ARTIFICIAL INTELLIGENCE AND INTERNATIONAL LAW: A FOCUS ON SELECTED MEANS OF TRANSPORTATION*

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Abstract: The paper is focused on newly developed technologies operating on the basis of artificial intelligence and their use, especially in maritime transport and aviation, in the context of the applicable norms of public international law and European law. In relation to the issue of autonomous ships, the paper examines their use according to the UN Convention on the Law of the Sea. The paper also reflects on the work of the International Maritime Organization in relation to autonomous ships. Concerning the issue of autonomous aircraft, the paper assesses their use according to several relevant international treaties and according to two European Commission regulations. The paper also reflects the work of the International Civil Aviation Organization in relation to autonomous airplanes. Furthermore, the paper deals with the issues of the use of artificial intelligence in railway and road transport. The paper defines the basic concepts in relation to the examined types of means of transportation and contains a reflection of the current legal regulation. Attention is also paid to issues of the safety of these means of transportation.

Resumé: Příspěvek je věnován nově vyvíjeným technologiím fungujícím na bázi umělé inteligence a jejich využití zejména v námořní dopravě a v letectví, v kontextu platných norem mezinárodního práva veřejného a evropského práva. Ve vztahu k problematice autonomních lodí příspěvek posuzuje jejich použití podle Úmluvy OSN o mořském právu. Příspěvek také reflektuje činnost Mezinárodní námořní organizace ve vztahu k autonomním lodím. Ve vztahu k problematice autonomních letadel příspěvek posuzuje jejich užití podle několika relevantních mezinárodních smluv a podle dvou nařízení Evropské komise. Článek rovněž reflektuje činnost Mezinárodní organizace pro civilní letectví ve vztahu k autonomním letadlům. Dále jsou v článku obsaženy otázky využití umělé inteligence v železniční a silniční dopravě. Příspěvek vymezuje základní pojmy a ve vztahu ke zkoumaným typům dopravních prostředků obsahuje reflexi současné právní úpravy. Pozornost je dále věnována otázkám bezpečnosti těchto dopravních prostředků.

Key words: Artificial Intelligence, International treaties, Autonomous means of transportation, Legal regulation of emerging technologies, Transport safety.

* This paper refers to a contribution published in the journal Právník No. 1/2025, which was specialized in autonomous ships and aircraft. In addition to legal issues, it also included other (non-legal) aspects related to these means of transport.
ONDŘEJ, Jan, D'EVEREUX, Veronika. Umělá inteligence a mezinárodní právo (se zaměřením na některé autonomní dopravní prostředky). [Artificial Intelligence and International Law: A Focus on Selected Means of Transportation]. In: *Právník*, No. 1, 2025, pp. 66–83.
The following contribution is focused strictly on legal issues, i.e., the legal framework and operating conditions with a focus on safety. It is a comprehensive analysis of all types / kinds of means of transport operating on the principle of artificial intelligence. In addition to the ships and aircraft, it also focuses on trains and cars, which were not included in the article published in the journal Právník. As for the aspects of law, the previous article dealt with areas of international law, this contribution also includes EU law.

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Introduction

The issue of artificial intelligence is becoming an increasingly topical question not only in practical life but also across academic disciplines. Everything indicates that experts from various fields will continue to engage with the development of this area and will expand the domains in which artificial intelligence will permeate the everyday lives of its users. In relation to means of transport, which are the subject of interest in this contribution, namely ships, aircraft, trains, and automobiles, it can be initially noted that systems based on artificial intelligence are being developed that ensure a wide range of safety features. They enable the captain, pilot, train, and car driver to select automatic control at certain stages of the journey. Means of transport that will not require a human operator for their operation are already being tested, and in some countries, such vehicles can already be encountered, albeit marginally, in practice. This raises the question of legal regulation of the use and operation of artificial intelligence.

The selected means of transport are examined primarily from the perspective of existing rules of public international law, particularly international treaties. With regard to ships and aircraft, an international legal framework *(hard law)* already exists, and new sources (of a *soft law* nature) are currently being drafted and adopted. In contrast, with regard to trains and automobiles, it is not possible to apply a similar international legal framework, as such regulation has not yet been established. The diversity in the kinds of legal sources emerging in relation to different types of transport may appear justified in light of the manner, in which these means are used and the distances they cover. While ships and aircraft are used to transport goods and people over long distances, and in this context, global tourism is often mentioned, trains and cars are used for significantly shorter distances. Given this fact, a legal interest can be identified in ensuring that relevant rules of public international law exist already in the early phases of operating ships and airplanes with a high degree of autonomy, at least in the form of recommendations or other legally non-binding instruments. In this regard, the paper analyses relevant rules in the field of artificial intelligence being developed in particular by the International Maritime Organization and the International Civil Aviation Organization. On the other hand, in the case of trains and cars, the rules stipulating their operation are and

will continue to be addressed primarily from the perspective of national law. It may also be expected that states will show interest in establishing bilateral or multilateral, i.e., regional legal frameworks, for example, within the territory of the European Union. With regard to trains and automobiles, the contribution discusses relevant European Union rules in the field of artificial intelligence. For all the means of transport examined, the question arises as to the extent to which current rules of the public international law are applicable to the issue of artificial intelligence. For the purposes of this paper, it is possible to work with the hypothesis that in the future, international legal regulation in the form of legally binding rules *(hard law),* especially international treaties, will be necessary for all means of transport. It can also be expected that rules of a non-binding nature *(soft law)* will be drafted, and the states might be willing to respect them, despite their lack of legal enforceability.

The diversity in the types of legal regulation applicable to the means of transportation examined, together with the legal framework defined for this paper, justifies the authors' greater focus on ships and aircraft and the allocation of less space to trains and cars. This paper does not address all issues in the field of international law and artificial intelligence, but rather focuses on the theoretical question of transport vehicles utilizing various degrees of control by artificial intelligence. The paper reflects on how current public international law rules are applicable to autonomous systems being developed in relation to ships, aircraft, trains, and automobiles. From the perspective of individual branches of international law, attention is paid to relevant issues in the areas of international maritime law and international civil aviation law, with a view toward future legal development. From the perspective of regional legal regulation, the unifying framework for all the means of transport examined is the EU AI Act, which, however, is conceived at a very general level. With regard to trains and cars, it is therefore currently appropriate to rely primarily on relevant directives, i.e., EU secondary law.

1. Definition of the general terms

The term *artificial intelligence (AI)* is not defined in general international law through a legally binding definition. International legal regulation should be flexible and capable of responding to forthcoming technological changes. However, given the nature of the contractual and customary sources of international law, and the complicated, long-term process of their creation, such flexibility appears unlikely. The creation of international legal regulation of artificial intelligence at a general level thus seemed difficult to implement.

On the other hand, the tolerance of states towards the use of artificial intelligence, particularly in its legally unregulated forms, remains evident in widespread practice.[1] However, efforts to address artificial intelligence issues within certain areas (branches) of international law should not be overlooked. Examples include international maritime law, where the International Maritime Organization (IMO) addresses this issue in relation to ships, and civil aviation, where the International Civil Aviation Organization (ICAO) plays a significant role. Considerable attention is also devoted by states and scholars to the issue of weapons that can operate without human intervention, or only with limited human supervision.

[1] BURRI, Thomas. International law and artificial intelligence. In: *German Yearbook of International Law.* 2017, vol 60, pp. 97–98.

The issue of artificial intelligence is also systematically addressed by the European Union and individual states within their national legal frameworks. Moreover, it is a concept receiving increasing attention from scholars.

According to L. Kolaříková and F. Horák, many AI developers are opposed to using the term *artificial intelligence*.[2] There is ongoing consideration of alternative terms such as *smart* or *autonomous*. Nevertheless, despite contradictions in its definition, the term *artificial intelligence* remains widely used, making any attempt to replace it unlikely to succeed.[3]

The first officially accepted regional definition of artificial intelligence appears in the EU Artificial Intelligence Act. Article 3 defines AI as

> *a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments.*[4]

This convention is intended as an international treaty open to accession by other states. In addition to the EU Member States, current signatories include the USA, the United Kingdom, Andorra, Georgia, Iceland, Norway, Moldova, San Marino, and Israel. Argentina, Australia, Canada, Costa Rica, the Vatican, Japan, Mexico, Peru, and Uruguay participated in the negotiations on joining the treaty.

Sceptical opinions have emerged concerning the enforceability of obligations arising from this convention. For example, F. Fanucci stated that '*the formulation of the principles and obligations in this convention is so exaggerated and full of reservations that it raises serious questions about their legal certainty and effective enforceability.*' She identifies the exceptions made for AI systems used for national security purposes as particularly problematic. Furthermore, she believes the adopted concept is not entirely satisfactory due to the limited oversight of private companies compared to the public sector.[5]

Among the terms often considered synonymous with artificial intelligence, *autonomous* is frequently encountered in both scholarly literature and various official documents. It is also important to distinguish between the terms *automation* and *autonomous*. According to S. A. Kaiser,[6] automation does not imply full autonomy. *Autonomy* should be understood as independence from direct human control.[7] As Kaiser further explains, a system can be considered autonomous even if it is connected to networks, information systems, and other devices, as long as the entire system functions independently, without human intervention.

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2 KOLAŘÍKOVÁ, Linda – HORÁK, Filip. *Umělá inteligence a právo.* [*Artificial Intelligence and Law*] Praha: Wolters Kluwer ČR, 2020, p. 9.

3 Ibidem.

4 Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139, and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) In: Official Journal of the European Union, CS, L Series, 12.07.2024.

5 GONZALES, J. C. US, UK, EU sign international AI treaty. In: DW, 2023, [online] [cit. 04.05.2025] Available at: https://tinyurl.com/2h8sc2aj.

6 KAISER, Stefan. A. Legal Challenges of Automated and Autonomous Systems. *German Yearbook of International Law,* 2018, p. 175.

7 Ibidem, p. 176.

Currently, various land, sea, and air vehicles can operate without a human crew. However, if these vehicles are remotely controlled, it means they do not operate fully autonomously. The following part of this chapter describes different degrees of autonomy. Autonomous vehicles can operate, to varying extents, independently of human intervention. While automation can simplify control over certain processes, autonomy implies that these processes and decisions are carried out either partially or entirely without human control and independently of it.

In addition to fully autonomous systems, we are also witnessing the emergence of hybrid systems that combine different levels of automation, often operating side by side, including systems approaching full autonomy. For instance, in the context of road traffic automation, the Society of Automotive Engineers (SAE) identifies six levels of automation, ranging from no automation to full automation.[8] The categorization from automated to fully autonomous systems can include fewer or more stages, depending on the degree of human influence.

In connection with the term *artificial intelligence*, we also encounter the term *robotics*. Intelligent robotics can be characterized as the application of artificial intelligence in the physical world.[9] A robot is a tangible entity expected to perceive, reason logically, act, learn, and interact with other systems.[10] The term *robotics* is therefore narrower in scope than *artificial intelligence*. The development and operation of robots involve various levels of automation, up to systems that function entirely without human input, and are thus considered autonomous.

Last but not least, the term *artificial intelligence* is often associated with *Big Data systems*. These systems are sometimes compared to large and complex databases. Managing and manipulating such systems is logistically demanding and cannot be accomplished using conventional data processing methods and applications. Big Data systems are instrumental in the development and testing of artificial intelligence.[11]

2. Autonomous Ships

The maritime transport of goods plays an irreplaceable role in global trade and industry. Everything indicates that new technologies will lead maritime transport into a new era. It is expected that the transformation of shipping through the integration of artificial intelligence systems will also be closely linked to substantial changes in the operation of ships themselves.

Autonomous or partially autonomous ships may bring several advantages in the future. Among the most frequently cited benefits is the significant reduction or even elimination of the human factor in ship operation and navigation. Crew-related costs are often among the highest components of a vessel's operational budget. Ships without a crew, with non-permanent crews, or with a reduced number of crew members, are expected to be lighter and less expensive to operate. In some cases, the human crew could be passive or serve in a temporary capacity. Ships may also be operated by personnel stationed ashore, who would take on monitoring and control roles. In this way, autonomous ships have the potential to transfer human judgment and decision-making to artificial intelligence systems.

8 Ibidem, p. 176.
9 KOLAŘÍKOVÁ – HORÁK, ibidem p. 16.
10 Ibidem.
11 PRESS, G. 12 Big Data Definitions: What's Yours? In: Forbes, 2014, [online] [cit. 01.05.2025] Available at: http://tinyurl.com/5csxe4ny.

However, the emergence of autonomous ships raises numerous questions. One of the most pressing concerns is the absence of seafarers on board or the redefinition of their role in ship operations. Traditionally, the presence of seafarers has been regarded as a fundamental requirement for a vessel's seaworthiness and a necessary condition for its authorization to operate in both national and international waters. As A. Kepesedi[12] observes, the delegation of certain tasks to mechanical systems and the reduction in crew numbers necessitate a reassessment of several legal obligations assumed by flag states for the purpose of vessel certification. This could also lead to changes in the liability regimes governing the operation of merchant ships.

These developments raise further questions, including whether autonomous ships would be classified as seagoing vessels within the meaning of the 1982 United Nations Convention on the Law of the Sea. Regarding crew requirements, an important issue is what the minimum standards should be for crew members performing various duties on board, especially in light of the increasing automation of ship operations. It is also worth considering whether automated systems would be capable of effectively responding to emergency situations, such as preventing collisions, rescuing people and ships at sea, or managing pollution incidents. In the case of ships that are not fully autonomous, another question arises: should shore-based operators be considered seafarers under existing legal frameworks?

2.1 Assessment of Autonomous Ships in the Light of the UN Convention on the Law of the Sea

The United Nations Convention on the Law of the Sea (UNCLOS) does not provide a definition of the term *ship*. Instead, this concept is defined in specific international treaties related to maritime affairs. For example, the International Convention on Salvage of 1989 defines a vessel in Article 1(b) as '*any ship or craft or any structure capable of navigation.*'[13] This definition is quite broad and could arguably apply to autonomous ships as well.

According to Article 91(1) of UNCLOS (1982),[14] ships sail under the flag of a particular state, specifically the state in which the ship is registered. The Convention stipulates that a ship is subject to the jurisdiction of the state under whose flag it sails. Furthermore, Article 91(1) provides that '*very State shall fix the conditions for the grant of its nationality to ships, for the registration of ships in its territory, and for the right to fly its flag.*' Under Article 94(2)(a), each state must, in particular, maintain a register of ships flying its flag, recording the names and other particulars of those ships, except those which are exempt from generally accepted international regulations due to their small size.

The criteria for registering a ship are determined individually by each state. Many states do not include information about the ship's crew as a condition for registration.[15]

Ship registration and inclusion in a national register also trigger specific obligations for the flag state. According to Article 94(1) of UNCLOS, 'every *State shall effectively exercise its*

[12] KEPESEDI, Argyro. Maritime Autonomous Surface Ships: A critical 'MASS' for legislative review. In: UNCTAD, Article No. 97, Transport and Trade Facilitation Newsletter N°96 – Fourth Quarter 2022. 13 December 2022. [online] [cit. 05.05.2025] Available at: https://tinyurl.com/2temj5wy.

[13] International Convention on Salvage, 28 April 1989, UNTS No. 1953, p. 165.

[14] United Nations Convention on the Law of the Sea, 10 December 1982, No. UNTS 1833, p. 396.

[15] CHIRCOP, Aldo. Testing International Legal Regimes: The Advent of Automated Commercial Vessels. *German Yearbook of International Law,* vol. 60, 2017, p. 120.

jurisdiction and control in administrative, technical and social matters over ships flying its flag.' This raises the question of how such jurisdiction would apply to fully autonomous ships. Would the flag state exercise its jurisdiction over administrative and technical matters only to a limited extent or perhaps not at all? In addition, it is necessary to consider how *social matters* would be handled, especially with respect to labour law. These issues will depend largely on the degree of autonomy involved.

In the future, the emergence of autonomous ships will require a clear determination of the competences and qualifications of personnel responsible for the remote control and monitoring of these vessels, including their technical connectivity and oversight.[16]

Further obligations of the flag state are set out in Article 94(3) of the United Nations Convention on the Law of the Sea (UNCLOS), which concerns the safety at sea. Subparagraph (b) specifically refers to the *manning of ships, labour conditions, and training of crews*, taking into account applicable international regulations. This requirement would be difficult to satisfy in the case of fully autonomous ships, as they are by definition unmanned.

An even more demanding obligation for the flag state arises under Article 94(4) of the Convention, which mandates that each state take the necessary steps to ensure, *inter alia*, that, pursuant to subparagraph (b),

> *that each ship is in the charge of a master and officers who possess appropriate qualifications, in particular in seamanship, navigation, communications and marine engineering, and that the crew is appropriate in qualification and numbers for the type, size, machinery and equipment of the ship.*

The plain language of this provision implies that a ship must be under the command of a human captain and staffed with a qualified human crew.

Thus, several provisions of UNCLOS, particularly Article 94, presuppose the presence of a captain and other personnel aboard a ship. However, it may be argued that the requirement for a crew is relative and dependent on the type of ship. As noted by A. Chircop,[17] if a vessel is partially or fully autonomous, the presence of a crew may not be necessary for a certain period of time, or even at all, without constituting a violation of the rule. Nevertheless, such an interpretation would require a common agreement among states on how to apply and possibly reinterpret the Convention's provisions. Alternatively, it raises the question of whether a formal amendment to the Convention is necessary.

Given that the text of UNCLOS was drafted in the early 1980s, it clearly reflects an expectation that ships will be operated by human crews. However, future developments in autonomous technologies must still ensure equivalent standards of operational safety, environmental protection, and compliance with international regulations as those applicable to traditional crewed ships.

In the case of remotely operated ships, the presence of shore-based personnel with responsibility for the vessel's navigation and operations will be essential. These personnel should possess equivalent authority and responsibility to those of an onboard captain and crew, reflecting the technical and legal shift in how such vessels are managed.

[16] Ibidem, p. 121.
[17] Ibidem, p. 121.

If the manning requirements in Article 94 cannot be waived by interpretation, then amending the Convention may be necessary, but not without difficulty.[18] As outlined in Article 312 of UNCLOS, the procedure for amending the Convention is complex and challenging in practice. Nevertheless, Article 313 offers a simplified procedure for technical amendments.

According to Article 313(1),

> *A State Party may, by written communication addressed to the Secretary-General of the United Nations, propose an amendment to this Convention, other than an amendment relating to activities in the Area, to be adopted by the simplified procedure set forth in this article without convening a conference. The Secretary-General shall circulate the communication to all States Parties. [Furthermore, under Article 313(3),] if, 12 months from the date of the circulation of the communication, no State Party has objected to the proposed amendment or to the proposal for its adoption by the simplified procedure, the proposed amendment shall be considered adopted. The Secretary-General shall notify all States Parties that the proposed amendment has been adopted.*

Despite this simplified procedure, it remains uncertain how states parties would respond to such a proposal. The procedure allows for a single objection to block the amendment, which makes achieving consensus particularly challenging.

In contrast, the legal framework of the International Maritime Organization (IMO) is more flexible and responsive.[19] Several IMO[20] instruments relating to autonomous ships include procedures for tacit acceptance of amendments.[21] For instance, the International Convention for the Safety of Life at Sea (SOLAS),[22] 1974, includes several mechanisms to amend under Article VIII. According to Article VIII(b)(iv), amendments may be adopted by two-thirds of the contracting states present and voting in the Maritime Safety Committee, provided that at least one-third of the contracting states are present at the time of the vote. Once adopted, such amendments are formalized through resolutions of the IMO Maritime Safety Committee.

2.2 The Role of the International Maritime Organization in Relation to Autonomous Ships

In recent years, the International Maritime Organization (IMO) has increasingly addressed the issue of autonomous ships. A significant milestone in this effort occurred during the 103rd session of the IMO Maritime Safety Committee (MSC), held in May 2021, where the Committee approved the Outcome of the Regulatory Scoping Exercise (RSE) for the use of Maritime Autonomous Surface Ships (MASS).[23]

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18 Ibidem, p. 138.

19 Convention on the International Maritime Organization, 6 March 1948, UNTS No. 289, 1958, p. 3.

20 On the issue of international agreements concluded within the IMO: CHURCHILL, Robin. R. – LOWE, Vaughan – SANDER, Amy. *The Law of the Sea*, 3rd edition. Manchester: Manchester University Press, 1999, p. 265 etc.

21 CHIRCOP, ibidem, p. 138.

22 International Convention for the Safety of Life at Sea, 1 November 1974, UNTS No. 18961, p. 278.

23 International Maritime Organization. *Outcome of the regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS)*, MSC 1./Circ. 1638, 3 June 2021.

The primary objective of the Regulatory Scoping Exercise was to evaluate how existing IMO instruments could be applied to autonomous ships, particularly from the perspective of maritime safety, environmental protection, and other key areas of regulation. The document provides a foundational framework for assessing the compatibility of current international maritime conventions and guidelines with the operation of MASS.

According to the IMO's characterization, an autonomous ship is defined as a vessel capable of operating independently of human intervention, to varying degrees. The IMO identifies four levels of autonomy, which reflect the extent to which ships can function without direct human input: Level 1 – Ship with automated processes and decision support. The ship operates with seafarers on board who manage and control ship systems and functions. Certain processes may be automated or operate in an unattended mode; however, crew members remain available to assume full control when necessary. Level 2 – Remotely operated ship with seafarers on board. The ship is remotely controlled from a location outside the vessel, while seafarers remain on board to take over operation and control if required. Level 3 – Remotely operated ship without seafarers on board. The vessel is operated entirely from a remote location, with no crew present on board during navigation or operational procedures. Level 4 – Fully autonomous ship. The ship's operating system is fully autonomous, capable of making decisions and executing all aspects of navigation and operations without human involvement.

This classification system represents a fundamental step toward developing tailored regulatory responses for each level of automation. It also provides guidance for member states and industry stakeholders in anticipating the legal and operational challenges associated with the deployment of MASS in international waters.

As part of the Regulatory Scoping Exercise (RSE), the International Maritime Organization (IMO) assessed whether existing instruments could be adapted to accommodate Maritime Autonomous Surface Ships (MASS). For each relevant provision, the RSE examined whether it could be addressed through equivalency provisions under current instruments, through interpretative clarification, by amending existing regulations, or by developing entirely new instruments.

Among the priority international conventions analysed were the International Convention for the Safety of Life at Sea, 1974 (SOLAS), the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers,[24] 1978 (STCW), and the Convention on the International Regulations for Preventing Collisions at Sea,[25] 1972 (COLREG). These instruments were identified as requiring significant clarification in terminology, particularly regarding the roles of the *remote operator*, *crew*, and *person in charge* (RSE, para. 5.5).

It was also acknowledged that MASS could be operated from a remote control station or center, a concept not yet fully integrated into current IMO documentation. This was flagged as a regulatory gap (RSE, para. 5.6). Moreover, another substantial gap was identified concerning the potential classification of a remote operator as a seafarer. The RSE emphasized

[24] International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 7 July 1978, UNTS No. 1361, p. 2.

[25] Convention on the International Regulations for Preventing Collisions at Sea, 20 October 1972, UNTS 1050, p. 16.

the need to address the qualifications, responsibilities, and legal status of remote operators, which emerged as one of the most complex and frequently cited issues (RSE, para. 5.7).

In continuation of the RSE, the Joint Working Group on MASS (MSC-LEG-FAL MASS-JWG) held its second meeting from 17 to 21 April 2023 at IMO headquarters. A seminar on legal issues related to MASS preceded the meeting.[26] During this session, the Working Group established that: A human must always be responsible for the operation of a MASS, regardless of its mode of operation or level of autonomy. A master respectively a remote operator is always required, even if not physically present on board, depending on the ship's autonomy and technology. The remote operator must retain the ability to intervene when necessary. A single remote operator may be responsible for multiple MASS simultaneously, under certain conditions. Conversely, a single MASS may be under the command of different remote operators during a single voyage, also under specific conditions.

Given the centrality of the remote operator's role, the group concluded that it was premature to define the roles of other crew members until the remote operator's role was clearly established. These matters are to be discussed further at subsequent meetings.

The group also defined the concept of a Remote Operations Centre (ROC), a location, remote from the vessel, that may control some or all aspects of the MASS's functions. Key positions adopted included: Only one ROC should be responsible for a MASS at any one time. A ROC may be responsible for more than one MASS simultaneously, under appropriate regulatory conditions. A remote operator was defined as a *qualified person employed or engaged in the control of some or all aspects of the functions of a MASS from a ROC*.

The third meeting of the MASS Joint Working Group was held from 11 to 15 September 2023, where further steps toward a draft Code on MASS were discussed. It is envisaged that the draft Code will be finalized in 2025. Initially, the Code will be non-mandatory and will apply only to cargo-carrying MASS.[27] However, the IMO plans for the Code to become mandatory under the SOLAS Convention by 1 January 2028, with eventual expansion to cover passenger ships.[28]

The ongoing work reflects a clear trend: while fully autonomous ships are not yet expected in the immediate regulatory framework, there is an effort to ensure that every MASS has a designated responsible operator, even if remotely located. The framework under development envisions the remote operator having comparable authority and responsibility to that of a remote operator on a conventionally manned vessel. Similarly, the legal status and functions of Remote Operations Centres will need to be addressed in future instruments.

3. Autonomous Aircraft

Air transport represents the fastest and most globally interconnected mode of transportation. It plays a vital role in the economic development of the international community, acting as a key facilitator of international trade, tourism, and employment.

[26] Developing a regulatory framework for autonomous shipping, In: IMO. 27 April 2023. [online] [cit. 09.05.2025] Available at: http://tinyurl.com/2p9xbpjd.

[27] MASS Update Part 1. Regulations: Catching up with Technology. In: HFW. July 2023 [online] [cit. 08.05.2025] Available at: http://tinyurl.com/58derunf.

[28] Ibidem.

The emergence of autonomous aircraft has also prompted legal and regulatory scrutiny. A consultation paper addressing some of the legal issues surrounding autonomy in air transport was published by a committee of legal experts at the request of the UK Civil Aviation Authority (CAA). Among the key issues considered was the legal responsibility associated with autonomous flight, particularly in situations where existing national legislation imposes duties on a human pilot or a remote operator.

The consultation paper observed that, under current law, flying a fully autonomous aircraft at a "reasonable height" does not in itself constitute a legal offence. However, the term "reasonable" lacks clear legal definition in this context, and case law on this issue is limited. As a result, the operation of such aircraft may fall into a legal grey area. The committee therefore recommended that fully autonomous aircraft should be required to comply with existing aviation law and that their operation be subject to authorization by the relevant authority, such as by meeting criteria applicable to drones in the specific or certified category.[29]

This cautious approach may be viewed by some legal scholars as placing regulatory or political constraints on technological progress. For this reason, some advocate for the amendment of existing legislation to accommodate the evolving nature of autonomous flight more effectively.[30]

As noted by S. Rowan Kelleher, current aircraft remain under the exclusive control of the human pilot during ground movements and take-off procedures. However, once cruising altitude is reached, modern cockpit automation systems are already capable of handling the remainder of the flight, including the landing phase.[31] From this perspective, the transition to aircraft that are either remotely piloted or eventually fully autonomous, operating entirely on the basis of artificial intelligence (AI), may appear as a logical progression of existing technology.

Nevertheless, this transition represents a fundamental shift in the aviation paradigm. While the technological potential is substantial, it is accompanied by a wide range of legal, regulatory, and ethical challenges that must be carefully addressed before autonomous aircraft can be safely and widely integrated into civil aviation systems.

3.1 Assessment of Autonomous Aircraft in Terms of International Treaties

The airspace above the territory of sovereign states is governed by the principle of territorial sovereignty. Consequently, the overflight and landing of foreign aircraft are permitted only with the explicit consent of the territorial state concerned. Such consent may be granted on an ad hoc basis for individual flights or, more commonly, through bilateral or multilateral international treaties.[32]

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[29] YOUNG, Alison. (et al.) Aviation Autonomy. Consultation Paper. In: Law Commission. [online] [cit. 10.05.2025] Available at: https://tinyurl.com/mv4pz6f6.

[30] MORAN-ELLIS, Hannah M. – PHIPPARD, Simon. Aviation Autonomy – New Legal Order? In: Bird & Bird. [online] [cit. 10.05.2025] Available at: https://tinyurl.com/yp2f4bea.
HEYWOOD, Debbie. Law Commission consults on regulation of autonomous aviation. In: Taylor Weasing [online] [cit. 10.05.2025] Available at: https://tinyurl.com/2tb7x6sf.

[31] ROWAN KELLEHER, Suzanne R. No Pilot, No Problem? Here's how soon self-flying planes will take off. In: Forbes [online] [cit. 05.05.2025] Available at: http://tinyurl.com/y6wdpk7y.

[32] ŠTURMA, Pavel – ČEPELKA, Čestmír. *Mezinárodní právo veřejné, 2. vydání.* [*Public International Law, 2nd issue*] Praha: C. H. Beck, 2018, p. 188.

At present, the most significant international treaty regulating civil aviation is the Convention on International Civil Aviation (Chicago Convention) of 1944,[33] which succeeded the earlier Paris Convention of 1919[34] and the Pan-American Convention on Commercial Aviation (Havana Convention) of 1928.[35] The statute of the International Civil Aviation Organization (ICAO) is an integral part of the Chicago Convention. In the field of commercial aviation, the Chicago Conference also produced two important agreements: the Agreement on International Air Transport[36] (commonly referred to as the *Five Freedoms Agreement*) and the Agreement on International Air Transport Services[37] (*Two Freedoms Agreement*). The commercial aspects of scheduled air services are additionally governed by a network of bilateral and regional treaties.[38]

Since the 1990s, air transport has undergone substantial liberalization, leading to the adoption of a number of open skies agreements.[39] These various international instruments govern the overflight and operation of civil aircraft within the airspace of sovereign states. In contrast, overflights in international airspace (including by both civil and military aircraft) fall within the scope of the United Nations Convention on the Law of the Sea (UNCLOS).[40]

When it comes to autonomous aircraft, i.e., aircraft operated remotely or without a human crew on board, it can be inferred from the text and context of existing treaties that the drafters did not intend to allow for such broad or general overflight rights without restriction. This is particularly evident in Article 8 of the Chicago Convention, which explicitly provides that

> *no aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so con-trolled as to obviate danger to civil aircraft.*

In addition to this explicit limitation, several other legal obstacles can be identified in existing international aviation treaties. These include, notably, the requirement for aircraft registration and the associated requirement for the professional qualifications of the aircraft's commander, pilots, and crew. This requirement is contained in Articles 11 to 13 of the Paris Convention and in Articles VII to X of the Havana Convention.

Further, the crew nationality requirements in treaties such as the Agreement on International Air Transport (Article 1(1)), defining the third and fourth freedoms of the air presuppose the presence of a human crew, and by implication, a pilot on board. A similar assumption appears in the Multilateral Convention on Commercial Rights in Non-Scheduled Air Services in Europe, Article 1(b), which applies to 'civil *aircraft flown by a national of one*

[33] *Chicago Convention on International Civil Aviation* (07.12.1944), UNTS, Vol. 15, p. 295.
[34] *Convention for the Regulation of Aerial Navigation* (Paris, 13.10.1919), U. K. Treaty Series, No. 2 (1922).
[35] *Havana Convention on Commercial Aviation* (20.02.1928), AJIL, Vol. 22 (1928), Suppl., p. 124.
[36] *International Air Transport Agreement* (1944), UNTS, Vol. 181, p. 387.
[37] *International Air Servis Transit Agreement* (1944), UNTS, Vol. 84, p. 389.
[38] e. g., *Agreement on Commercial Rights of Non-Scheduled Air Services in Europe* (Paris, 30.04.1956), U. K. Treaty Series, No. 42 (1960).
[39] EU-*US Air Transport Agreement,* OJEU, L. 134 (Vol. 50, 25.05.2007).
[40] ŠTURMA, ČEPELKA, ibidem, p. 188.

of the contracting states.' The EU–US Air Transport Agreement also refers repeatedly to crew presence, reinforcing the view that current treaty law assumes human operation of aircraft.

At the European Union level, the requirement for pilot presence and qualifications is reinforced by multiple instruments. For instance, Article 7 of Annex III to Regulation (EC) No. 216/2008 mandates rules for pilot certification, training, testing, periodic checks, and medical fitness.[41] Similarly, Commission Regulation (EU) No. 1178/2011 sets out technical requirements for the training and certification of pilots and crew.[42]

In the case of remotely piloted aircraft (RPA), a legal question arises as to whether a remote operator could be considered a *pilot* under existing legal definitions. While it may be argued that an operator possessing equivalent professional qualifications should be treated as a pilot, such an interpretation is not universally accepted and may become the subject of disputes between states. The question thus remains open, and regulatory clarity will be essential as the use of autonomous aircraft becomes more widespread.

In light of the aforementioned legal sources, it can be concluded that current legislation is not adequately prepared to permit the operation of autonomous aircraft remotely controlled by an operator for the purpose of passenger or cargo transport. It is likely that technological development will outpace regulatory adaptation, with autonomous aircraft systems being ready for real-world testing and deployment before the corresponding legal frameworks are in place. This growing discrepancy between emerging technologies and existing legal norms must be urgently addressed.

One potential interim solution could involve the continued presence of human pilots and crew members, even in aircraft otherwise capable of fully autonomous operation. As noted by S. Hobe and B. I. Scott, the presence of human pilots may be justified by practical concerns, especially in emergency or exceptional situations where human judgment is superior to that of artificial intelligence.[43] Examples include machine failures, software errors, or unexpected changes in environmental conditions, including adverse weather. Overly cautious AI systems could misinterpret such situations and make inappropriate decisions, potentially resulting in aviation accidents.[44]

Moreover, the complete replacement of flight crews by artificial intelligence remains difficult to imagine in the context of commercial aviation, particularly on long-haul or transcontinental flights. The human presence on board continues to be essential, especially in scenarios requiring medical intervention. For instance, crew members may need to assist passengers experiencing medical emergencies, including rare but documented situations where women give birth mid-flight. While AI-based technologies, such as those described by M. Kandas, which provide visualized guidance to facilitate first aid procedures, can

41 REGULATION (EC) No 216/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC.

42 COMMISSION REGULATION (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council.

43 HOBE, Stephan – SCOTT, Benjamyn I. International Civil Aviation and the Dehumanisation of Activities. In: *German Yearbook of International Law.* Vol. 60 (2018), pp. 154–155.

44 Ibidem pp. 155–156.

greatly enhance the speed and accuracy of medical responses, they cannot fully replace the human element involved in compassionate, adaptable, and often life-saving care.[45]

The testing of new aviation technologies is currently facilitated by EU Commission Regulations No. 748/2012[46] and No. 1321/2014,[47] which lay the groundwork for incremental innovation in aircraft systems. As such, it can be anticipated that cockpit automation will continue to advance, progressively reducing the role of human pilots in aircraft operation. Nevertheless, at present, the concept of a fully unmanned cockpit in commercial passenger aircraft remains difficult to imagine. That said, it is plausible that this perception will evolve over time, especially with the development of unmanned air taxi technologies, which could serve as a transitional phase.

When it comes to fully autonomous flights, several scenarios may emerge. One likely path is the initial deployment of remotely controlled unmanned aircraft for cargo transport, which poses fewer legal and ethical challenges compared to passenger flights. Alternatively, it is conceivable that both cargo and limited passenger transport using unmanned aircraft could begin concurrently, depending on regulatory openness and market demand.

However, it is also plausible that states will adopt a conservative stance, choosing to retain the requirement for human pilots and onboard crew, thereby rejecting the sufficiency of remote control or full autonomy for the commercial transport of people or goods. In such a scenario, autonomous technologies may instead be leveraged to enhance the work of aviation personnel, improving efficiency, safety, and reliability without replacing human oversight entirely.

Moreover, environmental considerations may emerge as a more politically and socially acceptable focus for aviation innovation. In the absence of legal pathways for unmanned commercial flight, technological development could be redirected toward reducing aviation's carbon footprint, promoting greener propulsion systems, such as electric or hybrid engines, and alternative aviation fuels. Such a shift would align with the broader goals of the international community, particularly those reflected in the UN 2030 Agenda for Sustainable Development, and could garner stronger political and public support.

3.2 The Role of the International Civil Aviation Organization in Relation to Autonomous Aircraft

The International Civil Aviation Organization (ICAO), established under the Chicago Convention on International Civil Aviation of 1944,[48] plays a central role in shaping global standards and regulations in civil aviation. According to its statute, ICAO is empowered to adopt and amend international standards in areas such as communication systems, aerodrome infrastructure, navigation aids, flight rules, air traffic control procedures, licensing of aviation

[45] KANDAS, Mike. How augmented reality, AI and apps are helping to improve first aid education. In: Revenues and profits. [online] [cit. 05.05.2025] Available at: http://tinyurl.com/yaevpdkx.

[46] COMMISSION REGULATION (EU) No 748/2012 of 3 August 2012 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations (recast).

[47] Regulation (EU) No 1321/2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks.

[48] *Chicago Convention on International Civil Aviation*, U.N.T.S., No. 102, 1948, p. 296.

personnel and mechanics, airworthiness certification, aircraft registration, and various operational and administrative procedures related to international civil aviation.

Under the Chicago Convention, contracting states have undertaken to implement domestic regulations that are fully compliant with the Convention and with ICAO's adopted standards. In the context of emerging autonomous aircraft technologies, a significant legal and regulatory barrier exists: the current ICAO framework presumes the presence of human pilots and crew. The requirement for certification of professional competence for each crew member is particularly problematic for aircraft that would operate without any human onboard, whether remotely piloted or fully autonomous and operated exclusively by artificial intelligence.[49]

The operation of pilotless aircraft is addressed in Article 8 of the Chicago Convention, which provides that

> *no aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so con-trolled as to obviate danger to civil aircraft.*

This provision clearly reflects the cautious stance adopted by the drafters of the Convention toward unmanned aircraft. As a result, the regulation of remotely piloted and autonomous aircraft has largely been left to national legislation, and no uniform global regime has yet been established.

A significant change occurred on 31 December 2020, with the adoption of uniform European Union rules, developed by the European Union Aviation Safety Agency (EASA). These regional regulations provide a harmonized framework for the registration and operation of unmanned aircraft, and categorize drones into three operational classes: open, specific, and certified.[50] The certified category, the most complex and highest risk, applies to future systems intended for the transport of people or cargo, or for operation over crowds. Aircraft in this category are subject to rigorous certification procedures, including approval of their design, production, and maintenance. Moreover, their remote pilots, operational personnel, and the aircraft operators themselves must obtain relevant certifications.

Unmanned aircraft larger than 3 meters and intended to fly over gatherings, carry passengers, or transport hazardous materials may fall into this certified category.[51] In cases where the Civil Aviation Authority determines that the operational risk is exceptionally high, aircraft may also be classified in this category even if they do not meet the standard criteria.

The development of rules for this certified category of unmanned aircraft is currently being addressed within ICAO's regulatory framework. The global applicability of these new standards is expected to take effect on 26 November 2026.[52] However, it is important to

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[49] JANKUV, Juraj (et al.) *Medzinárodné právo verejné.* [*Public International Law*] Plzeň: Aleš Čeněk, s. r. o., 2016, p. 48.

[50] Nová legislativa pro provoz dronů platná od 31.12.2020. [New legislation for drone operations valid from 31 December 2020] In: Robot World. [online] [cit. 05.05.2025] Available at: https://tinyurl.com/yc7w4fvv.

[51] Certifikovaná kategorie provozu. [Certified operating category.] In: Létejte zodpovědně. [Fly responsibly.] [online] [cit. 16.12.2023] Available at: https://tinyurl.com/2k4w627z.

[52] ICAO makes progress on new remotely piloted aircraft system (RPAS) standards. In: ICAO. [online] [cit. 06.05.2025] Available at: https://tinyurl.com/4kf2tyfb.

highlight that these forthcoming ICAO standards will only apply to unmanned aircraft controlled by human operators, they do not yet extend to fully autonomous aircraft operating solely on the basis of artificial intelligence.

Thus, despite ongoing technological advancements in AI-based aviation systems, the creation of a comprehensive legal framework for fully autonomous aircraft remains a future challenge. Its realization will depend not only on the pace of technological innovation but also on institutional will and consensus within ICAO and among its member states regarding the desirability and safety of such aircraft in civil airspace.

4. Autonomous Trains

Also, in the field of rail transport, autonomous (automatic) trains, or trains with varying degrees of autonomy/automation, are currently being tested in several countries. According to the International Electrotechnical Commission,[53] it is possible to distinguish several grades of automation. The first grade is called *GOA 0, On-sight train operation,* in which the driver has full responsibility, and no technical system is required to supervise his activities. However, the points (switches) and single tracks can be partially supervised by the system. The second grade is called *GOA 1, Non-automated train operation,* in which the driver (i.e., the train operator) is in the front cabin of the train, observing the guideway and stopping the train in case of a hazardous situation. Acceleration and braking are controlled by the driver in conformance with wayside signals or cab signalling. The signalling system supervises the activities of the driver. This supervision may be discrete, semi-continuous, or continuous. Safe departure of the train from the station, including door closing, is the responsibility of the operations staff, whether on board the train or on the station platform. The third grade of automation is called *GOA 2, Semi-automated train operation,* where the operations staff is located in the front cabin of the train, observing the guideway and stopping the train in case of a hazardous situation. Acceleration and braking are automated, and the speed is supervised continuously by the system. The safe departure of the train from the station is under the responsibility of the operations staff, whether on board the train or on the station platform. The fourth grade of automation is called *GOA 3, Driverless train operation,* in which the train is operated with operations staff present on board the train, but the human operator is neither responsible for accelerating or braking, nor for observing the guideway in front of the train. The operator does not stop the train in case of a hazardous situation. Safe departure of the train from the station, including door closing, is either the responsibility of the human operator or of the technical system. The fifth grade of automation is called *GOA 4, Unattended train operation,* and it is a fully automated system. The train is operated without any operations staff on board. All functions fall within the responsibility of the technical system.

At present, in normal railway traffic, the degree of automation GOA 2 can be considered as the maximum. The driver is in the cabin while the train is running, and the human operator monitors the railway in order to detect danger in time. Examples of danger on the railway might include people, animals, and objects on the track. As early as 2021, Deutsche Bahn and Siemens Mobility began operating a train that moves fully automatically on public

[53] *International Electromechanical Commission. IEC 62267 International Standard. Railway applications – Automated urban guided transport (AUGT) – Safety requirements.* [online] [cit. 22.05.2025] Available at: https://tinyurl.com/bde7x9nb.

railways. The companies developed the train together with the city of Hamburg as part of the Digital S-Bahn project, and the train has been in operation since December 2021. Automatic trains in Hamburg's S-Bahn are supposed to run with an accuracy of one second. These trains may carry up to 30 % more passengers and are expected to significantly improve the accuracy of arrivals and departures, and even save up to 30 % on energy costs. Although the train is fully automated, the driver is still present and oversees the ride whenever passengers are on board.[54] In the Czech Republic, the transport security technology manufacturer AŽD Praha[55] started operating an autonomous train with passengers on the so-called "free track,"[56] with level crossings, etc. This is a 24 km long track between the towns of Kopidlno and Dolní Bousov. The current legal regulation does not allow the operation of fully autonomous trains without a crew. Therefore, there is also a driver in an autonomous train, but they only supervise the journey between the stations. The train will operate with passengers on the set dates.[57] The technicians on board only check that the systems are working properly and can intervene. However, during the above-mentioned journey, a human-made mistake occurred, and because of this, the ETCS security system intervened, which resulted in the train being stopped.[58] Train operation in the GOA 4 automation mode is currently possible only for systems in closed environments,[59] for example underground systems used in mines, or in the case of subways.

4.1 Assessment of the EU Legal Rules Related to the Autonomous Trains

The basic requirements regarding rail interoperability within the European Union, which should apply to its rail system, are contained in Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union.[60] The directive contains essential requirements concerning the subsystems, structural, or functional parts of the Union's rail system listed in Annex II, which must be met. These requirements are defined in Annex III; in particular, they cover the safety of rolling stock in Section 2.4.1. Concerning this directive, the Commission Implementing Regulation (EU) 2023/1695 of 10 August 2023 was adopted on the technical specification for interoperability relating to the control-command and signalling subsystems of the rail system in the European Union, repealing the earlier regulation from

[54] DB a Siemens představily první automatický vlak na veřejné trati pod ETCS. [DB and Siemens present the first automatic train on a public line under ETCS.] In: *ZDopravy.cz* [online] [cit. 22.05.2025] Available at: https://tinyurl.com/3vedzeux.

[55] The abbreviation AZD stands for the English equivalent of Automation of railway transportation.

[56] The free track refers to a track section which is on each side of track bounded by either a train station, a traffic lane, or by the end of the track, e.g., by the end of the track at a railway stop or by a loading dock.

[57] Evropský unikát. V Česku vyjel první autonomní vlak na běžné trati. [Unique in Europe. The first autonomous train on a regular line has started operating in the Czech Republic.] In: *ČTK* [online] [cit. 22.05.2025] Available at: https://tinyurl.com/dnhvy38m.

[58] Autonomní vlak svezl v Česku první cestující, v akci byl i zabezpečovač. [Autonomous train carries first passenger in the Czech Republic, ETCS security system got involved] In: *iDnes.cz* [online] [cit. 18.05.2025] Available at: https://www.idnes.cz/hradec-kralove/zpravy/kopidlno-dolni-bousov-autonomni-vlak-zahajeni-zeleznice-etcs.A250404_115637_hradec-zpravy_tuu.

[59] GESMANN-NUISSL, Dagmar, KUNITZ, Stephan. Auditing of AI in Railway Technology – a European Legal Approach. In: *Digital Society* 2022. [online] [cit. 20.05.2025] Available at: https://tinyurl.com/m5eswjud.

[60] Official Journal of the European Union. L 138/44. Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union (recast) (Text with EEA relevance). [online] [cit. 24.04.2025] Available at: https://tinyurl.com/bdshyrzr.

10 August 2023.[61] According to paragraph 7 of the preamble, this implementing regulation provides the complete specifications for automatic train guidance (automation grade 2) and for the interface with the FRMCS system, which was available at the time of the regulation's adoption. Full specifications for FRMCS, Advanced Train Positioning Systems, and Digital Automatic Coupling are not yet available, as they require further technical development. Concerning the legal regulation of autonomous trains within the EU, it will thus be necessary to refer to Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024.[62] According to paragraph 3 of this regulation, 'AI *systems can be easily deployed in a large variety of sectors of the economy and many parts of society, including across borders, and can easily circulate throughout the Union.*' Transportation, including rail transportation, is undoubtedly such a sector.

In this regard, concerning autonomous trains, as stated by A. Diviš from AŽD Praha, it will be important to pay attention to the legislation.

> *Unfortunately, European legislation makes the position of railways more complicated compared to road transport. The requirements for vehicles, their homologation, ETCS, ECM, digital coupling, and the requirements for a number of other obligations make railways extremely expensive compared to roads.*[63]

5. Autonomous Automobiles

Autonomous, self-driving, robotic automobiles use technology capable of partially or entirely replacing the human driver while navigating the car, avoiding road hazards, and responding to traffic conditions. In contrast to autonomous ships and airplanes, there is no applicable treaty, convention, or draft article falling under the regime of public international law. Therefore, regarding the classification of degrees of autonomy, it is possible to refer mainly to sources of domestic law, e.g., rules developed by the Society of Automotive Engineers (SAE) and the U.S. National Highway Traffic Safety Administration (NHTSA).[64] This classification was proposed for adoption by the United Nations Economic Commission for Europe (UNECE), and the harmonised vehicle regulation entered into force on 30 September 2024.[65] This classification has thus become legally relevant within a regional scope, i.e., for Europe.

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[61] Official Journal of the European Union. L 222/380. Commission Implementing Regulation (EU) 2023/1695 of 10 August 2023 on the technical specification for interoperability relating to the control-command and signalling subsystems of the rail system in the European Union and repealing Regulation (EU) 2016/919 (Text with EEA relevance). [online] [cit. 24.04.2025] Available at: https://tinyurl.com/5f2zwntm.

[62] Official Journal of the European Union. Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) (Text with EEA relevance). [online] [cit. 24.04.2025] Available at: https://tinyurl.com/p6dp7whe.

[63] Evropská legislativa činí pozici železnice ve srovnání s automobilovou dopravou složitější, říká Antonín Diviš z AŽD Praha. [European legislation makes the position of railways more complicated compared to road transport, says Antonín Diviš from AŽD Praha.] In: *Ekonomický deník*. [online] [cit. 22.05.2025] Available at: https://tinyurl.com/mrs4nj7e.

[64] Autonomous Vehicles Factsheet. Pub. No. CSS16-18. In: Centre for Sustainable Systems, University of Michigan. 2024 [online] [cit. 22.04.2025] Available at: https://tinyurl.com/yfs8r575.

[65] New UN regulation paves way for deployment of driving assistance systems worldwide. In: UNECE. 2024.

The above mentioned documents identify six degrees or levels of automation. Cars at level 0 have no automated features and require the driver's full control over the vehicle. The AI system in such a car issues warnings and provides momentary assistance, such as emergency braking, blind spot warnings, or lane departure warnings. Cars at level 1 are equipped with one or more primary automated features, such as cruise control, but the driver is required to perform all other tasks. The AI system in such a car supports the driver in steering or brake deceleration, such as lane centering or adaptive cruise control. Cars at level 2 are equipped with two or more primary features, such as adaptive cruise control and lane-keeping. These features work together to relieve the driver from controlling those functions. The AI system in such a car enables support for the driver in steering and brake acceleration, such as lane centering and adaptive cruise control operating concurrently. Cars at level 3 have features that allow the driver to relinquish control of the vehicle's safety-critical functions depending on traffic and environmental conditions. The driver is expected to take over control of the vehicle, given the constraints of the automated features, after an appropriately timed transition period. The AI system is capable of driving the vehicle under limited conditions, while the human driver must serve as a backup. Cars at level 4 have a system allowing the driver to relinquish control of the vehicle's safety-critical functions. The vehicle can perform all aspects of driving, even if the driver does not respond to a request to intervene. The AI system is thus capable of driving the vehicle under limited conditions and will not require a human to take over driving. This level of automation might be considered a meaningful safety and security feature of the car, as the AI system is capable of reacting and stopping the car safely in case the driver loses the ability to drive, e.g., due to an unexpected medical condition. Vehicles at level 5 are fully autonomous, with features developed to monitor roadway conditions and perform safety-critical tasks throughout the duration of the trip, with or without a driver present. Such cars do not require human control over driving.[66]

5.1 Assessment of Autonomous Cars in Terms of the Rules Adopted by the EU

Regarding the framework regulating the use of autonomous vehicles, it is possible to consider the rules stipulated by the European Commission (EC) as an internationally relevant regional legal rule. On 27 November 2019, the EC adopted the revised General Safety Regulation 2019/2144, which became applicable on 6 July 2022. The regulation introduces a range of mandatory advanced driver assistance systems to improve road safety. It also establishes the legal framework for the approval of driverless and automated vehicles in the EU. These rules are relevant only to new types of vehicles manufactured from 7 July 2024 and stipulate AI-based advanced driver assistance features that are mandatory for cars produced after the above-mentioned date. All road vehicles produced after this date must have intelligent speed assistance, reversing detection with a camera or sensors, attention warnings in case of driver drowsiness or distraction, event data recorders, cybersecurity, and an emergency stop signal. Cars and vans must additionally have lane-keeping systems and automated braking.[67]

[online] [cit. 22.04.2025] Available at: https://tinyurl.com/murkkd.

66 DWORKIN, Olivia, ORTIZ, Jorge, XENAKIS, Nicholas. Regulatory Frameworks for Smart Mobility: Current U.S. Regulation of Connected and Automated Vehicles and the Road Ahead. In: *J. L. Mobility.* 4, 2023. [online] [cit. 22.04.2025] Available at: https://tinyurl.com/ydw6d6at.

67 European Commission. Vehicle safety and automated/connected vehicles. [online] [cit. 22.04.2025] Available at: https://tinyurl.com/y7jedz6s.

The EC adopted a draft implementing regulation, which may have the potential to become the first set of rules of its kind concerning vehicles with full automation (driverless cars, which may be used as robotaxis or urban shuttles). The EC's adopted technical rules establish a comprehensive assessment of the safety and maturity of fully automated vehicles before they are introduced to the EU market. The rules cover testing procedures, cybersecurity requirements, data recording rules, as well as safety performance monitoring and incident reporting requirements for manufacturers of fully driverless vehicles.[68]

In relation to AI technologies used in cars, it is therefore possible to identify a trend toward adopting obligations for car producers to install these systems in newly manufactured cars. The above-mentioned regulation applies to levels 2, 3, and 4 of automation. In conclusion, it can be noted that the legal framework relating to level 5 is likely to be subject to further development. It is more likely that this will again be a regional regulation at the EU level. Conversely, it is less likely that a universal adjustment will be created, similar to the case of autonomous ships and aircraft.

Conclusion

The authors of this paper examined the currently applicable legal regulation and its application to the use of not only remotely controlled, but also fully autonomous ships, aircraft, trains, and automobiles. From the perspective of legal regulation, there are differences between the means of transport addressed in this study. In the case of ships, there is an international legal framework concerning their legal status and the associated rights and obligations, which forms part of the broader framework of international maritime law. Therefore, the issue of autonomous ships is also a matter of interest to the International Maritime Organization, which is currently working on relevant rules. As regards aircraft, there is also an international legal framework developed within the International Civil Aviation Organization, which addresses the issue of autonomous aircraft. In contrast, in the case of trains and automobiles, there is no comparable international legal framework. The international treaties in this area do not concern the vehicles or the requirements associated with their operation in the same way as is the case with ships and aircraft. International treaties in the field of rail and road transport focus on the transport of persons and goods, and relate to the area of private international law and commercial law. The legal regulation concerning the vehicles, trains, and automobiles, originates from national law. At the international level, rules are being developed within the European Union, which do not constitute international law but rather EU law, within which rules relating to autonomous cars and trains are also being formulated.

In all cases, the authors conclude that the application of existing legal regulation, whether public international law or EU law, to autonomous means of transport would likely not be without complications. These could arise, for example, due to the absence of regulation in certain areas or because existing rules are too general, which could lead to disputes stemming from their lack of specificity. Therefore, it appears more appropriate to consider amendments to existing treaties or the creation of new, specific treaty frameworks applicable to the various types of means of transport.

[68] European Commission. Document Ares (2022) 2667391. [online] [cit. 22.04.2025] Available at: https://tinyurl.com/bde558yf.

In relation to the legal issues surrounding the operation of ships, the authors identified several problems. It would be necessary to determine whether an operator remotely controlling a ship from a remote operations center could be unequivocally considered a full equivalent of a captain. Based on the currently applicable rules of public international law, this appears doubtful due to the requirement for (physical) control of the ship by a captain and the presence of officers and crew on board. It is therefore likely that it would be necessary either to amend the existing regulations or to adopt new treaties that would permit this type of remote control. A fundamental precondition would be an amendment to the relevant treaties, which could encounter divergent approaches by states. If this were not achievable, the conclusion of a new international treaty allowing the use of such technologies among a specific group of states could be considered. The same recommendation regarding at least remote human control could in the future be extended to the operation of fully autonomous ships. Even such ships, technologies of which would theoretically enable exclusive operation by artificial intelligence, should have a designated person responsible for their operation. Lastly, it would also be necessary to address the legal status of the remote operations center from which operators would control these ships.

Similar problems may be identified in relation to remotely controlled cargo aircraft. In the case of air transport, another factor also plays a role, namely the presence of a pilot and human crew on board passenger aircraft. For commercial aircraft, it may therefore appear more realistic to maintain the physical presence of captains and personnel even in cases where the aircraft is otherwise equipped with technologies enabling fully autonomous operation. These technologies could then be used to enhance the safety of transport under adverse weather conditions or in cases of reduced visibility, to expedite aircraft turnaround procedures, and so forth.

As for the legal issues concerning the operation of autonomous trains, there is no public international legal framework applicable to their operation. With regard to regional regulation under EU law, the operation of fully autonomous trains without the presence of a human operator is currently not permissible, except within closed areas. Therefore, the operation of autonomous trains in the near future appears likely only to a minimal extent, for example in large cities where underground systems are in use. However, it could be disputed whether the operation of fully automated trains without the presence of a human operator would be automatically possible on all existing underground routes, since some sections of metro systems run above ground. It seems more plausible that driverless trains should be operated only on lines that are fully enclosed underground, as is to be the case with Line D of the Prague Metro.

Regarding the legal questions associated with the operation of fully autonomous automobiles, similar to trains, there is no public international legal framework that could be applied. Once again, it is necessary to rely on regional regulation under EU law, which currently anticipates the broad integration of various artificial intelligence elements into newly manufactured vehicles and even imposes obligations on manufacturers to install such systems in cars. However, it does not foresee the operation of fully autonomous cars without any human driver involvement.

In the case of ships, aircraft, trains, and automobiles, the authors assume that in the near future there will likely not be the adoption of legal regulation allowing the operation of vehicles

controlled exclusively by artificial intelligence, that is, fully autonomous means of transport. It appears more realistic that, from a legal perspective, whether at the level of international law or EU rules, the cases to be addressed will involve autonomous or semi-autonomous vehicles under human supervision. The relevant international organizations, namely the International Maritime Organization and the International Civil Aviation Organization, are currently engaged in the preparation of relevant rules. Within the European Union, legal acts concerning autonomous trains and automobiles are gradually being adopted.

The existence of fully autonomous means of transport is, however, technically highly plausible in the future, considering the ongoing development and testing of such technologies. Therefore, in order to bring these vehicles into operation, it will be necessary to adopt appropriate legal regulation that would permit the use of these autonomous means of transport.