PROCEEDINGS

2nd Roundtable for the Purpose of Autonomous Driving (ROAD 2017)

June 8-9, 2017

Koshoji-Temple, Nagoya, JAPAN

Event Outline:

Event Name:	2nd Roundtable for the Purpose of Autonomous Driving (ROAD 2017)
Date:	June 8 (Thursday) - June 9 (Friday), 2017
Venue:	Yagotoyama Koshoji-Temple (78 Yagotohonmachi, Showa, Nagoya, Aichi, JAPAN)
Organized by:	ROAD 2017 Organizing Committee Green Mobility Research Institute (GREMO), Institutes of Innovation of Future Society, Nagoya University
Co-organized by:	University of Applied Sciences Kempten Center for Automotive Research, Nihon University (NU-CAR) Automotive Technology Center, Kanagawa Institute of Technology FOURIN, Inc.
In Association with:	The Society of Automotive Engineers of Japan
Supported by:	DAIKO FOUNDATION THE KAJIMA FOUNDATION The Murata Science Foundation SBS Kamata Foundation
Number of Participants:	70 researchers and experts from universities, industry and government in the fields of autonomous driving and advanced driver assistance systems, from 5 countries/areas (Japan, Germany, The Netherlands, U.S.A. and Taiwan)
Participation Fee:	Free
Language:	English
Event website:	http://www.fourin.com/english/road/

Keynotes:

Session Chair: Stefan Schneider, *University of Applied Sciences Kempten*

1. Megacity Mobility (as the purpose of Autonomous Driving)

   Tsuguo Nobe

   Director, Business Development and Government Policy, Intel Corp.

   Visiting Associate Professor, Nagoya University

2. Rural Area Mobility (as the purpose of Autonomous Driving)

   Pongsathorn Raksincharoensak

   Associate Professor, Department of Mechanical Systems Engineering,

   Tokyo University of Agriculture and Technology

3. Future Mobility for Seniors and People with Disabilities

   Yasuyuki Izu

   Chief Engineer, Marketing/New Product Planning & Technology Development,

   Sekisui S-Lec B.V.

4. Does Autonomous Driving make society happy?

   Yoshimi Furukawa

   Professor, Graduated School of Engineering and Science,

   Shibaura Institute of Technology

5. Shaping the future of mobility - together

   Bert Wolfram

   President and Chief Executive Officer,

   Continental Automotive Corporation

Workshops:

✧ Megacity Mobility (as the Purpose of Autonomous Driving)

Moderators: Hirofumi Aoki, *Nagoya University*
Jürgen Stübner, *University of Applied Sciences Kempten*

✧ Rural Area Mobility (as the Purpose of Autonomous Driving)

Moderators: Masashi Yanai, *Sekisui S-Lec B.V.*
Gerhard Steininger, *GFFT e.V.*

✧ Future Mobility for Seniors and People with Disabilities

Moderators: Kuniko Urashima,
National Institute of Science and Technology Policy
Yoann Pencreach, *FORUM8*

✧ Social Acceptance of Autonomous Driving

Moderators: Ichiro Kageyama, *Nihon University*
Bela Peterson, *University of Applied Sciences Kempten*

✧ Roadmap of Societal Implementation of Autonomous Driving

Moderators: Keiichi Motoyama, *Mississippi State University*
Rolf Adomat, *Continental Automotive Corporation*

Program:

DAY 1: Thursday, June 8, 2017

09:00 - Registration

09:20 - 09:50 Opening
Chairperson of ROAD 2017: Tetsunori Haraguchi
Professor, Nagoya University
* Bell Transfer Ceremony
* Welcome to Nagoya and Koshoji-Temple
* About ROAD and the Origin
* Looking back on ROAD 2016 held in Bavaria, Germany
* Aim of ROAD 2017

09:50 - 10:15 Keynote 2
Rural Area Mobility (as the purpose of Autonomous Driving)
Pongsathorn Raksincharoensak
Associate Professor, Tokyo University of Agriculture and Technology

10:15 - 10:40 Keynote 3
Future Mobility for Seniors and People with Disabilities
Yasuyuki Izu
Chief Engineer, Sekisui S-Lec B.V.

10:40 - 10:50 Coffee Break

10:50 - 11:15 Keynote 4
Does Autonomous Driving make society happy?
Yoshimi Furukawa
Professor, Shibaura Institute of Technology

11:15 - 11:40 Keynote 1
Megacity Mobility (as the purpose of Autonomous Driving)
Tsuguo Nobe
Director, Intel Corp. / Visiting Associate Professor, Nagoya University

11:40 - 13:30 Lunch & Matcha Tea Ceremony with a live performance of Japanese Harp (Koto)

13:30 - 13:40 Introduction of Working Groups and Working Mode

13:45 - 15:15 1. Round Workshop

15:15 - 15:30 Coffee Break

15:30 - 17:00 2. Round Workshop

17:00 - 17:15 Coffee Break

17:15 - 18:45 3. Round Workshop

19:00 - Banquet at Sapporo Kanihonke

DAY 2: Friday, June 9, 2017

08:30 -	Registration
08:45 - 08:55	Welcome Remarks Hideaki Ohmura *Governor of Aichi Prefecture*
08:55 - 09:20	Keynote 5 Shaping the future of mobility - together Bert Wolfram *President and Chief Executive Officer, Continental Automotive Corporation*
09:25 - 10:50	4. Round Workshop
10:50 - 11:05	Coffee Break
11:05 - 12:35	5. Round Workshop
12:35 - 13:30	Lunch
13:30 - 14:30	Wrap up of ROAD 2017
14:30	Closing * Closing * Invitation to ROAD 2018 by Daniel Carruth, *Mississippi State University* * Bell Transfer Ceremony

ROAD 2017 Organizing Committee:

Chairperson:	Tetsunori Haraguchi, *Nagoya University, Japan*
Vice Chairperson:	Stefan Schneider, *University of Applied Sciences Kempten, Germany*
Members:	Ichiro Kageyama, *Nihon University, Japan*
	Masashi Yanai, *SEKISUI S-LEC B.V., The Netherlands*
	Gerhard Steininger, *GFFT e.V., Germany*
	Bernhard Schick, *University of Applied Sciences Kempten, Germany*
	Hideo Inoue, *Kanagawa Institute of Technology, Japan*
	Tatsuya Suzuki, *Nagoya University, Japan*
	Yoshiki Ninomiya, *Nagoya University, Japan*
	Hirofumi Aoki, *Nagoya University, Japan*

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General: Significance of ROAD 2017

Greeting from Chairperson of ROAD 2017

Tetsunori Haraguchi (Nagoya University)

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Opening Address

Good morning everyone. My name is Tetsunori Haraguchi, Vice Director of Green Mobility Research Institute of Nagoya University, and I am serving as the chairperson of ROAD 2017. First of all, I would like to thank all participants for taking time out of your busy schedule to take part in this event, the sponsors who agree with the spirit of this roundtable, and the committee members and secretariat for their hard work of preparation. I am delighted that over 60 researchers and experts from universities, industry and government have joined us for the second roundtable meeting on the purpose of autonomous driving.

Two years ago, I visited the University of Applied Sciences Kempten, Germany and confirmed the significance of discussing the purpose of Advanced Driver Assistance Systems (ADAS) and autonomous driving with Prof. Stefan Schneider. We agreed it would be really important to discuss the fundamental purpose of autonomous driving as well as considering its realization from the technical and methodological standpoints.

In June, 2016, the first roundtable meeting was held at an ancient castle in Bavaria, Germany, home of the University of Applied Sciences Kempten. Over 50 academic and corporate experts gathered from Germany, Italy, France, the UK and Japan, and we discussed the objective of autonomous driving from various viewpoints touching on issues such as improvement of user friendliness and safety, reduction of social loss and ethics.

At this second meeting, we have set up five topics; “Megacity Mobility (as the purpose of autonomous driving)”, “Rural Area Mobility (as the purpose of autonomous driving)”, “Future Mobility for Seniors and People with Disabilities”, “Social Acceptance of Autonomous Driving”, and “Roadmap of Societal Implementation of Autonomous Driving”. The participants will be divided into five groups, and will discuss each topic with two moderators in turn. At the final session, following the distinguished keynote speeches on each topic and the roundtable discussions, we will hear a wrap-up on each topic.

Through the interdisciplinary discussions on the purpose of autonomous driving, we aim to propose directions for technology development to promote autonomous driving and social changes. The adorable stuffed guide dog you received at registration is a mascot which is worthy of the spirit of the event, embodying the purpose of advanced safety driving and autonomous driving.

So now, I shall open the meeting followed by the bell transfer ceremony from the former host, the University of Applied Sciences Kempten to Nagoya University.

General: Significance of ROAD 2017

Organizer's Greeting

Stefan Schneider (University of Applied Sciences Kempten)

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(Summary based on interview conducted at ROAD 2017)

Very good efforts. It was a well prepared and well organized meeting at a wonderful place. It was really delightful. I also like Japan and I am glad that I could get a taste of the Japanese culture.

At ROAD 2017, it was great that we could discuss an issue which Japan is currently facing. Japan has the fastest aging society in the world. For this reason, the country is looking for an answer to address this issue. Another issue is providing support which is very important.

This time, we had participants from the United States. I think next year we will have many American participants so I am looking forward to its impact.

The way of thinking of Americans, Japanese and Germans are different.

When a problem occurs, Germans and Europeans in general are thinking how to solve the problem without costing any money. Japanese are looking for the best solution to solve a problem. Meanwhile, Americans are looking for a solution through which they can make money. Another characteristic American problem-solving method is "open solution." It is a very American way of solving problems. Because of this, I am anticipating a very lively discussion. Moreover, the United States is a country which relies on cars. I am already looking forward to the discussions about the purpose of autonomous driving in a country where cars are needed anywhere one goes. Probably, it will have an extremely good impact. I wonder if we can use the American problem-solving method.

I am in Japan for the fourth time, but I still very much admire the Japanese way of using public transportation. It is because many people are using public transportation and it is very refreshing to see how they avoid bumping into each other. I want to know how it is possible to use public transportation so smoothly. I guess it is a cultural difference and social difference.

For me, the purpose of autonomous driving is to allow people to do other activities while going from one place to another. On the other hand, I like driving. So, even if autonomous driving becomes reality, I want to drive. My priority is to drive on my own. If autonomous driving becomes a possibility, I want to make use of it to enjoy the view or do various other activities while I am riding.

Road conditions in Germany are different from those of Japan or the US. It is said that Germany's autobahn does not have speed limit, but it is only true to 20 percent of the network and other 80 percent does have speed limit.

Expectation from ROAD 2018

I expect a lot from ROAD 2018. I am very excited to go to Mississippi. I wonder what kind of autonomous driving meets rainy road conditions in the US. And I am also looking forward to the US discussion topics. If we talk about the differences and similarities among Japan, the US and Europe, we can start discussions which are consistent with the spirit of ROAD.

I think common points are safety, comfort and efficiency improvement, but it is no doubt that needs of people vary. I think there are many similarities in the pursuit of safety. Efficiency has measurable objectives such as travel time, distance, fuel economy and emission. However, discussions may start with limitations. Since social objectives and road conditions vary from city to city, talks should start from the bottom. There are major differences in comfort depending on the region and the society of Japan, the US and Europe. For instance, speaking of comfortableness it largely depends on the country or region what temperature is comfortable. Now there are smartphone apps which can adjust temperature.

At ROAD 2016, the discussion on the objectives of autonomous driving was extremely rough. Prof. Haraguchi grouped the discussion topics into eight groups with Japanese conditions in mind to set up working groups. For this reason, discussions moved to a new level.

The ultimate objective of ROAD activities is to not to stop at the discussion level, but to provide a roadmap on autonomous driving to society. In addition, based on the results of discussions on the objectives of autonomous driving, my personal aim is to give support for the preparation of policies while shedding light on the issues which should have high priority.

Today, it is delightful that we can start discussions which could have an important role when policy makers conduct policy reviews and enquiries.

General: Significance of ROAD 2017

Governor's Greeting

Governor of Aichi Prefecture, Hideaki Ohmura

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Good morning, everyone.

I am Hideaki Ohmura, Governor of Aichi Prefecture.

Thank you for inviting me to the Second Roundtable for the Purpose of Autonomous Driving. And to the researchers from Japan and abroad, welcome to Aichi-Nagoya.

Aichi is a region that attracts many industries promising strong potential for future growth, including next-generation automobiles, aerospace, and robotics. As the industrial capital of Japan, Aichi leads our nation's economy.

Aichi is also the world's No. 1 center for the automobile industry, being home to Toyota Motor Corporation and many suppliers. To encourage their further growth, the Aichi Prefectural Government is promoting the use of fuel cell vehicles and building hydrogen stations. We are also actively conducting field tests of autonomous driving aimed at its practical application.

Last year, we conducted such testing on public roads in 15 regions throughout Aichi. The scale of the tests was the largest in Japan, covering a total 41 kilometers of roadway and a total distance of 2,800 kilometers. We also invited our citizens to ride in the vehicles. As a result, we discovered that the citizens have high expectations for autonomous driving, which is said to be the ultimate safe technology.

Autonomous driving technology is making dramatic progress. Social implementation of the technology is also advancing, with deregulation at the national level and other institutional reforms taking place. This year, the Aichi Prefectural Government will begin tests in 10 cities, using a cutting-edge, remote autonomous driving system for the first time in Japan.

Currently, global competition for autonomous driving is intensifying. Not only automotive-related industries but also IT firms and electronics manufacturers are entering the market.

We see these trends as big opportunities. We will strengthen partnerships with companies and universities, and create new business models using autonomous driving systems. I look forward to your support and cooperation in our efforts.

Finally, I would like to close by wishing you all a very successful event.

Thank you very much.

General: Significance of ROAD 2017

Looking Back Through Pictures

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Continental




Autonomous Driving
June 8th and 9th, 2017


Chapter 1: Megacity Mobility

Summary of Keynote Speech 1 and Interview

Tsuguo Nobe (Intel Corp. / Nagoya University)

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(Summary based on interview conducted on November 14, 2017)

What's the purpose of autonomous driving?

Broadly speaking, the purpose of autonomous driving is to reduce human errors to a very minimum. Cars have become safe but 96 percent of fatal traffic accidents are caused by the driver's bad judgement or operational mistake. Autonomous driving is a necessity. The fun part of driving should remain and autonomous driving mode should be an option. I think the use of fully-autonomous driving will take hold as an option.

Market creation with driverless driving

With the use of driverless driving technology, we can travel from the nearest station to our destination using fully-autonomous driving. Surprisingly, it has been already completed by a company and has a huge impact on society. The only one company in the world which succeeded in fully-autonomous driving is Google, surprising global automakers.

Google's autonomous driving car quadruples the distance it can travel on its own every year. There are situations when the driver must intervene in autonomous driving mode which is called "disengagement." However, between two disengagements the driverless car's driving distance quadruples every year. As of November 2017, Google's driverless car reached the same level of frequency of causing accidents as a human being. The average distance after humans cause an accident is about 20,000 km. By November 2017, Google's driverless car traveled about the same distance without disengagement. By November 2018, driverless driving distance without disengagement is likely to reach 80,000 km. This means that by next year driverless driving will be four times more efficient than human driving.

Currently, there are people who cannot ride the taxi from the nearest station to their home because it is too expensive. At this point, it is certainly difficult because 73 percent of the taxi fee covers driver's expenses. However, driverless taxi service would reduce cost to 30 percent. This could trigger the birth of a new transportation service. This can become a major factor in the expansion of autonomous driving.

Possible expansion of autonomous driving along with urbanization

Currently, the populations of advanced as well as emerging countries are flocking to cities, advancing urbanization. The advancement of urbanization limits the attraction of owning a car. Rather than owning a car, there is growing demand for sharing a car. Car sharing increases the motivation toward using autonomous driving. Aside from car sharing, there is a growing expectation toward autonomous driving if it can reduce travel expenses.

Moreover, demand in China, which is the world's largest automobile market, is anticipated. Although

annual new car sales already surpassed 27 million units in China, ownership rate is still below less than one car per household. If ownership continues to increase at this pace, the required fuel source must be taken into consideration. It is said that roads will be too congested similarly to advanced countries. In other words, the government does not wish to increase the number of cars. Against the backdrop of this, car sharing combined with autonomous driving is rapidly gaining ground. In this respect, it is said that India will take the same path.

Autonomous driving for cargo hauling

Regarding full automatization, autonomous driving is attracting attention not only as a means for human transportation but also for cargo transportation. Generally, cargo delivery is on the rise. Along with the development of e-commerce, there is growing demand for home delivery. Not only there is a lack of sufficient number of taxi drivers, but the shortage of delivery drivers is also causing concern. For this reason, the idea of replacing delivery drivers with autonomous driving is gaining ground. Currently, there is not enough delivery drivers. In an effort to resolve this issue, as well as to ease demanding working conditions of taxi, bus and truck drivers, the use of autonomous driving is driven forward. Rather than fully-autonomous driving, it is only intended to reduce the workload of the driver.

In other words, the fundamental purpose of autonomous driving is to reduce the number of accidents caused by human error. This new mobility service can help realize a more efficient society by reducing car ownership in cities and create a more content society by easing driving tasks. This is Intel's as well as my personal opinion about the purpose of autonomous driving.

Benefits of autonomous driving for mega cities

As more and more people are concentrated in cities, there is a growing need for more efficient urbanization. Autonomous driving could be used in this area. It could eliminate traffic congestion and help restrict driving in urban areas as it is done in Europe. More people in cities means more cars; however, the introduction of autonomous driving can aid more efficient city development. The use of autonomous driving will also change urban design. If automobile ownership volume could be reduced in cities, it would lead to less parking spaces. Electric vehicles could use autonomous driving technology in urban areas.

The use of autonomous driving technology toward urbanization is actively discussed in connection to urban planning around the world except in Japan. In the past three years, 8 trillion yen were invested in urbanization by relevant entities in Europe, the US and China. In contrast, Japan invested a mere 400 billion yen in urbanization. The gap is a major problem and could become a cause for weakened international competitiveness in the future. America's Maas and Germany's Daimler proposed the idea CASE.

Expectation regarding autonomous driving in suburbs

There is a major demand for autonomous driving in suburban areas. I am talking about suburbs which are close to city centers. One travels from the city center to the nearest station by train and walks home from there. These kinds of satellite cities are optimal places for autonomous driving systems. Apartment complexes among other dwellings built on high ground are perfect locations for autonomous driving. There are many apartment complexes built on high ground in city centers as well. When residents become older, walking becomes a major issue from the nearest train station to one's home which located on high ground. Traveling from the nearest bus stop to one's home is a promising opportunity for the autonomous driving market.

Moreover, the delivery issue is intended to be resolved simultaneously with autonomous driving service. In other words, the deliveryman could send packages by robot taxis which travel between the nearest station

and one's home. The delivery industry is looking for a way to somehow automatize the "last 50 feet." It is because even if the package is delivered to the front door, no one takes it from the front door to the house. Since this last 50 feet cannot be automatized, it is causing a lot of problems for people concerned. However, if the robot taxi could carry not only the commuter but also the package which is addressed to the commuter, then the commuter could carry the package home. This idea is currently under study. When the commuter calls for a robot taxi, the package could be loaded into the taxi and the commuter could unload it at home.

Autonomous driving for seniors and people with disabilities

It would be very effective for shopping support. Moreover, the system could go shopping without the shopper leaving home. Google began autonomous driving in 2014. At that time, Google announced that the system can enable the blind to go shopping. NHTSA's documents also mention that enabling mobility for seniors and people with disabilities is one of the purposes of autonomous driving.

Actively going out by seniors and people with disabilities using autonomous driving technology could also improve their health. Healthier seniors and people with disabilities can also reduce cost burden on the society.

Social receptivity

Social receptivity will largely depend on familiarity. A self-driving car without any occupants is creepy. Or a car which starts moving without a driver is also creepy. When the car is called it starts moving. It could make people very uneasy and surprised. It is an extraordinary occurrence. People must get used to these situations. Also, the occupant can feel uneasy as well. If the car suddenly starts moving the occupant could be surprised. So it should be considered giving a warning right before the car starts moving. Also, route announcements along the way can dispel distrust of the occupant. For instance, the system could inform the occupant for instance that "I am turning here." Similarly to a taxi, the system could inform the passenger in advance. This kind of communication with the passenger while traveling will be necessary in the future.

Recently, automakers proposed that during autonomous driving the computer could communicate with the driver. This kind of approach, which could eliminate uneasiness of passengers during autonomous driving, is gaining ground.

Different autonomous driving roadmaps depending on country / region

There are changes compared to the initial idea. Until 2014, highway use started from Level 3, but it has largely changed since. Thanks to the development of deep learning, Level 3 autonomous driving, which was said to start from highway use, is now becoming a possibility in certain regions on ordinary roads as well. If the study of "last one mile" continues, which means a 1.6 km radius, robot taxis could come to one's home or take one home from the nearest station by 2020. There are already such predictions overseas.

Automakers understand that Google has been successful in developing autonomous driving and recognized that it is feasible. Since it can be done on ordinary roads, automakers are shifting their focus from Level 3 to Level 4 and began to put forth plans entering the mobility service sector using their own autonomous driving and electric vehicle technologies. This is a huge development since July 2016. From 2021 onwards, companies are planning to launch self-driving cars in specific markets and begin car sharing service in those limited areas. Since these are fully-automated vehicles, they have no steering wheels as well as brake and accelerator pedals. Products are planned to be sold to mobility operators only. For this reason, automakers and parts suppliers are entering the mobility sector one after another. Since the end-users are mobility service providers, which have full knowledge about public reception and usage, more and more automakers are entering the sector.

In addition, the US government intends to provide personal mobility to the elderly, people with disabilities and those who are too young to drive with an eye on Level 4 application. The government is expecting fully-autonomous driving to be realized by 2021. Autonomous driving is scheduled to start on community roads from 2021 and the service area is planned to gradually increase. Sometime after 2030, autonomous driving areas are expected to link up enabling autonomous driving service anywhere in the country. This will lead to the realization of Level 5 autonomous driving.

Highway autonomous driving will start as it is originally planned and its service area will gradually expand. Once, autonomous driving service of community roads and highways link up, Level 5 application will begin. Level 5 is believed to start in 2030–2035.

This development is enabled by deep learning technology. Environment monitoring is carried out by cameras, lasers and radars.

On one side 3D map data is needed. If everybody becomes able to provide data, it will expand at once. Map definition and algorism is developing one-to-one. Companies that realized autonomous driving would likely to go forth supplying maps also. HERE is collecting 3D map data of highways. Now it is working on the task of how to computerize this data. HERE is planning to speed up 3D data collection in an effort to be prepared for the increase of Level 2 and Level 3 vehicles around 2021. When collecting trunk highway data, sizeable map data needs to be collected and arranged. In contrast, autonomous driving maps required for ordinary roads are made in designated areas for the “last one mile.” Since these maps can be created with much smaller data and are only sold in a specific area, they are more economically reasonable compared to highway map data.

Expectations from ROAD 2018 to be held in Mississippi

Now, equipping a car with ICT (information communication technology) is perceived as autonomous driving in the US. Through autonomous driving technology, the US is anticipating to return to the top in the global automotive industry. Against the backdrop of this expectation, Silicon Valley joined forces with Detroit and the government to pass a bill on autonomous driving.

This bill will authorize NHTSA to increase the number of fully-autonomous driving vehicles on public roads. The US is peculiar in this regard. The administration, the IT industry, the automotive industry and the congress joined forces and move forward the same direction which is a rare phenomenon. So how’s development going by relevant companies? Is not it desirable to study this cooperation between the industry, government and academics? Is not it a good opportunity to learn how the US will actually go forward in this respect? This bill was submitted to the Lower House in June 2017 and deliberations about it started at the Upper House from October.

Both parties the Democratic and the Republican agree on this issue. The conventional automotive industry and the IT industry also support it, uniting the US industry, government and academics to promote autonomous driving. It almost never happened before. It could be a good opportunity to learn about this new US trend.

In regards to the rapid establishment of an autonomous driving market, it will really depend on each country. To date, even if the culture, religion, traffic rules, implicit regional rules were different, products made in one country could be exported to another country and used by the local people without any major problem. However, when it comes to autonomous driving, the car cannot operate without corresponding maps and it is also necessary to send and receive data through LTE and carry out V2X communication. Therefore, compatibility will be extremely necessary in the future. In this respect, the US and Europe are advancing development while keeping compatibility in mind. The US and Europe are intending to standardize DSRC (dedicated short range communications).

The US and Europe want to implement autonomous driving. However, although they have a common goal, their cities and roads are very different. Speaking of “last one mile” for instance, requirements for autonomous driving are very different in the US where there are no train stations nearby. In the US, autonomous driving is advanced with an aim of unburdening the occupant from driving. The acceptance of autonomous driving depends on the particular culture. I think it would make a very interesting discussion topic to see how acceptance is different between Europe, the US and Japan.

The case of the US is easy. Streets are clearly designed enabling easy autonomous driving. Cities in Europe clearly designed as well. There are no haphazardly built buildings. Looking down from an airplane, houses in the US and Europe are built along roads. In contrast, buildings and roads have no such connection in Japan. This is partly due to the policy of reducing acreage under cultivation. For this reason, houses built scattered across the land in Japan. Taking this difference into consideration, I think it would make a meaningful discussion topic on how to realize autonomous driving.

When it comes to sharing, the concept of ride sharing is well established abroad. On the other hand, in Japan it is lagging behind in development. Moreover, in case of sharing, routing is too complex and takes time. I think how these kinds of differences impact the expansion of autonomous driving would make a good discussion topic.

Regarding correspondence to different road designs, adjustments will be made to software. Similarly to the current situation, it is unlikely that the same software will be able to correspond with the entire global market. Unlike to the current practice, it will be impossible to make hardware in Japan and sell it abroad. Instead communication equipment will be sold tailored to the communication situation of each market. Fax machines were once like this, when faxes were only introduced to Japanese companies, they were useless unless they were also introduced to foreign companies which received those fax messages. Since similar thing can happen now, development must be tailored to each market. Development with compatibility in mind is necessary.

Surely, V2X is a “nice to have” technology for autonomous driving, but it will be a necessary technology in the future. However the software will have to be compatible with each market. Autonomous driving and map sets must be paired. Automakers must have development capability of artificial intelligence which is compatible all over the world. The German Big 3 are in talks with GM and Google. They are also working together. Besides, Europeans are advancing IT.

In an effort to maintain that competitiveness, automakers must develop software in-house. A company which tries to sell cars cheap is a 10 million units-class automaker. Good software cannot be made without getting data from those 10 million cars. It is almost like you must oligopolize the market to sell this many cars. The underlying technology is driven by various entities. In the coming years it will be common practice that various rival companies will use the same technology.

Chapter 1: Megacity Mobility

Discussion Overview and Interview with Moderator

Hirofumi Aoki (Nagoya University)

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(Summary based on interview conducted at ROAD 2017)

Megacity Mobility Working group report

In our discussion group on Megacity Mobility, we tried to find an answer to what percentage of automobiles will be electric by 2050 and what percentage of automobiles will have autonomous driving function. Many participants said that all automobiles will be electric by then and 80 percent will have self-driving function. Some participants thought that the pace will be lot slower and 90 percent of automobiles will remain conventional in 2050. Others said that 30 years is about five model changes so probably 40 percent of all automobiles will change by 2050.

Megacities consist of extremely complex systems. As for infrastructure, someone must take responsibility for administration and investment. Someone must resolve technological and business issues of the business model. Megacities have high, intermediate and low-level development. Social and political aspects are influenced by the "human factor." However, similarly to smartphones, autonomous driving could gradually permeate society and gradually accepted.

Regarding permeation, a roadmap, regulations and simulations will have a very important role. If there is no clear roadmap on the permeation of autonomous driving, it will not be possible to realize autonomous driving in megacities by 2050. In addition, in order to construct a systematic traffic system, if driving within cities is not restricted similarly to London or Beijing, the spread of autonomous driving will be very difficult. It is necessary to design a mix of means of mobility such as small electric cars, buses and trains which are suitable for megacities. For this, securing advanced simulation technology is a major challenge. It is important to find a solution how to optimize people's comfort, travel time, traffic flow and emissions through simulation.

So I felt that it is important that not only automotive industry engineers participate in discussions, but also transport engineers, city planners and politicians as well in an effort to make autonomous driving in megacities possible. I think discussions could go deeper next year at ROAD 2018 if transport engineers and city planners participated as well.

Impression as a moderator

Looking at megacities as a single system, since they consist of multilevel sub-systems they are very complex. For this reason, it is very important how system architecture is created. The keywords are roadmap, regulation and simulation. The question is from where this major system should start and how it should spread and be connected. In some cases, the use of large trucks is likely to be restricted and the total number of small electric cars limited in megacities. It is necessary to consider what the dominant parameters are, and see how factors change upon parameter study and how factors change upon simulation. However, not

only car engineers should be involved, but also city and traffic engineers. This was my impression as the moderator. I am a human factors engineer, when a system is not fully reliable I try to solve the problem by looking at human-system exchange. I worked in the fields of psychology and medicine so I look at people's quality of life as well as the happiness of the individual and society as a whole.

Along with autonomous driving, logistics will become more effective. It is possible that human mobility will become part of logistics. Since logistical cost is added to product price, human mobility might be ignored in the autonomous driving sector. Given that the primary purpose of self-driving is cargo transport and human mobility is secondary, logistics vehicles could also carry humans. Since logistical cost is included in product price, mobility cost of riders can become cheap. If riders could watch ads or play games, it could possibly generate extra profit.

Regarding major natural disasters, I felt that we need to think about this issue which is peculiar to Japan. This issue should be carefully considered in connection to the application of autonomous driving in cities. It is necessary to examine this possibility when we deal with a major system such as a megacity. The agenda is whether ambulances, police cars and other emergency service vehicles should be automatized or not. Other vehicles equipped with autonomous driving technology could be directed to the side of the road to give priority to emergency service vehicles.

Technology is advancing at a fast pace. I felt that we must be aware that the optimal point could change with the advancement of technology.

Impression of ROAD 2017

ROAD was held last year for the first time. It was somewhat vague trying to grasp a clear direction in the beginning. This year, more than half of the participants attended ROAD for the second time. Moreover, autonomous driving technology advanced, social recognition expanded and information became available enabling discussions to be more specific. However, it seemed that discussions should have gone deeper which may be achieved next year. In particular, I strongly felt that interdisciplinary cooperation is necessary. Many of the participants were automobile engineers especially from the areas of sensing and control for autonomous driving. I felt that that the cooperation of transport engineers and city planners is necessary to have more specific discussions.

Autonomous driving is ultimately a tool. I felt that we need to further discuss the purpose of autonomous driving and why it is necessary. In a good way, it is intended to make people's life comfortable and happy. However, is it necessary in the first place? And if it is necessary, what is it after? Will it turn out the way as it is imagined? To answer these questions, it is necessary to launch autonomous driving in a moderately-sized city and receive constant feedback. It is also necessary to discuss the type of problems that could occur after an actual launch which did not come to the surface in the concept stage. It is important to clarify tasks which are necessary for actual launch.

Autonomous driving is also undergoing testing at Nagoya University within SIP. That kind of feedback is needed. COI is also researching what makes the elderly happy. What needs to be done for making the elderly happy. In addition, COI also researches what is needed in the future that gives satisfaction to men and women of all ages. In that context, I think it would be great if humanities experts who study whether autonomous driving benefits society could join our discussions.

It is possible that once the elderly stops driving their physical and mental health declines. However, it is also possible that going out more will have a positive effect on them. The elderly could enjoy both driving and going to places if they rode cart-like vehicles safely and within limited distance.

ROAD 2017 was attended by American participants as well. The US is advancing autonomous driving as

market priority. The US approach is different compared to that of Europe. More than that, the industry and the academia cooperates in this area. If anything, governments are taking the lead in Europe. On the other hand, in the US, Google, Tesla and other private enterprises join forces with venture companies, universities and university-originated ventures. While both sides are active, their approach is different.

Expectations from ROAD 2018

The next ROAD meeting will be held at Mississippi State University, so both viewpoints will be heard. With the participation of Mississippi State University, it would be great if other universities took part as well such as University of Michigan, Carnegie Mellon University and MIT.

At ROAD 2017, although participants had various expectations, to a certain extent discussions remained on the selected topics. While it is a problem if discussions go off track, the talks were significant as they will continue next year.

Having discussions without any concern over money was interesting. Participants were invited by non-corporate entities so in that respect discussions covered a wide-range of areas.

The next will be held in Mississippi and the next next one will be in Japan again. By that time, whether it is good or bad, Profs. Haraguchi, Kageyama and Inoue will retire. So us, the next generation must take over.

Social sciences and humanities have just begun to focus on the elderly. I think it would be great to talk about this topic next time and hear everybody's opinion. If we just talk about it as something extra, we will shift to laws and regulations, we need to think about whether we can discuss this in terms of a roadmap. Talks on Level 3-related thinking and how to fill in the gap between Level 2 and Level 3 could be based on Volvo's announcement regarding the "Drive Me" self-driving program. The location-limited Level 4 application may also offer some feedback. Volvo's parent China's Geely said that they plan to carry out testing in China. So if someone who knows about Chinese developments could come next time, it would be very interesting.

Autonomous driving increases the effectiveness of city planning. If convenient personal mobility were adopted, its popularity would increase. If parking were no longer needed, it would radically change city design. This time, this viewpoint was not represented, so it would be great if city planners and traffic engineers attended the next meeting.

I think the ultimate objective of autonomous driving is reducing accidents and effectively using time. Needless to say it depends on the level of autonomous driving. Autonomous driving does not necessarily have to be connected solution. Level 2 application is intended to lower accidents related to braking and drowsiness. Level 3 application is intended to take Level 2 capabilities one step further. Level 4 will enable users to do other things than driving while in motion. Improved energy use and emission control can improve traffic flow. However, the question how far overall optimization should be taken remains. Optimal solution also depends on social consensus. Besides overall social optimization and sustainable solutions are needed. Optimal value can be generated with the use of renewable energy.

Heading toward 2018, we need to prepare projections based on evidence for the next meeting. It is also necessary to put forth a secure benchmark which is compatible with rapidly changing global trends.

Chapter 1: Megacity Mobility

Discussion Overview and Interview with Moderator

Jürgen Stübner (University of Applied Sciences Kempten)

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Impression of the Japanese Traffic System

It was the first time I came to Japan and I was very impressed. I was very surprised how well organized Japan's traffic system. Everything is clearly marked for people with disabilities and foreigners. Everything is orderly and forethought to prevent mistakes. A lot of effort is devoted to the design of airports, train stations and cities to make them user friendly. In addition, I was also very surprised how efficiently people use the transportation system such as how they stand in line in orderly fashion and wait for the train. Unlike in Germany, people who get on and get off the train do not bump into each other in Japan. It also caught my attention that there are many signs in connection to safety and security. There are no such signs in Germany. I felt that Japan is highly technically organized when it comes to using the transportation system in major cities. Same applies to using the elevator. In Japan, even when it is jam-packed people make sure not to bump shoulders with others. In Germany, people are not concerned about bumping into others. For this reason, it was a truly valuable experience to have discussions about autonomous driving which will have a major impact on future of transportation in a country whose culture of using transportation facilities is different.

Firstly, my impression of ROAD 2017 was that I felt that it was carefully organized. The venue is wonderful and the program was well thought over. The overall planning was well organized. Based on a good layout, discussions were prepared on various topics. Workshops on different areas could be attended by all participants and it was very effective that various opinions were expressed. Participants were not only from the industry, but also from the academic, government and other areas giving a good balance of attendees. Moreover, there was a lot of time for discussions which enabled official as well as unofficial communication helping creating future ties.

Proposal to autonomous driving development

Regarding autonomous driving, we talked in various contexts. We had discussions on mobility which is different depending on the country or region, on social acceptance of the diffusion of autonomous driving and on various other topics. Many automakers only think about technology; however, essentially, they also should more focus on society and culture. In an effort to realize autonomous driving in various parts of the world, HMI is indispensable. A viewpoint on understanding how relations with people will change is definitely necessary. In one car there is only one HMI system, but various systems are needed depending on the region.

Speaking from an academic standpoint, we must not think only about the technical aspects when we think about HMI. Apart from the engineer's viewpoint, it is necessary to be aware of totally different viewpoints as well. We must come up with switches and signs which cannot confuse users of self-driving cars.

Automakers and many suppliers are developing ADAS. They are using current systems as base and focusing on how to harmonize them. But what really necessary is a viewpoint from the future. What is needed is to line up the future implementation of autonomous driving and optimal design of ADAS on the same line and then merge various necessary functions to create a large roadmap. At the same time, the guideline will become customers' viewpoint. In other words, both engineers and customers' viewpoint is necessary for designing HMI.

Purpose of autonomous driving

I think there are three main purposes of autonomous driving. One is providing mobility to the elderly and vulnerable road users. The second is providing mobility to young people. We could lower the age limit on acquiring driver's license. The third is changing the way of mobility as it is. For instance, visitors no longer needed to be picked up at the station if there is autonomous driving service in place. That time can be used by the host to prepare for the arrival of the visitor. This is only one example, but the impact of autonomous driving on mobility has many hidden possibilities to make life richer.

Once autonomous driving is implemented, various advantages which are attached to it will arise. One of those is the elimination of environmental problems. Whether it is an internal combustion engine vehicle or an electric vehicle, realization of efficient routes and socially useful mobility is expected to dramatically decrease carbon dioxide emission by the transportation sector. It can also lead to the elimination of traffic jams in large cities. Autonomous driving can also reduce automobile ownership volume itself. It might be a problem for automakers, but we are heading toward that kind of future for sure. Automakers will be pressed to change their business model.

In the future, automakers will develop software and other solutions instead of vehicles and engines making large investments. Apart from focusing on assembling electronics and mechanical components, software and data will be important areas. That will be a dramatic transformation for automakers. In other words, it means that automakers will transform into data producers. Compared to the speed of Apple and Google, automakers are advancing slowly. Although they have already begun transformation, the structural change of automakers and major suppliers will be a tense topic in the next 10-15 years.

It is an important issue for universities and other educational institutions as well. About 10 years ago I was involved in the development of small cars for urban areas at BMW. Since it had to be small and light, CFRP was selected as material. CFRP ensures lighter vehicle body, carbon dioxide emission can be reduced. Since CFRP has not been used before as material for vehicles, it created a new sector. Serial production was achieved through the cooperation with research institutions. This vehicle was the i3. I think there is need for cooperation between corporations and academia in the areas of ADAS and autonomous driving.

Government support and development environment of autonomous driving

Governments have a major role in the development of the automobile industry both in Japan and Germany. Purchase subsidies are promoting the diffusion of electric vehicles. Many of these incentives flow to large corporations. That can become an obstacle for open technology development especially for medium and small automakers. They must rely on themselves regarding development. I am from Austria where there are many medium and small companies. These corporations form clusters which enable them to realize great performance despite their size. One company makes a product which is used, exchanged or improved by another company. We introduced this practice in Germany about 10 years ago to support the growth of small businesses.

I think this type of network will become even more important for autonomous driving development. Attending ROAD 2017 was very significant in this respect as well.

Chapter 2: Rural Area Mobility

Summary of Keynote Speech 2 and Interview

Pongsathorn Raksincharoensak

(Tokyo University of Agriculture and Technology)

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When we think about the feasibility of autonomous driving with regards to Rural Area Mobility, the important point is how to ensure mobility in rural areas with steep mountainous roads where many elderly people live.

According to a survey we conducted with 10,000 elderly drivers living in rural areas, elderly people want to continue drive freely to go places whenever and wherever they want. However, routes and time frequency of trains and buses have been decreasing which means public transportation can be only used within the restricted time. And even if public transportation is used it takes a lot of time which makes it inconvenient. Meanwhile, there are many elderly people who want to continue to enjoy driving, indicating a positive attitude toward driving. However, driving capabilities of elderly people deteriorate over time, making it difficult to maintain reliable driving performance. Nevertheless, they have a very strong motivation toward driving in order to maintain their quality of life. For these reasons, autonomous driving should be considered as a tool to aid deteriorated driving capabilities of elderly people and reduce concerns over driving.

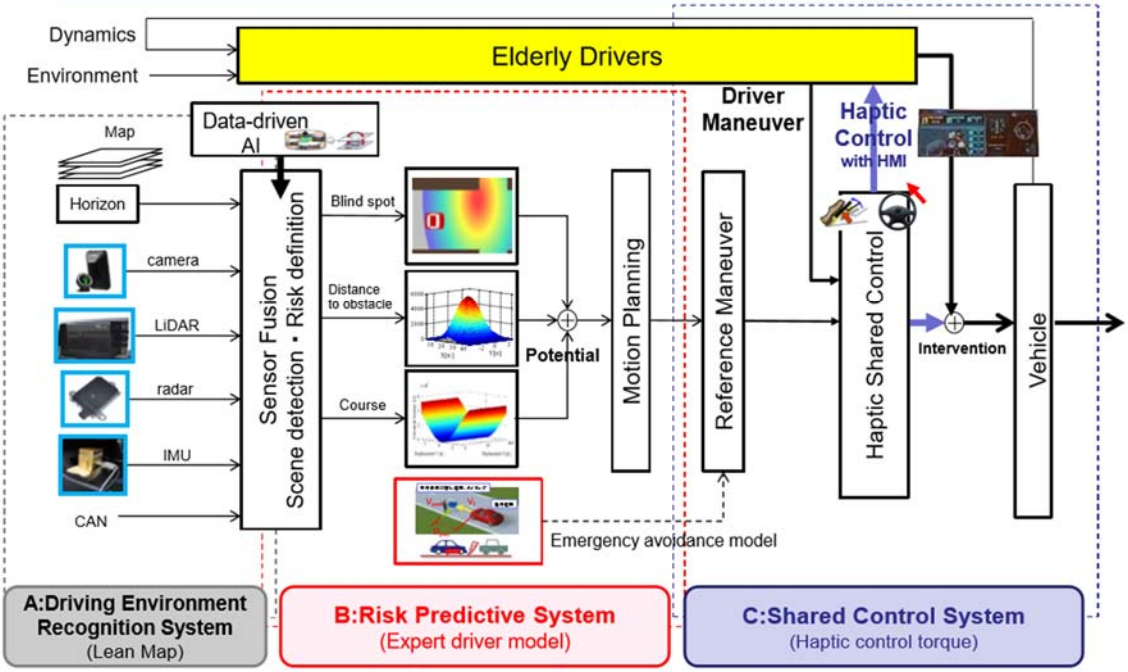
Based on the premises that it is difficult for elderly people to fully able to drive, I think the role of autonomous driving is provide a support system that actively intervenes in vehicle control such as warning system or automatic brake system. Based on the presumption that elderly people over 65 years old have impaired vision, the use of an environmental monitoring system that greatly enhances field of vision would be very effective in aiding visual ability. Also, elderly drivers have trouble driving in reverse or parking So, an assist system for detecting obstacles or eliminating pedal mis-operation would be beneficial. Taking into consideration the wishes of elderly drivers, autonomous driving should not be a driverless driving technology, but a control system that shares driving between the driver and the autonomous driving system. However, it is also important to assist drivers adjusted to their driving states.

In an effort to reduce the number of accidents that stem from elderly people's deteriorated driving capabilities, a shared control system is necessary that shares operation between the driver model and the actual driver through Adaptive Driver Assistance System. This expert driver model should be able to estimate risks with extensive driving capability.

During actual autonomous driving, the relationship between the system and elderly driver in connection to driving will be the following.

The driving software, which is modeled after an experienced driver, supports steering and acceleration maneuvers by guiding driving operation with haptic shared control. The system supports driving by avoiding potential risks providing assistance for safe driving.

Autonomous Driving Intelligence System



Summary: Advanced Safety Vehicle with Driving Intelligence

Car following, Course tracking

AEB, PCS

LEVEL 1, 2

Cooperative-ACC

Lane Keeping Control

Source : Toyota

LEVEL 1

Autonomous Emergency Braking/ Pre-Crash Safety

Lane Departure Prevention

Source : Toyota

Impression regarding your participation

In my presentation, I wanted to raise the question which direction will autonomous driving move forward in the next stage. Autonomous driving has been being developed along a rule-based system focusing on imitating operations which humans can do. Rule-based autonomous driving, which can do what humans can do, such as following another vehicle, not crossing the lane or stopping in front of an obstacle, have been already realized. I think the technology should switch toward the direction of intelligent autonomous driving, making it a good partner with drivers. Leaving aside autonomous driving which excels human capabilities, what is important is to develop autonomous driving which can do things that humans cannot do. For instance, when the driver overlooks something or is absent minded or assumes something, the support system should give a casual notice such as “didn’t you forget?” I think development of autonomous driving should go to this direction.

Your objective of autonomous driving

For me, the foremost objective of autonomous driving is ensuring safety. Next is comfortable and smooth driving on highways. In cities, the ideal situation would be that people mainly have authority to control the vehicle and machines only intervene when there is some occurrence. Consequently, it is comfortable and acceptable. As people drive autonomous driving behind the scenes ensures safe driving. I think this kind of autonomous driving is ideal. Once fully-autonomous driving is realized, it will be a very different vehicle compared to today’s automobiles. Being a different vehicle, I think a new era will come.

Heading toward ROAD 2018

Although the topic was autonomous driving, we did not touch upon many issues. Next year’s discussion should be about autonomous driving with specific goals on the purpose and type. For instance, the places and operating design domain (ODD) or setting a specific limit for speed would make next year’s discussions deeper. Regarding the definition of autonomous driving, I felt that there should have been a discussion involving everyone. In that sense, instead of the currently globally used Level 1, 2, 3 etc. definition, which divides up autonomous driving by level, ideally a new definition should be proposed to the world which is more consistent with reality.

Chapter 2: Rural Area Mobility

Discussion Overview and Interview with Moderator

Masashi Yanai (Sekisui S-Lec B.V.)

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About round workshop

Before discussing our topic Rural Area Mobility, it was necessary to clarify the definition of rural area. Some participants thought that rural area is a sparsely populated area, while others assumed that that the definition of rural area covers cities like Odawara and Hiroshima as opposed to megacities discussed in another workshop. Moreover, definition differs depending on country of origin whether it is Japan, Thailand or Europe. Since cities are relatively small in Europe, the outskirts are considered rural areas. It was interesting to note that in Germany mountainous areas are considered rural areas.

Speaking of mobility in rural areas, it was necessary to think about the future of rural areas. There are two ways of thinking. One is rural areas are facing declining population, meaning that the countryside is disappearing. The other is that as technology advances people can live in the countryside without any discomfort surrounded by a good environment.

Thinking about autonomous driving, it is not realistic in Tokyo, but it is a possibility in a city the size of Toyohashi. In sparsely populated areas, the conditions required are different. One of the things I regret that the definition was not clearly defined.

Introduction to sparsely populated areas

While there is need to consider the definition of rural area, for many people rural area is a sparsely populated area so we focused our attention on this definition. There were many opinions from the viewpoint of how autonomous driving can support people living in these areas.

However, the problem was that many of the participants did not have any experience living in the countryside. For this reason, they do not know those conditions. If one thinks of rural areas as the outskirts of a city or medium and small-size cities as opposed to megacities, then they do not have the correct picture of sparsely populated areas. When discussions are based on guesswork, it must be taken into account.

There was an opinion that sparsely-populated areas are facing economic difficulties and shortage of human resources which brings up the issue of declining services compared to cities. For this reason, robots must be introduced to resolve this problem. As of now, when someone is receiving nursing care, a car picks up the person at their home and takes them to the care center. It has been argued that driverless cars would lead to improved service.

This sparked a discussion if the concept of autonomous driving was this, then could it be introduced in sparsely populated areas. Taking into consideration the conditions of sparsely populated areas, such as low price and few users, the introduction of autonomous driving is indispensable. Technology and service could

be narrowed down to the needs of sparsely populated areas making excessive number of sensors unnecessary. In other words, it must be made practical.

As for the presumed model, to what extent can be specifications downgraded? For instance, in cities there are several lanes, complex traffic signals, many automobiles and other conditions must be considered. In other words, under such complex conditions, data processing technology is needed for safe operation.

Since sparsely populated areas have few residents, there are less traffic lanes, traffic lights and other cars on the roads which mean that the required data processing technology is simpler compared to cities. Naturally, the number of sensors can be reduced but only to the level that safe operation can be maintained.

Regarding safety, speed should not be 100km/h as thought to be the ordinary highway speed by city dwellers, but should be set at 50km/h to ensure safe driving enabling introduction by making various functions simpler.

Regarding the vehicle which is to be initially introduced, it would likely to function as a door-to-door service vehicle limited to sparsely populated areas. Various ideas came forth regarding ownership, whether it will be private, state or corporate. It could be purchased to expand business operations by a company which lacks the means to pay labor cost. This type of company would purchase a self-driving vehicle because it is cheaper than hiring a driver.

Sparsely populated areas to become advanced regions

Looking at it from another perspective, autonomous driving will be launched in rural areas sooner compared to megacities thanks to simpler functions. In other words, cutting-edge vehicles will be launched in rural areas ahead of megacities. Lower vehicle and population density increases the chance to release autonomous driving.

Cutting-edge technology can be applied to logistics service, medical service, commercial activities and government service. Inconvenience in rural areas can be solved along with reducing cost. Since individuals cannot afford it financially, services are introduced by local governments or companies. Automatization is adopted as an alternative to ease labor shortage. Autonomous driving can be used by the wealthy in megacities to ensure even more convenient living conditions, but it is another story.

It can be also said to be a new business model. Once demonstration tests are concluded in rural areas, we can start studying how autonomous driving can be introduced in cities. Autonomous driving which was once a megacity phenomenon is now shifting to rural areas. Cutting-edge technology to be introduced in rural areas will move to megacities in the future. Currently, autonomous driving technology is mainly tested in rural areas with low population density.

How to use travel time

Let’s change the point of view and think about rural area mobility. People will live in rural areas and commute to megacities. As means of fun, how will self-driving cars be set up?

Let’s consider that there is a certain distance between one’s home in the rural area and the megacity. Naturally, the travel time will be long. While cars have to be driven now by the driver, driving will be unnecessary once fully-automatic driving is introduced.

If there is no need for driving and the travel time is long, then the interior will be expected to be more comfortable. In Europe, there is an expression for it “lounge concept.” It has the image of moving one’s space. This thinking is in contrast with car sharing which is gaining popularity in megacities.

There is also an idea called smart house” fusing houses and cars together. Weekdays one remains in the megacity, but on weekends goes to rural areas. The car and its passenger go to an optimum place. When smart houses become reality, car interior space becomes even more important diversifying the ways cars are used.

Implementation period

Regarding the implementation period of privately-owned self-driving vehicles, fixed-route vehicles will be probably launched by 2020, while the technology to allow driving freely anywhere is expected to be completed around 2030. While the technology will be there, it is a different story when people can drive on city roads. As for fixed-route autonomous driving, since it would be no different from bus lanes and train tracks, discussions on reaching the level of driving freely anywhere is important.

In Japan, the words fully-autonomous driving and autonomous driving company seem to go in pair. In Europe, autonomous driving is treated as an extension of technology. In an effort to improve discomfort during driving, Mercedes Benz is advancing the launch of follow cruise control, automatic parking and other cutting-edge functions. By increasing safety and comfort functions, fully-autonomous driving is believed to be reached eventually.

Challenges in connection to the introduction of self-driving cars are development of laws, security and infrastructure development. Regarding laws, they are expected to be gradually put in place, but concern over security remains. As robot taxis become a reality, measures are needed to prevent malicious use such as terrorism. However, the diffusion of robot taxis has also the meaning of returning public transportation to cars which needs to be discussed in the future.

About self-driving vehicles

As a personal opinion, I think of cars as private space. When I ride alone I use that time to think about personal matters, but when I ride with somebody it becomes a place where I share space with someone. Coming up with such situation in the form of public transportation is difficult. Moreover, there is also the joy of driving and the high importance of private ownership.

Automobiles are not merely means of mobility. So, people spend money to purchase them and own them. So, if automobiles are no longer needed to be driven will people put up the cash for them? In a society where self-driving cars become commonplace, I think it will be necessary to think about added value with regards to cars.

About ROAD 2017

The second ROAD meeting ROAD 2017 was held in Japan. Discussion topics were unique issues of Japan which are megacities and the elderly. In Japan, the percentage of the elderly aged 65 and over is higher compared to other advanced countries. However, this situation will reach Europe five years from now. So by discussing Japan’s current issue, I wanted to create an opportunity to think about Europe’s future.

Next year, ROAD is scheduled to be held in Mississippi State. Population density of the US is lower compared to Japan. I think the importance of the round workshop’s topic of “rural area mobility” is very high. ROAD always includes the locality of the venue as one of the topics. This time in Japan, “rural area mobility” was included. Hopefully we will have even deeper discussions next time.

Achievements of ROAD 2017

ROAD is not an academic conference where an audience of 200-1,000 people listen to a lecturer. Instead, after keynote speeches, it focuses on discussions in small groups. Having discussions with people at the same table from other companies helps create close ties.

ROAD 2017 was attended by not only people from Japan, but also from Europe, the US and other parts of Asia. Going beyond countries, it helped create making contacts. Moreover, many students also attended the conference giving students a chance to meet company representatives which may lead to future ties.

Chapter 2: Rural Area Mobility

Discussion Overview and Interview with Moderator

Gerhard Steininger (GFFT e.V.)

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Rural Area Mobility (Working group report)

In the Rural Area Mobility working group, participants discussed the possible appearance of the years 2020, 2030 and 2050 as well as the possible outlook of autonomous driving in these years from the viewpoints of mobility concept, infrastructure, technology, security and law. The year 2020 is close so participants did not expect great changes. However, participants had various views about the years after 2020 and had really opposing future views of 2050. Among the projections were extreme views such as rural areas will become megacities or megacities will gobble up rural areas.

Some shared ideas were that the attraction of rural areas will increase, more and more people will want to live in rural areas, and it will be commonplace that the "last one mile" from the nearest station to one's home will even surpass 20 miles. It was pointed out that since distance and travel time increase which will require autonomous driving. Critical difference between megacities and rural areas will be that rural areas will have less restrictions on autonomous driving so it was pointed out that it is likely that autonomous driving will start in rural areas, which is already shown in different Use Cases in Europe and Asia.

Looking back at ROAD 2017 (Summary based on interview conducted at ROAD 2017)

I was one of the organizers of ROAD 2016, but I felt that this year's meeting was very well organized compared to last year's. The management of ROAD 2016 relied on a large number of students, while I felt that this year's conference was prepared very well and professionally.

ROAD 2017 was special in a sense that it was held in Japan where the Olympics will be held in 2020 whose showcase item will be autonomous driving technology. Another reason for having discussions about autonomous driving in Japan arises from the special characteristic of the Japanese automotive industry. The strategy of German and Japanese OEMs is different. Japanese manufacturers emphasize space and cost efficiency, while German automakers have many premium brands and luxury makers are trying to engage in autonomous driving development. As a result, the introduction of autonomous driving in Japan and Germany will be carried out along different strategies. In Germany, which has many luxury vehicle manufacturers, the emphasis tends to be on "driving experience" rather than on merely traveling from point A to point B. In contrast, a region like Tokyo, where not only automobiles, but also public transportation, such as subways, trains and buses, are evolving, is an environment where it is easy to think about mobility efficiency and automobile ownership efficiency. Learning this point was very significant.

At ROAD 2016 also, discussions were held in separate working groups. Last year, we discussed five topics: Total global fatalities, test strategies, organizational impact, ethical questions and new business models. This time, on the premises that the conference is held in Japan, Prof. Haraguchi suggested to select topics which are important for the advancement of autonomous driving in Japan which were elderly and people

with disabilities, rural area mobility, megacity mobility, social acceptance and autonomous roadmap. These points are not only important for Japan, but also for the entire world.

As the moderator, I participated in discussions about rural area mobility and I took great interest in this topic. Despite Germany and Japan having different traffic system, urban development and road conditions, I was a really valuable experience. Hearing the opinions of Japanese academics and industry professionals was a learning opportunity beyond imagination.

Having ROAD 2018 in the US is significant and I am really looking forward to it. There are many opportunities to use autonomous driving in the US. Moreover, amid growing importance of software which supports autonomous driving, holding the next conference in the US is significant. The automotive industry is facing a challenging era. Everything is changing so we must adapt to survive.

I believe academics, automakers, parts suppliers and engineering firms among others will be invited, but I think it would be important to put more emphasis on the business side of this issue. I think it would be great to talk about potential markets and specific Use Cases and how these markets can be influenced by Use Cases.

Chapter 3:
Future Mobility for Seniors and People with Disabilities

Summary of Keynote Speech 3 and Interview

Yasuyuki Izu (Sekisui S-Lec B.V.)

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When we think about the possibility of autonomous driving for seniors and people with disabilities, we must take into consideration their global population. Looking at seniors, as of 2015 seniors aged 65 and above made up over 30 percent of Japan's population. The same scenario will occur in Germany and Italy by 2020, in Spain, Finland and Greece by 2025, in Korea by 2030, in Canada by 2035, in China by 2040, in Thailand and Chile by 2045, and in Western and Eastern Europe by 2050. In other words, between 1990 and 2050, the elderly population in major automobile markets will dramatically increase.

Meanwhile, the global population of people with disabilities is around 1 billion people, which means that one out of seven people has some kind of a disability. Of which the hearing-impaired accounts for 36 percent followed by the visually-impaired with 20 percent and mobility-impaired people who require a wheelchair with seven percent. Seeing these figures I was very surprised. There are in fact many people with disabilities. Moreover, looking at people with disabilities by age group in Japan, as of 2006 people aged 65 and above accounted for over 61 percent. In view of a growing population of elderly around the world, the number of people with disabilities will increase even further. That is because the issues of the elderly and people with disabilities cannot be treated separately.

Under these circumstances, I think ADAS and HAD (high automated drive) technologies will be capable of supporting the driving performance of the elderly and people with disabilities in the future. Just to give you some examples, since hearing-impaired people cannot hear warning sounds, warning appears on a visual display. As for visually-impaired people, information acquired through cameras, radars and other means can be provided through voice guidance. This way, technology required for autonomous driving can increase the number of elderly and disabled drivers.

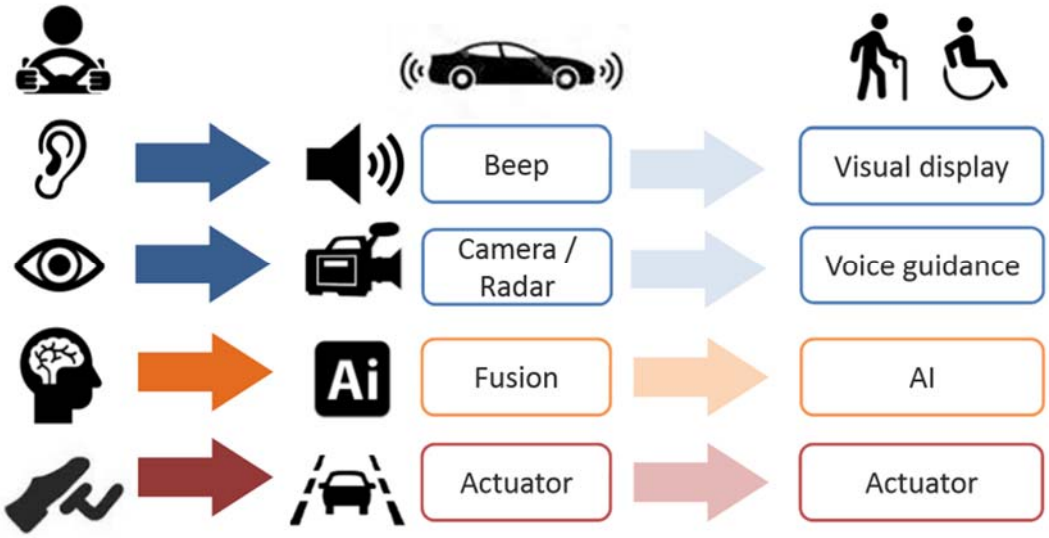
Here, I would like to introduce you the demonstration test on autonomous driving which is taking place in Oberallgäu district by Kempten University. Oberallgäu is a hilly region with lush greenery. Since it lacks public transportation, it is very inconvenient to get around without a car. Subsidized by the government, testing of autonomous driving is taking place here in an effort to accumulate knowhow. Autonomous driving is intended for two purposes. Firstly for the large number of tourists who visit the area, and secondly for roads which are only accessible on foot or by horse-drawn cart. Similar projects are taking place in Oberstdorf and Zukunftsstadt. The total distance is 9 km with a difference in elevation of 200 m. A total of five bus stops are set up.

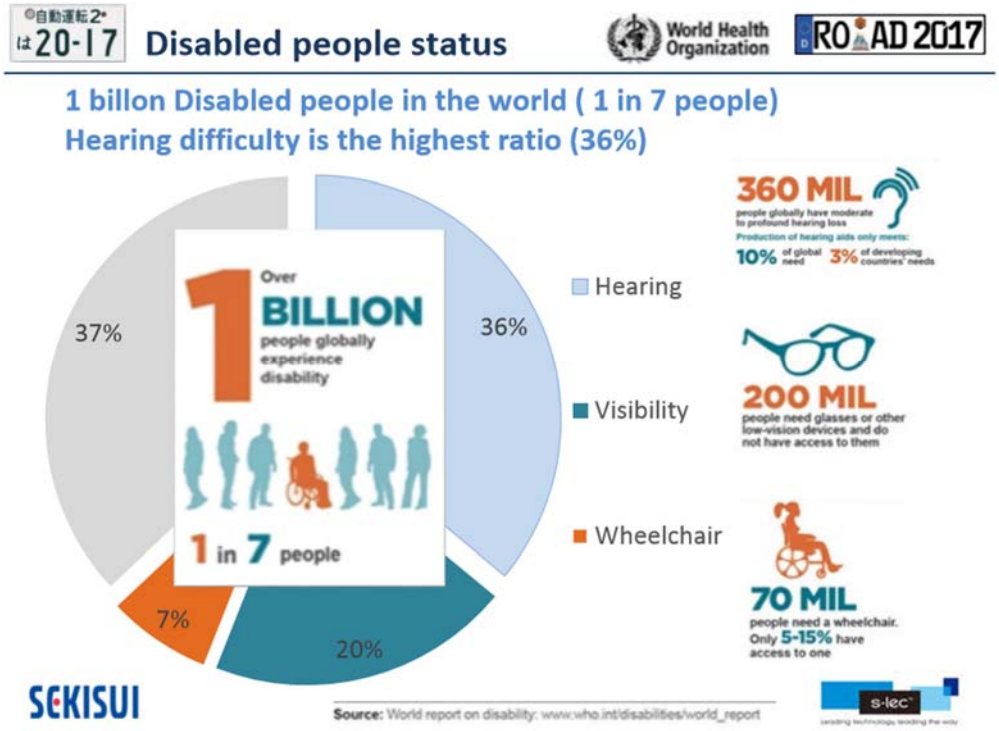
The next step is to set up an R&D framework and improve mapping and scanning accuracy.

Finally, I will introduce one idea on beneficial technology. HMI technology has an important role in the autonomous driving sector and is anticipated to expand. In particular, it is a new technology that enables

communication between automobiles and pedestrians. As a solution for Outside HMI, windshield display, which reflects messages on the windshield, is one of the many important technologies. The projector in the car irradiates a special light onto the windshield, which can be seen by pedestrians, informing them about the car's situation or movement. This technology is made possible by the interlayer film which is affixed to the windshield and was developed by us. This technology is especially useful at night for pedestrians who are unsure whether they can cross the road in front of an approaching car. The car can display a message for instance "Please go ahead" ensuring safe traffic flow.

This technology can also provide various pieces of information to the driver such as speed, outside temperature, navigation, phone and audio devices. The HUD eliminates the driver's need to shift their line of vision by showing the necessary information on the windshield significantly enhancing driving safety. This system is a very useful support for seniors and people with disabilities.





Outside HMI Pedestrian

Application proposal Sub information

Chapter 3:
Future Mobility for Seniors and People with Disabilities

Discussion Overview and Interview with Moderator

Kuniko Urashima (NISTEP)

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Impression of ROAD 2017

Participants held group discussions on five topics which I felt was very meaningful, rather than just listening to lectures. Since I was one of the moderators, therefore I could not attend other discussions, which I regret, but there were many different opinions about the topic I was in charge which made my task easy. Since there were some topics which did not stir much discussion, each topic should have had a more specific framework. Even if we talk about the same thing, given the premises of 2020–2050, participants were thinking very differently about the future. Since everybody's definition was different, it was difficult to reach a common ground. Topics should be refined for next time.

Biggest achievements of the meeting

Being one of the moderators, I only got a vague idea about autonomous driving. I was not sure which areas had to be moderated. The foremost issue is the elderly who live in the countryside with diminishing driving capability. They want to drive, but they should not be let to drive. I think for these people, autonomous driving, which provides safe driving, is very much needed. The absolute minimum which is required from this technology is to prevent collision. Mobility and autonomous driving are two completely different topics. In this respect, this discussion about autonomous driving is from the rider's point of view. It would have been good to have a discussion from the mobility service user's point of view.

No one gave an answer to the energy issue. During idling, energy is consumed. I cannot believe that energy use will decline just because there are no more traffic jams. I am greatly interested in the energy issue.

The fundamental question is whether cars are needed in the first place. Autonomous driving supports people who have trouble driving. Once elderly people get used to autonomous driving, they can go out on their own. However, the elderly are lonely so I think they do not want to go out alone. Those who go out a lot are exceptions, but it is often said that elderly people whose purpose to go to the hospital is to meet people. Viewed in this way, single-seater autonomous driving vehicles might be bad for the environment and bad for the elderly. Rather than that, ten-seater autonomous-driving commuter bus would be better. An aging society requires more and more energy. As the elderly people spend more and more time at home energy so that energy consumption will be increasing. So the question remains whether the promotion of one-seater autonomous driving is better for the society which is aiming for energy saving. When we talk about the aging society, we should be thinking about not the present but we must be thinking about the future 20 years from now.

I often hear the automotive industry saying that they do not want government intervention. Meanwhile, it

is a fact that environmental regulations drive forward technological innovations in the automotive industry. In an effort to do something for elderly drivers, seniors aged 75 and above could be mandated to use only autonomous driving vehicles. The priority should be to create a happy and healthy environment for the elderly without feeling lonely. My aunt who lives in the countryside often uses taxi, but her nearby friends, niece or nephew give her a ride too to save money. But also this is good chance to communicated with people. The use of autonomous driving would isolate the elderly even more. Communication with neighbors and family members could possibly decrease.

The government wants the elderly to live together close to train stations. This would enable energy consumption reduction and ensure healthy and peaceful living. I think bedridden or blind people shouldn't use autonomous driving. Even if it were technologically feasible, society would not accept it. If a blind person were driving and caused an accident, dispute over responsibility would never end. Discussion about autonomous driving for the elderly should be about what kind of mobility the elderly need. The issue of the elderly should be discussed from all angles. Regarding the discussion on autonomous driving for the elderly and people with disabilities, two trains of thought were mixed together, one is autonomous driving for the elderly and the other is future mobility. Participants held group discussions on five topics which I felt was very meaningful, rather than just listening to lectures. I felt this meeting is very interesting to think about future society development.

Even if we talk about the same thing, given the premises of 2020–2050, participants were thinking very differently about the future. Since everybody's definition was different, it was difficult to reach a common ground. Topics should be refined for next time.

Chapter 3:
Future Mobility for Seniors and People with Disabilities

Discussion Overview and Interview with Moderator

Yoann Pencreach (FORUM8)

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Working group report

Since the elderly and people with disabilities have various physical and other conditions, it was necessary to clarify our topic first before starting discussions. Our working group decided to focus on healthy seniors with declining mobility. Healthy seniors wish to actively go out to meet family and friends, go shopping and do similar activities. However, along with aging, people lose their ability to drive safely and they may even have to give up their driver's license. Despite losing certain abilities, seniors who want to go shopping can possibly do so by taking advantage of autonomous driving. One of the goals of autonomous driving is to provide support to people who wish to drive. Seniors characteristically do not want to go out alone. Although there are some people who want to drive by themselves, many people want to talk to friends while driving or go together for trips. However, the elderly are unable to financially maintain a car. Moreover, communication with friends takes priority over driving. What is necessary is a business model for autonomous driving service directed toward the elderly and people with disabilities. Car leasing, robot taxi and other car sharing solutions can use autonomous driving. It is necessary to provide an on-demand, flexible autonomous driving service for low-income groups with diminishing health sponsored by municipalities, private enterprises, hotels and shops.

During autonomous driving, the occupant could undergo health check or engage in physical exercise. Adding added value could recover cost. Autonomous driving not only could guarantee the freedom of mobility, but also could reduce health insurance cost, which money could be used to cover autonomous driving expenses. In the future, societies will need to deal with a larger number of elderly and people with disabilities than today. At that time, it will be possible for people to freely go anywhere. This benefit could be brought about by autonomous driving.

Autonomous driving will not only provide support and bring about happiness, but will also bring about a new merit of society.

Impression of ROAD 2017

It was great that we could talk about some fundamental issues such as where is autonomous driving is heading and what is its purpose. Although we did not reach a conclusion, interesting things came up during the discussion.

Proposal toward the future

I think it should be thought over how autonomous driving can fit into our current social system. The society must create relevant laws. Preparation should start now.

We must think about how automatization affects drivers once autonomous driving is adopted. Alternative businesses must be created for drivers who will be no longer needed. On the other hand, it will give a chance for the birth of new businesses.

Purpose of autonomous driving

Autonomous driving is not developed just because people do not want to drive. “Not driving” is not the purpose of autonomous driving. Meanwhile there is demand for safety and comfort. Autonomous driving allows people to freely use their time while traveling. From the car user’s point of view, it increases the number of options. From the society’s point of view, a mentality must be prepared which accepts that autonomous driving does the driving in place of the user. I want to use autonomous driving as an option. I want to use it when it becomes convenient.

Requirements for realizing autonomous driving

As a car technology, sensing is needed to gather input. Be it whether radar, laser or image data. AI technology is required to sort out collected data. Infrastructure development and upgrade are also needed. Road signals and information from surrounding vehicles are needed to ensure V2X communication.

Education is also necessary. When everything is automatized, everything can be entrusted to the machine; however, there will be a period when both automatized and non-automatized cars will be on the road. So it will be necessary to know whether surrounding cars also have the same functions as one’s own.

Although it is not a bottom-line conclusion, autonomous driving may let pedestrians think that “automated cars will stop no matter what,” letting their guard down. However, once autonomous driving is introduced to societies, new manners may be introduced.

Social receptivity

There are two types of autonomous driving in terms of use. Firstly, used as a tool when the user is unable to drive. Secondly, the user wants to drive but wants driving to be safe. In this case, autonomous driving used as a correction device. Society needs these two solutions.

As a tool, it raises no concern; however, as a technology with capabilities superior to its users, it may make feel people reluctant. People are proud so they may feel inferior to the car.

However, it is highly probable that people’s mindset will change. Or maybe it is different depending on the generation. While the elderly show resistance, younger generations may not find it strange. The youngest generation, which grew up on computers and smartphones and are in their 20s now, find it probably most acceptable.

When computers, smartphones and other new technologies arrived, people said all kinds of negative things, but now everybody uses them. The issue of acceptance is only temporary.

Tasks

Information and ICT control poses a challenge. Competitive areas, AI, sensing and infrastructure are all information systems. The country which has those technologies will win in the future. Ultimately, ICT is the key to the task. There is no chance to win, if it is not created domestically.

In terms of machinery, technology is needed which senses people. The type of technology which can check the health conditions of the driver and the passenger. In other words, human interface is necessary.

Apart from technology, the driver's license system must be revised and new laws are needed. Social acceptance is also necessary. For instance, autonomous driving allows shorter "safe following distance" compared to the current distance. Does that mean we do not have to keep the current safe distance while driving?

I think autonomous driving will be different from country to country. However, there will be common areas. Common areas must be standardized.

ROAD brought up some issues, but I hope it will bring forth some currently pressing issues for discussion.

Finally, virtual reality simulation is necessary for autonomous driving development. Simulation is required to test and verify areas altered by autonomous driving.

Chapter 4: Social Acceptance of Autonomous Driving

Summary of Keynote Speech 4 and Interview

Yoshimi Furukawa (Shibaura Institute of Technology)

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(Summary based on interview conducted on November 28, 2017)

Presentation summary

Regarding the social acceptance of autonomous driving, it is necessary to analyze advantages and disadvantages, as well as examine it from the point of view whether technological progress and legal measures are feasible. In particular, discussions on the social acceptance of Level 3 and higher applications are very important. I want to propose a model for the study of social acceptance of autonomous driving.

Advantages of autonomous driving must be maximized while disadvantages must be minimized. In addition, after taking into consideration technological advancement and social progress, the solution must be clarified and an objective set. Meanwhile, discussions on social acceptance are necessary.

Advantages include improved safety, comfort and efficiency as well as new business opportunities. More concretely, safety improvement it is intended to prevent fatal accidents, reduce injuries, and eliminate driver mistakes and errors. In terms of comfort, autonomous driving can take over operation when the driver is tired or at nighttime reducing the burden on the driver. Looking at efficiency, autonomous driving decreases travel time by reducing traffic jams. It also improves vehicle speed and adjusts the number of vehicles on the road to road capacity. As for new business opportunities, various services such as driverless taxi, car sharing and driverless delivery can become reality. Looking at safety more closely, according to a WHO report, 1.25 million people die in traffic accidents annually around the world. In Japan, highway accidents account for two percent of all accidents and five percent of all fatal accidents. Most traffic accidents including fatal accidents occur on roads other than highways. However, autonomous driving will be first introduced on highways because realizing autonomous driving on other roads is difficult. In other words, the benefits of autonomous driving on safety are small. As for comfort, in Level 2 mode traffic jams cause just as much stress to the driver as in Level 0 mode. Even in Level 3 mode, the driver must pay close attention to the entire system. The driver must pay attention because operation can be transferred from the system to the driver at any time, keeping the driver on the edge of his seat. In other words, it is uncertain that autonomous driving improves comfort at all at this level. The impact will be great in Level 4 and Level 5 modes, but the required technology is extremely complex. Looking at disadvantages of autonomous driving, it reduces driving skills and communication among drivers. Lack of eye contact could raise the risk of traffic accidents. Other possible negative occurrences could be accidents caused by misjudgment or overconfidence. Moreover, hackers could take control of vehicles, terrorists could transport bombs or kidnappers could abduct children. Autonomous driving could increase the number of accidents and traffic jams. Overconfidence or weakened driving skills could result in poor vehicle control. It is also unclear who will take responsibility for traffic accidents. It will be difficult to identify who is responsible for an accident, whether it was the driver, the automaker or the communication management provider. The introduction of autonomous driving could result in unemployment of professional taxi, delivery truck and bus drivers.

There is also the issue of increased cost. Onboard systems, communication systems, road infrastructure and various other investments are needed in addition to the cost of consumer education. Based on the analysis of advantages and disadvantages, and on the evaluation of technological possibilities and relevant laws, careful consideration is needed about the specific solution for autonomous driving. Many players are involved worldwide, each of which with a different idea. After clearing the two major issues technological possibilities and relevant laws, discussions are needed on social acceptance in connection to system cost, social cost, development cost and the objective of autonomous driving.

Impression of ROAD 2017

Various people attended this meeting with various standpoints. It was too bad that we could not find a common objective. Even if the meeting's goal were to summarize a future vision about the practical application of autonomous driving, I felt that the discussions were somewhat light. On the basis of the purpose of the discussions, I think they were not too practical. It is probably because discussions did not move forward on the business side of the issue. Talks were unclear on what of kind business will be brought about by autonomous driving. Who, where and how will benefit from it. What is the economic effectiveness of that benefit. And what kind of business it can bring forward. Talks lacked the point of view which was in my keynote speech.

Social acceptance

Discussions did not touch upon what social acceptance is. It is necessary to evaluate the social value of autonomous driving when it is put into practice. Not only at this meeting, but companies which are involved in the autonomous driving sector in Japan and abroad also fail to consider this issue. For instance, looking at the safety benefits of autonomous driving, Level 3 increases the chance of accidents rather than decreasing it. Even if Level 3 and Level 4 applications were already established, using them on ordinary roads will not be possible in this century. These applications will be only used on highways. But highway accidents account for only two percent of all accidents. And fatal accidents account for five percent of all accidents. In other words, autonomous driving technology cannot prevent 95 percent of all fatal accidents. Therefore discussions about the safety benefits of autonomous driving are not realistic. Even if Level 4 application were already in place, it would not improve safety too much. On the contrary, it could increase the chance of accidents. For this reason, a model is needed to predict the advantages and disadvantages of autonomous driving in each level of application. If it is not done properly, development results will not come through fully.

The merits of autonomous driving do not come when Level 3 or Level 4 is reached. Instead, safety is steadily improving with the development of currently available safety technology. The concept of Level 2 driving assistance technology has been already clearly defined and it is advanced forward with a clear goal of reducing traffic accidents to zero.

Personally, I think the idea to divide up autonomous driving into levels is ridiculous. Rather than dividing up autonomous driving into levels, demand for traffic safety should be divided up. With an ultimate goal for reducing traffic accidents to zero, we need to understand what we need to do and in which step we come near to our goal. I think this kind of classification is very necessary. Discussions should not be based on technology, but on needs. That's why I attended ROAD 2017 and I had a lot of expectations. The whole world should have this kind of discussion. The Japanese government and companies need to clearly state their goal and talk with the international community. Countries all over the world say, "It is a global boom, so let's not stay behind." Automakers act the same. If Toyota says it, Honda follows suit. If Nissan does it, others imitate it. Since plans were put forth without executives fully understanding them, people in charge of technology development are now having a hard time.

For instance, it is not true that autonomous driving can be used in sparsely populated areas. It might be safe for slow-moving mobility scooters but not for ordinary cars which travel at high speed. Autonomous driving-only roads could be a solution, but if they intersected ordinary roads autonomous driving would be difficult. There are people who say that autonomous driving would eliminate accidents, but it is far from the truth. Although Google announced that autonomous driving has become safer compared to human operation, Google's self-driving cars were involved in accidents which would not have happened if a human driver had been behind the wheel.

Human drivers are able to communicate with each other and proceed after understanding each other's intention. In contrast, autonomous driving technology cannot look at the other driver's face, so for instance where two roads merge into one, the self-driving cars are unable to enter the main road. That kind of problem occurs already and can create traffic jams.

There is ongoing discussion on social acceptance without actually clearly defining its meaning. Social acceptance should decide whether there is any value in autonomous driving for society. Even if there is some value but it also comes with some risks which are unacceptable by society then it has no social benefit. It should be thought over whether there is some benefit. Since tax money is invested, development should go forward after evaluating actual social need for autonomous driving.

It would have been better if ROAD 2017 were a place for cool-headed discussions. Doable solutions and fantasies should have been separated. The reason it could not be achieved was because there were only a few people who understood the depth of this technology and could form an overall outlook. Autonomous driving could not be developed purely based on the IT revolution. However, it is a mistake to think that deep learning and AI technology, which were made possible by the IT revolution, will be enough to realize autonomous driving. Too much is expected from AI. It is believed that machine learning and deep learning can calculate and put together software faster than humans. But if AI did it the same way as humans then it can make the same mistake as humans. IT people are wrong when they say that AI is more accurate and computes faster than humans. There should be a place to talk about this fundamental issue.

Valuable areas of autonomous driving technology

One of the areas which could benefit from autonomous driving technology is currently-used advanced driving assistance systems. The collision-reduction brake cannot function if the driver is unable to decide whether he wants to avoid a collision by steering or by braking. Collision-avoidance distance by steering is shorter than the collision-avoidance distance by braking. If the brake is applied when the driver tries to avoid a collision by steering the car becomes unstable. When steering appears to be useless to avoid a collision so the brake is applied instead the collision is unavoidable. If this kind of safety assistance system were upgraded, the brake could be applied quicker by sensing the driver's intention. For higher speeds, the development of such function becomes more and more difficult. So, autonomous driving technology could be used to develop a system which can avoid accidents anytime. That kind of approach is necessary.

Looking at autonomous driving on ordinary roads, most likely areas where accidents could occur must be identified and the improvement of the driving assistance system should start there. The only area where it can be applied is self-parking. The speed is steady, the operational area is limited and practical application has already started.

Similarly to European airports, autonomous driving could be used in areas which are off limits to other vehicles. If there are special roads in place, autonomous driving is a possibility. At low speed with restricted area of operation and without the interference of other vehicles and pedestrians autonomous driving is likely to work well.

Lane keeping and automatic following have already begun on highways. However, that is only keeping

assistance because the driver must hold on to the steering wheel. However, even if in the next level the driver can let go of the steering wheel, he will be still responsible for safe driving. He must be alert just as if he were driving which is very tiring. In fact, it is very stressful and a disadvantage of self-driving in terms of convenience and comfort. Recently, a new function is proposed which can diagnose the driver's condition by having a conversation. However, forcing the driver to have a conversation could be annoying causing stress to the driver so I do not see it as an advantage.

Recently people began to realize that it is very difficult to transfer the control of the car from the system to the driver in Level 3 mode. Various people started to say this, but I knew that from the beginning.

Moreover, following another car on the highway is a feasible function. However, following at 60km/h as was announced by Audi is difficult I think. Autonomous driving has certain conditions which are low speed and the elimination of uncertain factors such as the sudden appearance of pedestrians from the side. If we think a lot about autonomous driving it appears to be not feasible.

Whether these limitations will disappear in the future with the advancement of technology, I think it will be very difficult. Even if technology advances, these limitations will stay. I am certain about it. If speed is increased the impact in the event of a collision will become greater. It is a simple theory. Even if technology advances, the limits of autonomous driving will be the same.

Advantages and disadvantages of autonomous driving

There are a number of things that AI cannot do. One of those is the so called "trolley problem." In the trolley problem one must decide whether the trolley should go left and run off the cliff or go right and smash into the wall. In another version of this thought experiment one must decide whether the trolley should go left and kill a young woman or go right and kill a wealthy elderly. AI is unable to choose between the two choices. It is almost an impossible undertaking to enable AI to make an ethical choice.

Another thing that AI is unable to do is to notice its own mistake. Humans can also mistake a shadow for a traffic lane. AI can also mistake some area for a road. The answer to the question whether AI can correct itself when the situation surpasses its capabilities is no. It can detect a broken sensor or a dead battery, but it is unable to correct a mistake. It is difficult to address the issue of misrecognition which can easily happen.

Full automatization is not sought after by users. Simply technology is heading toward automatization. The main objective is to reduce traffic accidents to zero. Heading toward that goal, autonomous-driving assistance system is intended to be upgraded. A roadmap is needed on reaching accident-free operation. Within the framework of driving assistance, it is absolutely necessary to create driving assistance with the use of advanced technology, and through that advancement reach accident-free operation. This is the roadmap I came up with. A roadmap based on demand.

The ideal form of driving assistance is which protects the driver without making its assistance obvious. When the driver of such car feels safe and has a piece of mind then the car is in fact safe. In case of danger the system intervenes but without making it noticeable. The type of assistance which makes the driver feel confident is feasible at any speed. Taking all this into consideration, I think the best would be to change the current objective and aim for the reduction of accidents to zero by 2030.

Discussion on reducing traffic accidents to zero

Ninety five percent of traffic accidents are caused by erroneous operation by the driver. The elimination of erroneous operation is also the objective of people who promote autonomous driving. However, the construction of this system concept is strange. Development should not be based on technology but on demand. Demand must be carefully analyzed and the appropriate technology must be selected which creates

demand. The role of HMI should also be considered. The extent of technology development should be clarified based on the analysis of accidents.

Driving assistance still lacks a major function which can evaluate the driver's condition and whether he can recognize hazards. If this function is not in place, the system cannot provide the appropriate support. Although line-of-sight detection technology is under development, it is far from to be completed. Well-made HMI technology and technology which can understand the driver's intention are imperative. These technologies are different from automatization.

Since the definition of autonomous driving is vague, making it an objective is strange. Ultimate safety is having no accidents at all. Autonomous driving technology is a tool and its purpose is to eliminate traffic accidents. Over 1.2 million people die in traffic accidents every year around the world. This figure is comparable to the crash of five Airbus A380 aircraft every day. Rather than driving manners, most of these accidents occur because of lack of alertness or mental fogginess. So just by alerting the driver would be very effective to reduce accidents. However, apart from sounding an alarm, the driver should be informed about the type of danger. It is possible to significantly reduce the number of accidents just by alerting the driver.

Upgrading connectivity

Connectivity is a good technology which can be expected to improve safety. Toyota was the first company to commercialize V2V communication. It is very important to aim for this type of new solutions. It is difficult to prevent right-turn accidents, but if cars could communicate with each other, then there is a possibility to avoid such accidents. However, the biggest issue is Navi's self-position estimation. GPS location received from the satellite has a margin of error of 20–30m. If a few more of the Michibiki-class quasi-zenith satellite systems were put into orbit then the margin of error could be reduced to several tens of centimeters significantly improving communication technology.

As for the development of the connectivity infrastructure, automakers follow various paths. Toyota chose the 700MHz band from the 80s, while Honda and Nissan selected the 5.2GHz band also from the 80s.

Initially Toyota tried the 5.2GHz band but later proposed the 700 MHz frequency band which has a greater range than a high-frequency signal. However, even if frequency bands are not unified globally, communication is still possible by the adjustment of communication tools and software to the global market. Choices will increase as the connectivity infrastructure develops further.

Expectations from ROAD 2018 held in the US

Moving toward next year's meeting, I think the format of discussions should be changed. Rather than focusing on technology, the focus should be on demand. Discussions should be about how to realize ultimate safety, what kinds of services are effective and the like. It is necessary from the user side to clarify efforts made toward accident-free driving as well as advantages and disadvantages of autonomous driving. Advantages and disadvantages are not equal. It is necessary to look at disadvantages as well and strengthen areas which are crucial for people. It is also important to understand to what extent these areas should be enhanced. Now we are moving forward without a clear direction. Although we are not facing the Galápagos effect, but I feel we are just running forward without gaining a firm foothold.

In order to gain a foothold, discussions are needed on demand. It is necessary that all relevant parties in Japan take part in these discussions. Even globally, this issue is far from going smoothly. I wonder how Volvo's practice of loaning and offering test drives to the general public will turn out. The head of Google's Waymo project changed twice since the start. Is it because people who are actually involved in the project

find it impossible? Since Germans often use the autobahn, they have a strong feeling about using autonomous driving on the autobahn. Audi says that the A8 can run at 60km/h in self-driving mode; however, it goes against the regulations of a number of countries. So even if the car is put on the market, many of its functions cannot be used. Even in Germany, it is likely that Audi will tone down some features after it realizes its limitations.

Japanese automakers realized in the beginning that it cannot be done, but German automakers believe that somehow autonomous driving can be used on the autobahn. There are some people who say it is possible. It also depends on how much the driver understands about the system. If the user uses the system but has the notion that it can fail then that is fine that way. However, it is very dangerous if one puts too much trust in it.

It would be very important to gather the three major players in the automotive industry under one roof. There are people in the US and Europe as well who believe that this issue should be tackled by focusing on needs. It is necessary to have talks on the advancement of autonomous driving. There are people around the world who share the same vision about autonomous driving. These people should get together and have realistic discussions.

Chapter 4: Social Acceptance of Autonomous Driving

Discussion Overview and Interview with Moderator

Ichiro Kageyama (Nihon University)

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About the round workshop

Our discussion topic was “Social Acceptance of Autonomous Driving.” We set 2050 as our target year and tried to predict what will happen then and to what extent will be autonomous driving adopted by society.

Heading toward 2050

First we took into consideration what we need to think about as we head toward 2050. When we think about conditions of 2050, its process is also important. The two key points were whether autonomous driving technology is heading to the right direction and whether it fits into the image of 2050.

However, we did not reach a conclusion on this topic. The main reason for that was that participants had vastly different opinions on current conditions and conditions of 2050. The year 2050 feels like it is still far away, but is that so? Some participants thought that automobiles will be fully autonomous and the social structure will undergo great changes by 2050. In contrast, others thought that 2050 will not be that different from 2017.

Although 2050 is 33 years ahead, 33 years ago it was 1984. How did the environment which surrounds the automotive industry change since 1984? Although new technologies such as battery electric vehicles, hybrid vehicles and partially automated driving have been introduced, but did the social structure change much? To what extent did it change?

In Japan, the average lifecycle of a car is said to be less than 13 years which means 2050 is 2.5 generations away. The question remains whether cars will be fully autonomous in 2.5 generations.

In the end, we divided our various opinions into two groups “visionary technology of the future” and “realistic thinking.” Although there were various opinions on the process toward 2050, we could not narrow it down to an all-encompassing opinion.

Autonomous driving technology

We inspected the issue from a different point of view also, which is how society will welcome autonomous driving technology. Since initially fully-automated cars will be extremely expensive, how these products will be introduced. It is important to think about where autonomous driving technology will be applied. Someone said that such technology will be first used for large freight trucks as well as for public transportation such as taxis and buses. Taking into consideration initial cost, it is easier to launch it in the public transportation sector.

If the service routes are fixed, the system construction is relatively easy. In Japan, the work conditions of parcel delivery workers and the insufficient number of drivers are becoming social issues. In addition, profitability of public transportation in sparsely populated areas is posing another problem. In response to

these problems, if autonomous driving could be proposed as a solution, social acceptance would be easier.

For instance, initially large trucks on highways could adopt autonomous driving technology. They could run in convoys with only the very first truck driven by a human driver. All the other trucks could be driverless. Taking into consideration safety and decreasing number of drivers, it could be an effective solution said one of the participants.

Meanwhile, as for buses, the primary target would not be public transportation buses but school buses and courtesy buses with fixed route. Courtesy buses could run between a specific station and the company. Someone said that it could be easily introduced because the number of stops is limited.

As for taxis, Uber is currently gaining ground. Although Uber has human drivers, it is an internet-based service. If it were replaced with robot taxis, public transportation could possibly further expand. As we near toward autonomous driving, I think it could make one of the potential target areas.

Locality

It is necessary to separate the use of autonomous driving into urban and rural use. It is because the two areas need different technological level and content. There was an opinion that since rural areas are safer than urban areas, autonomous driving should be introduced in rural areas first. However, there was an opposing opinion that rural social infrastructure is less developed, so urban areas should come first.

Two types of autonomous driving technology are necessary. A fully-automatic type which uses its own sensors for navigation. And an environment-dependent type which gains necessary data for navigation from the surrounding infrastructure. The former one can be used in rural areas, while the latter one in urban areas.

This issue led to a discussion about which technology could be possibly introduced first. Most believed that it is easier to introduce cars fitted with their own sensors than building up a pricy social infrastructure. Moreover, taking into consideration social needs, social acceptance of means of mobility for the elderly which is posing a problem in sparsely-populated areas would likely to be greater.

Diffusion in passenger car sector

Since fully-automatic vehicles are believed to be very expensive in the initial phase, passenger car purchases will likely to be limited to the wealthy. Someone said that car sharing will gain ground as private ownership will be too costly. For instance, if one fully-automated car is maintained by several people, individual cost would go down.

Already, a growing number of people think that car sharing is convenient. One of the participants of our workshop who lives in Yokohama borrows a car whenever he has to go on a business trip to Nagoya by using car sharing. He said that it is very convenient for domestic business trips and travel. I think it is realistic to share ownership of a fully-automated car with several other people

Using smartphone and the internet, it is easy to use car sharing. Fully-automatic cars are expensive, but car sharing can reduce individual cost.

Regarding the elderly, we will enter the information society era after 20-30 years. Looking at today's elderly, especially the people above 80 years old, there are some who never used the internet or a smartphone. Twenty-thirty years from now, people who are currently in their 50s and 60s will be in their 80s and fully adapted to the information society era. I believe there are not too many people currently in their 50s and 60s who never used the internet. From this aspect also, I think the introduction of automated cars used primarily for car sharing will be one of the starting points of automated driving.

Tasks

One of the major issues raised during the discussion was that traffic rules will be needed to be adjusted to autonomous driving. Setting up lanes used exclusively by automated cars for instance will be indispensable for efficiently using autonomous driving.

There are also security concerns. A driverless car must be linked up with the internet which means that the threat of hacking cannot be ignored. I strongly believe that the key to diffusion is whether a system can be put in place which ensures safe driving. It will not be accepted by society if there is a threat of terrorism.

In terms of safety, there is the issue of responsibility. In Japan, mandatory insurance coverage has been decided for up to Level 3. However, liability for Level 4, in which application the car can run in fully-automatic mode, has yet to be decided. As a driver, I want to think that I am not liable for accidents in fully-automatic mode, but can automakers take full responsibility?

Although in Level 3, responsibility lies with the driver, how operation will be transferred back and forth between the system and the driver has yet to be resolved. It may be said that the introduction of autonomous driving is difficult as long as the issue of stopping safely in a dangerous situation is not resolved.

In terms of social acceptance, it is necessary for drivers to change their way of thinking. How do drivers feel when they see a driving school car or a car marked with a beginner driver or elderly driver sign? They feel the urge to overtake the car in front. On one-lane roads in rural areas, where people cannot overtake each other, drivers behind such cars feel frustrated. So what happens when a driverless car drives slowly in front of someone? Will he unconditionally accept the situation?

Introduction scenarios of autonomous driving

The comprehensive analysis of our discussions indicates that introduction should start in the cargo transport industry and the public transportation sector due to high cost of self-driving vehicles. Looking at our topic “Social Acceptance of Autonomous Driving,” if autonomous driving could resolve current social issues, it would be readily accepted. Some of these issues are for instance driver shortage in the transportation industry and public transportation in rural areas which are facing an aging and shrinking population. In these areas, society would readily invest even in costly self-driving cars. If there were social consensus, it could easily reflect on rules and regulations set for self-driving cars on public roads.

If we think about this scenario as out primary scenario for introducing autonomous driving, then it will be easy to develop laws. Although there was an idea that autonomous driving makes driver’s licenses unnecessary, I think in the initial stage it will be necessary to establish a special license system. Self-driving cars will surely have a complex electronic system. So in case of a malfunction, it is indispensable that users have some sort of driving ability.

Similarly to the current automatic-only driver’s license system, which does not allow driver’s license holders to operate a manual car, a special driver’s license should be issued to autonomous driving vehicle users. It can be limited to drivers in the cargo and public transportation sectors. The implementation of specialized training would be relatively easy.

After successful performance in the cargo and public transportation sectors, it is highly likely that self-driving passenger cars will be also introduced. Of course people are thinking about the fast introduction of autonomous driving limited to highways, but I think the launch of fully-automated cars will not be easy. Even setting the launch date at 2050, the release of automatic passenger cars will be difficult I think. It is more reasonable to think that self-driving will be limited to the cargo and public transportation sectors.

Global situation

A fully-automated society requires infrastructure network. Countries around the world have various level of enthusiasm about it. Developed countries, like in Europe where advanced traffic networks are in place, are going forward the fastest. Next is probably Japan which also has a favorable environment for introduction.

Looking at Europe, a straight road connects Lyon with Marseille on which fully-automated cars could travel easily. A concerning matter is traffic circles. Although there are no traffic circles on highways, but there are many traffic circles built on ordinary roads. Self-driving vehicles could maneuver through traffic circles but more technology will be required.

On the other hand, in the US distances between cities are great and there are many places without guardrails along suburban roads making the introduction of fully-automated driving a time-consuming task. Naturally, some autonomous driving functions will be launched early, but driverless mobility between cities faces many issues. Unlike in Europe or Japan, collision with animals, rollover and flat tire frequently occur on intercity roads in the US.

There was an opinion that the intention of governments in developing countries is greatly affected by various factors. For instance, apart from automobiles and motorcycles there are also cows and other animals on the roads in India making it impossible to clarify traffic rules. Autonomous driving requires lane recognition technology, but it is common that four cars travel next to each other on a three-lane road. These and other circumstances make autonomous driving problematic. As a result, it is no need to say that it will take a lot of time to implement autonomous driving.

Looking at rural areas of Japan, infrastructure development is not underway. If the government made a strenuous effort, infrastructure development would be possible. If infrastructure development were included in government policy, a fully-automated society could come earlier compared to other developed countries which already have the necessary infrastructure network in place.

Chapter 4: Social Acceptance of Autonomous Driving

Discussion Overview and Interview with Moderator

Bela Peterson (University of Applied Sciences Kempten)

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Report on Roundtable Workshop Regarding Social Acceptance

During our roundtable discussion, (hosted by Prof. Dr. Ichiro Kageyama, Nihon University, and myself, with five expert rounds, each round with approx. 5-10 members coming from the automotive industry or universities, with a standardized agenda and an open discussion with partial "graphical recording" of the talk) we pondered over the meaning of the words "acceptance" and "social". In order to conceptualize these two terms, we used the theory of diffusion of innovations, coined by Everett Rogers (see Rogers 2003). Following this author, it must be recognized that imitation and innovation are important keys for social acceptance.

But in the case of autonomous driving, social acceptance was not the first goal: Its routes in military applications come first, followed by scientific competitions and the third step now occurs by bringing Advanced Driving Assistance Systems (ADAS) into serial production (for development and definitions, see a holistic perspective: Peterson (2014)). Now, the benefit for customers and more broadly the society of ADAS comes more into focus as the public's willingness to pay determines the success of this game-changing technology. "What is it good for?" is still an important question which needs to be answered. It has been pointed out many times that there are advantages in bringing autonomous driving into serial vehicles. From an economical, ecological and social perspective the following table summarizes the advantages and partially reflects the roundtable discussion:

Economical	Ecological	Social
New business opportunities e.g. for regional products or local created energy	2nd chance for cars non based on internal combustion engine	Reducing number of citizens involved into a motor crash and reaching goal of vision zero
Cars as part of the internet creating new business opportunities	Increase capacity of the roads and avoid over-utilization of nature e.g. for new roads	Have quality time while the car is driving
New possibilities for components like HMI-system, wheel, brakes, lock-system, lighting concept	Automatization of charging for electrical vehicles supports positive its market diffusion	Synchronization of law and technology
Investment in infrastructure for high technology like telematics, lane systems etc.		Deliver new benefits for customer target groups (e.g. parental control of car use)
New business offers like pay as you drive/ pay as you use		
IP-address linked with the internet can match geographical with economic data		

Source: Adapted from a workshop by the author: EuMW 2014 Conference in Rome, Italy.

By evaluating an innovation such as AD from economical, ecological and social point of views, sustainability could be used as a generic term. In fact, understanding the economic circumstances, becoming environment-friendly and serving to the social system is a leverage to increase revenues. This is why

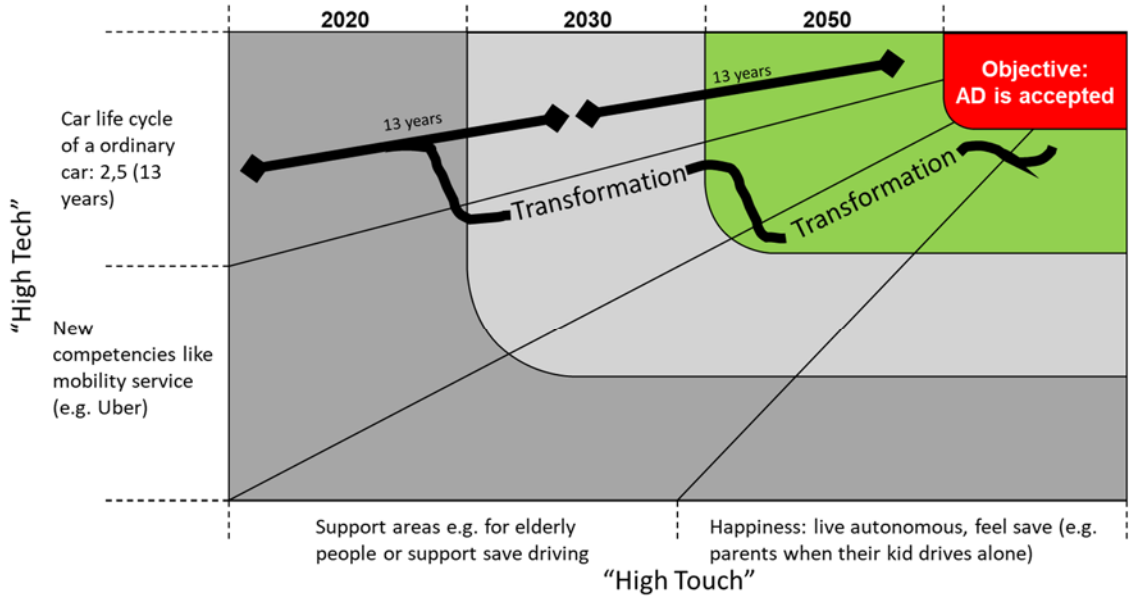
sustainability should be a core element of all future innovation activities, strategies and strong visions of companies. Enterprises that define sustainability as their goal will reach competitive advantages, but in parallel this increases the complexity of products and processes (e.g. Vehicle-to-Infrastructure, agile development etc.). This is why we came to the conclusion that the concept of autonomous driving has an intricately intertwined existence.

In order to deconstruct the 4b-topic despite its complexity we used system theory and current transitions research* on a very high level. With the experts of our roundtables we discussed several societal changes that are necessary to support new technologies like Autonomous Driving (AD). All agreed on the fact that nowadays AD is a main topic for the automotive industry in terms of currently tough competition on technical concepts to gain future revenue streams.

*(see https://transitionsnetwork.org/wp-content/uploads/2018/01/STRN_Research_Agenda_2017.pdf, last checked 18.3.18)

Showing the need

Haraguchi (2015) points out that "adjusting the technology advancement to the speed of human sustainability" is vital to creating a kind of "social sustainability". Is society prepared for the transformation of giving power to the vehicle, to a driver who is not a person anymore? Does this work in a more radical way, e.g. when the driver is at home operating the vehicle, will this be accepted by society? It can be assumed that the transformation to reach the final objective, the acceptance of AD, is a slow process. Cars have a life cycle of about 13 years. This means that until 2050 we can expect 2.5 cycles where AD technology needs to be integrated. In parallel, new competencies, new segments and new benefits will occur, not overnight, but more incremental. This competence swap is shown in the picture below. We see a transformation from high technology to customer segments, represented by high touch. High touch stands for openness, acceptance and positive perception for new technologies like AD.



Source: elaborated while discussion with roundtable experts

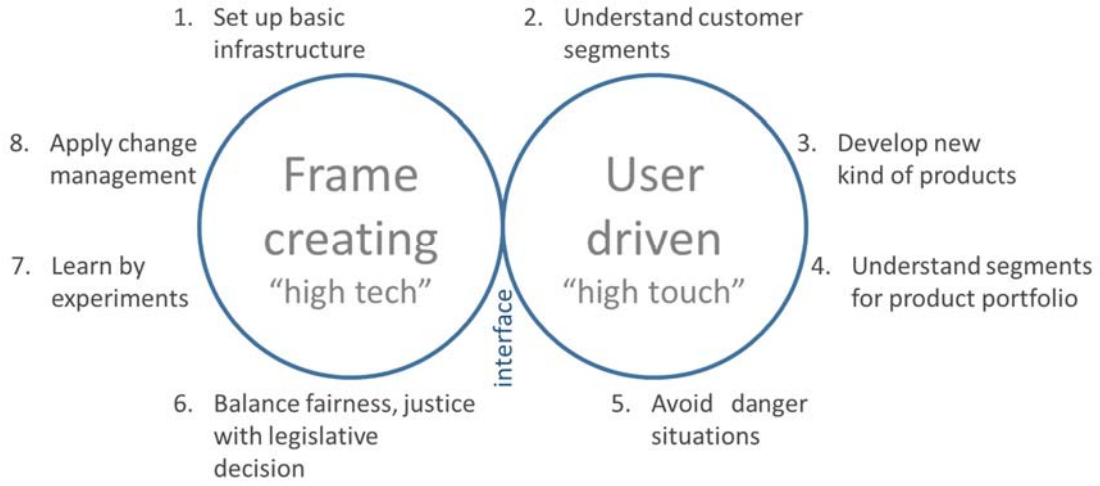
Acceptance e.g. of elderly people depends on age and other high-tech experience like use of smart phones, grade of disability, requirements for speed and/or distance or avoidance of traffic jams. In 2050, AD technology is mature, reliable and e.g. elderly people are not afraid of high tech like AD. Instead, they are heavy users of this new technology.

A sustainable innovation is preventive and enforces actions at one point in time in order to avoid unwanted consequences at some future time (see Rogers 2002). If we understand innovations also in that sense and not only technical, broader visions and solutions come into discussion on new requirements before they are worked out in the product development processes.

So, understanding innovations in a broader context opens the way to understand social innovations. They are necessary to accompany high tech products. E.g., high tech produces with automatization new benefits but also destroys plenty simple jobs, done by blue- and white-collar workers and employees.

Concept - Eight areas summarize the roundtable discussion

The concept of sustainability combines multiple views which cover social, economic and ecological elements. While diffusion of innovations consists of imitation and innovation, acceptance is crucial for new technologies like AD to spread out. During the conference ROAD in Nagoya, Japan (8./9.6.2017), I pointed out that there are eight areas influencing the societal acceptance of AD. There are two main areas that help to distinguish between those: “Frames” and “User”. One major aspect is the preparation of the stage for high tech like AD. But, as pointed out, imitating an innovation is vital for its diffusion in a social system. Technology needs acceptance, high touch should be reachable. Both aspects are linked through an interface. If an interface exists, positive aspects regarding social acceptance will probably arise. The eight areas presented during the discussions and represent the social acceptance:



Source: elaborated while discussion with roundtable experts and afterwards

1. Set up basic infrastructure

Setting standards is very important, as we can tell from different charging philosophies in Japan, Europe and North America. Local standards for communication or products are not sufficient - global standards that allow travelling through different countries, especially in regions like Europe, are vital. Since autonomous technology also requires the development of appropriate infrastructure, it is difficult to think of a solution based on personal interests or on economic rationality. The management of data shared with self-driving cars through the cloud is considered a sensitive issue, especially in Japan and Germany. This requires a cautious approach to the handling of data. This infrastructure (e.g. 5G, common and open data protocols to exchange data) needs to fulfill safety and security requirements. Data cloud control and “private data” could be a solution to win the trust of customers. It is necessary to differentiate between public and private cloud. Dangers, associated with data handling, were pointed out (see also 5). It is important to

include the region, so that equal infrastructure is supplied. After big public discussion, investment decisions are necessary.

2. Understand customer segments

During the roundtable discussion several customer segments from non-user to robot-taxi were identified and evaluated by social acceptance, constraints, target groups and affordability:

AD Vehicle / Acceptance	Non users	AD School Bus	Heavy Duty Vehicles	Transport of elderly people	Company Cars/Bus	Local Bus	Private Cars	Robot Taxi
Social acceptance (estimation)	▪ Low	▪ Good	▪ High, e.g. in case of platooning (highway)	▪ High	▪ Easy ▪ Shuttle principle	▪ Easy Connect with train	▪ High	▪ Safe to go home in the night
Todays constraints	▪ Rejection of technology development	▪ Unattended transport of kids if automatizati on happens	▪ Loose of jobs for drivers of trucks	▪ Cold machine – people relation	▪ High effort	▪ High effort	▪ Fear to loose control	▪ High costs
Target group	▪ n/a	▪ Kids ▪ Parents	▪ Company owners	▪ Hospitals ▪ Elderly people	▪ Workers	▪ Public transport	▪ All drivers in Japan, EU, US, China	▪ Public transport ▪ Women
Affordability ○ Costs low ● Costs high	○	○	◔	◔	◔	◔	●	○

Source: elaborated while discussion with roundtable experts and afterwards

Another possibility to take advantage of autonomous driving is providing vehicles that carry cargo e.g. for inner-city logistics. But to reach this social acceptance is crucial. In particular, as has the potential to make mobility comfortable in rural areas, it will be accepted with all likelihood. Developing the infrastructure for autonomous driving requires the investment of taxes, therefore after social acceptance, the reallocation of technology and capital will be two major issues. Since major investments will be necessary, autonomous driving for privately-owned passenger vehicles will most likely start out from the luxury vehicle segment. However, the market scale is likely to be unavoidably small for the premium segment. Inclusion of lower vehicle segments helps gaining market shares. In contrast, self-driven buses can be shared by many users reducing the burden on individual users. For this reason, it can grow to become an important market segment. Following our discussion, privately-owned luxury vehicles and public buses are believed to become the two major segments of autonomous driving. By applying it to school buses, the service area of self-driving vehicles could expand especially in rural areas, acquiring wide-scale social acceptance.

Thinking in a long-term perspective, social change becomes extremely big. Residential areas will undergo multiple changes when we take a closer look at the development of work styles and new jobs in the future. In some areas it will be better to use autonomous driving, e.g. when we think of bus drivers and social change in some areas.

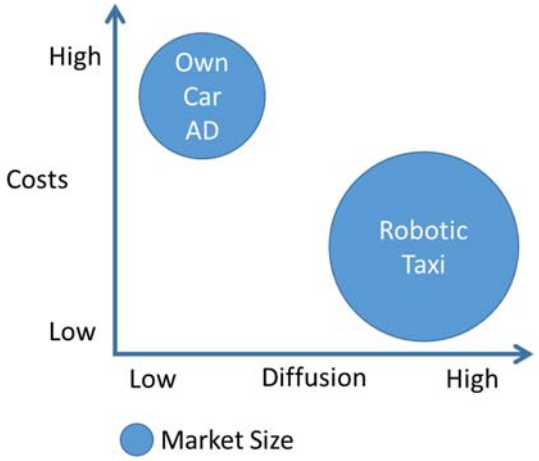
3. Develop new kind of products

One example for the industrialization of ADAS, which is more and more implemented in serial production, gives a hint on the massive change between the interaction of man and machine: The Parking Assistant. This feature supports comfort and safety for the driver and pedestrians. Its functions reduce the risk of small crashes that are the reason for 40% of all accidents at a speed under 40km/h. By matching measurements done by sensor technology and ultrasound as well as through feedback by actuating elements in steering, brakes and speed-up, this ADAS feature works even when the driver is near to the car and maneuvers the parking process e.g. via the key or with the help of a Smart device.

When we have advantages or new features like the Parking Assistant, why is it important to also discuss the social acceptance of autonomous driving? The Example of the Parking Assistant is a first step into the divorcees of man-machine interface where the driver physically has a steering wheel in his or her hand and uses pedals in parallel to steer the vehicle into its parking lot.

4. Understand segments for product portfolio

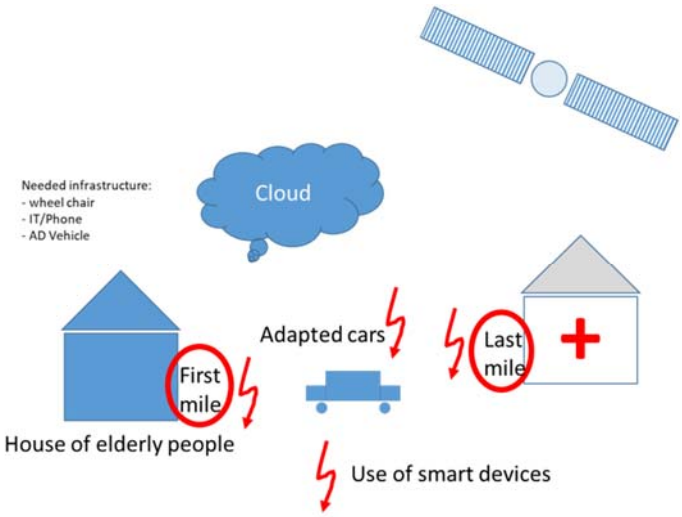
It is important to understand the difference between two segments: If you have your own car, which is equipped with AD functions, the individual costs of ownership are higher compared to those of robotic taxis. Robot taxis will claim a bigger market segment in the future.



Source: elaborated while discussion with roundtable experts and afterwards

An example of adapted cars or robotic taxis is shown in the picture below. People want to have control of their life at every moment of their lives. But it is also commonly known that people accept automation when it is possible to drive by themselves. Sharing Mobility will be accepted by people if they save or improve the environmental situation (save money, water, etc.)

Constraints for elderly people to use AD
Experience giving up control
Vehicle not reliable (at least in the perception)
Standards have to be accepted (e.g. IT-Infrastructure, Billing)
Vehicle with included Robot
Combined wheel chair with vehicle
HMI - Design - Usability - Different modes (gesture, speak)



Source: elaborated while discussion with roundtable experts and afterwards

5. Avoid dangerous situations

The possible occurrences of dangerous situations were pointed out with regards to considering autonomous driving as the next big thing. Unfortunately, this technology becomes interesting more and more for hackers, too. They could take control of such cars. Only one incident could have a negative effect on the reliability of the entire technology. For this reason, the issue of reliability of technology should be carefully considered.

- Avoiding Hostage of AD
  - Hackers can open the car
  - Legal issues
  - If it happens, 10 years of marketing work are necessary
- Eye contact
  - Check drivers' faces
  - Pedestrian – driver "situation/communication": Check eyes of pedestrian
  - Eye contact can be internal or external

6. Balance fairness, justice with legislative decision

Despite the fact that there is a worldwide trend that people live in urban mega-cities, understanding demand from rural areas is a chance. It is important to allocate tax-money for region and cities. Another topic is to develop an understanding of ethical questions, coming up by more and more digitalization e.g. of mobility. E.g. in Germany an ethical commission elaborates ethical guidelines for cyber security, safety, a fair data management or accountability.

7. Learn by experiments

Automated driving is a well-known companion of the automotive industry thanks to new players like UBER or Google: But, before making business even for these giants, it is necessary to understand failures and its causes by using prototypes testing e.g. LiDAR radars on the vehicles roof or test cloud based services and limitation in data transfer. E.g. the tests performed by Google led to 341 incidents within 14 Months (Source: lecture Green Mobility at the joint event on Friday): Out of these failures, 69 were classified "serious". This number proves that, technically speaking, many topics in the controversial field of data management and mobility are not solved yet.

De-central Platooning	Central Platooning
Human driver all have AD; Platooning by chance	Human driver 1st vehicle, then all the other only AD
	But: More planning needed (build train, connect, disconnect at target)

Source: elaborated while discussion with roundtable experts and afterwards

So, making real (but not on public roads) experiments and more simulation is the first step for common use. How about fear of loss of control? Use of the sky? Transportation: Maybe shape of cars is changing. Agreement on standards is important, too (which standards have impact on social acceptance of AD)?

8. Apply change management

Thinking in a long-term perspective, social change influences the weak areas like the social system, especially of western societies. Taking into consideration future work styles and new jobs, residential areas will undergo change. Taking bus drivers as an example, regarding social change and areas, it is believed

that in some areas it will be better to use autonomous driving instead of a bus. In consequence, education of younger people should adapt the future changes in current curriculums. Another weak area is the creation of new jobs to balance the loss of jobs which will be caused by enormous automatization potential in several areas of daily life. Therefore, social innovations are very important, too.

Changed Jobs	New Jobs
Bus driver	Operator e.g. to conduct 10 busses in parallel
Maintenance of infrastructure	Energy Management
Cook	Social innovation manager
	Robot for individual or work purposes

Source: elaborated while discussion with roundtable experts and afterwards

Impression of ROAD 2017

The plan was well conceived, the staff was kind and the topics were well defined. Especially the inclusion of non-technical aspects opened the door for strategic topics in combination with technology. This is very crucial to achieving the same level of business model creation. I met many new people and overall, I am very satisfied. What is more, I think it was a wonderful idea to hold this meeting in a temple. I could get a good picture of Japanese culture and possibilities.

Achievements of Road 2017

It is difficult to point out one great achievement, rather it yielded many fine points. What made the biggest impression on me was the keynote speech on mobility for the elderly and people with disabilities. Although autonomous driving will bring about negative as well as positive effect on society, nevertheless it will be enough to make people and society happy as a whole. Although happiness is not an area that engineers of autonomous driving really focus on, I think it is important that development is carried out with making people happy by delivering new and astonishing benefits.

Purpose of autonomous driving

Many standards and methods of advanced technologies needed for autonomous driving have yet to be put in place. However, some of these undecided areas will influence the future trend of autonomous driving technology. While I am concerned about this, sustainable evolution of innovation is important when we look at the society 100 years from now. Sustainability is a common topic of autonomous driving and large cities. Cities are places where sustainable evolution is needed, socially and economically.

In my thinking, although automakers cooperate to develop technologies, they tend to not share standards with others. Creating technological standards is a process of making everybody use the same standards. For instance, AUTOSAR is a renowned process in Germany. New players have entered the autonomous driving segment. IT companies and new automakers such as Tesla. In this situation, competition and cooperation have been optimized. Coopetition (competition + cooperation) is now becoming a major issue in the automotive industry.

For example, efforts are being made to replace driver's licenses through smart phones. It would enable young people to drive without a driver's license. In Germany, people can acquire a driver's license when

they turn 18 years old, but autonomous driving would enable younger people to use automobiles. Connecting cars with smartphones is an area that I am very much interested in. In that case, it would be unavoidable for IT companies that handle smart phones and automakers to cooperate. ADAS is more than electronics that deserve being welcomed. Major achievements can be obtained through the cooperation of many players. These development methods should be adopted.

Challenges of autonomous driving

It goes without saying that the issues are automobile technology and infrastructure. However, I think another problem is the path dependence. Consequently in the world, the selected mechanisms and systems are weeded out by the evolution principle and the competition principle. In other words, they are not all rationally selected. For instance, a certain manufacturer invested a large sum of money to develop a diesel engine. Once it is developed, it is used until something very unusual happens. It is used because the manufacturer wants to see its invested capital back. In other words, autonomous technology decided upon by automakers and suppliers in the next 5-10 years will determine the direction of autonomous driving technology in the years after that. Accordingly, discussions about the determination of such major directions should not be done by a few manufacturers, but should find an open platform.

While each player in the autonomous driving sector is engaged in self-development, I think there should be open cooperation to go for new and better services.

Summary

The diffusion of high technologies such AD should be seen holistic. The understanding of the interface between frames and user is crucial. By investigating more in the field of the eight named areas the interplay of market entry of AD and social acceptance becomes shaper contours. Another important role is in the field of social innovations. By drawing a big picture, the understanding of AD will be improved if social aspects are in discussion, too.

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Chapter 5: Roadmap of Societal Implementation of Autonomous Driving

Summary of Keynote Speech 5 and Interview

Bert Wolfram (Continental Automotive Corporation)

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(Summary based on presentation conducted at ROAD 2017)

Continental is improving mobility to be safer, more comfortable and more efficient through technology advancement and product development.

Regarding safety, we have made “Vision Zero” our long-term goal, the vision of accident-free driving which is realized step-by-step from zero fatalities, zero injuries to zero accidents. I believe technological advancement improves safety. Actually, the Japanese government announced that the number of fatal accidents was around 3,900 cases in 2016, dropping below 4,000 cases for the first time since in 67 years. According to the government, this low figure comes not only because of better road safety, education and road conditions, but also because of growing adoption of ADAS technology and other technology improvement. At Continental, ADAS is driving forward the implementation of automated technology, serving as the key to realize “Vision Zero.”

Continental introduced radar sensor driving assistance system to the Mercedes Benz S-Class for the first time in 1999. In 2003, we began to supply color HUD to passenger as well as commercial vehicles. The image is projected on the windshield enabling drivers to receive vehicle and peripheral information without shifting their line of sight. In 2008, we began to supply automated emergency brake system to A-segment small vehicles. In 2013, we became the first supplier to acquire a testing license for automated driving in the US to conduct testing on public roads in Nevada State. We brought that test vehicle to Japan and started public road testing since 2014 and a total of 18,000 km testing on highways has been conducted. In 2016, we began to supply the latest brake-by-wire system, an important component of automated vehicles as well as its production of 48V mild hybrid systems. In other words, we are focusing on automated driving, electrification and connectivity.

Continental is considering three technological applications with automated driving. The first is Cruising Chauffeur (SAE Level 3) for highway/freeway environments excluding entry ramps and exits, including handling of traffic jams and stop-and-go traffic. The system is planned to come out at the end of 2019. The second application is Automated Parking. According to a report, about 40 percent of all collisions occur at low speed. The implementation of automated parking would not only ease traffic jams, but it would also reduce time for searching for parking spaces. The third approach is Self-driving Car which includes “robo taxis.” Although demand pattern would depend on the region, there is need even in non-urban areas where demand for automobiles is significant.

Continental is working on six key building blocks as automated driving work packages: 1) Sensor technology, 2) Swarm connectivity, 3) Dialogue between human and machine, 4) System architecture, 5) Reliability and 6) Acceptance. First of all, the performance level of sensors, which are the eyes of the car, must be improved. The acquired data is integrated into a 3D image. This data must be shared with all servers

and not with only one, maintaining constant information exchange. Swarm connectivity is necessary to ensure information exchange. Continental's dynamic eHorizon receives updates based on data from other vehicles' sensors and from other sources in real time. Not only eliminates the dangers of blind spots, but it also predicts the possibility of oncoming cars. This technology is much like the sixth sense that people have. However, the problem remains how automated driving cars and conventional cars on the street can communicate with each other. I think we will move forward from connected technology to swarm connectivity. As for HMI, I think it is necessary to establish who is responsible for what and to what extent. From this viewpoint, it is necessary to come up with a legal framework and standardization. Regarding HMI, we should consider standardization which is easily understandable for everyone.

For this kind of technological development, simulation only is not enough. There is also a need for demonstration. In 2014, Continental brought a test vehicle equipped with automated driving system to Japan to test it on highways. We were curious about unique Japanese driving conditions such as left-hand driving, intersection situations, road width and cornering. For the development and validation of automated driving systems the collection of test data is crucial. This type of technological development and testing is underway also in Japan. One of them is SIP (strategic innovation and creation program) which is promoted by the Japanese government, and Continental is participating in the project.

Apparently Japan is aiming to realize automated driving by 2020. I think the entire industry should join forces to resolve problems, develop appropriate laws and carry standardization.

Human interface technology is extremely important for Level 3 automated driving. It is difficult to create a technology for transferring driving between the driver and the system. In addition, automakers have various approaches. Currently, Continental is proposing a next-generation full-color HUD for the automated driving era. Various pieces of information are placed over the actual scenery, ensuring safe driving conditions. Information is combined with the actual objects seen by the driver.

Ensuring reliability is the foremost issue regarding development. Regarding automated driving, high product reliability is needed. Gaining trust of the public is very important for social acceptance of automated driving.

Olympics will be held in Tokyo in 2020. Demonstration of various automated driving technologies is expected around the Olympic venue.

Since automated driving consists of various factors, it must be developed as a product which is safe, comfortable and environmentally friendly. Automated driving is intended to be realized under Prime Minister Shinzo Abe. However, Continental is convinced that the possibility of fully-automated driving will be realized between 2020 and 2025. An important unresolved issue is the development of laws. I think we need to join forces to solve this and other issues.

Continental launched a public and independent website 2025AD.com to promote a global conversation on automated driving. This is a forum to discuss all technical, legal and social aspects of future mobility, helping to build consumer acceptance and trust on this topic. All stakeholders from industry partners, academics, politics, and society are invited so that we can all work together to define future conditions for automated driving in a more appropriate and reliable way.

Future mobility starts earlier with Continental
Innovation Highlights

1999 – First Market Introduction Driver Assistance System

Since the first series project in 1999 for the Mercedes S-Class,

The company has realized more than 100 projects for OEMs ww

2003 – First to Market Full-color Head up Display

Continental has served as the supplier for several of the industry's manufactures for a long time.
The company is offering this technology for passenger car and commercial vehicles.

2008 – First to Market Autonomous Emergency Brake

Also first to market with AEB for A-segment.

Safety is the pre-requisite for Automated Driving, Continental has been providing "Safety for Everyone"

2013 – First Automotive Supplier - Receive Testing License for automated driving

License granted in Nevada, US.

In 2014, the test vehicle was brought to Japan to continue public road testing on highways.

2016 – Technology Leadership

MK C1 – Latest generation of **integrated brake system**

48V Hybrid Driving System

Seamless Mobility
Automated Driving - 3 Technological Applications

› Cruising Chauffeur

1: Start from your own home

› Automated Parking

2: The vehicle park itself

› Driverless Vehicle

3: Reach your destination with the robo taxi

Chapter 5: Roadmap of Societal Implementation of Autonomous Driving

Discussion Overview and Interview with Moderator

Keiichi Motoyama (Mississippi State University)

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Impression of ROAD 2017

It was a bit off from my expertise, which is conceptual design, but it was a wonderful opportunity to have discussions on autonomous driving for two days at ROAD 2017. It was a new way of communication. We could also receive reference information on next year's ROAD event which will be held at Mississippi State University.

Although various entities are making large-scale investments in the autonomous driving sector, I think that competition will mainly surface between Japan and countries other than Japan. At that time, I do not want Japan to go through a bitter experience. Despite having very good technology, Japan is weak in the areas of business model and standards. ROAD has an impartial position and I believe it is not connected to any particular entity, but it is necessary to come up with a method for not getting hurt businesswise. In this respect, regarding autonomous driving development, it is probably necessary to identify Japan's special characteristics and have discussions about them. Facing toward the future, I think Japan will do its best to develop the necessary technology for creating a good automobile in the autonomous driving sector.

For this reason, it is very important to think over one more time the purpose of autonomous driving. It is a very important technology; however, it appears that it is driven by feeling of competition. So, its purpose must be thoroughly discussed one more time. Preparation for autonomous driving should be done thoroughly in order to not to lose in the end.

Autonomous driving is a technology which will make the society better and more convenient. It should be linked with the aging phenomenon and it must reflect on products. Autonomous driving is a good technology, but it requires infrastructure development and government regulation. In addition, it must have a practical business model as well. If not, the product is bound to run into the red. It must be profitable in all aspects.

Social reception is a difficult topic. There is no correct answer because there are always people who have a different opinion on certain aspects. Therefore, there must be a good leader and leading function. I want someone to lead with real intention.

When people think about the function of automobiles, they will come up with different answers for the purpose of autonomous driving depending on their social background. Some look at cars as leisure items, others as tools, so depending on these approaches the purpose of autonomous driving will be greatly different. If cars are looked at as means of transportation from place A to place B, then there is no need for a steering wheel. Then the function of cars could even be considered as an overnight flight. If the trend goes to that direction, cars might become something very different.

The greatest agenda of autonomous driving, its fundamental importance, is safety. Once safety is outlined,

we can start talking about cost. Safety is the most important aspect.

Aspiration toward ROAD 2018

ROAD 2018 will be held at Mississippi State University. As a professor of that university, I want to make it a very good meeting. I want Mississippi to be the meeting's special feature. Since it will be held in the US, there will be many American participants. I am hoping that we can have deeper discussions through the participation of Americans.

Although some people identify the US with Los Angeles or New York, those are only parts of the US. The majority of Americans live elsewhere. One of those other places is Mississippi State where many people live. Although they are different from people living in Silicon Valley, but I hope it will present an opportunity to talk about the purpose of autonomous driving with average Americans. Looking at it from my field of study that is conceptual design, we could talk about autonomous driving for two days which was trying but also very significant serving as a new communication channel.

Chapter 5: Roadmap of Societal Implementation of Autonomous Driving

Discussion Overview and Interview with Moderator

Rolf Adomat (Continental Automotive Corporation)

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In order to think about the roadmap of autonomous driving, our working group selected three milestones 2020, 2035 and 2050, and discussed what could happen by those dates. We can easily come up with several keywords and agree that those keywords are important events for the deployment of autonomous driving; however, the difficult part is to tell when those events will occur.

Our main topic was divided into four areas and discussed in order.

1. Ownership / Shared cars in 2050,
2. Infrastructure / Deployment until 2050,
3. Interaction with humans, and
4. Legal aspects / Homologation.

Before starting discussions, we selected the three likely countries that will lead autonomous driving. For 2020, we selected Japan, Germany and the US. For 2035, there was a disagreement whether it will be China or India. And for 2050, the top three candidates were India, the US and China.

Another aspect that aroused interest apart from autonomous driving was automobile ownership. The ratio of private ownership and shared ownership is expected to change with the advancement of autonomous driving. Our presumption is private and shared ownership will be on the same level by 2050.

Our first topic was ownership. Almost everyone agreed that shared mobility will increase in the future; however, we had disagreements over the rate of increase. Some put it as low as 20 percent while others placed it as high as 80 percent. Some argued that cars will become your personal companion and will communicate with the owner creating a special attachment for the owner. Moreover, not only for individuals but also for the entire family cars could become emotionally close. In other words, private ownership would not disappear. In addition, some argued that even if autonomous driving gains ground, the number of people who just want to drive for fun will increase, therefore private ownership will continue to rise. Simply put, we have not found a common ground regarding this topic.

Our second topic was infrastructure. We reached a common understanding shared-use means of transportation namely robot taxis and robot buses will be launched by 2020 in rural areas. Since infrastructure development will require major investments, it must be done gradually to gain understanding of the public. Confidence in technology will increase while the public views advancement in autonomous driving and its various achievements. It is of great interest that we all agreed that autonomous driving will fully enter megacities after 2050 due to the difficulties to interact with various traffic participants.

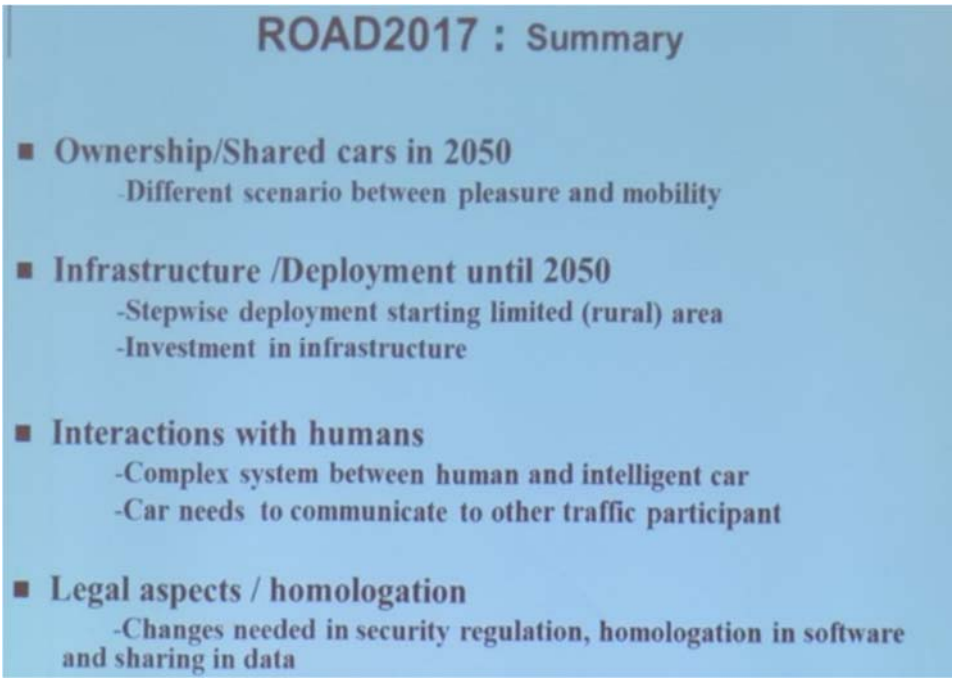
Regarding human-machine interaction, interaction will not be limited to the driver and the car, but will include occupants, pedestrians and other drivers. Since it is necessary to create communication among various traffic participants, this undertaking is extremely complex. While putting self-driving cars on the road, the complex interaction of cars with people must be further studied and accumulated information must

be used to create a next-generation of self-driving cars. Since such work has not been done before, it will require a huge amount of data to be accumulated.

As for the legal aspects, autonomous driving will bring forth new risks requiring countermeasures against cyberattacks and hacking. It will also be necessary to create driver's license exclusively for autonomous-driving vehicles, similarly to driver's licenses exclusively for AT vehicles. Homologation of autonomous-driving vehicles will be also necessary. In particular, software management will be a very important position for the system validation. At this point, there are no clear measures in place in this area. In addition, the shared use of various data such traffic accident data must be realized. A system for shared-use data has yet to be set up, and the usage of data has to be defined; however, it will be important to enhance safety of autonomous driving in the future.

In conclusion, looking at the roadmap of autonomous driving toward 2050, whether private or shared ownership will be more prevalent will depend on whether people attach more importance to driving for fun or to mobility. Infrastructure development will start in rural areas and gradually expand. Investment in infrastructure must increase also.

As for interaction with humans, it will require a complex system to achieve communication between driver and the car. Autonomous-driving cars must also communication with other traffic participants. Looking at legal aspects, safety regulations, homologation of control software and laws on data sharing must be enacted.



Epilogue: Road to ROAD 2018

Tetsunori Haraguchi (Nagoya University)

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Many researchers and engineers around the world are currently discussing autonomous driving based on means and not on purpose. However, I am afraid that it will not grow up to long-lasting technology unless we start with discussions on "what is necessary for autonomous driving in the first place?" ROAD was launched with agreement of Japanese and German researchers on this idea.

When many researchers and engineers to get together, it is natural that their discussions will shift to means and methodology. The first ROAD in 2016 in Bavaria, Germany could not avoid this trend perfectly. Later in Germany TechROAD started as a sister meeting. This is a discussion place of technologies and methodologies which are not the priority of ROAD, thereby clarifying the originality of ROAD which is a discussion place of the purpose of autonomous driving.

Technology development based on the idea of “seeds” is also valuable. Seeds are new technologies which are created with no apparent use, but have the potential to change the world. Geniuses can come up with great seeds, whereas ordinary people cannot. Ordinary people can probably earnestly think about the purpose. In other words, seeds-oriented and object-oriented approach both have a role. A technology which has firmly founded on purpose lasts long. A technology which makes people happy and increases people’s ability lasts long.

To implement technology in society properly

Considering the development period and lifespan of individual cars, we need to develop cars which are suitable for the society 15 years from now. In other words, we will create the upcoming future by those cars. Looking at the next twenty to thirty years ahead, there is an inevitable direction that society is heading. When considering the purpose of autonomous driving, we must cope with this social direction.

We should avoid deducing the future from the present technology and applying present methods and means to anything in the future. Ideally saying, for example, we should at first design a clear image of society of 2030. Then, we derive methodology and means to achieve that society and our themes will be positioned there. In this way, we will not mistake the way of applying technology to society.

Hosting ROAD 2017

From the experience of the first ROAD in 2016, I felt the need to invite participants from the United States. The second ROAD in 2017 had participants from the State of Mississippi, USA. It can be said that we were able to take a new major step toward ROAD's aim of sharing globally the purpose of autonomous driving.

For ROAD, it is not important to discuss and make clear the purpose of autonomous driving in each region and each country. Rather, we are comparing the differences among them and looking for common points. Common points of the purpose of autonomous driving across countries and regions will form a platform for autonomous driving. Several platforms will be prepared, same as the hardware platforms which are currently prepared for the world market.

Deep discussions about the purpose of autonomous driving have just begun. The result of ROAD 2017 was not perfect yet comparing with the ideally high and deep viewpoint of ROAD. But it was within our assumption because it was still the second meeting of the first round. Next time it will be held in the US

and then return to Europe again. This around-the-world approach will be able to proceed the meeting to the next level. Furthermore, I think it will approach the ideal form by making a second round and a third round around the world.

Format of roundtable on ROAD 2017

For example, someone suggested let's provide mobility to the elderly living in sparsely populated areas using fully-autonomous driving. However, would that make the elderly happy? Is not it a lonely solution? People want to talk to friends not only when they visit the hospital, but also when they move around. A manned taxi would make the elderly happier. Of course, they are even happier when they are given a ride by a family member. Rather than providing fully-autonomous driving technology to the elderly who can no longer drive, driving assistance technology, which addresses the issue of highly-skilled taxi driver shortage, would provide essential support.

The first three topics set up for the working groups were Megacity, Rural Area, and Elderly and People with Disabilities. In some ways, those feasible future topics were set in order to stimulate discussions and got a level of success. However, it did not reach an ideal level yet to concrete social design.

The fourth topic social acceptance was positioned as a discussion to come after discussions on the purpose of autonomous driving. Discussions touched upon how autonomous driving should be realized, who will fund it, who will take responsibility and whether it is ethical. After summarizing all these issues, we tried to talk about the roadmap of autonomous driving as the fifth topic.

The problem on ROAD 2017 was that we could not discuss them in order and we discussed them simultaneously. This point was inevitable due to the program construction and I think some participants felt it as well. I would like to ask these participants to come again and let's deepen discussions next time.

Heading toward ROAD 2018

Since the social implementation of autonomous driving is nearing, it is urgent to set a purpose which is shared by everyone. ROAD is intended to be continued with great respect toward the identity of each year's host. During the preparatory discussions of ROAD 2018, someone proposed that instead of having moderators report on discussions, panel discussion by moderators should be held and consensus should be extracted from the discussion.

Having the next meeting at Mississippi State University will enable ROAD to complete its first round of three main regions, namely Europe, Asia and the US. The second round will be held in a different European country, a different Asian country and a different US state. This way I am hoping that a network will take root which thinks about the necessity and purpose of autonomous driving.

Epilogue: Road to ROAD 2018

Daniel Carruth (Mississippi State University)

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I welcome the continuation of ROAD in Mississippi in 2018. Activities at ROAD 2017 created friendly relations which will lead to future ties. From here on, let me say a few words about my beloved Mississippi. I will start with the history of Mississippi State University. Established in 1878, the university has a long history. It started out as the Agricultural and Mechanical College of the State of Mississippi. Now it is a university with various engineering and sciences academic units. It has 160 undergraduate and 44 doctorate courses, and has a student body of 26,000 students.

Mississippi State University is also deeply involved in the automotive industry. We have ties with Japanese research institutes of Toyota and Nissan.

In the autonomous driving segment, we research ADAS, off-road SUVs, agricultural tractors, transport vehicles and industrial vehicles. We research the relationship between automobiles on one hand and pedestrians and roads on the other using VR as well as communication between self-driving vehicles and pedestrians. We also have conference infrastructure in place as well as entertainment facilities. And the nearby area is rich in nature. I anticipate your participation at ROAD 2018 which will be held at Mississippi State University in 2018. I would like to continue the success of ROAD 2017 next year and use all my power to support the conference in order to realize new achievements.

Impression of ROAD 2017

ROAD 2017 was a very valuable event. I met various people and was able to networking. New ideas arouse by talking with many people.

I attended ROAD for the first time, but personally I am very excited about next year's ROAD 2018. Let me say a few words about my personal impression. From this year's discussions I gained the understanding that even if we discuss the possibility of autonomous driving in rural areas, the Japanese countryside and Mississippi's countryside are totally different. An important point about concerning international cooperation in connection to autonomous driving, the recognition of autonomous driving will further increase by the earnest participation of the US. The State of Mississippi is the center of autonomous driving. It is an algorism and software development center. It is also an advanced driving system center.

The significance of holding ROAD 2018 in Mississippi does not stop with the automotive industry. Other areas involved are technology application, off-road autonomous driving and autonomous driving of agricultural machinery, all these topics becoming characteristic features of ROAD in Mississippi. Mississippi's industry is not large and industrial activities focus on development. Nevertheless, we are the organizers of the Mississippi Automotive Manufacturers Association. The association is deeply interested in autonomous driving so I expect their participation. Mississippi is characteristically a rural state. Cities are not big, and city centers and rural areas are separated. For this reason, the question is that who will invest in infrastructure development to realize autonomous driving. Roads are also less than adequate. As a result, rather than attracting industry, the state is trying to attract R&D facilities. In Mississippi, trucks do

not travel on roads, but on farmlands.

The significance of holding ROAD 2018 in Mississippi is that we focus on the research of autonomous driving in rural areas. For this reason, I want to invite relevant corporations and government officials from all over the US.

My personal desire for autonomous driving is to be able to go to the seacoast which is eight hours away. I would like to go home to my family at night, have dinner together, get in our self-driving car and wake up the next morning at the beach, spending the weekend there. That is my dream.

Appendix: ROAD 2017 Sponsors

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Next Meeting:
3rd Roundtable for the Purpose of Autonomous Driving (ROAD 2018)

ROAD 2018 will be held at The Mill Conference Center, Starkville, Mississippi, U.S.A., from May 29-30, 2018. The host institute is Center for Advanced Vehicular Systems (CAVS), Mississippi State University.

http://www.marriott.com/hotel-info/gtrsv-courtyard-starkville-msu-at-the-mill-conference-center

PROCEEDINGS

2nd Roundtable for the Purpose of Autonomous Driving (ROAD 2017)

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