Legal Issues of Spacecraft Maneuvering with Artificial Intelligence – Comparative Study with the Japanese Regulations for Autonomous Driving Vehicles on the Ground

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Abstract

What are the legal issues to realize safe operation of spacecraft with Autonomous Intelligent Systems in space? Technological innovations on autonomous systems for space operations are developing rapidly, but the legal infrastructure to solve such AI operated spacecraft incidents and/or accidents has not yet been evolved. When considering new means of resolving legal disputes in space, a comparative study with the legal regulations for automated driving of automobiles on the ground would be helpful. This research reviews the current status of legislation regarding the auto-driven cars being undertaken in Japan and other countries and examine whether it can be invoked in space. A new safety standards and evaluation methods that correspond to the operation of the autonomous driving vehicle will need to be set. This paper introduces the discussions and explore the design of the legal system that could be applied to incidents/accidents of automatically operated spacecrafts.

Keywords: autonomous driving, liability, legal issue, HTV-X, accident, insurance

1. Introduction

In this paper, I will explain the definitions of each level of automated vehicle operation first. Following topics are an overview of which level of automated vehicles have been technically realized in Japan, the progress of social implementation, and the current status of various legal revisions being made

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for the safe operation of automated vehicles and for dispute resolution in the event of an accident. In addition, I will also introduce an overview of the legal amendments that are underway in countries other than Japan to accommodate automated vehicles briefly.
Next, regarding the development of automated operation of space vehicles, I will introduce the automated docking method of the HTV-X space station, JAXA's transport vehicle as an example. Its legal liability in the event of an accident, assuming an accident to occur in the case of automated operation of ground vehicles, will be discussed by comparing them with simulations of traffic accidents involving autonomous driving cars.

2. Overview of the Evolution of Automated Ground Vehicle Driving in Japan and the Japanese legislative changes surrounding it

2.1. Definition

First, let us discuss the definition of autonomous driving.
In the "Public-Private ITS Initiative/Roadmaps 2017" announced by the Japanese government, the definitions described in J3016 of the Society of Automotive Engineers (SAE) International and its Japanese reference translation, JASO TP18004 (hereinafter referred to as "SAE Level") have been adopted as the official definition of automation levels in Japan. The SAE levels divide autonomous driving into six levels, from Level 0 to Level 5, each of which are shown in Table 1.[1]

1 Strategic Conference for the Advancement of Utilizing Public and Private Sector Data, Strategic Headquarters for the Advanced Information and Telecommunications Network Society, "Public-Private ITS Initiative/Roadmaps 2017 – Toward implementation of various highly automated driving systems in society – ", pp. 6-7, https://japan.kantei.go.jp/policy/it/itsinitiative_roadmap2017.pdf.

[Table 1] Overview of the definitions of automated driving levels(J3016)

Level	Overview	Object and Event Detection and Response for safe driving by:
Drivers perform all or part of the dynamic driving task (DDT)		
SAE Level 0 No automation	• The driver performs the entire dynamic driving task	Driver
SAE Level 1 Driver assistance	• The system performs subtasks of the dynamic driving task relating to either longitudinal or lateral vehicle control	Driver
SAE Level 2 Partial automation	• The system performs subtasks of the dynamic driving task relating to both longitudinal and lateral vehicle control	Driver
Automated driving systems perform all dynamic driving tasks		
SAE Level 3 Conditional automation	• The system performs the entire dynamic driving task (within operational design domains※) • The DDT fallback-ready driver is expected to respond appropriately to a request to intervene by the system	System (DDT fallback-ready driver)
SAE Level 4 High automation	• The system performs the entire dynamic driving task (within operational design domains※) • The DDT fallback-ready driver is not expected to respond to it	System
SAE Level 5 Full automation	• The system performs the entire dynamic driving task (not within operational design domains※) • The DDT fallback-ready driver, the user[5] is not expected to respond to it	System

※Domains here are not limited to geographical domains but include the environmental, traffic, speed, and temporal conditions.
※※ Dynamic Driving Task (DDT)
・ All of the real-time operational and tactical functions required to operate vehicles in on-road traffic, excluding the strategic functions such as and trip scheduling and determination of destinations and routes.
・ Specifically, it includes but is not limited to lateral motion (steering), longitudinal motion (acceleration/deceleration), monitoring of the driving environment, and maneuver planning, and enhancement of conspicuity (lighting, etc.)

Up to Level 2 of autonomous driving, the system only assists the driver in driving. In contrast, there is a major difference in that Level 3 and above delegate some or all of the driving behavior (dynamic driving tasks) to the vehicle system, and the monitoring and response entities related to safe driving are also shifted from the driver to the system.
In addition, there is an ODD (Operational Design Domain) for Levels 1 through 4, which is defined as the design of autonomous driving systems, etc.

In this regard, J3016 points out that the range of ODDs, along with the level of autonomous driving, is an important indicator in evaluating autonomous driving technology. Specifically, for any of SAE Levels 1 through 4, the wider the ODD, the specific conditions under which the autonomous driving system is designed to function, the higher the technological sophistication. In other words, even for SAE Level 4 (part of fully automated driving), if a system automates driving with only a narrow ODD, its technical sophistication is relatively low.
Also note that SAE Level 5 is defined as an SAE Level 4 autonomous driving system with no ODD limitations and is at an exceedingly high technical level[2].

2.2. Legal Revisions

The Japanese government has determined and announced its strategy for autonomous driving at the "Public-Private ITS Initiative/Roadmaps" every year since 2014. The reasons for the urgent need to introduce autonomous driving in Japan are the demand to reduce traffic accidents and the shortage of drivers for buses, trucks, and other vehicles due to the declining birthrate and aging society in Japan. The "Public-Private ITS Initiative/Roadmaps" identifies specific national strategies for autonomous driving in order to develop and commercialize advanced driver assistance technologies and automated driving systems. The "Public-Private ITS Initiative/Roadmaps" of 2014 not only addresses the technical aspects, but also the legal and institutional issues[3]. In 2018, the Japanese government formulated the "Outline of System Improvement for Automatic Driving"[4], a policy for the development of the system after studying what problems existed in the legal system and what kind of revisions were necessary in order to actually allow autonomous driving vehicles to drive on public roads. Based on this outline, various legal amendments were made to enable autonomous driving. The following four key issues were considered as preconditions for the revision of the law.

1) The state of safety standards (Road Transport Vehicle Law, etc.) and the state of safety assurance for existing vehicles already in use in society that are compatible with autonomous driving technology.

2 Strategic Conference for the Advancement of Utilizing Public and Private Sector Data, Strategic Headquarters for the Advanced Information and Telecommunications Network Society, "Public-Private ITS Initiative/Roadmaps 2017 – Toward implementation of various highly automated driving systems in society – ", pp. 10-32, https://japan.kantei.go.jp/policy/it/itsinitiative_roadmap2017.pdf.
3 Koji Nakayama et al, Automated Driving and Social Change – Law and Insurance, Meiji university's Institute of Autonomous Driving, Shoji Houmu, Tokyo, 2019, pp. 7-8.
4 IT Strategic Headquarters, Strategic Conference for the Advancement of Public and Private Sector Data Utilization, "Outline of System Improvement for Automatic Driving," (2018), https://www.mlit.go.jp/common/001260125.pdf.

The safety level required for autonomous driving and the technical requirements and evaluation methods were examined in the phased commercialization of autonomous driving.

2) State of traffic rules, etc. (Road Traffic Law, etc.)
To what extent are drivers allowed to do things while autonomous driving? For example, is it permissible to operate a cell phone or gaze at a car navigation screen? (Later, the Road Traffic Law was amended in 2020 to allow drivers to operate their smartphones and in-car navigation systems when driving in Level 3 autonomous driving.)
While keeping a close eye on the trends of the Geneva Convention (a treaty on road traffic) [5], traffic rules and regulations that would realize the practical application of the world's most advanced technologies were discussed. The Geneva Convention presupposes the existence of a driver as follows.
(Article 8.1) Each vehicle or coupled vehicle operating as a single unit shall have a driver.
(Article 10) The driver of a vehicle shall at all times keep the speed of the vehicle under control and shall drive it in a proper and prudent manner.

3) The state of liability relationships (Automobile Accident Compensation Security Act, Civil Law Act, Penal Code, Product Liability Law, etc.)
Criminal and civil liability for accidents that occur during autonomous driving and the state of relief for victims were considered. Appropriate way of assigning responsibility for private vehicles and, in particular, for businesses that utilize autonomous driving vehicles, was discussed.

4) Others
With an eye toward business utilizing autonomous driving, in addition to organizing the relationship with various business laws (e.g., Road Transportation Law), coordination with infrastructure (e.g., sharing of signal information) was discussed.

2.3. Attempts of Public Road Experiments and Mock Trials

The legal amendments to allow autonomous driving vehicles on public roads, as described in 1-2, were successively implemented, and about 30 public road tests of Level 2 and Level 3 autonomous driving vehicles were conducted in various parts of Japan starting in 2019.[6].

5 Convention on Road Traffic (Geneva,1949). https://treaties.un.org/pages/ViewDetailsV.aspx?src=TREATY&mtdsg_no=XI-B-1&chapter=11&Temp=mtdsg5&clang=_en.
6 Ministry of Land, Infrastructure, Transport and Tourism, https://www.mlit.go.jp/jidosha/jidosha_fr7_000046.html.

Then, in April 2022, the Japanese Diet passed a bill to amend the Road Traffic Law to allow level 4 autonomous driving on public roads. The ban on Level 4 autonomous driving vehicles is expected to be lifted by the spring of 2023 at the earliest.
Meanwhile, in anticipation of the social implementation of autonomous driving vehicles, a mock civil trial and mock arbitration simulating traffic accidents related to autonomous driving vehicles was conducted in Japan from 2016 to 2018. Assuming a total of five fictitious cases, each involving autonomous driving vehicles in various stages from Level 2 to Level 5 and a remotely monitored unmanned bus, lawyers, judges, university professors, and engineers were divided into plaintiff and defendant sides and exhausted their arguments and proofs[7]. Some of the results have been fed back into the revision of traffic laws and regulations to accommodate autonomous driving. Mock trial cases are discussed below.

2.4. Challenges of autonomous driving vehicles

The social implementation of autonomous driving vehicles faces the following multiple challenges

1) Improved driving technology for autonomous driving systems
2) Legal and liability issues
3) Social acceptability
4) Cyber security risk

Of the above challenges, this article will focus particularly on 2), the issue of "law and liability," as a challenge common to autonomous driving of spacecraft.
Under the SAE Level 3 standard, the system switches the driver from the system to the driver when a dangerous situation occurs, but there is no guarantee that a driver who is suddenly put in charge of driving will successfully avoid an accident. There is also room for debate regarding legislation on whether the system or the driver is responsible when a dangerous condition occurs. As for the actual distribution of responsibility between the system and the driver in the event of an accident, the decision criteria will probably be formed after multiple cases of accidents have occurred, based on an analysis of the specific facts of each individual case. The legislative fact of multiple traffic accidents is expected to lead to further development of traffic law amendments related to autonomous driving. However, it is desirable to simulate the risk of traffic accidents that can be expected from autonomous driving and to implement measures to prevent

7 Koji Nakayama et al., Automated Driving and Social Change – Law and Insurance, Meiji university's Institute of Autonomous Driving, Shoji Houmu, Tokyo, 2019, pp. 13-32.

damage before it occurs before the victims of traffic accidents are created. The "mock trial and mock arbitration" described in 2.3. is an attempt toward exactly that end.

3. Autonomous driving and legal reform in the U.S., Europe, and China

3.1. U.S.

In the United States, automakers General Motors Corporation (GM) and Ford Motor Company have submitted a petition to the U.S. Department of Transportation requesting an exemption from certain requirements for vehicles equipped with autonomous driving systems (ADS) in July 2022. In the United States, the federal government establishes vehicle safety standards and state governments set road traffic regulations. GM has obtained a license from the California Public Utilities Commission (CPUC) to operate a "Robotaxi" service in the city of San Francisco using Automated Driving System-Equipped Vehicles (AVs) converted from the Battery Electric Vehicle (BEV) "Volt". Google-owned Waymo and other companies are also developing services using existing vehicles. On the other hand, development regarding safety standards for AV vehicles has been slow, with only a partial revision of the Federal Motor Vehicle Safety Standards (FMVSS) for vehicles equipped with autonomous driving systems (ADS) in March 2022.[8]

3.2. Europe

Within the European countries of the UK, Germany, and France, legislation is being developed in Germany and France to enable SAE Level 4 autonomous driving vehicles to be driven on public roads.

In February 2021, the German Federal Government formulated and passed a cabinet decision on a draft law to amend the Road Traffic Law and the Compulsory Insurance Law – Autonomous Driving Law in order to utilize SAE Level 4 on public roads. Subsequently, the bill was passed in July 2021, and immediately after its passage, the Road Traffic Law, and the Compulsory Insurance Law, which added and revised these matters, began to take effect. In addition, a bill related to vehicle licensing as a related subordinate law is under consideration with the aim of promulgation and implementation by the end of FY2022.

In France, the transport law will be amended in June 2021 and will begin to be enforced in September 2022 in order to realize mobility services utilizing autonomous driving systems of Level 3 or higher, including SAE Level 4. At the same time, the Road Traffic Law was also amended to include provisions such as exempting the use of telephones, screen displays, etc. from the prohibition when driving with an autonomous driving system. However, they

8 JETRO, Biznews, 26 July 2022, https://www.jetro.go.jp/biznews/2022/07/530753a765e149ed.html, (accessed Aug. 20,2022).

must be ready to respond immediately when the system requests a replacement.

In the UK, a legal committee examined the legal framework for autonomous driving vehicles using SAE Level 4 systems and the impact of using autonomous driving vehicles as part of the public transport network, and a final report was compiled in February 2022. The UK, Scottish, and Welsh governments will be considering the specifics related to legislation and regulations to implement the results of the study.[9]

3.3. China

China has been revising its traffic regulations to accommodate public road testing of Intelligent Connected Vehicles (ICVs) across the country, beginning with the release of the Autonomous Driving Vehicle Test Road Management Law (Trial) in Beijing in 2019.

In January 2021, the “2021 ICV Law of the Ministry of Industry, the Ministry of Public Security, and the Ministry of Transport” (Intelligent and Connected Vehicle Public Road Test and Model Application Management Code (Trial)) (draft for comments), jointly issued by the Ministry of Industry, the Ministry of Public Security, and the Ministry of Transport, was published.[10]

According to media reports, China is aiming to reduce the burden on the car side by connecting the car with the road through communication and supporting some of the functions of “recognition” and “judgment” that the car currently performs by itself on the roadside with a larger system, in order to ensure the safety of road traffic and lower the cost, rather than the autonomous driving of the car itself.[11]

4. Autonomous driving of spacecraft

How would autonomous driving of spacecraft evolve in space? In fact, unlike ground vehicles, most spacecraft are autopiloted, with only a small portion involving humans. In the book “Space Safety and Human Performance”,[12] one of the authors, Paul C. Schutte wrote as follows:

9 National Police Agency, Report on Research and Study for the Realization of Automated Driving, Tokyo, 2021, pp. 31-38 https://www.npa.go.jp/bureau/traffic/council/2022houkokusyo.pdf, (accessed Aug. 21,2022).

10 Ministry of Economy, Trade, and Industry (Technova Inc.), Civil Liability and Social Acceptability of Automated Driving Social Acceptability of Automated Driving, Tokyo, 2021, pp. 154-155, https://www.meti.go.jp/meti_lib/report/2020FY/040660.pdf, (accessed Aug. 20,2022).

11 Nobuhiko Tanaka, China's Automated Driving is Changing Its Direction From ‘Car Alone’ to ‘Vehicle-Road Cooperation’ Integrated with Roads and Society, 20 July 2022, Wisdom, NEC, https://wisdom.nec.com/ja/series/tanaka/2022072201/index.html, (accessed Aug. 21,2022).

12 Barbara G. Kanki et al., Space Safety and Human Performance first ed., Butterworth-Heinemann, Oxford, 2017, pp. 440-441.

> *"Unlike many other activities that are currently being overtaken by automation, such as driving and flying, humans have never performed space travel completely without automation. In space travel, the concept of a truly "manual mode" is often impossible. Indeed, throughout the history of space travel, there has been a lively and sometimes contentious debate about the existence of a role for humans other than passengers. Humans lack the precision, speed, and computational abilities required for controlling spacecraft and its systems. In addition, humans are known for introducing human error into the system (in the commercial aviation world, a majority of the accidents are attributed to human error (Boeing Commercial Airplanes, 2014))."*

The docking of space station resupply vehicles to the space station, which is one of the limited opportunities for human intervention in spacecraft operations, is also about to become more automated. In that case, how would liability change in the event of a spacecraft collision? Now, let us consider the example of the new HTV-X space station resupply vehicle being developed by JAXA.

4.1. Docking with Robot Arm – Level 2?

The HTV-X docking to the ISS (International Space Station) is planned as follows. After launch, the HTV-X will approach the ISS at a distance of 10 meters from the ISS and maintain its relative position to the ISS while flying at the same speed as the ISS. Then, the ISS crew and the Mission Control crews on Earth will operate the robotic arm installed on the ISS to capture the HTV-X and dock it with the ISS.

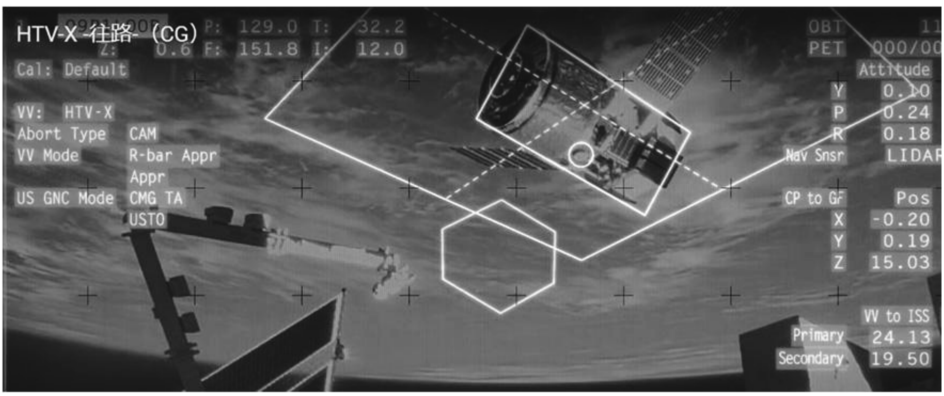

Fig. 1. HTV-X: To the ISS (Computer graphics)[13] *https://humans-in-space.jaxa.jp/htv-x/gallery/*

©JAXA

13 https://humans-in-space.jaxa.jp/en/htv-x/specifications/, (accessed Aug. 20,2022).

Until just before docking, the HTV-X is controlled remotely from the ground and its flight is controlled by three flight computers on board the HTV-X. Therefore, it may be said to be the equivalent of SAE Level 3 for autonomous driving of ground vehicles. However, the author assumes that this is equivalent to SAE Level 2, because human actions intervene from the stage when the ISS crew and ground control personnel operate the robotic arm. This most critical moment is probably the most accident-prone moment. What would be the legal liability if a person mishandles the robotic arm during this docking, resulting in a collision between the HTV and the ISS? Let's try the simulation for the situation by applying the SAE level standard."
In this case, liability for damages among ISS participating countries would be exempted under Article 16 of the "Intergovernmental Agreement on Space Station Cooperation."[14] in a cross-weber manner, except in cases of intentional or gross negligence. If the damaged equipment should fall to the earth or cause damage to third parties in orbit, the damage would be covered by insurance under the Convention on Liability for Damage Caused by Space Activities and the corresponding Japanese domestic law, the "Act on Launching of Spacecraft, etc. and Control of Spacecraft."[15] In such a case, the aforementioned Japanese domestic law does not require product liability (Article 36), so that the insurance company would dispute the percentage of the robot arm operator's negligence in causing the accident and would seek to reduce the amount of compensation. This is because if a Level 2 autonomous driving vehicle causes a traffic accident on the ground, the driver, not the system, is responsible for the operation. On the other hand, the operator of the robotic arm may blame the cause of the accident on communication system failure.

4.2. Automated Docking – Level 4?

In the future, HTV-X aims to dock with the lunar orbiting station Gateway using autonomous driving when resupplying supplies. In other words, it is docking without capturing the robot arm operation by the operator.

14 https://www.mofa.go.jp/mofaj/gaiko/treaty/htmls/B-H13-0101.html, (accessed Aug. 20, 2022).

15 https://www8.cao.go.jp/space/english/activity/documents/space_activity_act.pdf, (accessed Aug. 22,2022).

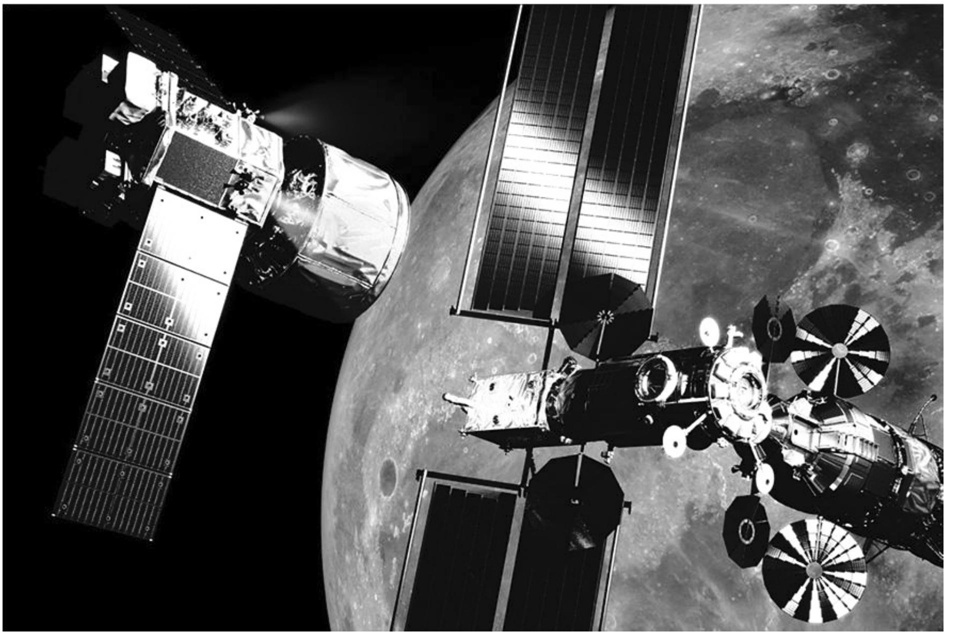

Fig. 2. HTV-X - Automated Docking with Gateway (Imaginary drawing by ©JAXA)[16]

While approaching the Gateway, the HTV-X will use its navigation sensors to measure its relative position and attitude to the target and compensate for misalignment while docking the docking mechanism on the HTV-X side to the international standard docking adapter to be installed on the Gateway side.[17]

To which of the SAE levels does this correspond? Depending on the state of communication between the Mission Control Center on Earth and the HTV-X and Gateway, it may be considered Level 4 or Level 5.

The orbit in which Gateway orbits the Moon will greatly affect the status of communications with the Earth. To prevent Gateway from entering the far side of the Moon and disrupting communications with the ground, the currently planned orbit is called the Near Rectilinear Halo Orbit (NRHO), an extremely long and narrow ellipse that is a special orbit travels around the Moon from north to south at an altitude of about 1,600 km on the north side and 70,000 km on the south side. This NRHO orbit enables constant communication with the earth because the orbital plane is always facing the

16 Norimasa Ito, "The new unmanned spacecraft HTV-X" p12, JAXA, https://fanfun.jaxa.jp/jaxatv/files/20191031_htv-x.pdf, (accessed Aug. 22,2022).

17 https://www.mofa.go.jp/mofaj/gaiko/treaty/htmls/B-H13-0101.html, (accessed Aug. 20, 2022).

earth.[18] If the HTV-X maintains constant communication with Earth, it is conceivable that its maneuvering could be handed over to a human in the event of a critical incident. In that case, it would be equivalent to SAE Level 4. If a collision were to occur during the automatic docking of the HTV-X at Gateway, who would be responsible and how? (Since Gateway is an activity under the IGA, Article 16 of the IGA applies, as does the ISS, and any loss incurred between each participating country is a cross-waiver.).

At SAE Level 4, only the system is responsible for maneuvering. Therefore, unlike the assumed accident case in 3-1, neither the flight crew nor the operator on the ground can be held liable for negligence. Hence, as in the case of 3-1, the most likely scenario is for the insurance company to compensate for the damage through insurance payments and then hold the manufacturer or component manufacturer liable for the product.

4.3. Comparison with a mock trial of an autonomous driving vehicle

In a mock traffic accident trial held in Japan for each SAE level of autonomous driving vehicles [19], the causes of accidents were assumed to be "driving by other cars, motorcycles, or pedestrians that the system did not anticipate (speeding, overstepping lanes, etc.)," "computer system malfunction or hacking," "road subsidence, natural disasters, etc." and so on.

In the case of a Level 4 autonomous driving vehicle, in the setting of a wheel falling into a sinkhole on a designated road where autonomous driving is permitted, the following were enumerated as civil liability entities:

a) The Government's responsibility for the installation and management of roads in the event of road subsidence.
b) Product liability of the complete vehicle manufacturer in the event of sensor malfunction.
c) Product liability of the manufacturer of the sensor in case of malfunction of the sensor.

The mock trial revealed that the preparation and presentation of evidence in court by each entity is time-consuming and protracted, and that companies do not like to have their confidential technical information revealed in an

18 NASA, A Lunar Orbit That's Just Right for the International Gateway – A unique halo orbit is the road less travelled around the Moon., May 16, 2022, https://www.nasa.gov/feature/a-lunar-orbit-that-s-just-right-for-the-international-gateway, (accessed Aug. 22,2022).

19 Strategic Conference for the Advancement of Utilizing Public and Private Sector Data, Strategic Headquarters for the Advanced Information and Telecommunications Network Society, "Public-Private ITS Initiative/Roadmaps 2017 – Toward implementation of various highly automated driving systems in society –", https://japan.kantei.go.jp/policy/it/itsinitiative_roadmap2017.pdf.

open courtroom. The Mock Trial Court found that a mock arbitration procedure was preferable to civil litigation for the early resolution of disputes and proposed a new alternative dispute resolution (ADR) scheme, such as an arbitration consortium.
I have hypothesized what the equivalent of a), b) and c) on the ground car accident would be in the case of a traffic accident in outer space as follows.

a) Negligence of the tracking and control operator, i.e., the spacecraft control operator under the Act on Launching of Spacecraft, etc. and Control of Spacecraft (Act No. 76 of 2016) [20], as the person responsible for managing space navigation.
b) Product liability of the manufacturer of the spacecraft.
c) Product liability of the manufacturer of the components of the spacecraft.

What if the manufacturer of a spacecraft, a component manufacturer, or a system manufacturer is held liable in the event of an accident in space? Japan's Product Liability Law provides that manufacturers are exempted from liability under certain conditions (Article 4, Item 1 of the law).[21]
"The fact that the manufacturer, etc. could not have been aware of the existence of the defect in the product at the time of delivery of the product depending on the knowledge of science or technology at the time the article was delivered by the manufacturer, etc."
A similar provision can be found in Article 7 of the EC Directive.[22]

5. Discussion

There would be far greater and unknown risks involved in flying in space than would be expected on the roads on the ground. If an accident occurs due to such an unknown risk, there may be many cases in which the manufacturer is exempted from liability under the Product Liability Law, as it is beyond "foreseeability" based on the manufacturer's knowledge of science or technology. Or, most likely, the manufacturer will withdraw from spacecraft production, fearing liability.
Would there be any insurance company that would underwrite the spacecraft control operator's risk for an accident?

20 https://www8.cao.go.jp/space/english/activity/documents/space_activity_act.pdf, (accessed Aug. 22,2022).
21 https://www.japaneselawtranslation.go.jp/ja/laws/view/3590, (accessed Aug. 22, 2022).
22 COUNCIL DIRECTIVE of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective product [85/374/EEC].

6. Conclusion

Space exploration and development have traditionally been carried out by the space agencies of national governments, but private capital is already increasingly entering the space business, including low orbit space. The likelihood of spacecraft accidents will increase accordingly. Leaving the resolution of legal disputes exclusively to litigation in the event of a spacecraft accident is undesirable, both in terms of litigation costs and in terms of expedited hearings. As a conclusion of the mock trial for a traffic accident involving an autonomous driving vehicle, Japanese legal experts recommended that the dispute be resolved through expeditious hearings and flexible procedures by ADR, and such a resolution method would be desirable in the case of spacecraft accidents. This is because in the event of a spacecraft accident, the plaintiff and defendant are likely not in the same forum, and a dispute from jurisdiction and governing law would be expected to take years to resolve.

In addition, spacecraft accidents in space are expected to cause far more damage than traffic accidents involving ground vehicles. However, in the event of such an accident, the spacecraft control operator, the spacecraft manufacturer, and the insurance company as mentioned in 3-3 would be required to share the risk in the event of an accident (since it would be difficult to identify the hacker and hold him liable in the case of an accident involving cybersecurity). It is not considered reasonable. If no insurance company underwrites insurance due to concerns about the magnitude of the risk, it would be exceedingly difficult for startups to enter the space business. Since space development and exploration activities involve far greater risks than activities on the ground, society needs to accept that there is a limit to the amounts of damages that can be compensated by insurance in the event of an accident. We need to design an innovative platform to share the risks of space exploration by everyone, in which each entity bears the small burden.

In order to examine the risk of possible accidents and to create a platform for quick resolution of disputes should they arise, it may be beneficial to attempt a mock trial of a traffic accident in space. The IAC has implemented mock trial programs for students in the past, but this new trial, in which legal professionals and jurists from different countries will run a mock trial simulating a spacecraft accident and feed the results back to their respective countries for law reform, will be worth a try. After all, simulation is something that should be performed in order to prevent accidents from occurring and, if an accident should occur, to minimize the damage.

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