Autonomous Driving Era and Its Transport Systems: Human, AI, Transportation and Society

2005C FY2020 Research Overview Report

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		Kera Naoyuki	Deputy Director, National Police Agency Traffic Bureau Traffic Planning Division Autonomous Driving Planning Office

1. Overview of FY2020 Research Activities

FY2020 was the final year for completion of our research. Based on the results from the past two years, we continued our research from various points of view:

One of these was the prediction of changes in transport systems along with the use of autonomous driving technology. The Road Traffic Act was revised to allow Level 3 automated vehicles on public roads, and this requires consideration of the acceptance of Level 4 automated vehicles due to the fact that Level 3 is a combination of Level 4 before takeover (TO) and Level 2 or lower after TO.

Then, it is necessary to examine issues regarding Level 4 automated vehicles. Before TO, passengers (P) do not control the vehicle; therefore, it is necessary to examine whether a remote controller (RC, a person or an organization) outside the vehicle can be classified as a driver (D), and whether certification of such a driver is possible under the current legal system. It is necessary to identify problems in the interpretation of the current Road Traffic Act when considering RC, not P, as D taking account of the purposes of Geneva Convention on Road Traffic, which is the foundation of the Road Traffic Act.

Next, it is desirable to suggest revisions to the Road Traffic Act, if necessary, from the viewpoint of clarification even if D with regard to Level 4 implementation is not problematic within the interpretation of the current Road Traffic Act. In such case, it is necessary to develop measures to address the ethical dilemma of the “trolley problem” (hereinafter the “Dilemma”) regarding vehicles that are operated at Level 4, but which are certified for Level 3.

2. Confirmation of the Current State and Identification of Issues in Japan

2-1. Issues related to Levels 3 and 4

We confirmed issues related to Level 3 from the viewpoints described in 1 above.

First of all, although Level 3 was allowed in Japan under certain conditions, basic issues have not yet been discussed.

Although a repetition of what we explained in 1 above, the issue is the legalization of Level 3 without examining the

requirements to legalize Level 4 based on the fact that the Level 3 is a combination of Level 4 (before TO) and Level 2 or lower (after TO).

2-2. Methods of Examining the Issue

Clarifying the issue presents a challenge. However, we decided to examine overseas studies containing discussions on Levels 3 and 4 to share awareness and promote understanding of the issue with participating specialists at an international symposium held in February 2021.

3. Examinations based on the Domestic State – Approaches by the Hokkaido Government Office

Second, since we are aware of the need to check Level 3 demand in Japan before the international symposium (we checked in the previous year), we discussed approaches to implementing autonomous driving on public roads due to the needs of individual areas. Along with discussion, we also examined approaches made by the Hokkaido Government Office, one of the local governments that is actively discussing the comprehensive implementation of self-driving vehicles.

Hokkaido satisfies the basic requirements for the experiments related to the implementation of self-driving vehicles on public roads for the following reasons:

1) Hokkaido covers a large area;
2) Hokkaido has many both overseas and domestic inbound tourists, which increases the demand for rental cars;
3) Because a considerable number of people visit Hokkaido in winter too, Hokkaido has higher Level 3 demand to support and ensure safe driving on snowy roads; and
4) Areas of Hokkaido with lower population density have higher numbers of farmers, and Level 3 demand among this demographic is high as a result of the need to maintain sufficient work efficiency on snowy roads.

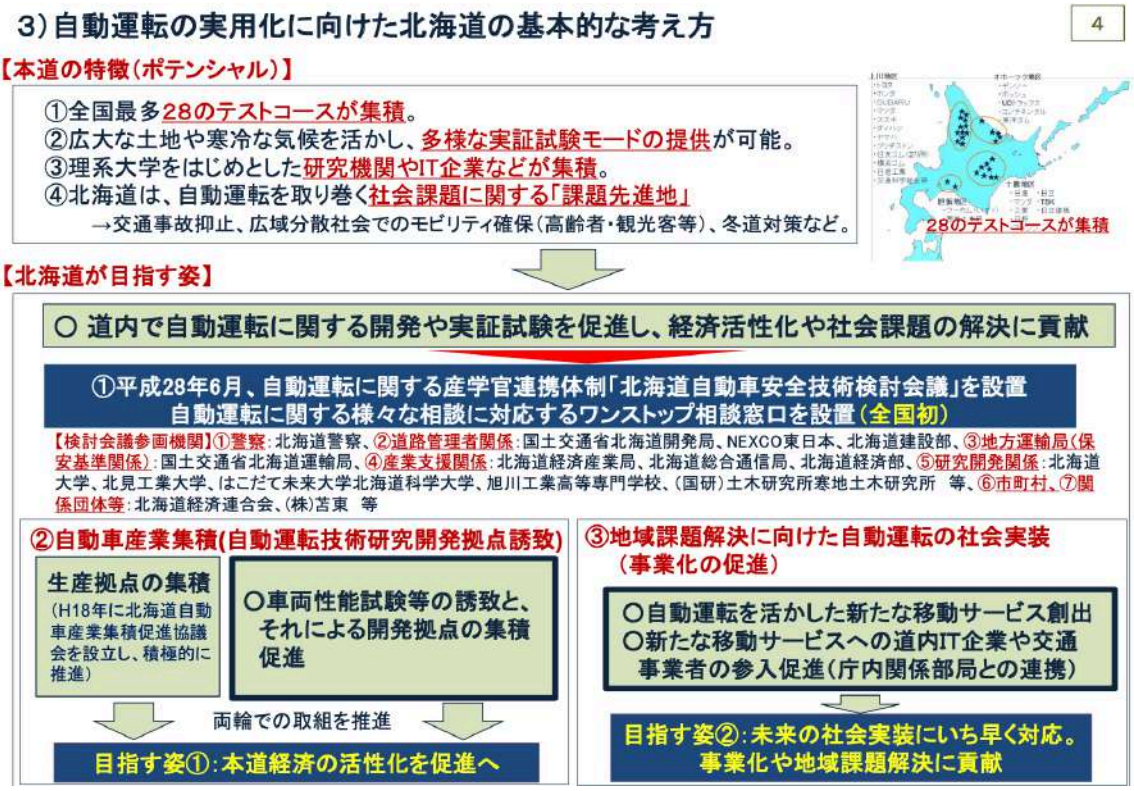
The Hokkaido Government Office has also considered a wide range of measures (drafts), listened to the opinions of specialists, and has repeated social experiments in a step-by-step manner.

We have been paying attention to this approach since last year, and we think it is valuable to continue monitoring progress because although the main means of long-distance transportation in Hokkaido, especially in winter, has been rail, railway lines have been decreasing. For this reason, it is easier to measure the tendency toward dependence on automobiles for transportation.

The viewpoints to be examined through a wide range of measures are described below.

i) Difference in need for automobile use between a large city (Sapporo) and suburbs (focusing on the age composition of residents, assets, rate of automobile ownership, need go out, etc.);
ii) Influence of severe climate conditions (possibility of safe operation of self-driving under snowy conditions); and
iii) Tourist demand for transportation, both inside and outside Hokkaido, (including transport to and from airports and train stations, Niseko and other tourist destinations, changes in awareness about traffic manners by tourists from Japan and overseas, etc.)

We checked measures taken by the Hokkaido Government Office from these viewpoints, and continued opinion exchanges. Some measures taken by Hokkaido Government Office are described in the following charts, which were provided by the Hokkaido Government Office.



A summary of the approaches is given below.

1) It is laudable that the Hokkaido Government Office attempts to identify different needs in different areas throughout its jurisdiction;

2) Establishing a viewpoint capable of unifying such needs may allow us to promptly respond to issues common to all areas and initiate long-term measures for unique issues in specific areas;

3) A unified viewpoint will be established by showing the limits of the use of Level 3 (before TO). The use of Level 3 (before TO) is convenient; however, it is difficult for all areas and residents to safely enjoy the convenience of Level 3 unless until we uniformly show when and under what conditions risk prevention by TO is possible; and

4) Level 3 (before TO) equals Level 4. Therefore, it is necessary for the Hokkaido Government Office to discuss issues related to Level 4. However, these approaches are associated with ordinances in the Road Traffic Act, which is under the control of National Police Agency, rather than the Hokkaido Government Office. It is necessary to indicate measures to identify drivers at Level 4 and responses to critical situations, including the Dilemma, which occurs when P is not recognized as D by the National Government, which is essential to preventing successive problems nationwide.

4. Issues Particular to Level 4 – Confirmation of D and P and the Relationship with Current Laws

4-1. Issues

We considered viewpoints to address issues particular to Level 4 at the national level.

Recent revision of the Road Traffic Act permitted autonomous driving at Level 3 under certain conditions. Theoretically, it requires approval for Level 4 before TO, which, however, has not been discussed at length or recognized; and important issues have been left unresolved. The basic issue is the definition of D when vehicles are operating autonomously before TO.

4-2. Concept of D – Discussion Considering International Viewpoints

"D" is not defined by the Japanese Road Traffic Act. Therefore, we need a commonly accepted concept of "D," which we consider to be "an individual who sits in the driver's seat of a vehicle and is capable of controlling vehicle behavior safely by driving by himself/herself."

According to this common understanding, an individual outside an autonomously-operating vehicle (a person, an organization, etc.), which we defined above as a remote controller "RC," is not considered a driver. Meanwhile, the RC controlling the vehicle operating autonomously at Level 3 from outside the vehicle may have the responsibility to report accidents involving the vehicle to the police and to render assistance to any injured party. Only D is subject to these requirements at present. Defining RC as D will increase consistency with existing road traffic act-related systems (which impose the legal obligation to report accidents and render assistance to injured individuals with legal punishment of D in the event of violation).

The conceptualization of D will become increasingly necessary; however, as mentioned above, it is a challenge to conceptualize D in terms of practical content according to the interpretation of the Road Traffic Act because it does not contain the definition.

For these reasons we argue the necessity of referring to international discussions regarding Article 8 of the Geneva Convention on Road Traffic, which is the foundation of the Road Traffic Act.

The results of the discussions are shown in the opinions[1]of specialists participated in the international symposium.

4-3. Approaches to the Dilemma

4-3-1. Organizing the Understanding of Premises

It is essential for Level 4 to confirm D and discuss legal responsibility for D and others when vehicles operating autonomously encounter the Dilemma.

Promoting awareness of the advantages of autonomous-driving technology is not sufficient to ensure the social acceptance of autonomously-operating vehicles, and it lacks fairness in cultivating public awareness. Public awareness should develop in a fair manner through the assurance of social acceptance after the public fully understands the disadvantages of autonomous-driving technology, especially the balance of risk and damage in the Dilemma.

Responses to the Dilemma should start identifying deviation of public awareness and indicating conclusions in a wide range of scenarios.

4-3-2. Participation in the Asian Transportation Research Society (ATRANS)

With awareness of the issues mentioned above, we participated in the 13th ATRANS Annual Conference held on December 4, 2020, explained autonomous driving in Japan, and exchanged opinions with other participants.

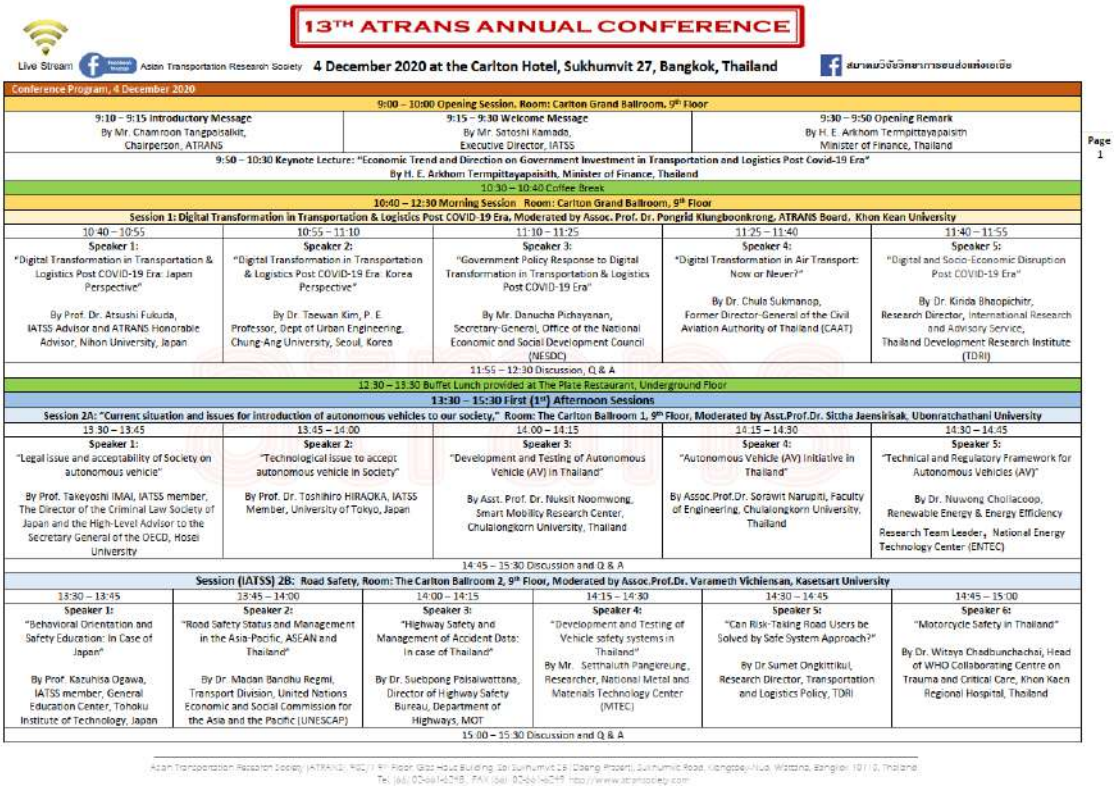
Specifically, Professor Hiraoka reported issues to be solved to increase social acceptance implementing autonomous-driving technology into society.

Professor Imai reported the background of the revision to the Japanese Road Traffic Act and the revised contents along with issues to be addressed for the legalization of Level 4.

ATRANS showed its desire for continual opinion exchange. Specifically, ATRANS is greatly interested in comparisons between Japanese and Thai legal systems (civil law including compensation for damage, insurance, etc.), and it is expected to have opinion exchanges by working groups regarding system design among specialists in consumer law (Professor Osawa)

[1] Cf.Lebreton Caroline ,IATSS 2021.2.25 Symposium english transcription_translation.

and specialists in criminal law in Japan.



13TH ATRANS ANNUAL CONFERENCE

Live Stream Asian Transportation Research Society 4 December 2020 at the Carlton Hotel, Sukhumvit 27, Bangkok, Thailand

Conference Program, 4 December 2020

9:00 – 10:00 Opening Session. Room: Carlton Grand Ballroom, 9th Floor

9:10 – 9:15 Introductory Message	9:15 – 9:30 Welcome Message	9:30 – 9:50 Opening Remark
By Mr. Chamroon Tangpaisalkit, Chairperson, ATRANS	By Mr. Satoshi Kamada, Executive Director, IATSS	By H. E. Arkhom Termpittayapaisith Minister of Finance, Thailand

9:50 – 10:30 Keynote Lecture: "Economic Trend and Direction on Government Investment in Transportation and Logistics Post Covid-19 Era"
By H. E. Arkhom Termpittayapaisith, Minister of Finance, Thailand

10:30 – 10:40 Coffee Break

10:40 – 12:30 Morning Session Room: Carlton Grand Ballroom, 9th Floor

Session 1: Digital Transformation in Transportation & Logistics Post COVID-19 Era, Moderated by Assoc. Prof. Dr. Pongrid Klungboonkrong, ATRANS Board, Khon Kaen University

10:40 – 10:55	10:55 – 11:10	11:10 – 11:25	11:25 – 11:40	11:40 – 11:55
Speaker 1: "Digital Transformation in Transportation & Logistics Post COVID-19 Era: Japan Perspective" By Prof. Dr. Atsushi Fukuda, IATSS Advisor and ATRANS Honorable Advisor, Nihon University, Japan	**Speaker 2:** "Digital Transformation in Transportation & Logistics Post COVID-19 Era: Korea Perspective" By Dr. Taewan Kim, P. E. Professor, Dept of Urban Engineering, Chung-Ang University, Seoul, Korea	**Speaker 3:** "Government Policy Response to Digital Transformation in Transportation & Logistics Post COVID-19 Era" By Mr. Danucha Pichayanan, Secretary-General, Office of the National Economic and Social Development Council (NESDC)	**Speaker 4:** "Digital Transformation in Air Transport: Now or Never?" By Dr. Chula Sukmanop, Former Director-General of the Civil Aviation Authority of Thailand (CAAT)	**Speaker 5:** "Digital and Socio-Economic Disruption Post COVID-19 Era" By Dr. Kinda Bhaopichitr, Research Director, International Research and Advisory Service, Thailand Development Research Institute (TDRI)

11:55 – 12:30 Discussion, Q & A

12:30 – 13:30 Buffet Lunch provided at The Plate Restaurant, Underground Floor

13:30 – 15:30 First (1st) Afternoon Sessions

Session 2A: "Current situation and issues for introduction of autonomous vehicles to our society," Room: The Carlton Ballroom 1, 9th Floor, Moderated by Asst.Prof.Dr. Sittha Jaensirisak, Ubonratchathani University

13:30 – 13:45	13:45 – 14:00	14:00 – 14:15	14:15 – 14:30	14:30 – 14:45
Speaker 1: "Legal issue and acceptability of Society on autonomous vehicle" By Prof. Takeyoshi IMAI, IATSS member, The Director of the Criminal Law Society of Japan and the High-Level Advisor to the Secretary General of the OECD, Hosei University	**Speaker 2:** "Technological issue to accept autonomous vehicle in Society" By Prof. Dr. Toshihiro HIRAOKA, IATSS Member, University of Tokyo, Japan	**Speaker 3:** "Development and Testing of Autonomous Vehicle (AV) in Thailand" By Asst. Prof. Dr. Nuksit Noomwong, Smart Mobility Research Center, Chulalongkorn University, Thailand	**Speaker 4:** "Autonomous Vehicle (AV) Initiative in Thailand" By Assoc.Prof.Dr. Sorawit Narupiti, Faculty of Engineering, Chulalongkorn University, Thailand	**Speaker 5:** "Technical and Regulatory Framework for Autonomous Vehicles (AV)" By Dr. Nuwong Chollacoop, Renewable Energy & Energy Efficiency Research Team Leader, National Energy Technology Center (ENTEC)

14:45 – 15:30 Discussion and Q & A

Session (IATSS) 2B: Road Safety, Room: The Carlton Ballroom 2, 9th Floor, Moderated by Assoc.Prof.Dr. Varameth Vichiensan, Kasetsart University

13:30 – 13:45	13:45 – 14:00	14:00 – 14:15	14:15 – 14:30	14:30 – 14:45	14:45 – 15:00
Speaker 1: "Behavioral Orientation and Safety Education: In Case of Japan" By Prof. Kazuhisa Ogawa, IATSS member, General Education Center, Tohoku Institute of Technology, Japan	**Speaker 2:** "Road Safety Status and Management in the Asia-Pacific, ASEAN and Thailand" By Dr. Madan Bandhu Regmi, Transport Division, United Nations Economic and Social Commission for the Asia and the Pacific (UNESCAP)	**Speaker 3:** "Highway Safety and Management of Accident Data: In case of Thailand" By Dr. Suebpong Polsalwattana, Director of Highway Safety Bureau, Department of Highways, MOT	**Speaker 4:** "Development and Testing of Vehicle safety systems in Thailand" By Mr. Setthaluth Pangkreung, Researcher, National Metal and Materials Technology Center (MTEC)	**Speaker 5:** "Can Risk-Taking Road Users be Solved by Safe System Approach?" By Dr.Sumet Ongkittikul, Research Director, Transportation and Logistics Policy, TDRI	**Speaker 6:** "Motorcycle Safety in Thailand" By Dr. Witaya Chadbunchachai, Head of WHO Collaborating Centre on Trauma and Critical Care, Khon Kaen Regional Hospital, Thailand

15:00 – 15:30 Discussion and Q & A

Page 1

Asian Transportation Research Society (ATRANS), 9th Floor, Gitpi House Building, 591 Sukhumvit 26 (Klang Project), Sukhumvit Road, Klongtoey-Nua, Wattana, Bangkok 10110, Thailand
Tel. (66) 0-2661-6248, FAX (66) 0-2661-6249, http://www.atransociety.com

4-3-3. International Symposium (held in February 2021)

Specific scenarios regarding the Dilemma were highlighted at the international symposium. Based on background (nationality, specialized legal fields, philosophical and cultural background), they provided a wide range of proposals.

Please check the attachments[2] for more details on the proposals. The basic content of the program and scenario is as shown below:

[2] Cf.Lebreton Caroline ,IATSS 2021.2.25 Symposium english transcription_translation.

IATSS 2005C Project

自動運転の時代と交通体系を国際的視点から考える
(人間、AI、交通社会のあり方を巡る、英国、ドイツ フランス、日本での取り組み)

主催:公益財団法人 国際交通安全学会

■日時：2021年2月25日（木）
18:00～21:00

■形態：Zoom

講演者・パネリスト紹介

Ms. Jessica Uguccioni　講演者①
Automated Vehicles Review - Lead Lawyer, at Law Commission of England and Wales

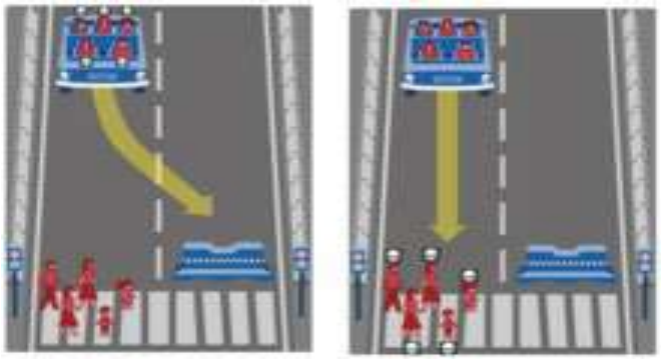
Dr. Mirja Feldmann　講演者②
Regional Court Judge seconded to the Federal Public Prosecutor's Office, lecturer at a University in Germany

Dr. Eric Andreas Hilgendorf　講演者③
German professor of law and legal philosopher. Dean of Würzburg Law Faculty

Prof. Jean-Christophe Roda　講演者④
French professor of private law. Director of the master of Commercial Law at Lyon 3 University. Specialized in international commercial law, contract law and competition law.

Prof. Takeyoshi Imai
Professor of criminal law at the Law School of Hosei University
Committee of the criminal law devision of the Legislative Council of the Ministry of Justice of Japan
Vice Chair of the Bid Oversight Committee of the Cabinet Office and the Cabinet Secretariat of Japan
High Level Advisor to the Secretary General of the OECD
Project leader of the Research Group on autonomous vehicle in the IATTS(researh number 2005C)

Prof.Aya Osawa,Lecturer Ms. Caroline Lebreton, Hosei University,Interpretaros and commentators



https://en.wikipedia.org/wiki/Moral_Machine

（Setting Scenarios）

An autonomous-driving vehicle at Level 4. The five Ps in the vehicle have no rights or obligations with regard to control of the vehicle.

Left Chart: The vehicle tried to avoid the five pedestrians (three adults and two children), and crashed into an obstacle, resulting in the deaths of the five Ps.

Right Chart: The vehicle attempted to protect the five Ps in the vehicle and hit the five pedestrians, resulting in the deaths of two adults and one child.

Is it possible to accuse the manufacturer of the vehicle with the autonomous-driving system or the employees who produced the autonomous-driving system of homicide or professional negligence?

	Left Chart	Right Chart
Areas controlled by common law (UK, etc.)	Failed. Five persons = Five persons	Failed. Five persons > Three persons
Areas controlled by civil law (Germany)	Failed. Cannot legally punish a corporation.	Approved. Prohibition against comparing the number of lives/ Deontology/ Kantianism
Areas controlled by civil law (France)	Failed? Can legally punish a corporation.	Approved? Similar to the case in Germany? A different result in a mock court?
Japan (Hybrid?)	Failed. Punishing a corporation depends on the establishment of new laws.	Failed? Provisions of Article 37 of the Panel Code

Through the exchange of opinion among speakers and the audience, the following points were shared.

1) P in the vehicle operated at Level 4 is not D. In order to appropriately identify D, it is necessary to reconsider the concept of D.

In regard to this point, it will be helpful to continue exchanging opinions with the Law Commission. The Commission is also strongly interested in the revision of Japanese laws.

2) The revised StVO (Road Traffic Law of Germany) in 2017 contained some confusion in the classification of Level 3 and 4. However, the recent revision has alleviated the confusion.

This shows that although people in Germany were not very interested in organizing a new concept of D, along the process of accepting Level 4, they have become aware of the need to reconsider the concept of D. Similar to Japan, Germany has been developing a foundation for discussions.

3) There are some differences in responses to the Dilemma among areas depending on their laws.

In other words, Germany and France tend to apply a deontological approach while the United Kingdom tends to apply behavioral and utilitarian approaches. Japan seems to apply a combination of these.

As a result, regardless of conclusions regarding the Dilemma, the discussions clarified the importance of solving the basic issues as described below:

i) Reorganize the concept of D suitable for the implementation of Level 4 considering revisions of treaties (such as the Geneva Convention on Road Traffic for Japan and the Vienna Convention on Road Traffic for Germany) on which each country's established laws regarding road traffic;

ii) Confirm rights and obligations suitable for D at Level 4; and

iii) Determine the balance of risk and damage, and define individuals involved in accidents (whether limited to those who are involved in the relevant accident), with an awareness of the limits of Level 4 technology, in regard to the emergency response necessary to resolve the Dilemma.

5. Public Awareness Survey

We held discussions at international symposiums, etc. considering public awareness of Level 4. It is also essential to understand public awareness more broadly, and seek methods of increasing social acceptance for autonomous-driving vehicles.

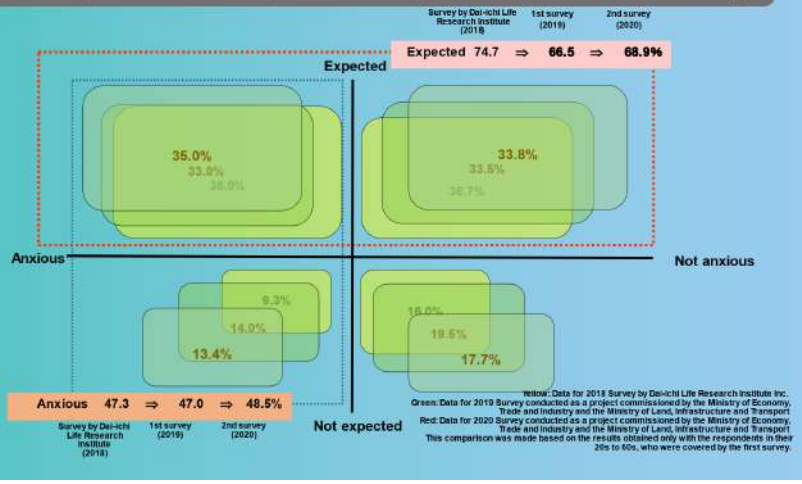
IATSS members held discussions in regard to this matter based on materials from the 2nd Questionnaire Survey on Automobiles and Autonomous Driving (FY2020 Commissioned Project by the Ministry of Economy, Trade and Industry and Ministry of Land, Infrastructure, Transport and Tourism) provide by Yukiko Miyaki[3].[3]

Some of the materials and analyses are shown below.

3: We would like to express our deep appreciation to Yukiko Miyaki for providing extremely important materials and analyses, which contributed to the promotion of our study.

Expectations and anxiety for social changes brought about through the development and spread of autonomous driving

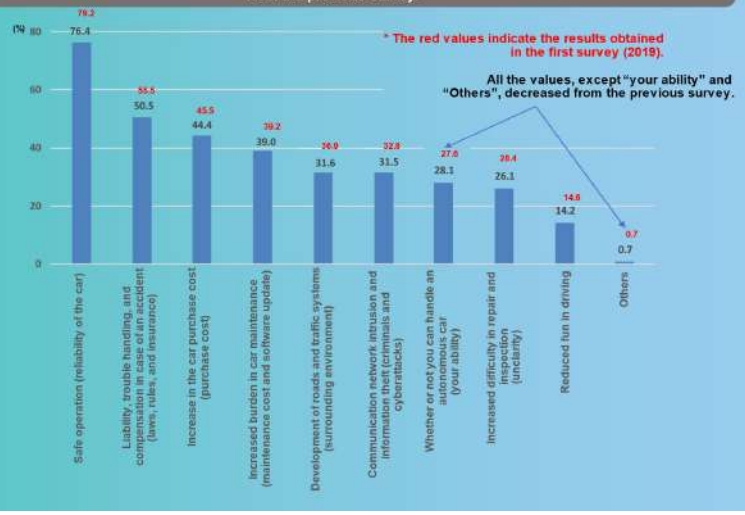
About 70% of the respondents have expectations and nearly half of the respondents have anxiety for autonomous driving.
17.7% of the respondents have neither expectations or anxiety, or are not interested in autonomous driving.

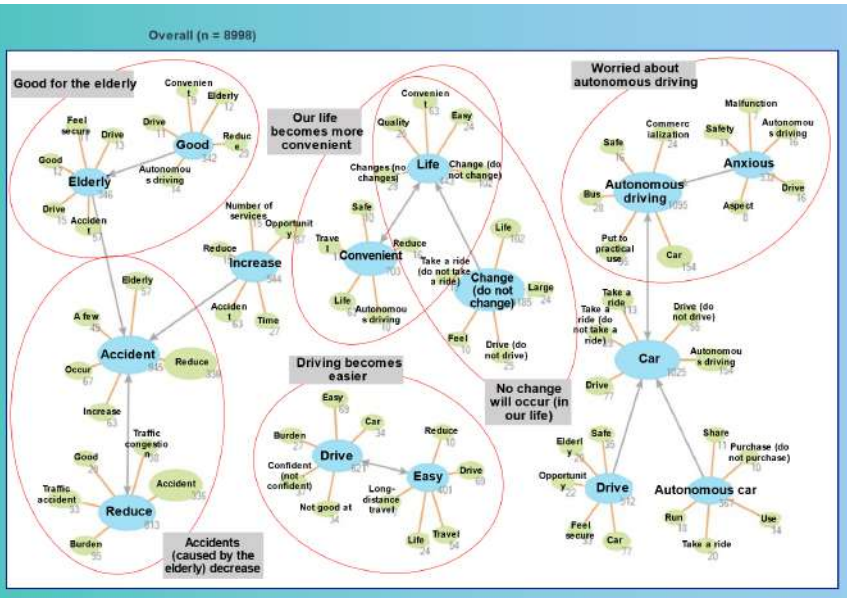


Yellow: Data for 2018 Survey by Dai-ichi Life Research Institute Inc.
Green: Data for 2019 Survey conducted as a project commissioned by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure and Transport
Red: Data for 2020 Survey conducted as a project commissioned by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure and Transport
This comparison was made based on the results obtained only with the respondents in their 20s to 60s, who were covered by the first survey.

Specific concerns about autonomous driving

The largest number of respondents answered "Safe operation" as a concern about autonomous driving, which remains unchanged from the previous survey.
"Safety operation" is followed by "Liability" and then "Cost burden," which also remain unchanged from the previous survey.





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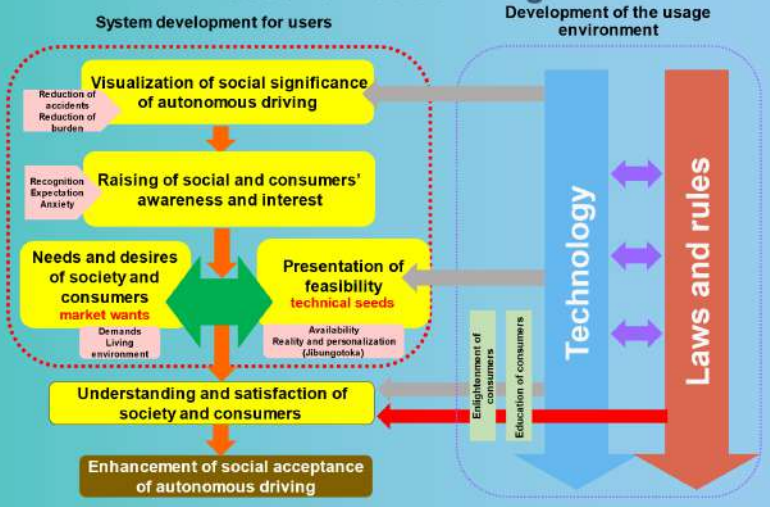
System for enhancing social acceptance of autonomous driving



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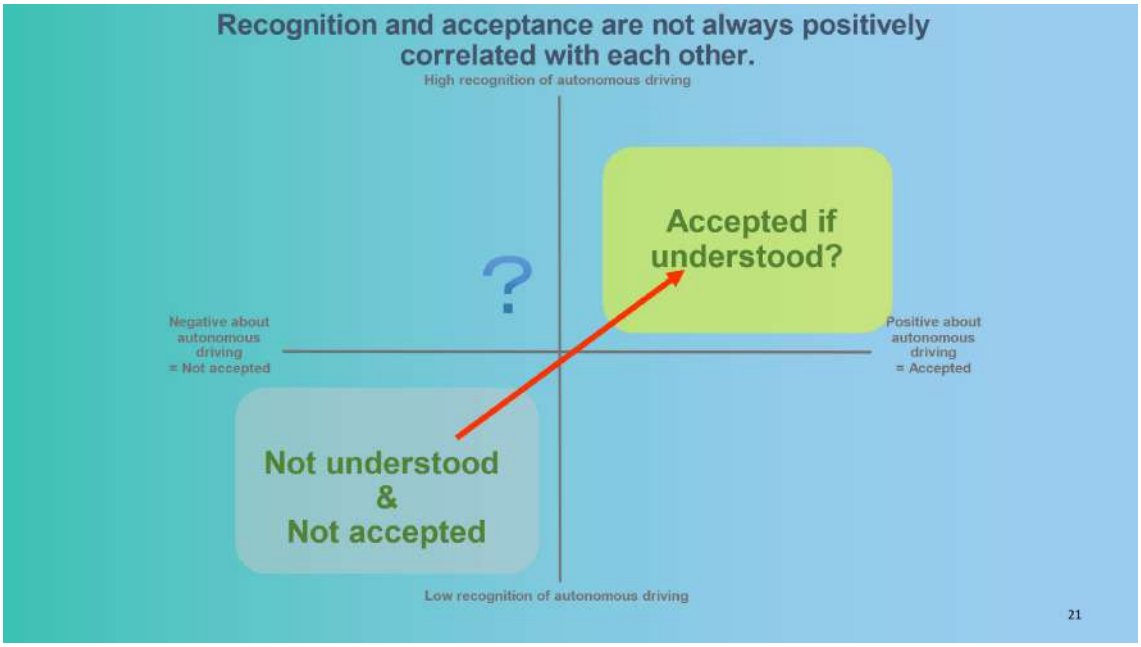

6. Study Achievements and Issues

6-1. Achievements

The achievements of this study are as described below:

1) Understanding of Level 3

Level 3 does not require P (passenger) to monitor the surrounding area before TO. After TO, P is deemed D. In this meaning, P is potentially D, but does not always have responsibility as D. In other words, P in a vehicle at Level 3 is equivalent to a User in Charge or Fall-Back-Ready User. However, according to the Road Traffic Act of Japan, D is always required to monitor the surrounding area. Strictly speaking, O in a vehicle operated at Level 3 does not fall under the category of D as specified by the Road Traffic Act. Based on this point, it is necessary to continue discussing the revision of the Road Traffic Act.

2) Understanding of Level 4

In a vehicle operated at Level 4, D is the automated driving system entity (ADSE), specifically, individuals or organizations that control vehicle behaviors from outside the vehicle. (This does not mean that P in a vehicle operated at Level 4 is deemed D.) However, it is impossible to consider such individuals and organizations as D under the current Road Traffic Act. It is necessary to consider revision of the Road Traffic Act. In this sense, in order to identify D, it is necessary to establish a new licensing system.

D will be obligated to report accidents to the police when they occur. Because assistance to injured parties must be rendered promptly, there are some cases in which it is inappropriate to place D under this obligation. (RC is deemed D; however, it may not always be possible for RC to rush to the accident site and render assistance to the injured.) Therefore, it is also necessary to discuss the placement of a third person under the relevant obligation. (For example, the third person can be an individual assigned by D to the road on which a vehicle is operated at Level 4.)

3) Revision of Transport Systems

Both 1) and 2) above suggest that revision of the Road Traffic Act is another issue that requires urgent action. We need to

accurately understand changes in the interpretation of Article 8 of the Geneva Convention on Road Traffic (also considering the revision of the Vienna Convention of Road Traffic) before discussing the issue. Based on the idea that D can be any individual or organization outside a vehicle as long as D is able to safely operate an autonomously-operating vehicle, it is necessary to establish an appropriate concept of D associated with the autonomously-operating vehicle.

4) Responses to the Dilemma

Through international symposiums, etc., we recognized the thinking that because the potential for the Dilemma may be low, the issue may be ignored. However, we believe that this issue cannot be ignored and must, therefore, be discussed.

In order for autonomous-driving system developers and automobile manufacturers to develop and sell autonomous vehicles that are practical for use by the general public, it is essential to have detailed emergency responses installed in the vehicles, including the option for vehicle operation with regard to the Dilemma to obtain social approval. In other words, if we cannot show a certain solution, it is impossible to establish legal safeguards to ensure social acceptance of autonomous vehicles. Based on the major premise, which is that autonomous vehicles are allowed to operate as long as their operation is under control, it is necessary to continue discussing responses to the Dilemma.

6-2. Future Vision

Through this study, we recognized basic viewpoints regarding traffic systems in the autonomous driving era. In order to promote social implementation of autonomous vehicles, we must reduce the rate of accidents caused by autonomous driving systems to that of current (traditional) vehicles or lower, and clarify the entity that has legal responsibility when accidents occur as well as the content of that responsibility.

The remaining issues that we clarified are described below:

1. Further refinement of the concept of D (driver); and
2. International agreement regarding the best behaviors of vehicles in a Dilemma, and reflection to domestic laws.

In order to address these two issues, we must continue deepening our understanding of laws and conditions regarding autonomous driving systems and vehicles through symposiums, etc. with concerned parties both at home and abroad.