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COMPARATIVE RESEARCH ON AUTONOMOUS SYSTEMS: THE ATTRIBUTION OF CRIMINAL LIABILITY

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ABSTRACT

The rapid emergence of Autonomous Systems (AS) has raised profound legal and ethical questions regarding the reconciliation of traditional fault-based liability with A.I. driven operations. The moral standing of these systems challenges the basic notions of Actus Reus and Mens Rea. This article explores the criminal liability issues surrounding various autonomous systems including Automated Vehicles and Automated Defense Systems with a comparative perspective on countries like the USA, China and the EU to address the challenges of assigning liability when A.I. driven systems cause a criminal offence.

By covering these autonomous systems and drawing on diverse national legal approaches, this article aims to clarify current criminal liability assessment challenges and advocate for an integrated, technology neutral framework that ensures fairness, safety and innovation across a variety of Autonomous system domains.

INTRODUCTION

Autonomous systems are defined as systems that have the ability to perform complex tasks independently, often enhanced by the integration of intelligence to automate human knowledge and technologies for achieving high levels of automation.[3]

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[3] M. Rodriguez, R.Sans, Volume 30,*Computer Aided Chemical Engineering*(717-721)(2012)Autonomous System - an overview | ScienceDirect Topics

They are the result of bringing together mechanical engineering, artificial intelligence (A.I.), sensor technology, connectivity and adaptive algorithms. They can be seen as the step forward in bringing A.I. into the physical realm to perform complex tasks in unstructured environments.[4]

These systems are being incorporated in our day to day lives which have presented unprecedented challenges for the legal systems worldwide. As these systems develop, questions around criminal legal liability of their actions become preponderant. This rapid integration has led to several challenges to the traditional legal liability attribution (whether rooted in negligence, product liability or strict liability) as these were designed to regulate human actors and predictable chain of causation[5]. This transformation also raises critical ethical questions, particularly concerning the split second decisions or prioritizing the lesser of two evils.

Additionally, the complex nature of Automated System accidents adds a new dimension to the challenge of assigning criminal responsibility. If a liability arises, it's complicated to establish whether the accident occurred due to the handler's negligence, software failure, malfunctioning code or a hardware issue. This assessment alone creates a multifaceted uncertainty over who ought to be held liable for damages caused by such an accident.

This research explores how different jurisdictions are dealing with the attribution of fault in such cases. Through a comparative lens, it examines the criminal liability, regulatory interventions and emerging legal trends that attempt to reconcile technical autonomy with established principles of law. Ultimately, this research underlines the need for legislations and legal guidelines in India that not only ensure accountability but also protect innovation in the safe and regulated use of Autonomous Systems.

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[4] M. Alonso," Bringing AI into the physical world with Autonomous Systems" World Economic Forum available at: https://share.google/EeymdRUBW7CslaYnU, (last visited on August 22 , 2025.)

[5] G. Chopra, M. Ahwalat, "Legal Personhood for Autonomous AI Agents: Liability and Accountability in Cyberspace", Research Gate,(1-2)(2025), available at https://www.researchgate.net/publication/394734410_Legal_Personhood_for_Autonomous_AI_Agents_Liability_and_Accountability_in_Cyberspace(last visited on August 27, 2025)

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AUTOMATED VEHICLES

Automated Vehicles (AVs) represent one of the most transformative technological innovations of the 21st century. They are defined as vehicles with some level of automation to assist or replace human control.[6] These vehicles are typically classified along a spectrum of automation ranging from Level 0 (no automation) to Level 5 (full automation), as defined by the SAE.[7]

The global adoption of AVs has generated significant interest due to their potential of enhancing road safety, traffic efficiency, and expanding mobility. To combat their increasing popularity, legal systems across the world are evolving their legal systems to address the unique legal and ethical challenges these systems raise.

Countries such as the USA and Germany are actively experimenting with regulatory and legal frameworks to govern AV deployment, while India has been cautious, with ongoing debates about regulatory safeguards before wide scale adoption.

USA

The liability of Autonomous Vehicles' incidents rely on established product liability law and state specific regulations, which focus on assigning responsibility to manufacturers, software developers or operators depending on the cause of accident.

The Federal Motor Vehicle Safety Standards (FMVSS)[8] ensures the federal regulation of vehicle design safety and The National Highway Traffic Safety Administration (NHTSA) functions crash investigation and defect enforcement. Various state norms include:

[6] F. Redavid,"The Implications of Autonomous Vehicles" Your Champions(1)(2023),available at https://yourchampions.com/articles/2023/august/the-legal-implications-of-autonomous-vehicles(last visited on August 27, 2025)

[7] Id.

[8] Federal Motor Vehicle Safety Standards, 2023 proposed by National Highway Traffic Safety Administration, USA.

California Vehicle Code, particularly Division 16.6 and related regulations in Title 13 requires permits for A.V. testing, liability remains with the operator or manufacturer[9].

Arizona Executive Orders (2015,2018) allows A.V. testing including fully driverless cars, liability rests with responsible party[10] and

Nevada Revised Statutes §§ 482A 030-482A200 defines Autonomous Technology, requires insurance and operator remains liable unless manufacturer's fault has been proven.[11]

In the case of State of Arizona v. Rafeala Vasquez (2020)[12]It was interpreted that the driver is liable for human safety not A.V. or Company, and in Tesla Autopilot Manslaughter case (California, 2020)[13] Interpretation was made that liability falls on the Human driver even when semi-autonomous mode engaged.

GERMANY

The Straßenverkehrsgesetz (StVG)[14], or German Road Traffic Act, is Germany's central legislation governing road traffic, driver obligations, and liability for accidents. It also provides the statutory framework for the integration of autonomous vehicles. Its amendment in 2021 introduced provisions for Level 4 autonomous vehicles, allowing driverless operation within defined operating areas. § 7 of this act establishes strict liability of the owner by the principle of Gefahrdungshaftung. Owners are liable for any damages caused by their vehicle regardless of fault, except in the case of Force Majeure[15]. Drivers can also be held liable on grounds of Negligence or Intent[16]. § 1b allows

[9] California Vehicle Code,2024 - VEH DIVISION 16.6 - Autonomous Vehicles Section 38755.,USA

[10] Governor Doug Doucey's Law, 2018, USA

[11] Nevada Revised Statutes, 2024, Section 482A 030-482A200

[12] State of Arizona v. Rafael(a) Vasquez, No. CR2020-001853-001 (Ariz. Super. Ct. of Maricopa)

[13] USA v. Brian McGee, No. 22-3071 (7th Cir. 2024)

[14] German Road Traffic Act (Straßenverkehrsgesetz, StVG),2017

[15] German Road Traffic Act (Straßenverkehrsgesetz, StVG), 2017 Sec. 7, translation available at German Federal Ministry of Justice, https://share.google/jeThcy8qogH20vClm

[16] Id Sec. 18-19

the driver to turn his attention away when the vehicle is controlled by highly automated driving functions but he must remain sufficiently responsible that he can fulfill his duty anytime. Besides assigning liability ,the act also establishes requirements for technical supervision, assigns clarified roles for manufacturers, operators and users and creates a legal framework for testing and approving AVs. § 63a(2) of the act provides for the transmission of data recorded in accordance with the position and time information to the authorities responsible under federal state laws for sanctioning of traffic offences. This framework demonstrates Germany's attempt to reconcile traditional liability rules with emerging risks posed by A.I. driven vehicles.

AUTOMATED DEFENSE SYSTEMS

Automated Defense Systems may be defined as technological frameworks that employ A.I., robotics, sensors and automated decision making algorithms to detect, track and neutralize threats with minimal or no human interventions. These systems are made to enhance national security, by providing rapid response in high-risk environments such as missile interception and drone defense[17]. They combine real time data analysis with automated weaponry or countermeasures to achieve speed and accuracy beyond human capabilities[18]. However, their deployment raises legal and ethical challenges, particularly regarding accountability, proportionality and compliance with International Humanitarian Laws[19].

China and Germany have adopted two different approaches to address the legality of such systems.

[17] 1. R. Sparrow, Killer Robots, Journal of Applied Philosophy, Vol. 24, No. 1, (2007), pp. 62–77, available at https://doi.org/10.1111/j.1468-5930.2007.00346.x, last seen on September, 2, 2025.

[18] 2. United Nations Institute for Disarmament Research (UNIDIR), The Weaponization of Increasingly Autonomous Technologies: Concerns, Characteristics and Definitional Approaches (2017), available at https://unidir.org/publication/weaponization-increasingly-autonomous-technologies, (last seen on September. 2, 2025.

[19] Human Rights Watch & International Human Rights Clinic, Losing Humanity: The Case Against Killer Robots (2012), available at https://www.hrw.org/report/2012/11/19/losing-humanity/case-against-killer-robots, (last seen on September 2, 2025.)

CHINA

The liability of Autonomous Weapons must comply with International Humanitarian Law (IHL) and the responsibility rests with the human operator and deployer[20]. China is the only P-5 country in the UN CCW[21] calling for a ban on LAWS, stressing the need for a binding protocol to govern these weapon systems. China at the UN CCW debates that "the characteristics of LAWS are not in accordance with the principles of International Humanitarian Laws (IHL), as these weapon systems promote the fear of an Arms Race and the threat of an uncontrollable warfare"[22].

The Constitution of People's Republic of China (1982), as amended centralises control of armed forces under the Communist Party and Central Military Commission (CMC) and the criminal law of the People's Republic of China applies to individuals including military personnels for war crimes. National Defense law regulates defense activities and assigns responsibility. The People's Liberation Army (PLA) Disciplinary Regulations (2018) provides criminal and disciplinary accountability for commanders and persons misusing weapon systems. [23]

China is a party to the Geneva Conventions (1949) and additional protocols, binding commanders under the Laws of Armed Conflicts (LOAC).China does not recognise Autonomous Systems as liability actors and commanders, operators are criminally liable under National Criminal Law.

GERMANY

Germany adopts a cautious and restrictive stance on lethal autonomous weapons systems (LAWS), emphasizing that weapons operating entirely outside of human control are incompatible with

[20] N.Davidson,"A Legal Perspective:Autonomous Weapon System under International Humanitarian Law",International Committee of The Red Cross, available at https://share.google/20gooYpDaZFDrXMO5(2017)

[21] United Nations War Crime Commissions,,1943

[22] Z.Channa, Lethal Autonomous Weapons Systems: A Gamechanger Demanding Evolution, Geopolitical Monitor(2024), available at https://www.geopoliticalmonitor.com/lethal-autonomous-weapon-systems-a-gamechanger-demanding-regulation/,(last seen on September, 3, 2025)

[23] Chinese People's Liberation Army Disciplinary Regulations, 2018, CHAPTER VI, available at China Law Translate

international law, particularly international humanitarian law (IHL).[24] Germany distinguishes between autonomous and automatic defense systems: for example, missile defense systems such as PATRIOT are categorized as automatic because they operate on deterministic algorithms in time-critical scenarios, and thus do not raise the same ethical or legal concerns as truly autonomous systems.[25]

Central to Germany's position is the requirement of meaningful human control at every stage of a weapon system's design, deployment, and use.[26]This includes ensuring accountability, predictability, technical safeguards (e.g., self-deactivation), and adherence to the chain of command. Germany insists that the decision over life and death must always remain with humans.[27] Germany suggests a two tier way ahead:

1. A legally binding instrument within the Convention on Certain Conventional Weapons (CCW) to prohibit LAWS that cannot comply with IHL.

2. A set of regulations governing weapons systems with autonomous functions to guarantee that human control is never lost.[28]

WAY FORWARD: INDIA'S APPROACH

India's regulatory and legal framework for autonomous systems remains at a nascent stage, with most discussions concentrated on testing guidelines and sectorial policies rather than comprehensive liability regimes. To ensure that technological innovation does not outpace legal safeguards, India must consider the following forward-looking measures:

[24] Federal Republic of Germany, National Contribution to the UN Secretary-General's Report on Lethal Autonomous Weapon Systems(LAWS),2024, p.1 available at https://share.google/BsFngNYZVbbuCQBIG

[25] Id,part 2.

[26] Id,part 2-3.

[27] Id,part 3.

[28] Id,part 4.

1. ESTABLISH A COMPREHENSIVE LEGAL FRAMEWORK

Enact specific legislation governing autonomous systems, drawing from comparative models such as Germany's Road Traffic Act (StVG) amendments and other international legal developments.. Liability should be defined clearly across stakeholders—manufacturers, software developers, operators, and users—particularly in cases of accidents or malfunctions. These legislations should be framed while addressing India's specific needs like its high risk accident prone roads and strict penalties.

2. INTEGRATE CRIMINAL AND CIVIL LIABILITY PROVISIONS

Develop legal doctrines addressing criminal accountability where autonomous systems cause harm, ensuring that negligence, software failure, or coding errors can be fairly attributed.

Strengthen product liability laws and insurance frameworks to protect consumers while fostering innovation.

3. ADOPT A PRINCIPLE OF HUMAN OVERSIGHT

Mandate meaningful human control in critical decision-making, especially in defense and law enforcement applications, aligning with global ethical standards.

Ensure that accountability ultimately rests with human actors, preventing legal vacuums in matters of life and death.

4. PROMOTE RESEARCH AND ETHICAL STANDARDS

Establish independent oversight bodies to review the safety, ethics, and transparency of autonomous systems.

Invest in AI ethics, algorithmic accountability, and indigenous R&D to reduce dependency on foreign technologies.

5. INTERNATIONAL ENGAGEMENT AND HARMONIZATION

Actively participate in global forums (e.g., UN CCW discussions on lethal autonomous weapons, OECD AI principl) to shape international norms.

Develop regional partnerships to harmonize standards on safety, liability, and data governance for cross-border use of autonomous technologies.

CONCLUSION

In the final analysis, the criminal liability surrounding the use of Autonomous Vehicles and Autonomous Military systems can not be left in a legal vacuum.

While advanced jurisdictions like the USA and China are still grappling with accountability and responsibility, India should focus on enacting legislations and giving guidelines which facilitates its functioning for the citizens and design laws that are proactive rather than reactive.

The laws must ensure that innovation should never become an excuse for impunity and the persons accountable must be published and justice must prevail. The technology may be autonomous but accountability must always remain human. Therefore, a balanced approach encouraging innovation while embedding accountability, ethics and human oversight will not only safeguard citizens but also enable India to emerge as a global leader in terms of responsible AI governance.