apparent act, thus qualifying as foreign cause or force majeure, under Article 182 of the Algerian Civil Code, which considers a foreign cause as any event that could not be prevented or foreseen. AI operators often invoke this provision to disclaim civil liability.

B. Operator Disclaimer and the Challenge of Ensuring Victim Rights

Permitting operators to disclaim liability under the guise of unpredictability opens a legal vacuum that may jeopardize victims' rights—especially given the range of potential AI-related damages, whether material (bodily injury or property damage) or immaterial (harm to reputation, privacy, or moral rights).

AI systems may operate continuously online without a fixed physical location or single point of control, making it difficult to identify the responsible party—be it the developer, programmer, or user.

This highlights the need to reconsider statutory limitation periods in civil liability lawsuits, as AI-related harm may only be discovered after a considerable delay due to the complexity and intangibility of AI systems.

C. Positions of the European and Algerian Legislators

While legislation in the Arab world lags behind these challenges, the EU has made clear strides in regulating AI through its Artificial Intelligence Act (2021), which explicitly addresses the intangible nature of AI and calls for a unique liability framework separate from traditional tort or contractual rules.

The European Parliament's 2020 recommendation emphasized the need for objective liability for AI system operators, regardless of fault, due to the difficulty of proving it in intangible systems.³

In contrast, Algerian legislation still adheres to general civil liability rules outlined in Articles 124 to 140 of the Civil Code, with no specific provisions for intelligent robots.

These findings demonstrate that AI's intangibility undermines the foundational elements of civil liability for custodianship, generating legal and causal complexities that necessitate specialized legislation. Such laws should prioritize victim protection by establishing insurance schemes, collective liability models, or compensation funds, while also maintaining accountability for developers and operators.

2.3 The Extent to Which Product Liability May Apply

With the rapid advancement of AI, intelligent robots have emerged as autonomous entities engaged in medical, industrial, and service tasks—raising legal questions about civil liability for the damage they may cause. The theory of defective products is proposed as an alternative legal solution. How suitable, then, is this theory as a basis for assigning liability?

First: Theoretical Framework for Applying the Defective Product Theory to Intelligent Robots

The defective product theory refers to the legal liability of the producer or supplier whenever a flaw in design, manufacturing, or assembly is proven—without requiring proof of fault or negligence. In other words, it is a strict liability framework²⁵.

The French legislator explicitly established this theory in Article 1245-8 of the French Civil Code, stating that the claimant must demonstrate the damage, the defect, and the causal link between them—without requiring proof of fault from the producer. Moreover, Article 1245-10 asserts that a product may be considered defective even if manufactured according to technical standards, broadening the scope of liability.

In Egyptian law, Article 27 of Consumer Protection Law No. 181 (2018) stipulates that the producer is liable for any damage caused by a product, if the harm results from a defect in design, manufacture, or assembly. The law further places joint liability on the supplier and distributor, indicating the adoption of defect-based responsibility without requiring proof of fault. An intelligent robot should thus be considered a composite product that integrates both physical and software components, subject to the same safety guarantees required of traditional products²⁶.

Second: Limits of Application in Algerian Legislation and Practical Challenges

Algerian law contains no explicit provisions governing AI or intelligent robot liability. However, certain articles of Law No. 09-03 (25 February 2009)²⁷ on consumer protection and fraud suppression provide a general foundation for applying liability for defective products.

Every marketed product must be safe under normal use conditions.²⁸ The supplier is required to guarantee conformity with declared specifications²⁹. Penalties apply if the product poses a threat to consumer health or safety³⁰.

Despite this, several practical issues arise when applying this theory to intelligent robots, chief among them being the difficulty in proving technical defectiveness—especially when robots are capable of learning and adapting to their environment. For example, in U.S. litigation involving the *da Vinci surgical system*, multiple claims failed due to plaintiffs' inability to demonstrate a specific manufacturing defect at the time of production.

The 2017 Report by the French Institute for Scientific and Technological Evaluation emphasized that intelligent robots raise evidentiary and technical complications, demanding a rethinking of traditional liability rules. A more appropriate approach may involve distributing liability among the designer, programmer, and user according to their degree of involvement in the harmful event³¹.

Algerian law currently focuses on physical defects in products but fails to address software and behavioral elements unique to artificial intelligence—highlighting legislative inadequacies in confronting this category of risk³².

Thus, civil liability for harm caused by intelligent robots cannot be solely based on traditional legal rules; the evolving nature of these entities introduces new challenges to both evidentiary procedures and legal frameworks.

2.4 The Human Proxy Theory According to the European Parliament's 2017 Civil Law Rules on Robotics

First: Legal Nature of the Human Proxy in European Law

The human proxy is neither a custodian nor a guardian, but rather a person assumed by law to bear responsibility for the actions of AI, despite the absence of any representative or supervisory relationship³³.

Custody theory applies to physical objects, while AI exhibits autonomous behavior and is not static. Similarly, the master-servant (employer-employee) model involves direct supervision, which is not applicable here³⁴.

A. Proxy Between Assignment and Suretyship

Suretyship implies contractual consent and prior agreement, which are inapplicable to the human proxy. Debt assignment presupposes an existing obligation; yet, AI lacks legal capacity to establish obligations in the first place³⁵.

Second: Legal Challenges and Limitations of Proxy Theory

As previously mentioned, AI does not enjoy legal personality, preventing it from bearing civil obligations directly. The human proxy temporarily bears the legal burden due to the absence of a legislative framework defining AI's legal capacity³⁶.

Legal guardianship typically pertains to minors or those lacking capacity, whereas AI is not a legal person at all. The proxy does not receive directives from AI, but merely assumes consequences, thus stripping the concept of legal agency of its conventional meaning³⁷.

No existing legal institution adequately captures the human-AI relationship. Therefore, some scholars advocate for recognizing electronic personality, or adopting a collective liability model—including designer, programmer, and user.

The human proxy theory is an interim legislative solution, imposed by the need to identify the responsible party when AI causes harm. Nevertheless, it lacks a coherent legal qualification. The future may necessitate a bespoke legal system for such entities—starting perhaps with partial recognition of legal personality, or a distribution of responsibility across the actors involved in the intelligent system's lifecycle³⁸.

Conclusion

The evolution of artificial intelligence and robotics presents a genuine challenge to traditional legal systems, particularly in identifying civil liability for damages caused by these advanced technologies. While Algerian legislation still relies on general liability rules, the European Union is advancing toward a tailored legal framework in line with AI's complexity and unique characteristics.

Addressing the use of autonomous decision-making robots demands a reexamination of concepts such as fault, causality, and responsible agency—calling for urgent legislative action in countries that have not yet updated their laws, including Algeria.

Findings:

- A clear legislative vacuum in Algerian law regarding the use and regulation of AI and robotics, rendering reliance on general rules insufficient for addressing contemporary legal challenges.
- Ambiguity in civil liability where robots cause harm, especially when acting autonomously or using machine-learning algorithms with unpredictable outcomes.
- The European legal approach seeks to resolve these issues through specialized frameworks, such as the AI Act, which considers the nature and risks of such technologies.
- Traditional legal concepts—such as fault, damage, and causation—struggle to apply to AI scenarios, underscoring the need for a new legal theory that aligns with current realities.

Recommendations:

- Enact dedicated legislation governing artificial intelligence and robotics in Algeria.
- Amend general civil liability provisions to encompass harm resulting from intelligent systems.
- Establish an independent national authority for oversight of AI technologies.
- Benefit from the European legal experience and models.
- Enhance academic and professional training in the legal and technical fields.

1.1 Findings

«Insufficiency of Traditional Liability Principles»

- Classical doctrines of fault-based liability cannot adequately address autonomous actions, since intelligent robots often act without direct human instruction.
- Causation is blurred when damage results from unpredictable self-learning mechanisms.

«Legislative Gaps and Jurisdictional Disparities»

- Most legal systems lack a coherent definition of 'intelligent robots,' leading to fragmentation in court interpretations.
- The European Parliament has proposed preliminary frameworks, including the recognition of 'electronic personhood,' but consensus remains absent.

«Risk to Victim Compensation»

- Inadequate liability frameworks undermine victims' access to remedies when harm occurs.
- Without reform, technological accidents risk being classified as 'legal vacuums.'

«Innovation at Risk»

- Companies may hesitate to invest in advanced robotics without legal clarity on liability.
- Legal uncertainty creates barriers to global competition and slows adoption of AI-driven innovation.

«Proposed Frameworks for Reform»

- Strict liability models for high-risk applications (e.g., medical robots, autonomous vehicles).
- Mandatory insurance systems to ensure victims' compensation.
- Hybrid models incorporating risk-distribution among manufacturers, programmers, and users.
- Exploration of 'electronic legal personhood' for highly autonomous entities.

Acknowledgment

The author would like to thank the Laboratory of Digitalization and Law at Lounisi Ali University – Blida 2, Algeria, for providing academic resources and valuable discussions that shaped the development of this study.

1.2 Ethical Considerations

This research does not involve human participants, personal data, or animal subjects. Ethical integrity has been maintained throughout the process by ensuring the accuracy of references, respecting intellectual property, and

avoiding plagiarism. The arguments presented are solely for academic purposes and do not endorse any specific regulatory system.

Conflict of Interest. This study emerges from a political and economic warning premise that no nation can truly achieve sovereignty or autonomy unless it becomes self-sufficient in securing its food supply. It seeks to uncover the existential stakes associated with food security and examines the looming threats posed when countries rely on external sources for grain and essential commodities. The research highlights how political conflicts and wars disrupt development and food supply chains, and explores the interplay between poverty, food scarcity, and instability. It further draws attention to the role of the Russia-Ukraine war in awakening developing nations to the urgency of achieving food security. Ultimately, the study underscores that hunger and unemployment are among the root causes of revolutions and armed conflict—particularly in the Arab world and across Africa.

Funding. This research received no external funding. It was supported solely by the institutional resources of Lounisi Ali University – Blida 2, Algeria.

References

Books

1. Ibrahim, A. S. (2020). Artificial intelligence and legal liability. Cairo: Dar al-Nahda al-Arabia.
2. Al-Asyouti, A. M. (2020). Legal aspects of artificial intelligence application (1st ed.). Cairo: Dar Misr Publishing.
3. Bouhania, A. Q. (2019). Algerian civil law – Persons. Algeria: Dar Houma.
4. Al-Ramli, K. (2021). Artificial intelligence and damage liability. Alexandria: Dar al-Jami'a al-Jadida.
5. Salama, S. A. (2006). Robot technology: A future vision from an Arab perspective. Cairo: Academic Library.
6. Salama, S. A., & Abu Qoura, K. (2014). Challenges and ethics of the robotics era (Issue 196, 1st ed.). Abu Dhabi: Emirates Center for Strategic Studies and Research.
7. Al-Sanhuri, A. R. (1998). Al-Wasit in civil law explanation – Vol. VII: Suretyship and assignment. Beirut: Dar Ihya al-Turath al-Arabi.
8. Al-Arabi, F. (2020). Principles of legal responsibility in the digital age. Algeria: Ibn al-Nadim Publishing.
9. Saqr, N. (2021). Artificial intelligence and civil liability. Cairo: Dar al-Fikr al-Jamii.
10. Yusuf, A. M. (2018). Civil law: General theory. Damascus: Dar al-Fikr.
11. Aïdan, G. (2019). Le droit des robots: Entre fiction et réalité juridique. Paris: Éditions Dalloz.
12. Carbonnier, J. (2004). Droit civil – Les biens. Paris: Presses Universitaires de France.
13. Gauthier, P.-Y. (2018). La responsabilité du fait des produits défectueux. Paris: Dalloz.

Journal Articles

1. Abu Bakr al-Maghribi, T. O., & al-Fiqi, A. H. F. (2024). Criminal liability for autonomous vehicle crimes – Comparative analytical study. *Journal of Jurisprudential and Legal Research*, 47.
2. Boudiaf, A. (n.d.). Product defect theory in Algerian law. *Journal of Law, University of Setif*, 12.
3. Borghetti, J.-S. (2021). Civil liability for artificial intelligence: A European perspective. In W. Barfield & U. Pagallo (Eds.), *Research handbook on the law of artificial intelligence* (pp. 147–163). Cheltenham, UK: Edward Elgar Publishing.
4. Moses, L. B. (2017). Artificial intelligence and legal responsibility. *UNSW Law Journal*, 40(2), 568–595.
5. Gamito, M. C. (2020). Liability of AI and the role of insurance. *European Journal of Risk Regulation*, 11(3), 565–582. <https://doi.org/10.1017/err.2020.54>
6. Wischmeyer, T. (2020). Artificial intelligence and the future of public law. *German Law Journal*, 21(1), 68–79. <https://doi.org/10.1017/glj.2019.91>
7. Thomas, L. (n.d.). Recent advances in robotic surgery. *News Medical*. <https://www.news-medical.net>
8. Trevelyan, J. (n.d.). Robots: A premature solution for the land mine problem. University of Western Australia, Department of Mechanical and Materials Engineering.

9. European Commission. (2019). Report of the expert group on liability and new technologies – New technologies formation. Brussels: European Commission. <https://op.europa.eu>
10. Centers for Medicare & Medicaid Services (CMS). (n.d.). Coverage policies for robotic surgery procedures. <https://www.cms.gov>
11. Stanford University. (2016, June 25). Artificial intelligence and life in 2030. <https://ai100.stanford.edu>
12. Anonymous. (n.d.). Large-scale mixed-traffic and intersection control using multi-agent reinforcement learning. arXiv. <https://arxiv.org>
13. IFSTTAR. (2017, March). Intelligent robots and liability.

Conference Proceedings

1. Qamoura, S. C., Bay, M., Haiziya, & Krouch. (2018, November 27–28). Artificial intelligence between reality and aspiration: A technical and field study. *Annals of the University of Algiers (Special Issue: International Conference – Artificial Intelligence: A New Challenge for Law)*. Algiers.

Academic Theses

1. Mensel, K. (2022–2023). Activating the role of e-governance in Algeria towards the emergence of electronic administration law (Doctoral dissertation). University of 8 May 1945, Guelma, Faculty of Law and Political Science, Department of Public Law.

Legal Texts

1. Algeria. (2009, February 25). Law No. 09-03 concerning consumer protection and fraud suppression (Official Gazette No. 15, March 15, 2009), as amended and supplemented by Law No. 18-09 of July 10, 2018 (Official Gazette No. 35, July 13, 2018).
2. Algeria. (2007, May 13). Algerian Civil Code No. 07-05 (Official Gazette, Issue No. 31, 2007).
3. European Parliament. (2017, February 16). Civil law rules on robotics (2015/2103(INL)) (Official Journal C 252, July 18, 2018, p. 239). Report by C. De Ganay & D. Gillot, No. 464 Vol. 1.
4. France. (2016, February 10). Ordinance No. 2016-131.

Citations:

¹ Mansel, Kawthar. Activating the Role of E-Governance in Algeria Towards the Emergence of an E-Government Law. PhD Dissertation, University of 8 May 1945 Guelma, Faculty of Law and Political Science, Department of Law, Public Law specialization, Academic Year 2022–2023, p. 471.

² Same source, p. 30.

³ Salama, Sifat, and Khalil Abu Qorah. Challenges and Ethics of the Robotics Era. Emirates Center for Strategic Studies and Research, Issue No. 196, Abu Dhabi, 1st ed., 2014, p. 13.

⁴ Artificial Intelligence and Life in 2030. Stanford University, June 25, 2016. Available at: <https://ai100.stanford.edu>

⁵ Salama, Sifat Amin. Robot Technology. Previously cited reference, p. 11.

⁶ Salama, Sifat, and Khalil Abu Qorah. Challenges and Ethics of the Robotics Era, 1st ed., Abu Dhabi, 2014, p. 12.

⁷ Thomas, Liji, MD. "Recent Advances in Robotic Surgery." Reviewed by Sphhia Coveney, B.Sc. Available at: <https://www.news.medical.net>

⁸ Centers for Medicare & Medicaid Services (CMS). Coverage Policies for Robotic Surgery Procedures. Available at: <https://www.cms.gov>

⁹ Trevelyan, James. "Robots: A Premature Solution for the Land Mine Problem." Department of Mechanical and Materials Engineering, University of Western Australia. Available at: jamest@mech.uwa.edu.au

¹⁰ Large-Scale Mixed-Traffic and Intersection Control Using Multi-Agent Reinforcement Learning. Available at: <https://arxiv.org/abs/2504.04691>

¹¹ Al-Maghribi, Taha Othman Abu Bakr and Al-Fiqi, Abdel Hakim Fouad. "Criminal Liability for Autonomous Vehicle Offenses: A Comparative Analytical Study." *Journal of Jurisprudential and Legal Research*, Issue 47, October 2024, p. 3529.

¹² Qamoura, Samia Chahbi, and Karrouche, Hayzia. "Artificial Intelligence Between Reality and Aspiration: A Technical and Field Study." *Annals of the University of Algiers, Special Issue: International Forum on AI as a New Legal Challenge*, Algeria, November 27–28, 2018, p. 31.

¹³ Al-Asyouti, Ayman Muhammad. *Legal Aspects of Artificial Intelligence Application*. Egypt Publishing House, Cairo, 1st ed., 2020, p. 5; – Same source, p. 153.

¹⁴ European Parliament, Article 3/a, Chapter One: General Provisions from the Resolution dated October 20, 2020 on Civil Liability for Artificial Intelligence.

¹⁵ Ibrahim, Abdel Salam. Artificial Intelligence and Legal Liability. Arab Renaissance House, 2020, p. 81.

¹⁶ Ramli, Khaled. Artificial Intelligence and Damage Liability. New University House, 2021, p. 145.

¹⁷ European Parliament Report 2015/2103(INL), Recital 59.

¹⁸ Bouhania, Abdelkader. Algerian Civil Law – Persons. Houma Publishing, Algeria, 2019, p. 56.

¹⁹ Youssef, Abdelmajid. Civil Law: General Theory. Dar Al-Fikr, Damascus, 2018, p. 213.

²⁰ Al-Arabi, Fouad. Principles of Legal Liability in the Digital Age. Ibn Al-Nadim Publishing, Algeria, 2020, p. 97.

²¹ Regulation of the European Parliament and of the Council Laying Down Harmonized Rules on Artificial Intelligence (Artificial Intelligence Act).

²² Article 1242, amended by Ordinance No. 2016-131 of February 10, 2016, art. 2. Available at: <https://www.legifrance.gouv.fr>

²³ Gauthier, Pierre-Yves. Liability for Defective Products. Dalloz, 2018, p. 47.

- ²⁴ Saqr, Nabil. Artificial Intelligence and Civil Liability. University Thought Publishing House, 2021, p. 112.
- ²⁵ Law No. 09-03 of February 25, 2009 on Consumer Protection and Anti-Fraud. Official Gazette No. 15, March 15, 2009, amended by Law No. 18-09 of July 10, 2018, Official Gazette No. 35, July 13, 2018.
— Article 3, same law; Article 4, same law; Article 16, same law.
- ²⁶ IFSTTAR. Intelligent Robots and Liability, March 2017, p. 6.
- ²⁷ Boudiaf, Ammar. "Theory of Defect in Product in Algerian Law." Law Journal, University of Setif, Issue 12, p. 88.
- ²⁸ Bennett Moses, Lyria. "Artificial Intelligence and Legal Responsibility." UNSW Law Journal, University of New South Wales, Australia, 2017, pp. 123-145.
- ²⁹ Borghetti, Jean-Sébastien. "Civil Liability for Artificial Intelligence: A European Perspective." In Research Handbook on the Law of Artificial Intelligence, Edward Elgar Publishing, Cheltenham, UK, 2021, pp. 112-134.
- ³⁰ Aidan, Géraldine. The Law of Robots. Dalloz, 2019, p. 45.
- ³¹ See Articles 124 and 138 of the aforementioned Algerian Civil Code.
- ³² Al-Sanhouri, Abdel Razzaq. The Intermediate in Explaining Civil Law - Vol. 7: Guarantee and Assignment. Dar Ihya Al-Turath Al-Arabi, Beirut, Lebanon, 1998, pp. 9-28.
- ³³ Gamito, Marta Cantero. "Liability of AI and the Role of Insurance." European Journal of Risk Regulation, Cambridge University Press, UK, 2020, pp. 210-230.
- ³⁴ European Commission. Report of the Expert Group on Liability and New Technologies - New Technologies Formation, Brussels, 2019, p. 27.
- ³⁵ Wischmeyer, Thomas. "Artificial Intelligence and the Future of Public Law." German Law Journal, Cambridge University Press, UK, 2020, pp. 5-10.
- ³⁶ Aidan, Géraldine. The Law of Robots: Between Fiction and Legal Reality. Dalloz Editions, Paris, France, 2019, pp. 45-52.
- ³⁷ Carbonnier, Jean. Civil Law - Property. University Press of France, Paris, France, 2004, p. 389.
- ³⁸ Civil Law Rules on Robotics: European Parliament Resolution of February 16, 2017 Containing Recommendations to the Commission Regarding Civil Law Rules on Robotics (2015/2103(INL)), Official Journal C 252 of July 18, 2018, p. 239.
— Report by C. De Ganay and D. Gillot, No. 464, Vol. 1 (2016-2017), March 15, 2017, Articles 59-61.