Activities relating to automated driving

Masamitsu Waga

ITS Policy and Program Office

Road Bureau

Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

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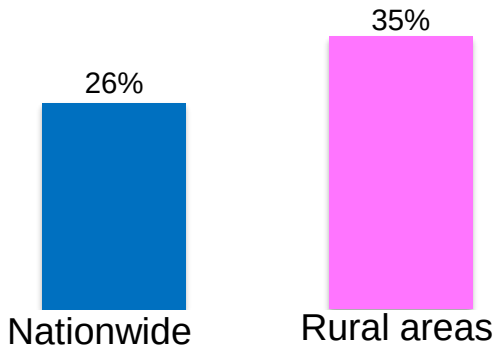
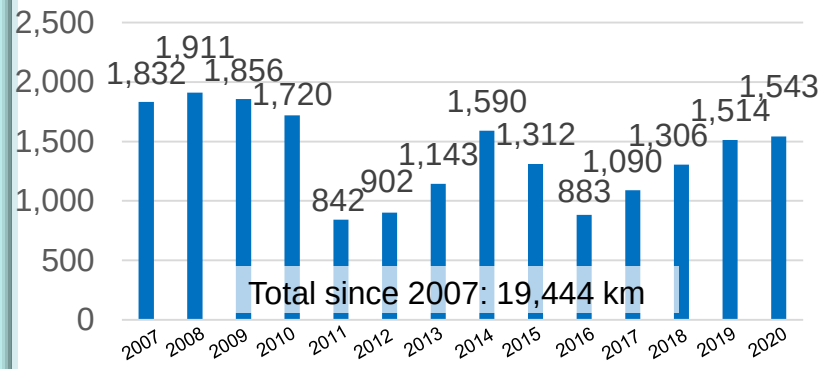
Challenges facing rural areas

Comparison of aged population (2015)



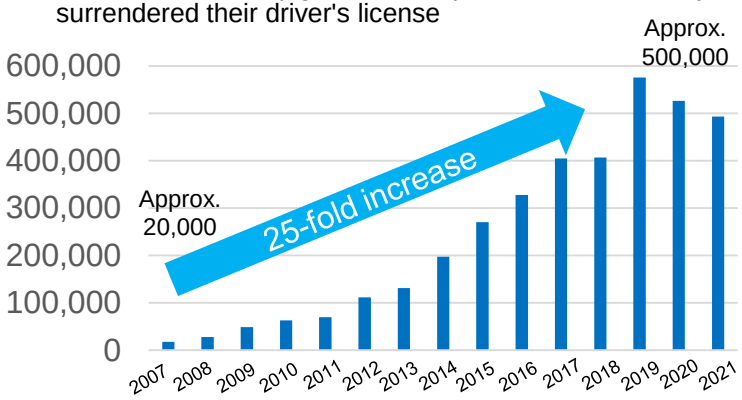
Total length of discontinued regular bus routes

It is difficult to go shopping or to the hospital because of a lack of adequate public transport.

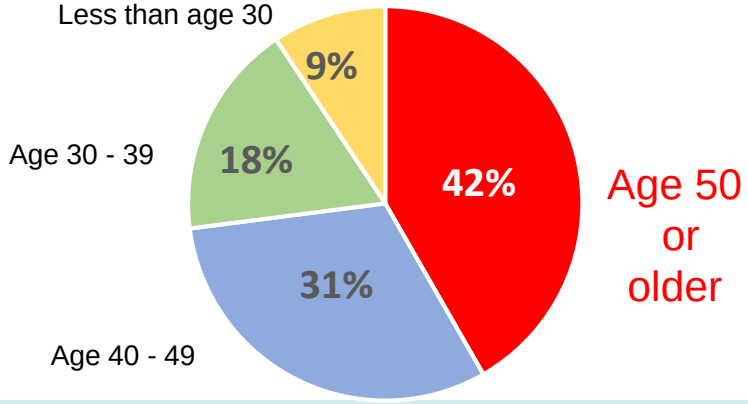


Rapid increase in senior citizens who cannot drive

Number of drivers (age 65 or over) who have voluntarily surrendered their driver's license



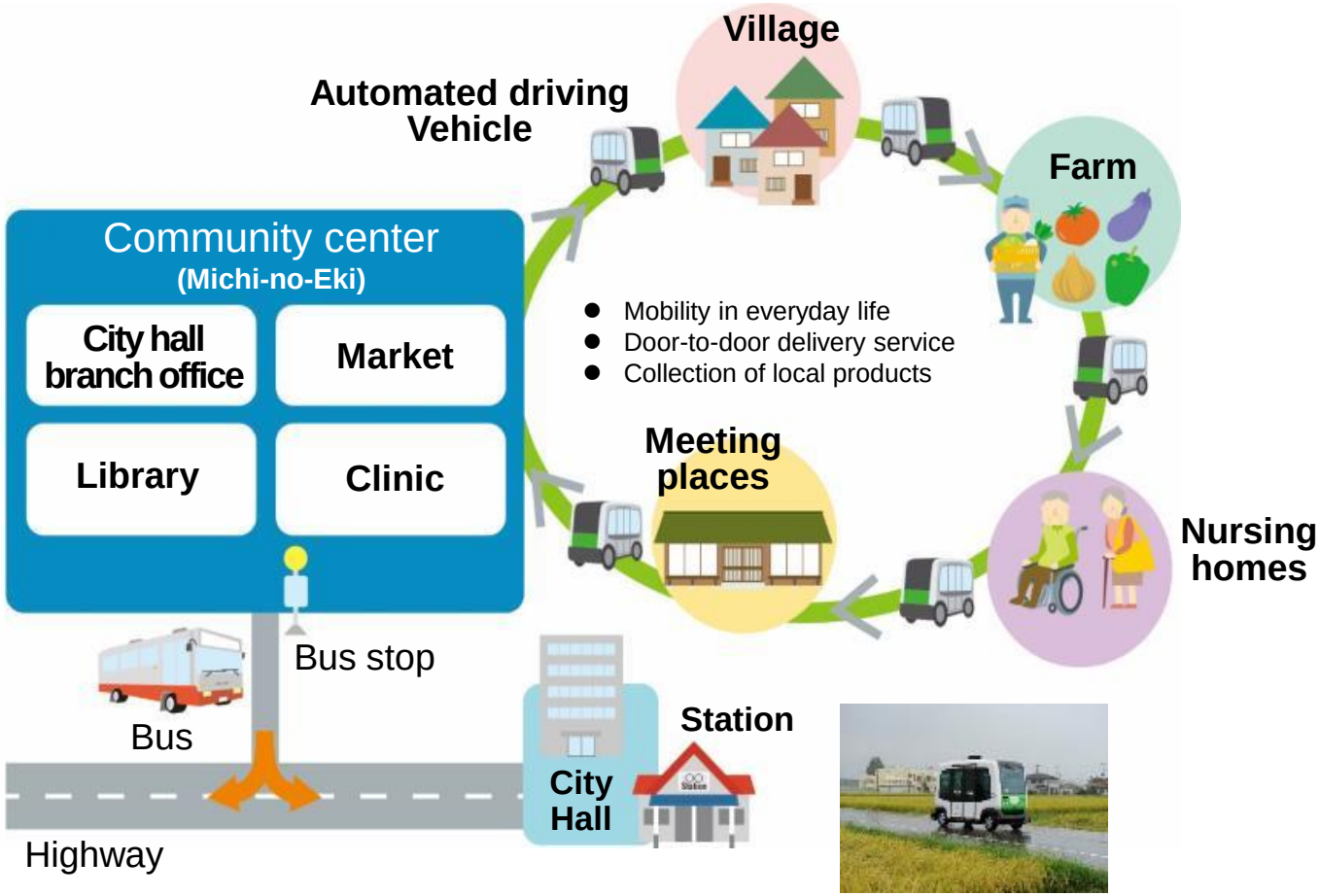
Lack of home deliveries due to truck driver shortage



Continuation crisis of villages in rural area

Automated driving services in rural areas

○Expected to sustain transport of both people and goods, and to contribute to further local revitalization.
○A series of FOTs of automated driving services based at Michi-no-Eki started in 2017.



AV : Automated driving Vehicle

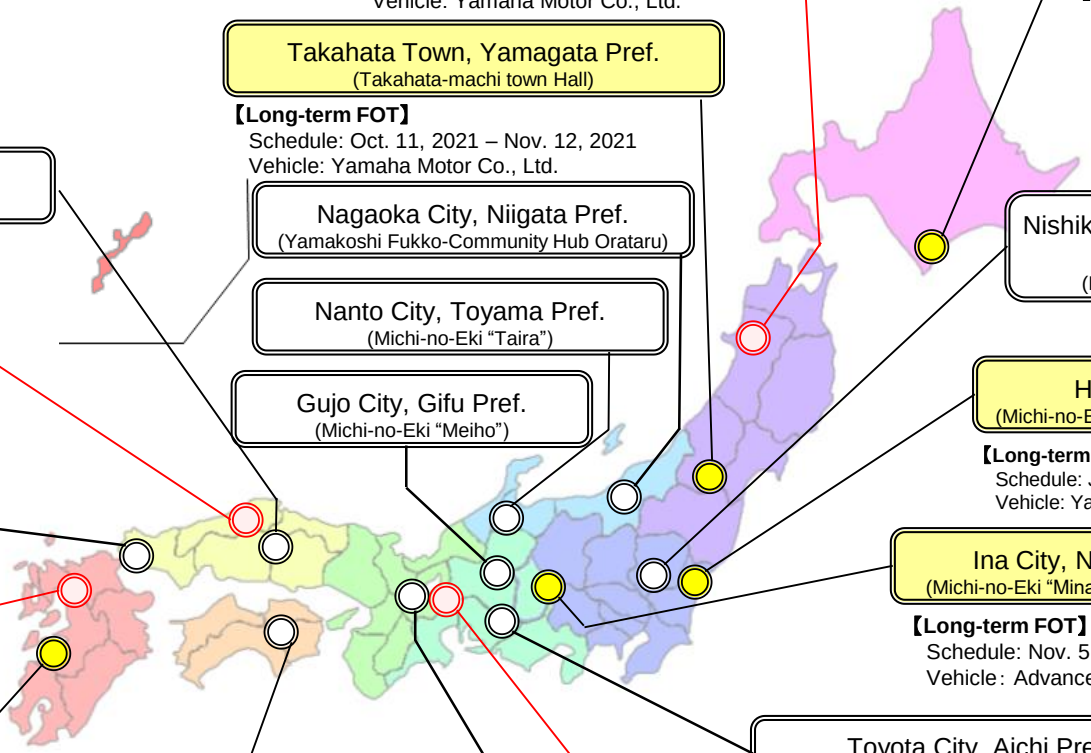
FOTs have been deployed in rural areas

As of September 2022

Short-term FOTs
◎ FY2017～2018 : **18** (* including both long-term and implementation service)

Long-term FOTs
○ FY2018～ : **9** (* including implementation service)

Implementation service
◎ FY2019～ : **4**



【Implementation service】From **Nov. 30, 2019**
Kamikoani Village, Akita Pref.
(Michi-no-Eki "Kamikoani")

【Long-term FOT】
Schedule: Dec. 9, 2018 – Feb. 8, 2019
Vehicle: Yamaha Motor Co., Ltd.

Takahata Town, Yamagata Pref.
(Takahata-machi town Hall)

【Long-term FOT】
Schedule: Oct. 11, 2021 – Nov. 12, 2021
Vehicle: Yamaha Motor Co., Ltd.

Taiki Town, Hokkaido
(Michi-no-Eki "Cosmall Taiki")

【Long-term FOT】
Schedule: May 21, Jun 21, 2019
Vehicle: Advanced Smart Mobility Co., Ltd.

Niimi City, Okayama Pref.
(Michi-no-Eki "Koigakubo")

Nagaoka City, Niigata Pref.
(Yamakoshi Fukko-Community Hub Orataru)

Nishikata-machi, Tochigi City, Tochigi Pref.
(Michi-no-Eki "Nishikata")

【Implementation service】From **Dec. 4, 2021**
Iinan Town, Shimane Pref.
(Michi-no-Eki "Akagi Kogen")

【Long-term FOT】
Schedule: Sept. 1 – Oct. 10, 2020
Vehicle: Yamaha Motor Co., Ltd.

Nanto City, Toyama Pref.
(Michi-no-Eki "Taira")

Gujo City, Gifu Pref.
(Michi-no-Eki "Meiho")

Hitachiota City, Ibaraki Pref.
(Michi-no-Eki Hitachiouta and Takakura Koryu Center)

【Long-term FOT】
Schedule: Jun. 23 – Jul. 21, 2019
Vehicle: Yamaha Motor Co., Ltd

Ube City, Yamaguchi Pref.
(Michi-no-Eki "Kusunoki Komorebi no Sato")

Ina City, Nagano Pref.
(Michi-no-Eki "Minami Alps Mura Hase")

【Long-term FOT】
Schedule: Nov. 5 – 29, 2018
Vehicle: Advanced Smart Mobility Co., Ltd.

【Implementation service】From **July 19, 2021**
Miyama City, Fukuoka Pref.
(Miyama City Hall Yamakawa Branch)

【Long-term FOT】
Schedule: Nov. 2 – Dec. 21, 2018
Vehicle: Yamaha Motor Co., Ltd.

Toyota City, Aichi Pref.
(Michi-no-Eki "Donguri no Sato Inabu")

Ashikita Town, Kumamoto Pref.
(Michi-no-Eki "Ashikita Dekopon")

【Long-term FOT】
Schedule: Jan. 27 – Mar. 15, 2019
Vehicle: Yamaha Motor Co., Ltd.

Miyoshi City, Tokushima Pref.
(Michi-no-Eki "Nishiiya"・"Kazura Bashi Yume Butai")

【Implementation service】From **April 23, 2021**
Tatehata-cho, Higashi-Omi City, Shiga Pref.
(Michi-no-Eki "Okueigenji Keiryunosato")

【Long-term FOT】
Schedule: Nov. 15 – Dec. 20, 2019
Vehicle: Yamaha Motor Co., Ltd.

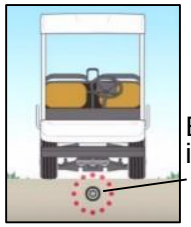
Otsu City, Shiga Pref.
(Michi-no-Eki "Imokonosato")

Full-scale introduction of automated driving service based at Michi no Eki "Okueigenji Keiryunosato"

■automated driving vehicle

Vehicle

Automated driving mechanism



Electromagnetic induction lines are placed to guide vehicles.

- Development: Yamaha Motor Co., Ltd.
- Capacity: Max. 6 persons (4 passengers)
- Speed: Approximately 12 km/h (during automated driving)
- Driver: Paid local volunteers

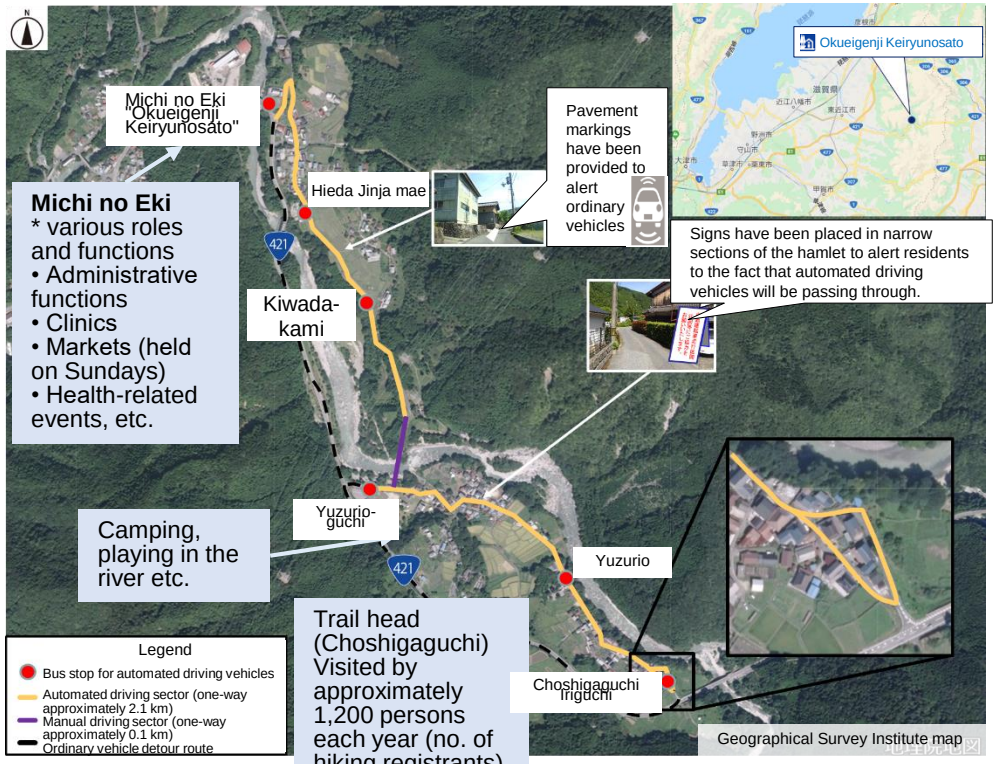
(Volunteers are on board for monitoring purposes only; they do not steer or otherwise operate the vehicle.)

■Operational organization

Operating entity	Higashi-omi City Office (for-profit cooperative private sector entity with Higashi-omi City taking the lead)
Services	Senior citizen pick-up and drop-off Tourist use (hiking, camping) Delivery of agricultural products, sundries and so on, etc.
Fares / shipping charges	Fare: JPY 150 / trip *sale of commuter passes and coupon tickets Shipping charge: JPY 100 / trip
Route	Michi no Eki "Okueigenji Keiryunosato" - Choshigaguchi Iriguchi (total round-trip distance approximately 4.4 km)
Schedule	Days of operation: 4 days a week (Saturday, Sunday, Wednesday, Friday) Regular trips:Total 6 trips (2 trips in the morning, 4 trips in the afternoon)

■Route

- Route based at Michi no Eki "Okueigenji Keiryunosato" (round-trip total length approximately 4.4 km)
- Signs and pavement markings have been placed along the route, and the local community has been made aware and is cooperating to ensure that automated driving vehicles are able to drive smoothly.



Automated driving service began on April 23, 2021 (Friday)

Overview of past activities: Short-term FOTs, long-term tests, full-scale introduction

〇2017 (short-term FOTs): Conducted to verify impact on driving environment, social acceptance, impact on the region etc.
〇2019 (long-term FOTs): Conducted to verify operational management, organization for project implementation, coordination measures etc.
〇2021 and thereafter: Start of full-scale introduction based on results of tests relating to technical aspects, business models etc.

2017	2018	2019	2020	2021～

Short-term automated driving FOTs

5 days (11/13 - 11/17)

Test vehicle: bus type

Driving past vehicles traveling in the opposite direction

Delivery of local agricultural specialties and other products

Verification of results

Long-term automated driving FOTs

36 days (11/15 - 12/20)

Remote monitoring

Operational management

Coordination with tourist events

Verification of results

Full-scale introduction of automated driving

4/23～

Status of use

○Mobility services using automated driving vehicles are provided to enable a variety of activities.
○Agricultural products are delivered to morning markets.

Doctor's visits at clinics located at Michi no Eki

Visits to citizen salons, etc. at Michi no Eki

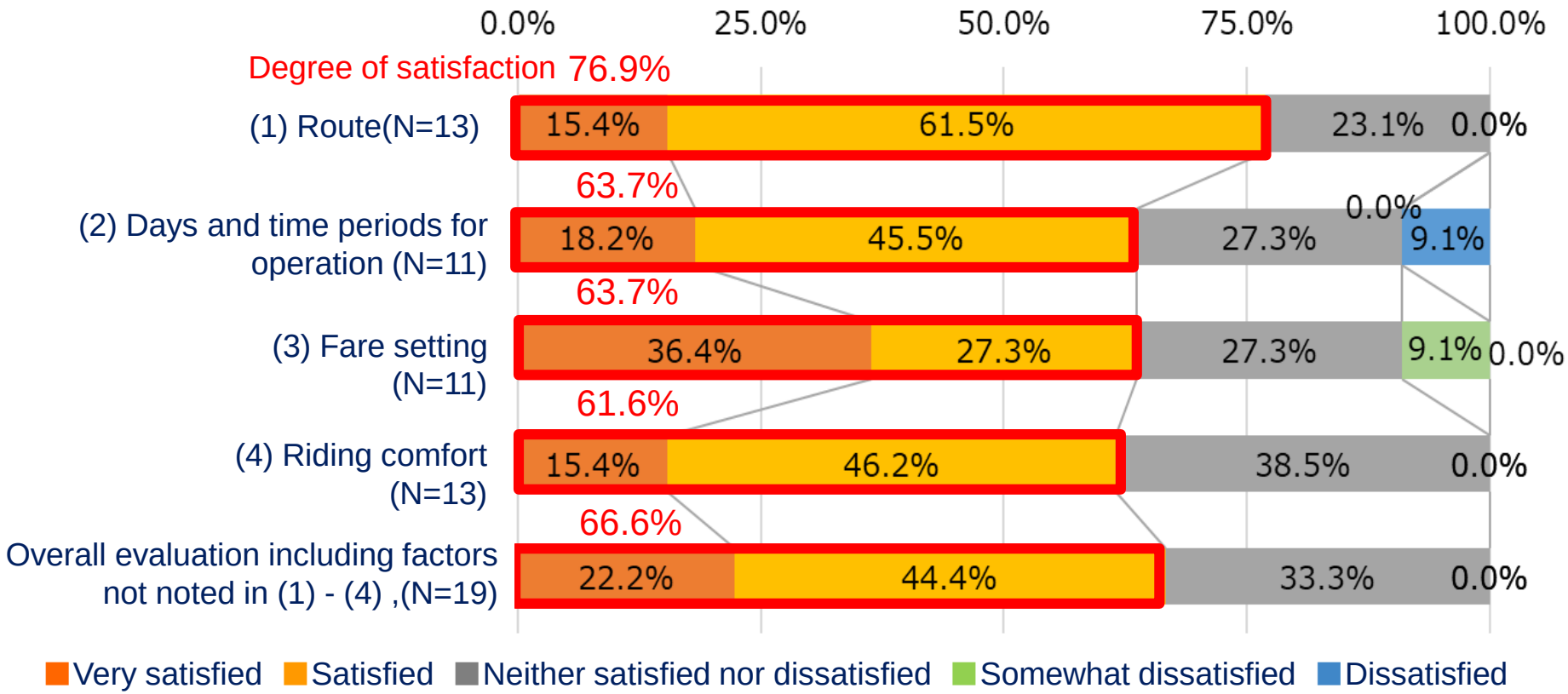
Hiker transport to and from trail heads

Delivery of agricultural products to morning markets at Michi no Eki

User feedback (local residents)

An opinion survey of users who live along the route found that
60% - 70% or more were satisfied with the automated driving service.

■ Degree of satisfaction with automated driving service (by item)



Movie of Michi no Eki

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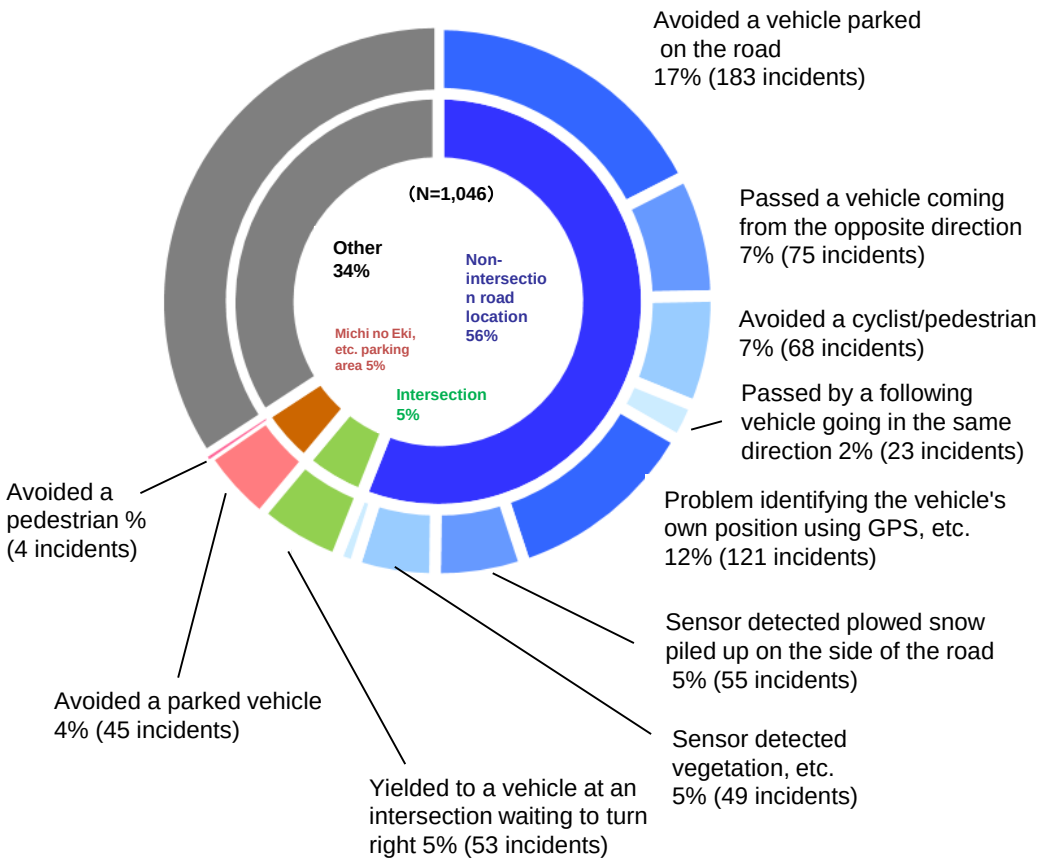
Automated driving services in rural areas based at “Michi no Eki” etc.

○ In FOTs, there were cases in which automated driving could not be continued and manual intervention was needed.
○ Various mechanisms are being put into place in keeping with local conditions to create a safe driving environment

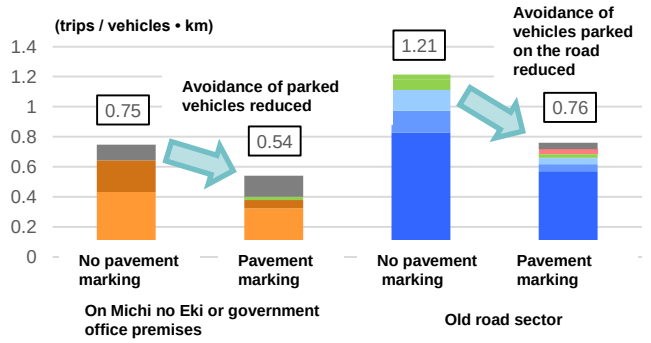
■Issues identified in FOTs

(frequency of occurrence, categorized in terms of road structure and the reason that manual intervention was needed)



■Various efforts in keeping with local conditions

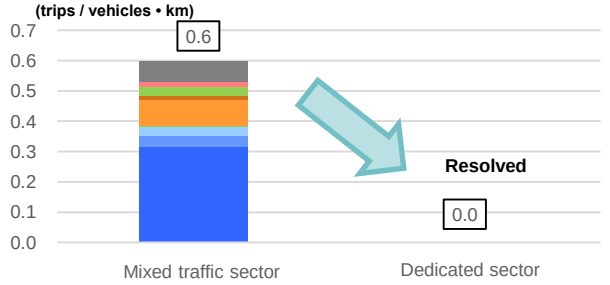
(Clear marking of driving locations)



▲No. of manual interventions before and after placement of pavement markings (Akagi Kogen)

Notes:
- Survey period (with no pavement markings): July 17 and 20-22, 2020 (weekdays), July 18, 2020 (weekend)
- Survey period (with pavement markings): September 1 - October 10, 2020 (weekdays), July 18, 2020 (weekend)

(Placement of dedicated lanes)



▲No. of manual interventions in mixed traffic sector and dedicated sector (Akagi Kogen)

Note Survey period: September 1 - October 10, 2020

[Legend]
■Avoided a vehicle parked on the road ■Passed a vehicle coming from the opposite direction ■Avoided a cyclist/pedestrian ■Passed by a following vehicle going in the same direction ■Avoided a parked vehicle at a Michi no Eki, etc. ■Avoided a pedestrian at a Michi no Eki ■Yielded to a vehicle at an intersection waiting to turn right ■Detected and avoided a fallen object on road ■Other

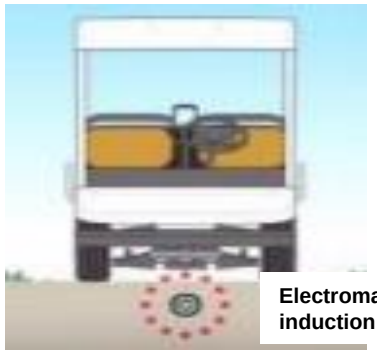
Facilities to assist operation of automated driving vehicles

(revision of Road Act, Act on Special Measures concerning Road Construction and Improvement, and Act on special national financial measures for development around Narita International Airport)

○ The Road Act, etc. was revised in 2020 to stipulate facilities (magnetic markers, etc.) to support automated driving vehicle operation as road facilities.

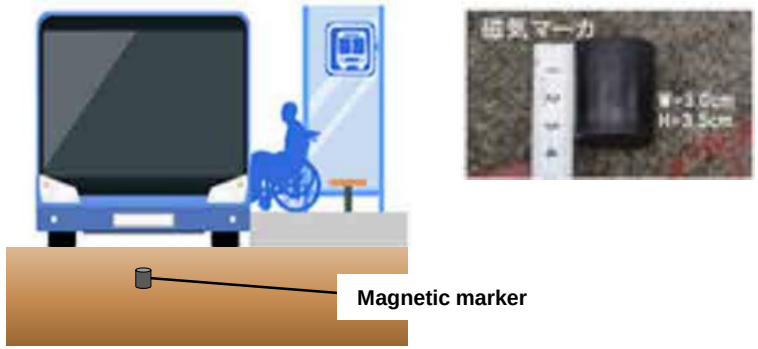
○For private companies (transport companies, etc.), regulations were established to enable these to be placed as occupancy facilities with permit from road administrators.

<Automated driving support facilities>

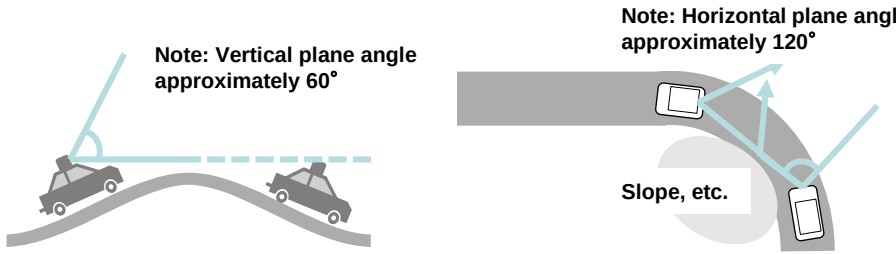


▲Assistance for operation through identification of own vehicle position by means of electromagnetic induction lines

▲Assistance for correction of own vehicle position by means of positional information display facilities



▲Assistance for operation through identification of own vehicle position by means of magnetic markers



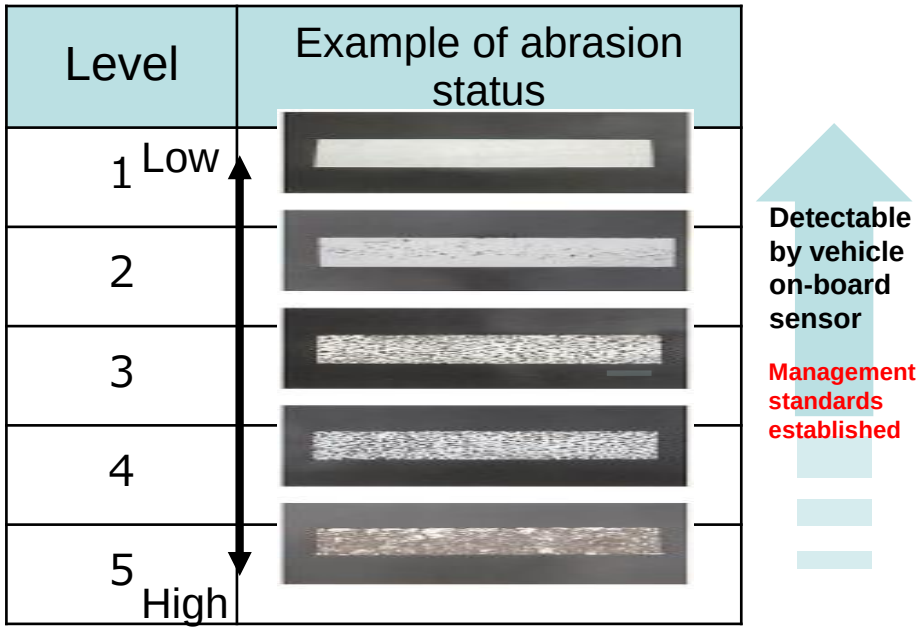
▲Assistance for determination of road status at locations that vehicle sensor signals do not reach

Automated driving compatible demarcation lines

○Joint research with private sector companies and the like is underway regarding management standards for the lane markings needed to ensure that automated driving vehicles stay within lanes, etc.

[Difficult for vehicle on-board sensors to detect (example: faded demarcation lines)]

[Management standards will be established for lane markings to ensure that they can be detected by vehicle on-board sensors.]

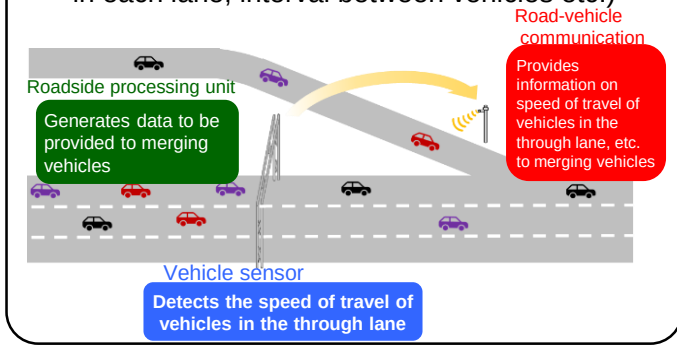


Methods for providing road traffic information

○Joint research with private sector companies and the like is underway, with the aim of developing methods to provide automated driving vehicles on expressways, etc. with road traffic information on road conditions ahead that are difficult for on-board sensors to detect.

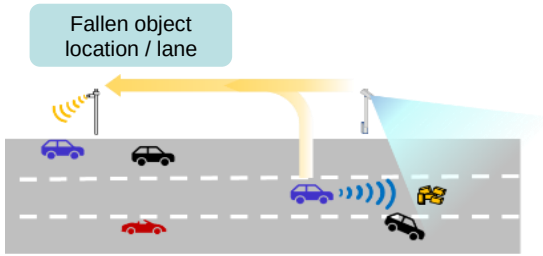
Merging information

Traffic information for the through lane is provided to merging vehicles (location and speed of vehicles in each lane, interval between vehicles etc.)



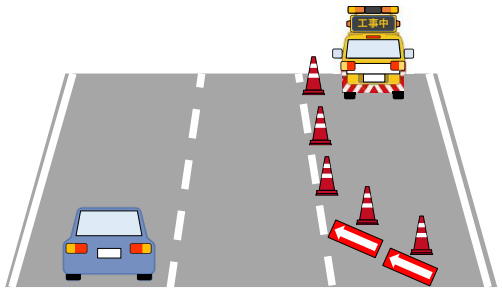
Information on fallen objects on the road

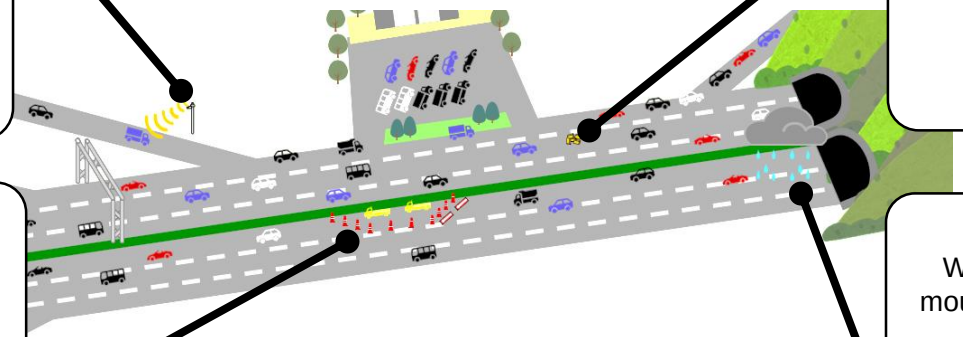
Information on fallen objects on the road that have been detected by the vehicle's on-board sensors and road administrators is provided.



Information on road construction restrictions [Construction]

Information on the location of construction work restrictions, lane closures etc. is provided.





Weather conditions

Weather conditions at tunnel exits, snowfall in mountainous areas and other Operational Design Domain (ODD) information is provided.