

The second phase of SIP-Automated Driving for Universal Services
Investigative Study on the Social Implementation and Permanent Adoption
of Self-driving Transport Service in Rural Areas

Interim Report

Highway Industry Development Organization
Oriental Consultants Co., Ltd.
Nippon Koei Co., Ltd.
Pacific Consultants Co., Ltd.
Fukken Co., Ltd.

(1) Goal of R&D or Study

Background

Growth Strategy 2020

In the mobility category, six KPIs (key performance indicators) are specified. The one that concerns rural areas is the following “KPI: Unmanned self-driving transport service within local areas will be made available at no less than 100 different locations across Japan by 2030.”

Public-Private ITS Initiative/ Roadmaps 2020

“〈Vision of self-driving transport for 2020: Self-driving transport service that utilizes the framework of Field Operational Test〉”
“The plan is to set up such service nationwide by around 2025 so that regional communities across Japan have means of mobility available to elders, etc.”



Purpose

Purpose of the research

“Demonstration of social implementation”: Support social implementation at five different locations.
“Long-term demonstration”: Conduct a long-term Field Operational Test at one location in such a manner that approximates the actual service adoption.
Update and compile **the introduction manual for social implementation** of the self-driving transport service based on the outcomes of the above tests.



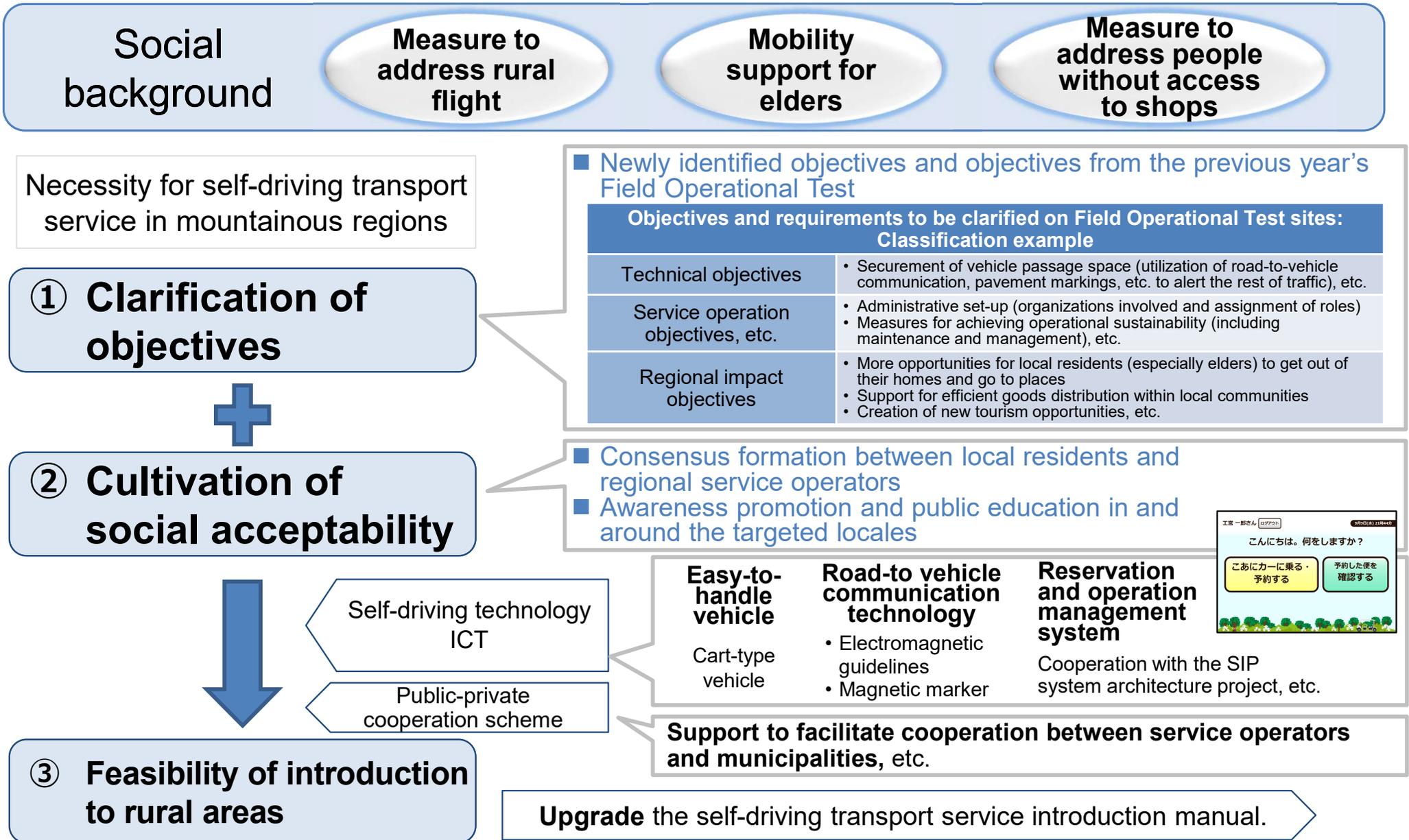
Project goal

Project goal

Establish, widely implement, and promote a sustainable service model.

(2) R&D or Study Descriptions and Methodology

1) Overall research design

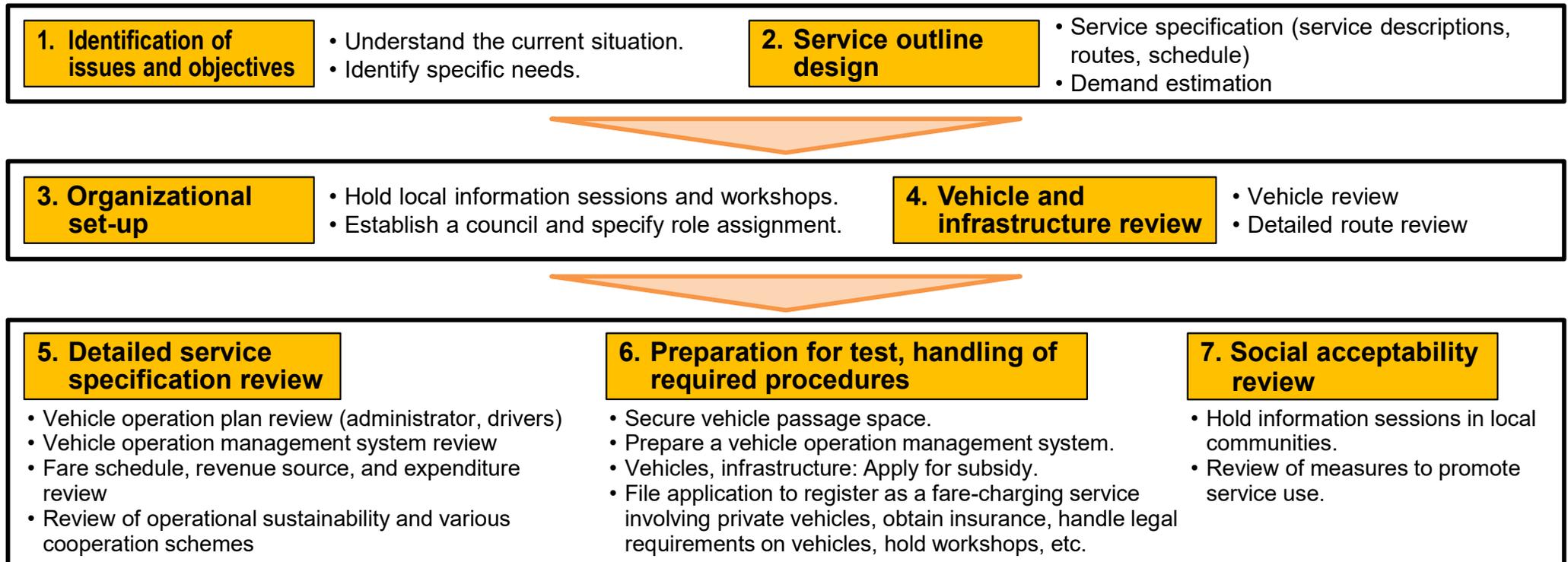


(2) R&D or Study Descriptions and Methodology

2) Creation of an up-to-date self-driving transport service introduction manual

- ① Update **the manual so that it can be used for the introduction of sustainable self-driving transport service in rural areas**, based on the measures tested and verified in this Field Operational Test for addressing specific objectives such as the manner of service delivery that is optimized for each locale's specific needs, service operation organization, etc.

- The introduction manual for rural areas must be practical and organized for a convenient step-by-step review of introduction feasibility so that it can be universally applied to similar projects in the future.



(2) R&D or Study Descriptions and Methodology

3-1) Key points of the social implementation demonstration

① Initial actualization of service maintenance and management for social implementation

Challenge: Lack of know-how related to the maintenance and management of self-driving-adapted road infrastructure and vehicles

- ⇒ Organize information on the maintenance and management methods by chronological phase (initial set-up, normal operation, and service malfunction periods). Actively accumulate and share related know-how through information exchange with other SIP projects, etc. in preparation for the eventual social implementation.
- ⇒ The manual, Q&A, etc. that will be prepared must be easy to understand for both municipalities and service operators, specifying the assignment of roles in each phase among the road managers, service operators, etc.

② Improvement of service awareness and demand cultivation in local communities

Challenge: Many users are from outside the self-driving service introduction areas, and it is difficult for the service to take root in the local communities.

- ⇒ Accurately understand the challenges being faced by the municipalities along with the needs of local residents, etc. so that the transport service can be delivered to those who truly need it (in terms of routes, schedule, vehicle operation method, etc.).
- ⇒ Implement it with a schedule that is coordinated with the schedules of community buses, food trucks, etc. as well as with local community events so that it becomes an essential service that is part of local people's daily living.

(2) R&D or Study Descriptions and Methodology

3-1) Key points of the social implementation demonstration

- ③ Promotion of the service across wide-ranging age demographics in cooperation with educational institutions, etc.

Challenge: Low level of understanding of self-driving technology and service among people interferes with smooth operation.

⇒ Cooperate with other parties involved in SIP self-driving transport projects in the area of social acceptability to **quantify the effects and improve social acceptability through information sharing.**

⇒ Offer educational sessions at local educational institutions (elementary schools, etc.) as to the features and necessity of self-driving transport service, etc. so that **those children can serve as a medium through which to promote awareness within families and communities.**

- ④ Update the service introduction manual so that it can be universally applied across similar projects.

⇒ Based on ①, ②, and ③ above, **set up a contact point for manual preparation, updating, and fielding inquiries.**

(2) R&D or Study Descriptions and Methodology

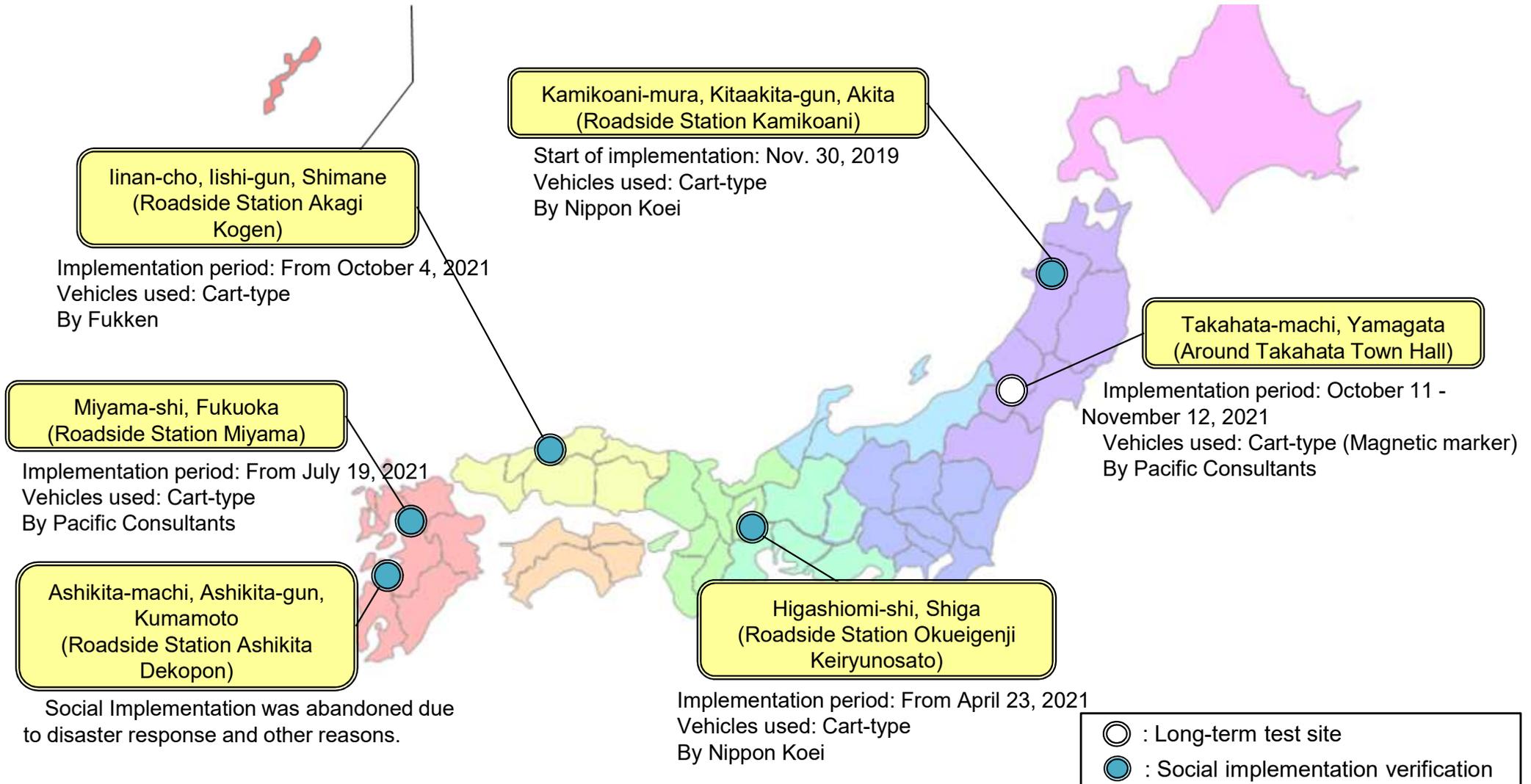
3-2) Key points of the long-term test

- ① **Introduce new technologies that allow for more flexible expansion of service routes**
 - ⇒ **Use vehicles that do not require electromagnetic guidelines** to conduct on-site tests on their technical and operational performance, while paying attention to the road conditions in rural areas and cost-effectiveness.
- ② **Conduct the test in such a manner that reflects future service operations.**
 - ⇒ **Formulate service operation plans in conjunction with prospective service operators** such as municipality, NPO, etc.
- ③ **Verify the service operation management system in actual operation**
 - ⇒ **Test the system for both prescheduled service and on-demand service**, depending on the needs of local users.
 - ⇒ Set up a service operation management center **for monitoring vehicle operation status and in-vehicle status**.
- ④ **Provide the service while charging fares.**
 - ⇒ **Use an applicable program in the locale**, such as the fare-charging transport service involving private vehicles, **and receive fares from the users**.
 - ⇒ Run the test for one to two months to promote regular use, and **examine the sustainability of the service operation**.

(2) R&D or Study Descriptions and Methodology

3-3) Demonstration sites

- Implementation and tests were carried out at five locations (four for social implementation verification and one for long-term test) in this project.
- The schedule was delayed due to COVID-19 pandemic, but started in order of readiness.



(2) R&D or Study Descriptions and Methodology

3-3) Demonstration sites

Test sites	Descriptions of the long-term test and the social implementation demonstration	Parties responsible for handling operation
① Kamikoani	<ul style="list-style-type: none"> • The local NPO and the roadside station to handle operation, after the local company sets up the service operation. • Assist with the handling of various procedures that are necessary for transferring the service infrastructure to the municipality, etc. • Provide service in a manner specific to each of the four seasons to maintain sufficient usership, etc. 	<ul style="list-style-type: none"> • Kamikoani-mura Iso Service Kyokai, NPO
② Okueigenji Keiryunosato	<ul style="list-style-type: none"> • Contemplate on service specifications that meet the needs of local residents, tourists, cargo transport, etc. • Design the service operation while involving various stakeholders from the locale. • Review measures for improving financial sustainability by implementing appropriate service operation specifications. 	<ul style="list-style-type: none"> • New organization will be set up to handle operation (as per plan).
③ Akagi Kogen	<ul style="list-style-type: none"> • Design the service operation such that it can be sustained by the existing organization with the help of local volunteers. • Contemplate on service specifications optimized for maintaining steady operating income and ease of use by local residents. • Examine a service model that is optimal for meeting various types of transport demands. 	<ul style="list-style-type: none"> • Iinan-cho Township • Iinan-cho Tourism Association
④ Miyama	<ul style="list-style-type: none"> • Provide a transport service to and from the service locations, along with a monitoring service for elders. • Provide a grocery delivery service to help with the shopping needs of those experiencing difficulty going shopping themselves and those affected by the coronavirus epidemic. • Contemplate on the feasibility of implementing an energy management system that utilizes the power generated at the biomass center. 	<ul style="list-style-type: none"> • Miyama-shi
⑤ Takahata	<ul style="list-style-type: none"> • Ensure availability of transport means to support elders with their activities of daily living. • Implement the transport service in coordination with existing public transport with a view to promoting local tourism and economy. • Develop a transport and service coordination scheme optimized for promoting local industries and economy. 	<ul style="list-style-type: none"> • We don't verify the operation

(2) R&D or Study Descriptions and Methodology

● Verification criteria for social implementation (1/2)

1. Items that are considered crucial for the permanent adoption of self-driving transport service

Verification items	Specific points of verification	Sites
(1) Implementation of service routes, schedule, transport switching methods, etc. in coordination with public transport and other vehicles that reflect user needs	<ol style="list-style-type: none"> 1. Improve the village's overall public transport service through optimization of intermodal passenger transport within the village. 2. Assist transport switching in a manner optimized for interconnection with the main public transport mode (i.e., community bus). 3. Consider adding shortcut routes to improve convenience and promote use. 4. Implement transport service in coordination with the community bus and provide transport assistance in disaster-affected areas. 5. Coordinate with JR and other existing public transport, and spread preexisting demands across different transport modes. 	<ol style="list-style-type: none"> 1. Kamikoani 2. Okueigenji 3. Akagi Kogen 4. Ashikita Dekopon 5. Takahata
(2) Diverse fare collection methods	<ol style="list-style-type: none"> 1. Verify the feasibility of publicity income diversification by offering monthly fare, children's fare, small-sized cargo transport service, etc. 2. Improve revenue by implementing an optimized fare schedule, generating additional income through cargo transport, etc. 3. Examine the feasibility of providing cashless service and introducing coordination with local currency. 	<ol style="list-style-type: none"> 1. Kamikoani 2. Okueigenji 3. Miyama-shi
(3) Examination of ways through which to ensure stable operation of the service status monitoring, reservation, and other key operation functions and the vehicle operation management system; and system verification	<ul style="list-style-type: none"> • Simplify the reservation and operation methods in cooperation with the system architecture project, and establish the operation manual. 	<ul style="list-style-type: none"> • All sites
(4) Examination of operational sustainability	<ol style="list-style-type: none"> 1. Review the operation plan and the prospect of applying for a license to operate fare-charging service involving private vehicles in conjunction with the service operator to which the operation will be handed over in the future. 2. Consider ways to reduce the operation cost by implementing alternate-day operation based on seasonal and other factors, adopting reservation-based service, etc. 3. Consider offering the service for four days or so per week, focusing mainly on weekends and holidays when demands will likely be high for tourism. 4. Consider adding shortcut routes to improve convenience and promote use. 5. Consider offering merchandise delivery service to local residents whose dwellings are along the service routes. 	<ol style="list-style-type: none"> 1. All sites 2. Kamikoani 3. Okueigenji 4. Akagi Kogen 5. Miyama-shi
(5) Compliance with various legal requirements	<ul style="list-style-type: none"> • Create manuals for the maintenance of guidelines and vehicles, and provide education and training to the local company, etc. 	<ul style="list-style-type: none"> • Kamikoani

(2) R&D or Study Descriptions and Methodology

● Verification criteria for social implementation (2/2)

2. Items related to securement of self-driving vehicle passage space

Verification items	Specific points of verification	Sites
(1) Measures for securing vehicle passage space utilizing road-to-vehicle communication technology, etc.	<ol style="list-style-type: none"> 1. Secure exclusive passage space on a permanent basis on agricultural roads (examine the feasibility of unmanned operation, etc.) 2. Review key topics on vehicles and infrastructure, such as magnetic-marker-based control, and examine potential solutions. 3. Examine the possibility of adopting a road design providing separate passages for self-driving vehicles and the rest of traffic on national roads to address the difference in their travel speed, and the possibility of installing gates at entry and exit points. 	<ol style="list-style-type: none"> 1. Kamikoani 2. Takahata 3. Akagi Kogen
(2) Measures for ensuring traffic safety in sections that are difficult for automated vehicles to navigate	<ol style="list-style-type: none"> 1. Install pavement markings, signs, and vehicle-approaching indication plates that are connected to road-to-vehicle communication. 2. Examine the possibility of adopting a road design providing separate passages and exclusive spaces for pedestrians and bicycles. 3. Examine the possibility of installing escape areas for oncoming and passing traffic. 4. Examine the possibility of providing detours for automobiles to get to bypasses and implementing measures for suppressing their travel speed. 	<ol style="list-style-type: none"> 1. All sites 2. Ashikita Dekopon 3. Ashikita Dekopon 4. Miyama-shi
(3) Assignment of functions between the vehicle and the road optimized for implementation	<ul style="list-style-type: none"> • Review the result of (2) as stated above and prepare a report describing optimal approach to functional assignment that takes into consideration the road and roadside conditions. 	<ul style="list-style-type: none"> • All sites
(4) Effective communication method (HMI) that promotes smooth integration of self-driving vehicles into the rest of traffic	<ol style="list-style-type: none"> 1. Promote service use across diverse age demographics through cooperation with educational institutions, etc. (provide an educational program to young children so that they become a catalyst for promoting understanding and awareness of self-driving transport service across a wide range of age groups). 2. Examine the feasibility of having the vehicles emit signals (audio and light) to promote alertness, etc. in cooperation with the related SIP self-driving transport project (HMI team), etc. 	<ol style="list-style-type: none"> 1. All sites 2. All sites
(5) Evaluation of vehicle operation environment	<ol style="list-style-type: none"> 1. Examine the allowable service operation conditions specific to each locale's seasonal, and climatic characteristics, etc. 2. Study the effects of guideline and RFID installation, etc. on the pavement. 	<ol style="list-style-type: none"> 1. All sites 2. All sites (with a main focus on Kamikoani)

(3-1) Outline of Social Implementation Operation in Kamikoani

■ Outline of implementation operation

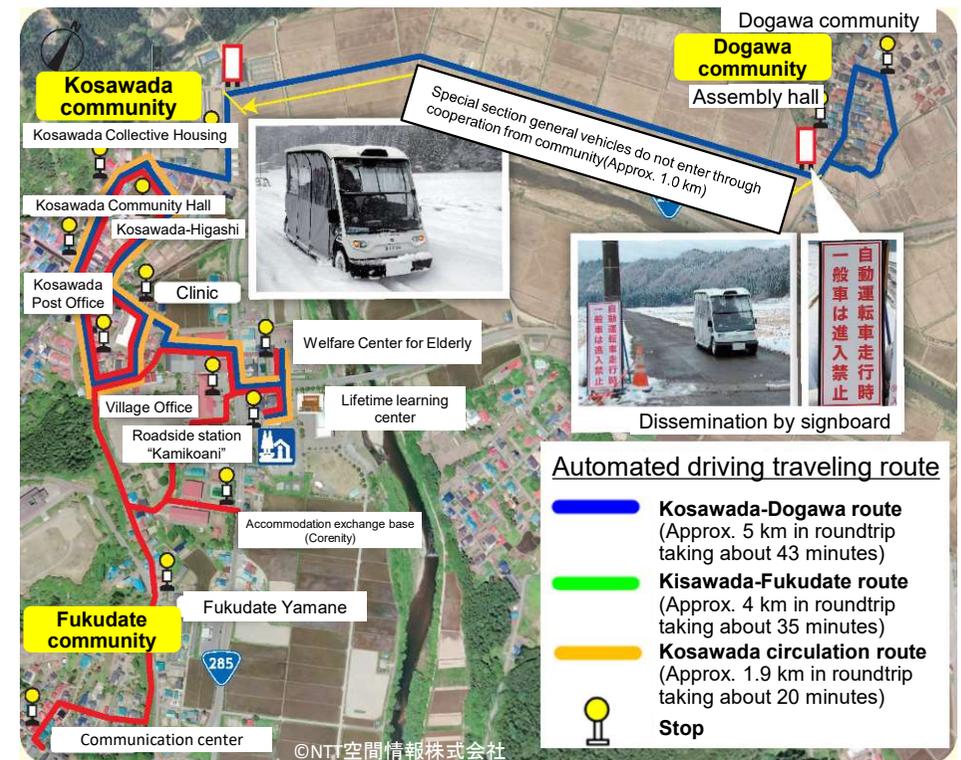
Operation start date	Saturday, November 30, 2019 * Every day except year-end and New Year holidays
Purpose	Regional revitalization and mobility support mainly for elders through self-driving transport
Population along the route	Kamikoani-mura: 2,246 *As of the end of February 2020 - Odasawa Area: 323 - Fukudate Area: 115 - Dokawa Area: 88
Bus route / Total distance	Total distance: Approx. 11 km I. Kosawada route: About 2 km round trip, 20 min II. Kosawada/Dokawa route: About 5 km round trip, 40 min III. Kosawada/Fukudate route: About 4 km round trip, 40 min
Operation method	Mixed traffic (on public roads) Self-driving transport level 2 Incl. dedicated section (approx. 1 km)
Operation pattern	Weekdays: Pre-scheduled service, 1 trip/day (II. Kosawada/Dokawa route at 8:30 a.m.) (Demand service at other times) Holidays: All-day demand service
Vehicle used	○ Yamaha Motor Power Products Co., Ltd. ○ Capacity: 7 ○ Travel speed: 12 km/h max. (auto) 19 km/h max. (manual)



■ Verification items

Main verification items	Operational structure at the time of full-scale social implementation Financial balance in terms of income and expenditure and business profitability at the time of full-scale social implementation Cooperation with other businesses at the time of full-scale social implementation
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■ Bus Route



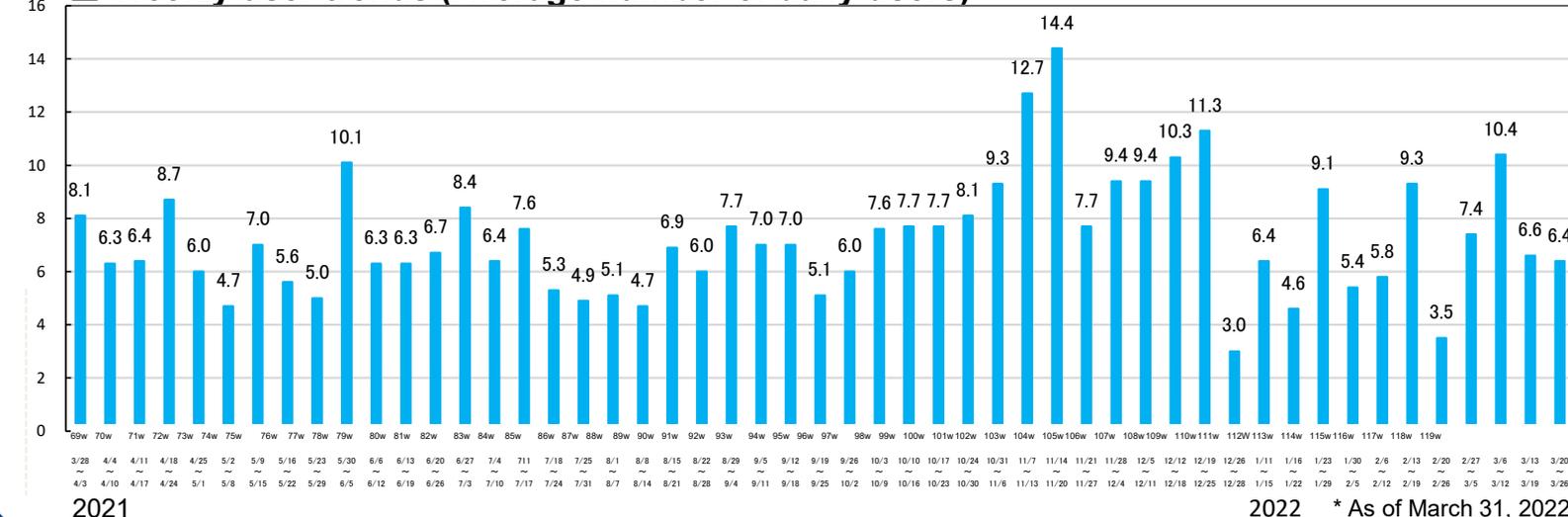
(3-II) Usage of Social Implementation Operation in Kamikoani

■ Progress of usage of social implementation

Due to the decrease in the number of people infected with COVID-19, the number is increasing until December. Due to the heavy snowfall, the number of users decreased in January and February.

<Status of usage>

□ Weekly user trends (Average number of daily users)



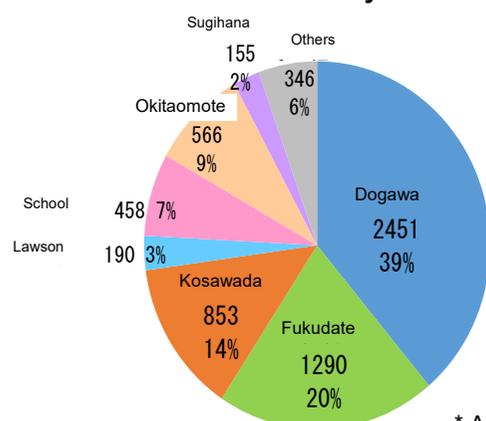
□ Number of monthly users

2021	Apr.	214	
	May	175	
	Jun.	234	
	Jul.	184	
	Aug.	177	
	Sept.	202	
	Oct.	228	
	Nov.	338	
	Dec.	247	
	2022	Jan.	140
		Feb.	98
		Mar.	169
Total		2,046	

○ The number of users of self-driving transport is about 60% inside the village, which is higher than outside the village. The majority of people are in their 60s or older, especially in their 60s.

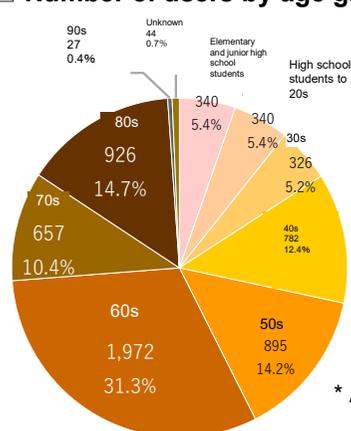
<Usage analysis>

□ Number of users by route



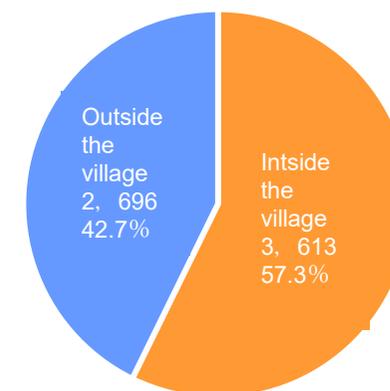
* As of March 31, 2022

□ Number of users by age group



* As of March 31, 2022

□ Numbers of users within and outside the village



* As of March 31, 2022

(3-III) Collaboration with Other Businesses in Kamikoani

■ Activities in collaboration with the self-driving transport service

- The feasibility of collaboration with the tourism business was examined as well as new collaborative businesses based on the opinions raised at self-driving transport tourism opinion exchange meetings.

[Trends in opinion exchange meetings]

- Self-driving tourism opinion exchange meetings by volunteers have been held five times to discuss activities in collaboration with the self-driving transport service.
- Since there is a high demand for tours and training programs, a fare table was prepared and new income linked to such tours was discussed.
- The feasibility of introducing self-driving vehicles as a means of transportation for sightseeing and farm stay experiences was verified by conducting monitoring tours.

[Tourism businesses being considered for collaboration]

- Inspection training tour business
- Farm stay and agricultural experience tour business
- Transportation business to famous sightseeing spots in the village (Kobusugi, Otaki, Inari Shrine, market days, etc.)
- Slow and healing ride experience business with photos and videos of old scenery
- Collaboration with product sales at the roadside station through stamp rallies, etc.

(4-I) Outline of Social Implementation Operation at Okueigenji

■ Outline of implementation operation

Operation start date	Friday, April 23, 2021 * Operates on Wednesdays, Fridays, Saturdays, and Sundays.
Purpose	Regional revitalization and mobility support mainly for elders through self-driving transport Tourist use (visit to the roadside station, mountain climbing, camping, etc.)
Population along the route	309 in the entire Okueigenji area *2020 census - 153 along the route (Yuzurio-cho, Kiwada-cho)
Bus route / Total distance	Total distance: (round trip) 4.4 km (2.2 km one way)
Operation method	Mixed traffic (on public roads) Self-driving transport level 2 * Incl. manual drive section (0.1 km on bridge)
Operation pattern	Wed, Fri, Sat: 6 regular trips/day Sun: Early morning trip (for morning market) + 6 regular trips/day
Vehicle used	○ Yamaha Motor Power Products Co., Ltd. ○ Capacity: 7 ○ Travel speed: 12 km/h max. (auto) 19 km/h max. (manual)

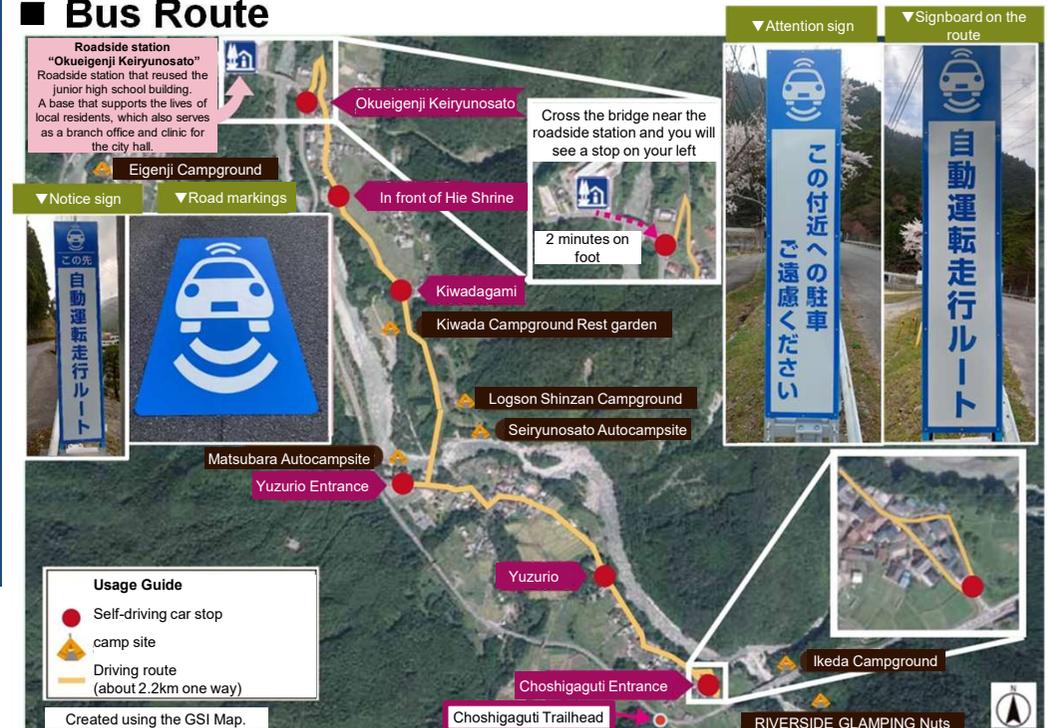


■ Verification items

Main verification items

- Securing vehicle passage space (facilitating operation by calling attention)
- Operation management system (operated by a local community-led system)
- Project implementation system (operational structure led by the local community, vehicle maintenance, etc.)
- Promotion of use through various collaborations (collaboration with local events / meetings, transit cooperation, cooperation with roadside stations, etc.)
- Business profitability (securing fare and other revenues, cost reduction, etc.)

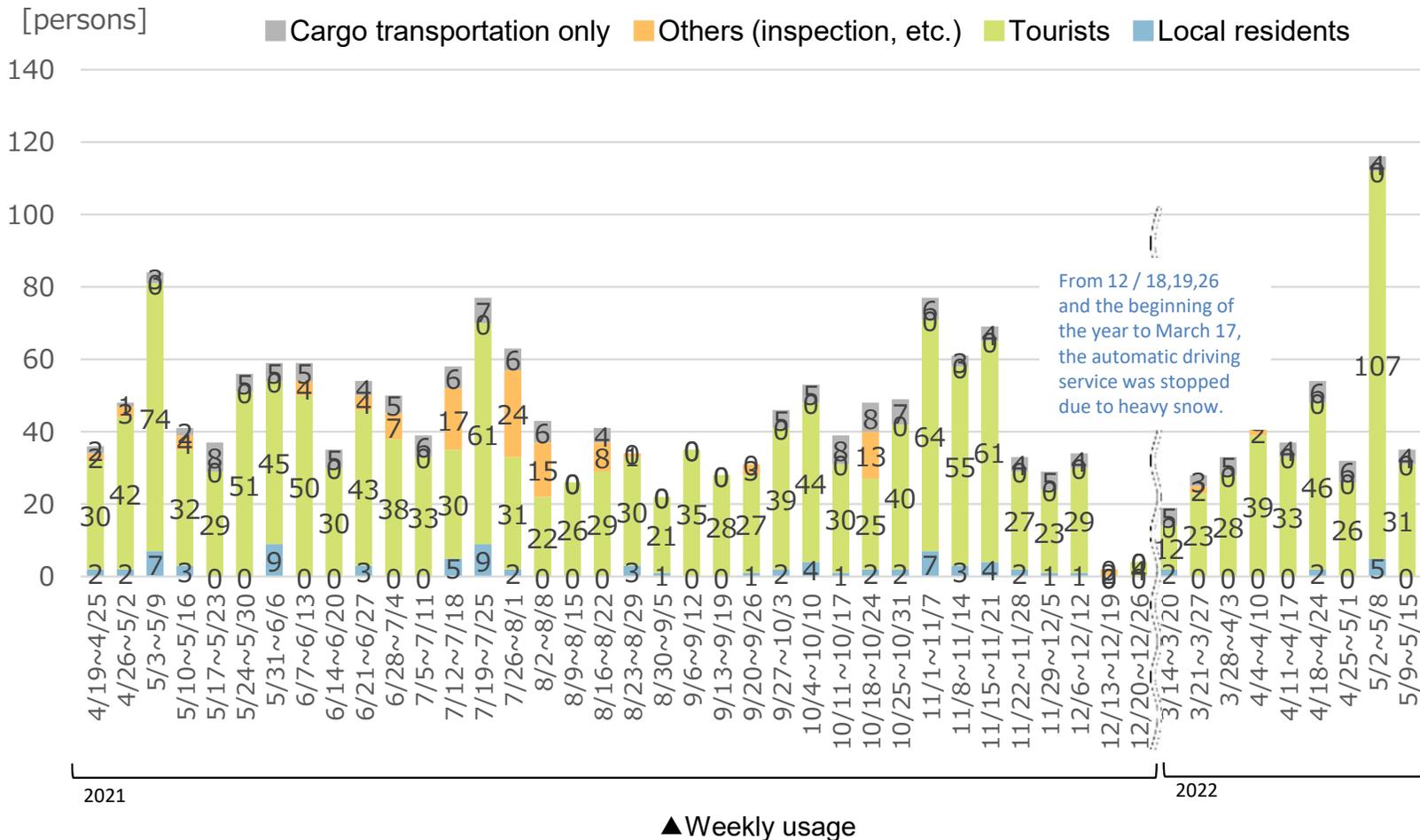
■ Bus Route



(4-II) Usage of Social Implementation Operation at Okueigenji

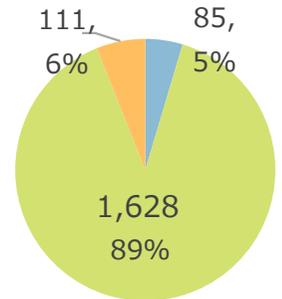
- As of May 15, 2022, 1,101 trips have been operated in 182 days, with a total of 1,819 users.
- As for user attributes, tourism is the main use, partly due to the influence of local residents refraining from going out and cancellation of events due to COVID-19 pandemic.
- The number of users varies greatly depending on the weather, partly due to the characteristics of the vehicles.

<Status of usage>



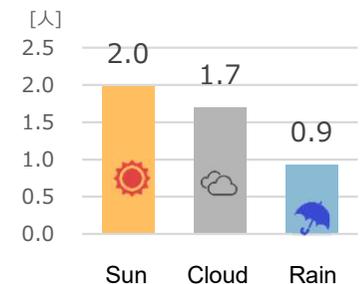
<Usage analysis>

<Analysis 1>
Mostly used by tourists



■ Local residents
■ Tourists
■ Others (inspection, etc.)
▲ User Attributes

<Analysis 2>
Greatly affected by the weather



▲ Number of passengers per trip by weather

(4-III) Collaboration with Other Businesses at Okueigenji

■ Activities in collaboration with the self-driving transport service

- Proposal of a model course tied up with a tourist spot (fish farm) along the road
- Transportation support during vaccinations at on-site clinics

新1号 自動運転乗車のモデルコース！

自動運転溪流満喫コース

自動運転車両の乗車では、愛知川の溪流や周辺の山々の素敵な景色を眺めることができます。このコースでは、途中下車して、溪流沿いを散歩した後、イワナ料理をご堪能いただけます。

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 ■自動運転乗車：050-6862-0024
※道の駅内の「道と車の教室」でも受け付けます
 ■池田養魚場：0748-29-0351

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 片道 150円
 奥永源寺地域の集落の雰囲気を感ぜられる他、溪流や山々の素敵な景色を眺めることができます。

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 養魚場に近いうちで乗降いただけます。

池田養魚場
 「谷の精霊」または「幻の魚」の異名をもつイワナ料理が味わえるレジャースポット。釣りやバーベキューなども楽しんでいます。

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池田養魚場

行程

① レックリコース：養魚場で約2時間滞在可能
 ② 通常コース：養魚場で約1時間滞在可能

道の駅 停留所 スタート
 往路：10:25 @ 12:30
※乗車出発時間

1. 自動運転車両
 乗車 約10分

養魚場 付近
 復路：12:47 @ 13:47
※乗車到着時間

2. 溪流沿い散歩
 徒歩 約5分

池田 養魚場

3. イワナ料理

凡例
 ● 乗車・下車ポイント
 〃 自動運転車両 走行ルート

ワクチン接種日に自動運転車をご利用いただけます!! (*予約必須)

道の駅「奥永源寺溪流の里」内の「永源寺東部出張診療所」にて実施される新型コロナウイルスのワクチン接種日に合わせ、以下の通り運行します！
 なお**予約がない場合は運行いたしません**のでご了承ください

- 臨時運行日：6月接種日…3, 10, 17, 24日（木）
 7月接種日…1, 8, 15日（木）

- 臨時運行便：行き…第3便(道の駅13:00着)、第4便(道の駅14:00着)
 帰り…第5便(道の駅14:50発)、第6便(道の駅15:40発)
 →各停留所の発着予定時間については裏面をご覧ください！

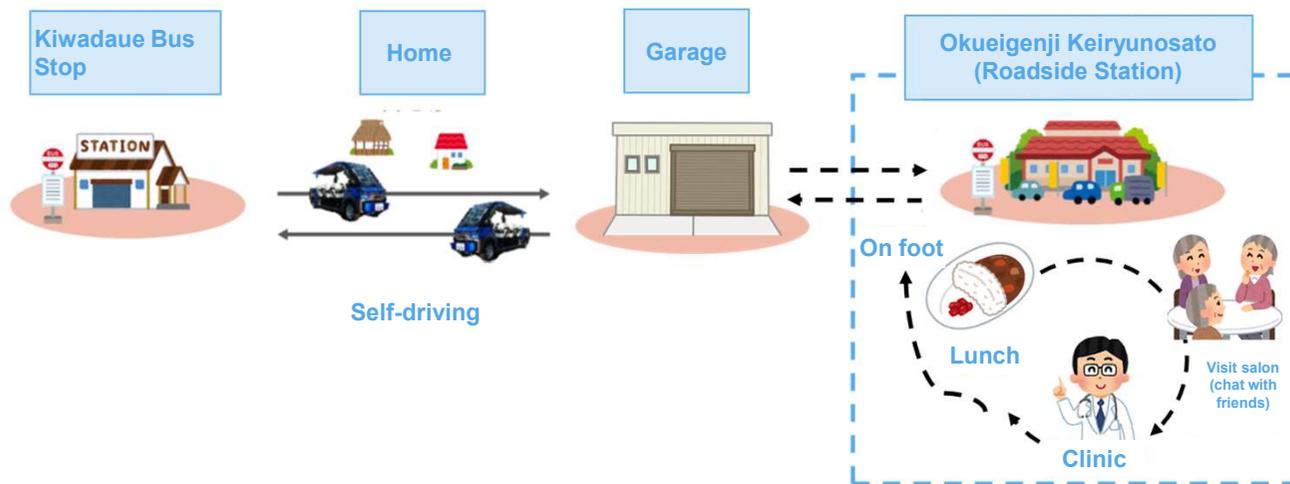
ご予約は以下へお電話いただくか、道の駅内設置の受付でも承ります。
TEL：050-6862-0024（事務局）



(4-IV) Collaboration with Other Businesses at Okueigenji

■ Use of local salons in collaboration with the self-driving transport service

- "Engawa Cafe" for local residents is held at the citizen salon of the roadside station.
- Residents along the route use the self-driving transport service to move to the roadside station to use the clinic, have lunch, and participate in the citizen's salon.



Driver calls out to a woman who are to use the service



Uses the service from the Kiwada Campsite to the self-driving vehicle garage



Walks with her friend from the garage to the roadside station



Have a cup of tea and talk with everyone at Engawa Cafe

(5-1) Outline of Social Implementation Operation in Miyama

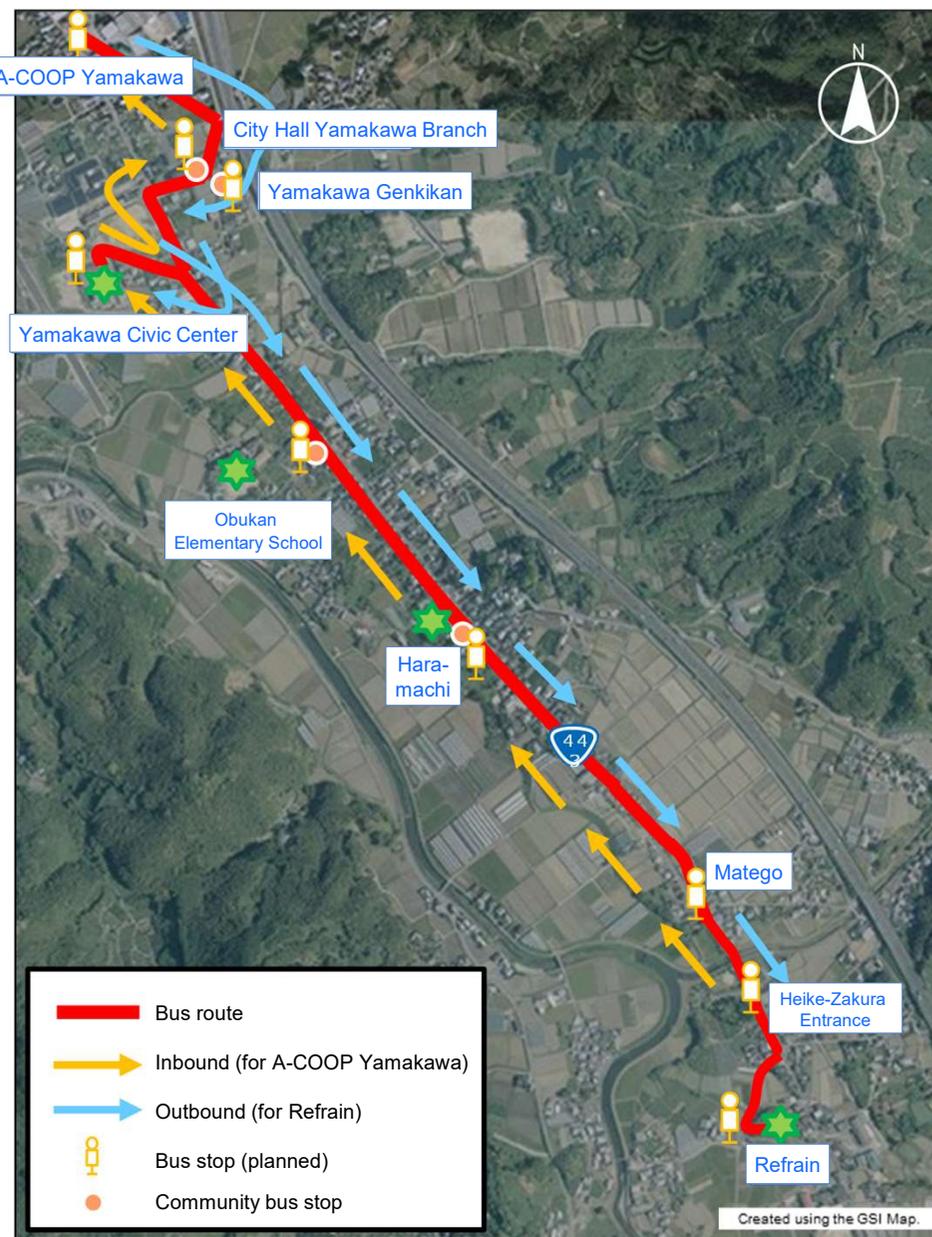
■ Outline of implementation operation

Operation start date	Monday, July 19, 2021 Operating days: Weekdays (Monday through Friday) Non-operating days: Saturdays, Sundays, year-end and New Year's holidays, Golden Week, and Obon holidays
Purpose	- Revitalizing the flow of people by creating a place for people to gather (e.g., Refrain) and providing a pick-up and drop-off service - Establishing a safe, secure, and sustainable local public transportation system in the future
Population along the route	Miyama-shi: 36,930 *As of the end of March 2020 Yamakawa area (Obukan Elementary School District): 6,526
Bus route / Total distance	Total distance: (round trip) Approx. 7.2 km Round trip between Refrain and A-Coop Yamakawa
Operation method	Mixed traffic (on public roads) Self-driving transport level 2
Operation pattern	Pre-scheduled service, 5 trips/day Operation hours: 9 a.m. - 4 p.m.
Vehicle used	○ Yamaha Motor Power Products Co., Ltd. ○ Capacity: 7 ○ Travel speed: 12 km/h max. (auto) 19 km/h max. (manual)

■ Preparation status for implementation

Preparation status	<ul style="list-style-type: none"> ● The 6th Regional Test Council (held by committee members in turn) ● Garage maintenance, electrical work, etc. ● Linkage with cashless services ● Verification of home delivery services (implementation period under adjustment) ● Safety measures by road-to-vehicle coordination display system
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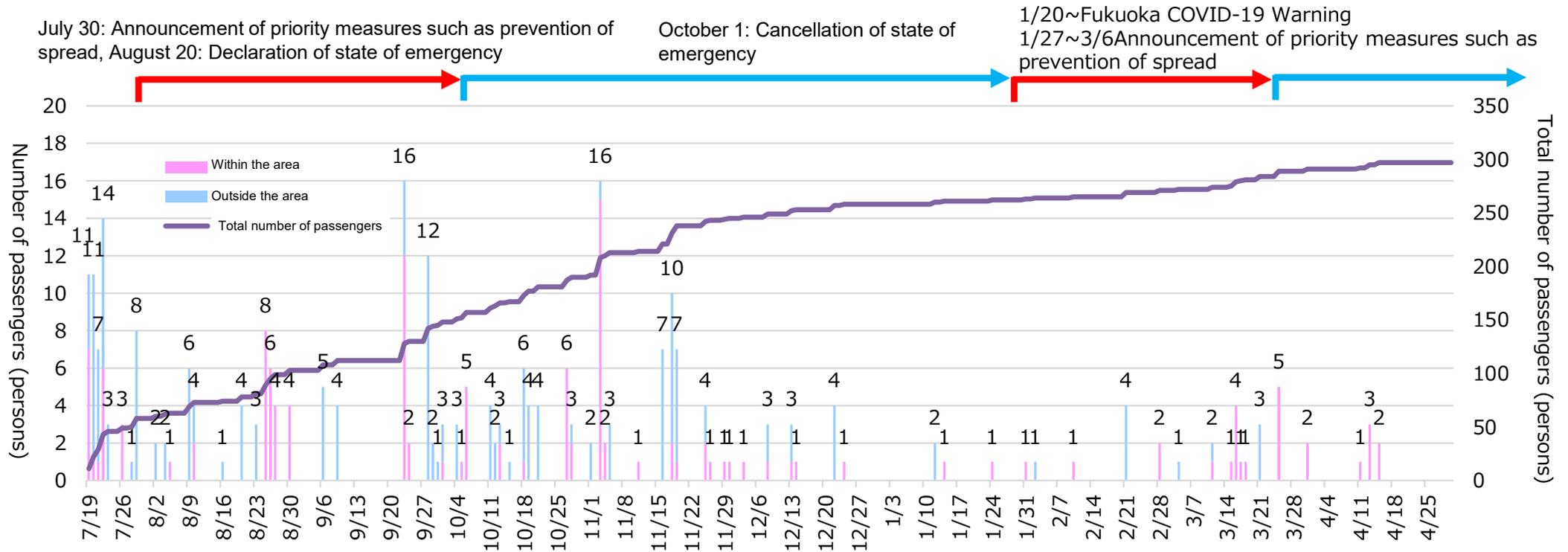
■ Bus Route



(5-II) Usage of Social Implementation Operation in Miyama

■ Progress of usage of social implementation

- A total of 297 people used the service between July 19th, 2021 to April 29th, 2022, and an average of 1.5 people used each day.
- In winter, it was difficult to increase the number of users due to the effects of COVID-19 and cold air.



Daily average/ Number of passengers	August	September	October	November	December	January	February	March	April
	2.1	1.9	2.1	2.5	0.7	0.3	0.4	0.9	0.3

- Operating days: Operates only on weekdays (3rd and 4th trips are suspended until 9/30 with summer timetable)
- 8/13 ~ 14 is Obon holiday, 8/12 and 17 afternoon is closed due to heavy rain, 12/29 ~ 1/3 is closed for year-end and New Year holidays

* As of April 29, 2022

(5-III) Collaboration with Other Businesses in Miyama

■ Activities in collaboration with the self-driving transport service

- Utilize Kyushu Electric Power's cashless system (Miyama Smile Pay App) to computerize user authentication.
- Introduce and verify the architecture system also on the community bus to grasp the vehicle position and number of boarding and alighting passengers (planned).

Cooperation with Kyushu Electric Power (cashless service)

- Issue electronic user cards through Miyama Smile Pay app provided by Kyushu Electric Power to users who have used the self-driving transport service for the purpose of promoting the use of the service.
* There are two types of user cards: paper and electronic.
- Users can use the self-driving transport service with their user card, and receive notifications of campaigns, as well as electronic coupons according to their usage of the service.



Link with community bus

- A tablet (in-vehicle terminal system) will be installed in the community bus operating in Miyama to manage vehicle position and boarding/alighting (under adjustment).

▼ Display image (confirmation of current vehicle position)



A tablet (in-vehicle terminal system) is scheduled to be installed in six community buses.

It is planned to be used for boarding/alighting management by entering the number of boarding and alighting passengers.



(5-IV) Horizontal Implementation Activities in Miyama (Educational Program)

■ Activities in collaboration with the self-driving transport service

- A class session about the mechanism of a self-driving transport service designed to promote students' understanding was offered to (about 50) 5th-graders and (about 50) 6th-graders from Obukan Elementary School on June 30 and November 16, 2021, respectively.
- This educational program explained the necessity of self-driving transport service and how the self-driving vehicles function. The students were then shown an actual self-driving vehicle to improve their understanding of the self-driving transport service.

■ Program (45-minute session) * As of November 16, 2021

Timetable	Content
2:00 p.m. - 2:10 p.m.	Why is self-driving transport necessary?
2:10 p.m. - 2:20 p.m.	What are some of the fascinating facts about self-driving transport?
2:20 p.m. - 2:25 p.m.	Do you now know enough about self-driving transport?
2:25 p.m. - 2:30 p.m.	What can we do with self-driving transport? * Let's discuss in a group!
2:30 p.m. - 2:45 p.m.	Let's take a look at an actual self-driving vehicle.

■ Children's responses

I learned that two tests were conducted before social implementation.



I had seen electromagnetic induction line installation work about two years ago on my way to and from school, and I am glad to be able to learn how they work in today's class.



■ Class sessions * As of November 16, 2021



■ Future schedule

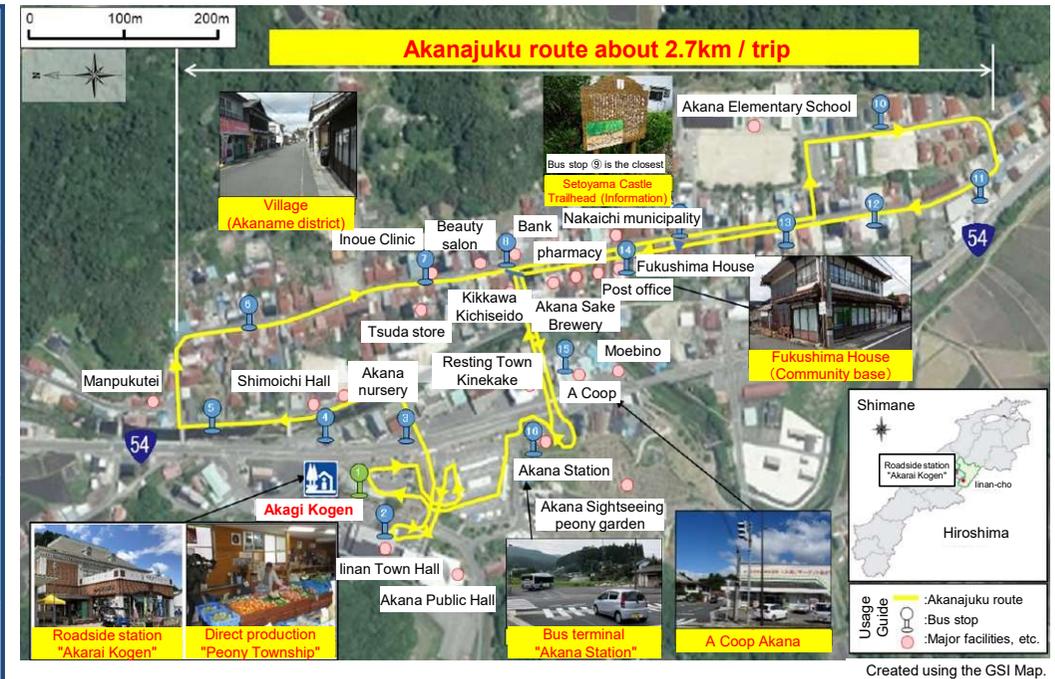
- Conduct a post-questionnaire (after a certain period of time).

(6-1) Outline of Social Implementation Operation in Akagi Kogen

■ Outline of implementation operation

Operation start date	Monday, October 4, 2021 Operating days: Mondays, Tuesdays, Thursdays, Saturdays, and Sundays Non-operating days: Year-end and New Year's holidays, Golden Week, and Obon holidays (Wednesdays and Fridays, even if national holidays)
Purpose	Establish a sustainable operational structure to be operated by existing organizations and local volunteers centered on linan-cho - Secure stable income such as commuter passes for residents and brush them up to services (operation forms) that are easy for residents to use.
Bus route Total distance	Total distance: (round trip) Approx. 2.7 km Operation on a circular route including Roadside Station Akagi Kogen, linan Town Hall, etc.
Operation method	Mixed traffic (on public roads) Self-driving transport level 2
Operation pattern	Pre-scheduled service: 10 trips (weekdays), 6 trips (Saturdays, Sundays, and holidays) Operation hours: 10 a.m. - 3 p.m. (weekdays), 11 a.m. - 3 p.m. (Saturdays, Sundays, and holidays)
Vehicle used	○ Yamaha Motor Power Products Co., Ltd. ○ Capacity: 6 ○ Travel speed: 12 km/h max. (auto), 19 km/h max. (manual)

■ Bus Route



■ Main verification items

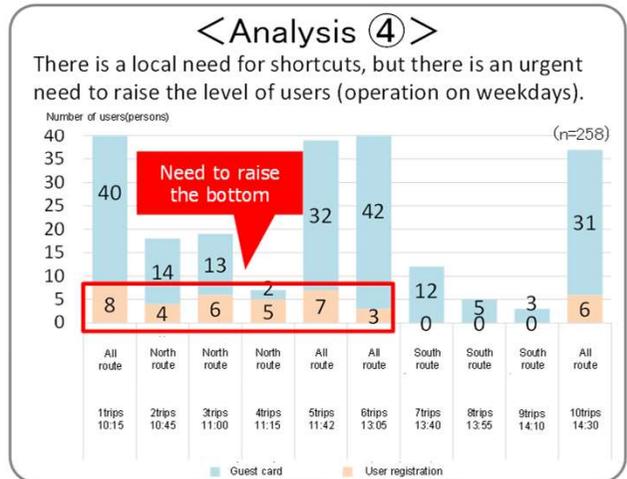
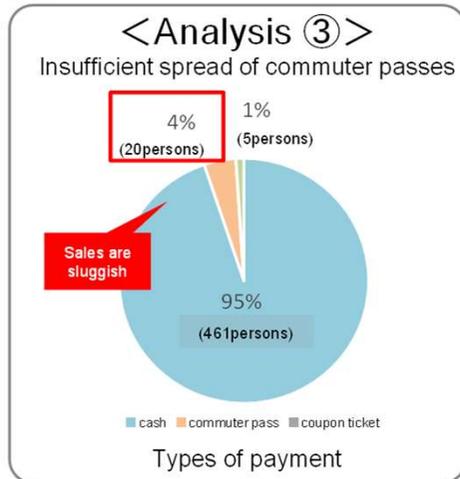
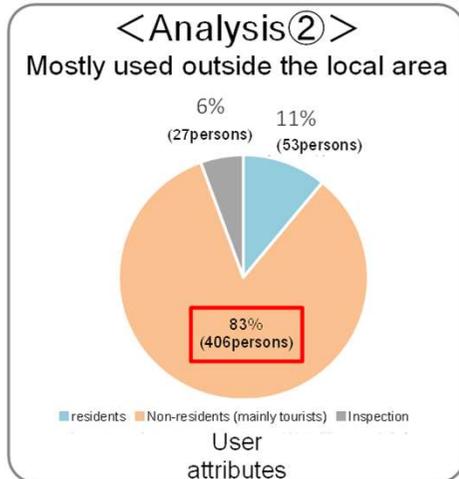
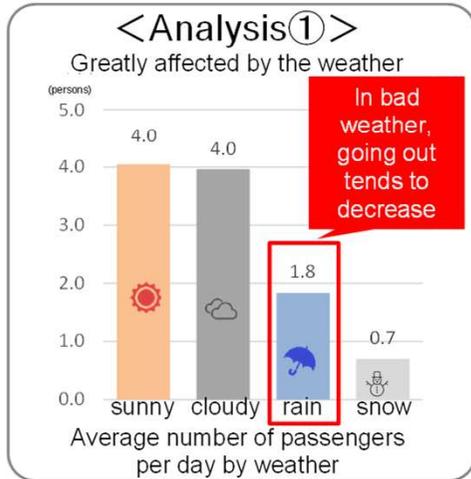
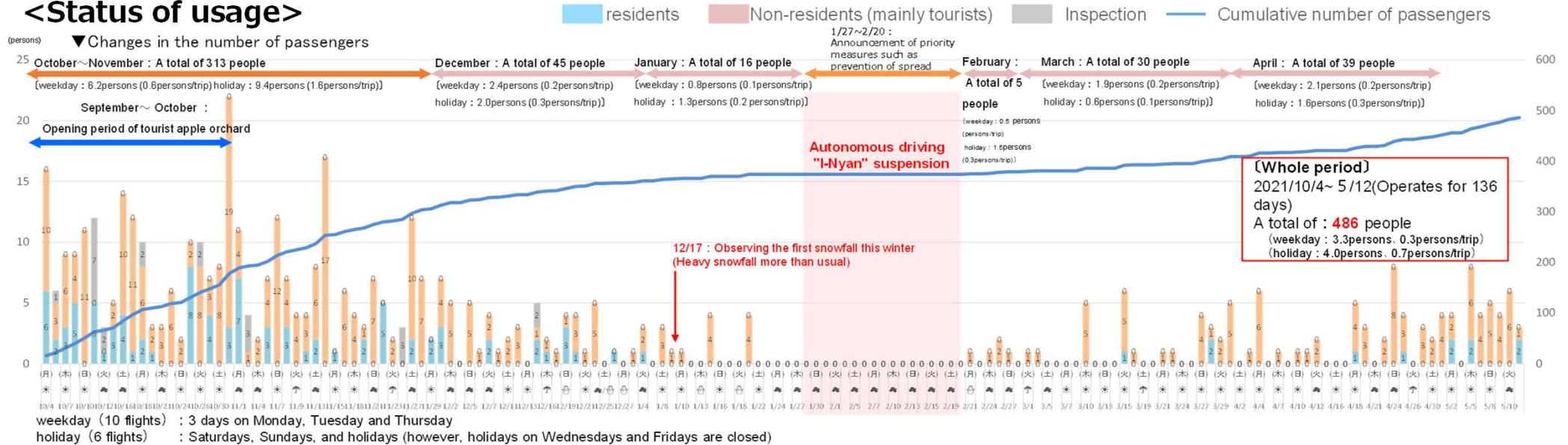
Verification items	Analyze the requirements for the demonstration environment for social implementation of the self-driving transport service based on the long-term demonstration. 1) Use as daily transportation 2) Coordination services with existing public transport and with regional development and outing support, etc. 3) Service model and operational structure in depopulated rural areas
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(6-II) Usage of Social Implementation Operation in Akagi Kogen

Progress of usage of social implementation

- It is used by 486 people for a total of 136 days (about 7 months). (As of May 12, 2022)
- The daily average on weekdays is 3.3 people (0.3 people / trips), and the daily average on holidays is 4.0 people (0.7 people / trips).
- In winter, it was difficult to increase the number of users due to the effects of COVID-19 and cold air., but the number of users have been on the increase since spring.

<Status of usage>



(6-III) Collaboration with Other Businesses in Akagi Kogen

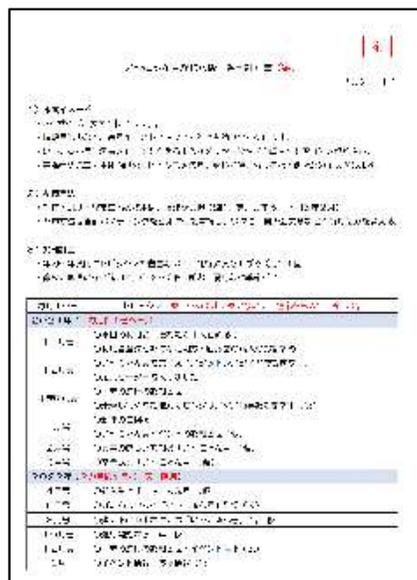
Public relations strategy led by the local community

- Poster and banner designed by the stationmaster of Roadside Station Akagi Kogen
- Public relations to familiarize children are underway based on the stationmaster's idea.
- Staff bench coats are in preparation for the coming full-scale winter season.

<Poster/banner>



<Public relations through social media>



▲ Publicity by e-newsletter



▲ Publicity through social media



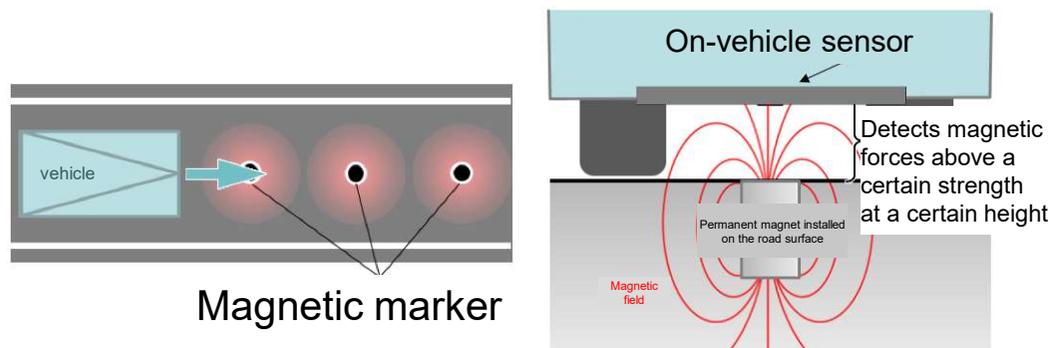
<Scenes of public relations>



(7-I) Outline of Long-term Field Operational Test in Takahata

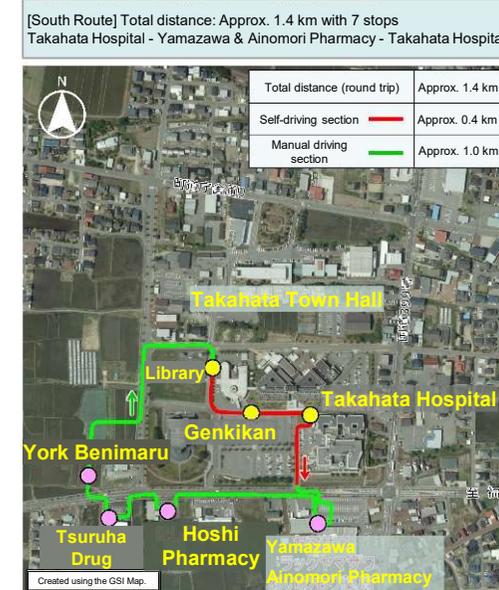
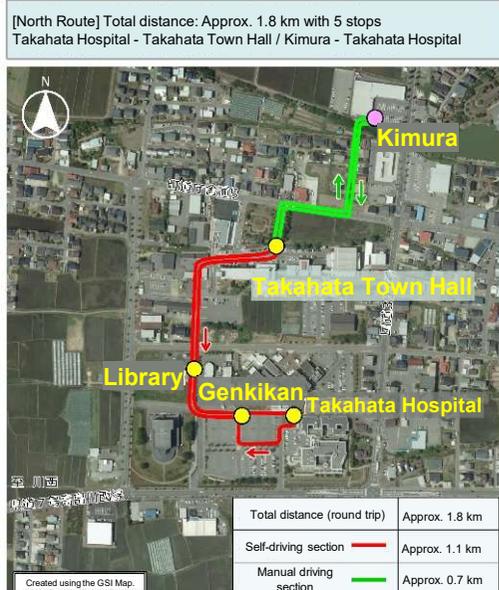
■ Outline of implementation operation

Field Operational Test operation period	From Monday, October 11 to Friday, November 12, 2021
Purpose	<ul style="list-style-type: none"> - Confirmation of adaptability and operability as a public transportation system - Confirmation of effectiveness and acceptability of short-distance transportation services and identification of challenges in business model development - Technical Verification of auto-driving support
Bus route Total distance	North route: 1.8 km, South route: 1.4 km Starting from and ending at the hospital, north route goes around the town hall, and the south route goes around pharmacies and supermarkets.
Operation method	Mixed traffic (on public roads) Self-driving transport level 2
Operation pattern	Pre-scheduled service: North route: 5 trips, South route: 5 trips Operation hours: 10 a.m. - 4 p.m.
Vehicle used	<ul style="list-style-type: none"> ○ Yamaha Motor Power Products Co., Ltd. ○ Capacity: 7 (passenger: 5) ○ Travel speed: 12 km/h max. (auto), 20 km/h max. (manual) ○ Use a vehicle that automatically travels by reading magnetic markers.



▲ Image of reading magnetic markers

■ Bus Route



■ Main verification items

Verification items	Vehicle
	Services
	Infrastructure

- Vehicle**
 - Effectiveness as a means of public transportation due to the increased riding capacity
 - Operability of the self-driving transport system with a proven track record of operation with an ordinary driver's license
- Services**
 - Effectiveness, acceptability, and business model development of a transportation service only in the central area that is liked with existing demand transportation
 - Questionnaire and interview surveys on user payments, usage needs, etc.
- Infrastructure**
 - Versatility and installation cost of automatic operation assistance facilities (magnetic markers)

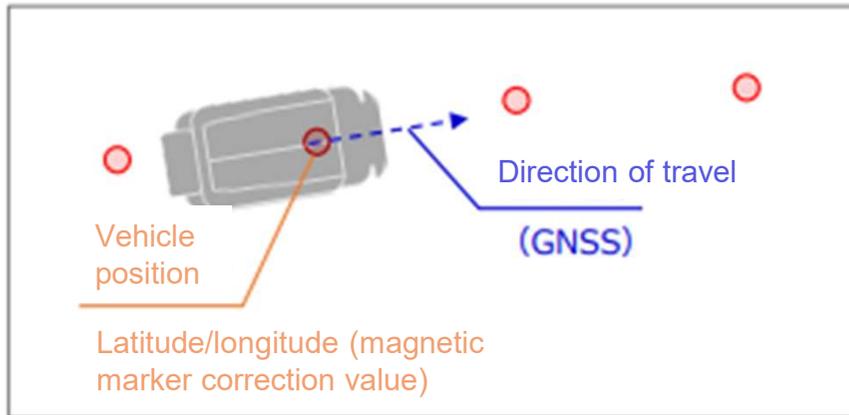
(7-II) Outline of Long-term Field Operational Test in Takahata

- Repeat “estimating the vehicle position from the vehicle motion” and “correcting the estimated position by referring to magnetic markers” to acquire the traveling position with high accuracy.

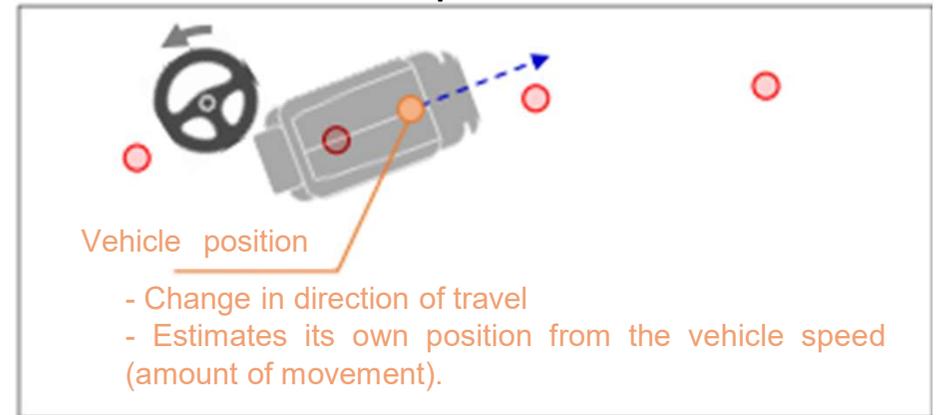
■ Estimate the vehicle position

Between markers, the vehicle estimates its own position from the vehicle motion (steering angle, vehicle speed, and yaw rate), and the direction of travel obtained from GNSS.

<Vehicle position estimation process until reaching the next marker>



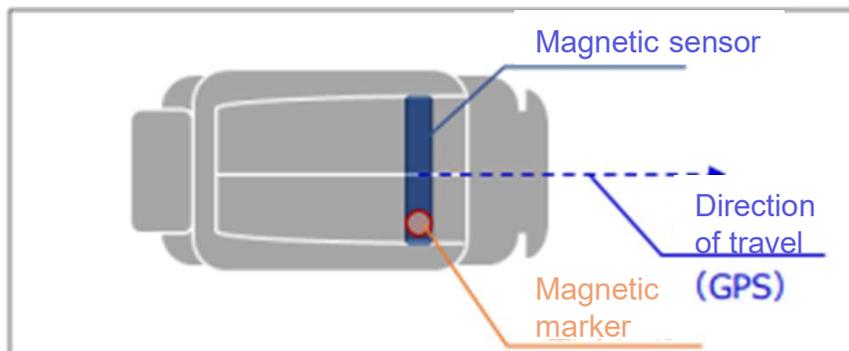
<Estimate the amount of movement based on the vehicle motion ≈ Estimated vehicle position>



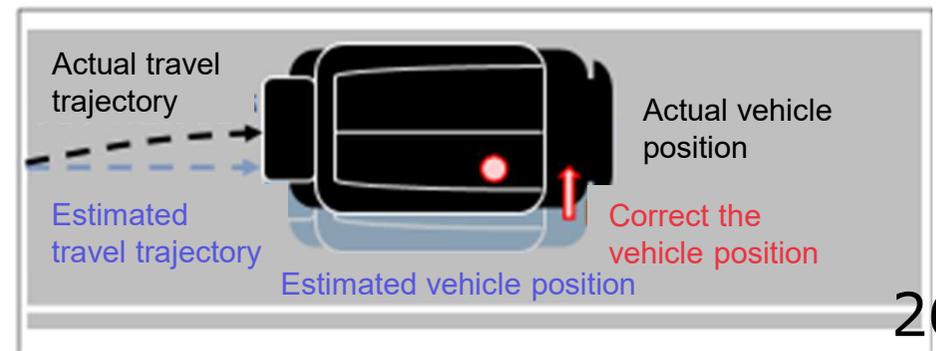
■ Correct the vehicle

Determines the current vehicle position by detecting magnetic markers (taking the GPS azimuth as the vehicle's direction of travel).
⇒ Taking the vehicle position determined based on magnetic markers as the "true value," corrects the estimated value (retry estimation from "true value").

<Detect magnetic markers with a magnetic sensor>



<Determine and correct the vehicle position based on the detected position>



(7-III) Outline of Long-term Field Operational Test in Takahata

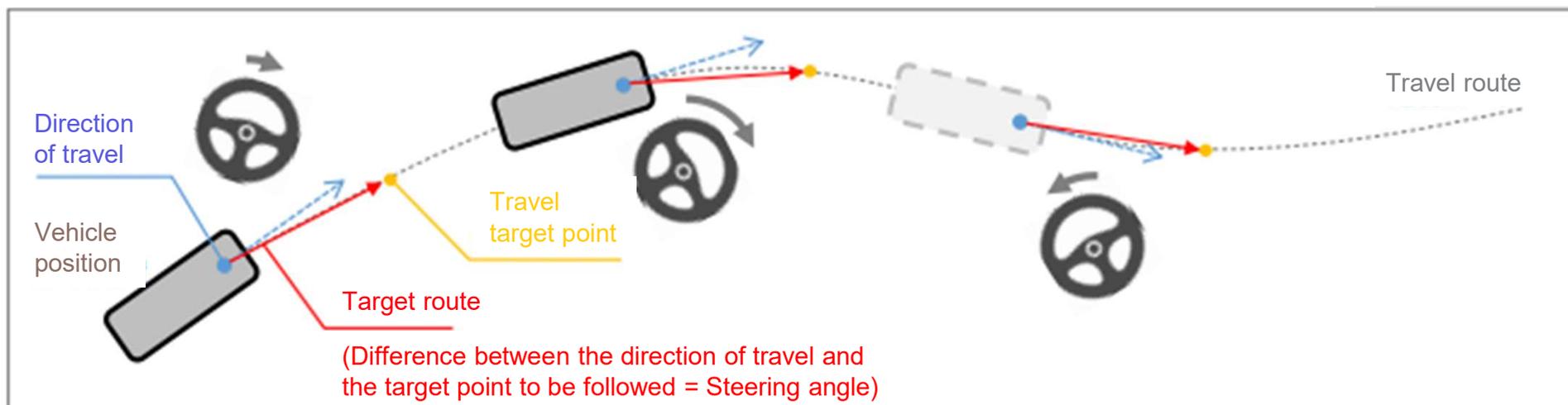
- Set the travel route in advance, and link "traveling speed" and "stop commands" to the route.
 - ⇒ Determine (calculate and output) the "target steering angle" and "target vehicle speed" according to the vehicle's traveling position.

■ Steering control

Determine the travel target point based on the preset travel route and the vehicle position.

⇒ Calculates and controls the steering amount so as to pass the target point.

※The target point is updated as appropriate according to changes in the vehicle position.



Impressions of the test operation staff (about ride on the electromagnetic induction type and magnetic marker type vehicles)

- ◆ In comparison with the electromagnetic induction type, especially in curves, the electromagnetic induction type requires frequent steering so that the sensor does not deviate from the induction wire, whereas the magnetic marker type determines the target steering angle and target vehicle speed so that the vehicle passes the travel target points, which allows smooth and comfortable travel.

(7-IV) Results of Long-term Field Operational Test in Takahata

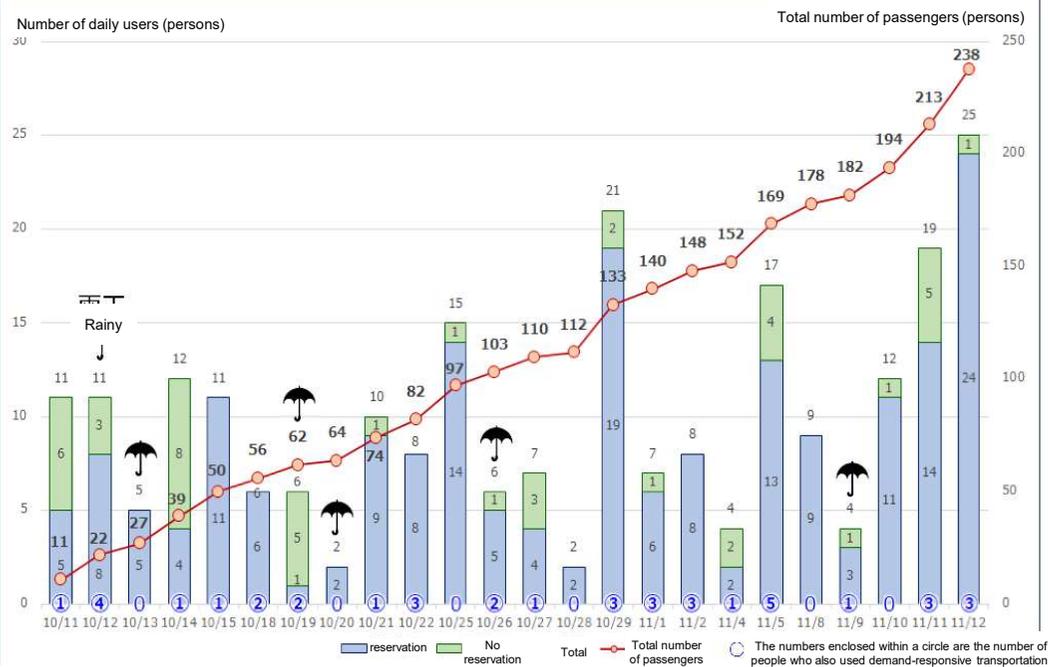
Results of long-term Field Operational Test (prompt report)

- The total number of users was 238, and the average number of daily users was 9.9. Used by elders, and we confirmed they desired to continue the service.
- As a measure to improve the acceptance of self-driving transport services, self-driving transport class sessions and test-ride sessions were held for elementary and junior high school students.

<Service usage status>

- Total number of users: 238, South route: 116, North route: 122
- A total of 40 people also used demand-responsive transportation, the average age is 76, and the oldest is 91.
- Number of registered users: 453 (283 before the start of service, 170 after the start of service)

Daily user trends



I have to take two breaks to get from the hospital to Yamazawa. I have a bad leg, so this helps a lot. I want it to keep going.

<Self-driving transport class sessions and test-ride sessions for elementary and junior high school students>

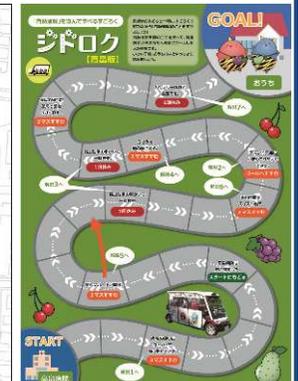
- Saturday, October 30, 2019, 10:00 a.m. - 3:00 p.m.
- Participants: 78 elementary and junior high school students and parents
- Held self-driving transport class sessions and test-ride sessions.



▲ Information leaflet



▲ Venue and test ride course



▲ Jidoroku Takahata version



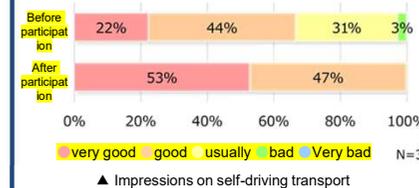
▲ Scene of hands-on test ride



▲ Scene of exhibition briefing



▲ Self-driving sugoroku



▲ Impressions on self-driving transport

● Opinions and impressions (from elementary and junior high school student questionnaire)

- To be honest, I was afraid of self-driving, but I **was relieved because it was slow.**
- I was happy to be able to ride with my family. I **want to teach my family.**
- I thought it would be better if it were more convenient and **could be used from home to school or nearby.**

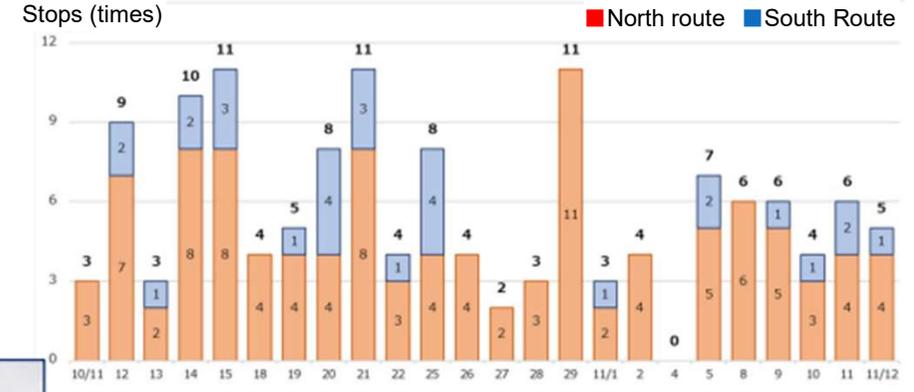
(7-V) Manual Interventions during 24 Days of Operation in Takahata

- The numbers of times of switching to manual operation by brake and steering wheel operation, and temporary stops

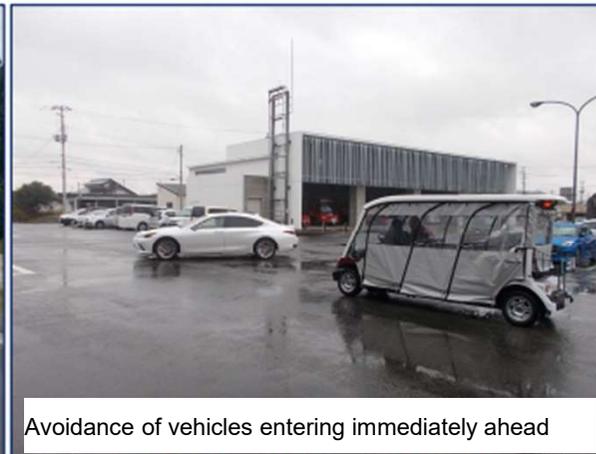
108 for 120 trips (0.90 per trip) on the north route
 29 for 120 trips (0.24 per trip) on the south route
 137 for 240 trips (0.57 per trip) in total

* Including 18 stops for safety confirmation in case of poor reading of GPS data, etc.

North route: 108 times, South Route: 29 times



- Typical cases of manual interventions

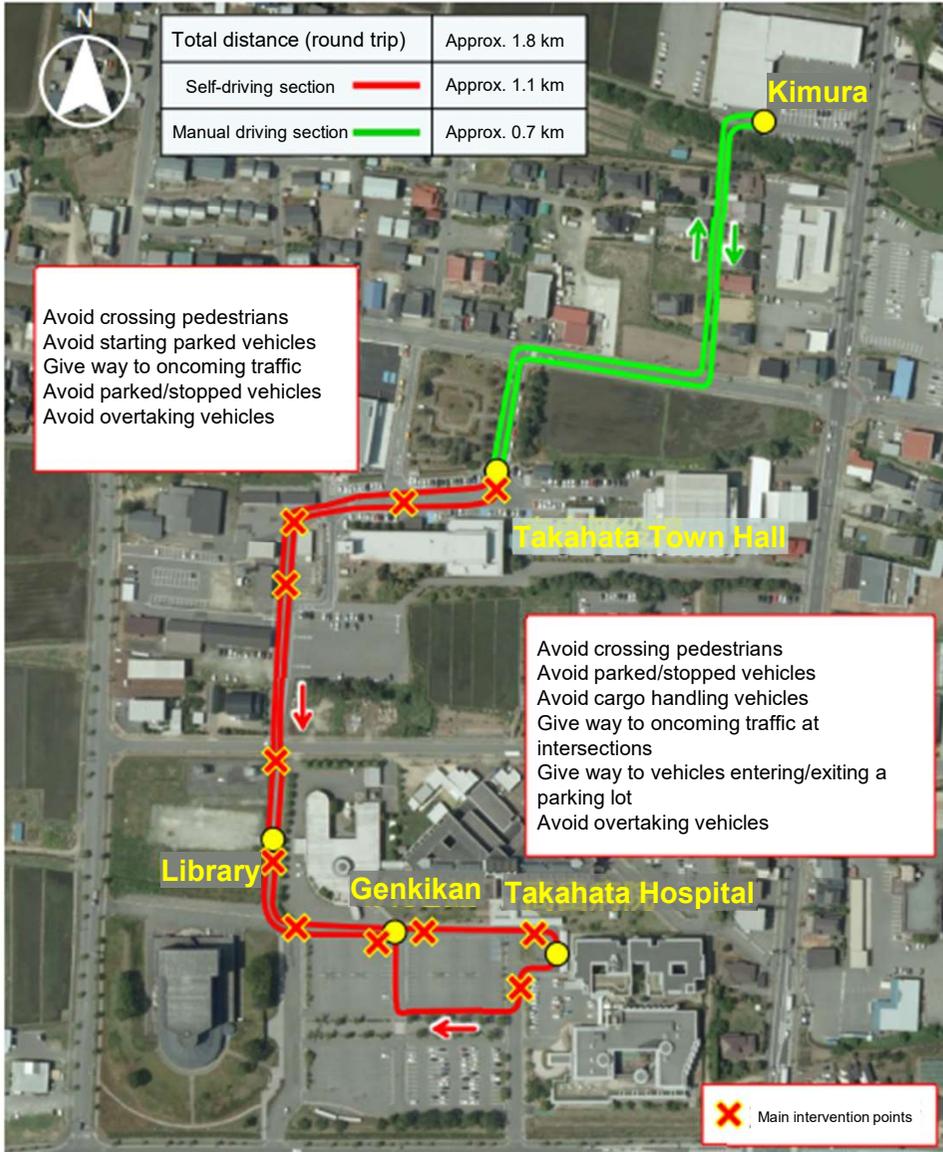


▲ Number of manual interventions during self-driving transport

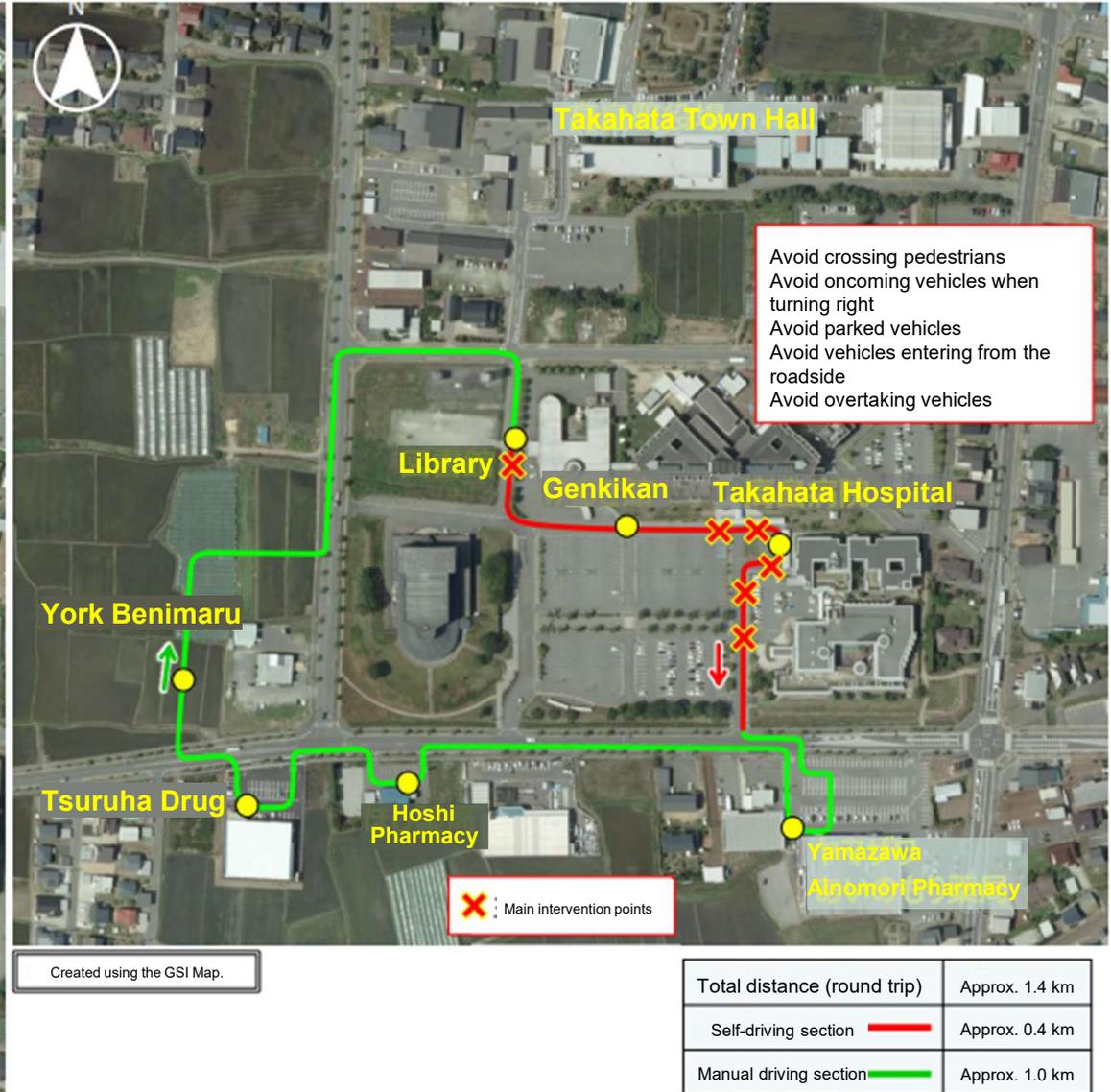
- The manual interventions were performed by the driver at his/her own discretion as a precautionary measure to ensure safety.
- No urgent interventions to avoid collisions or the like have occurred.

(7-VI) Locations and Reasons for Manual Interventions in Takahata

[North Route] Total distance: Approx. 1.8 km with 5 stops
Takahata Hospital - Takahata Town Hall / Kimura - Takahata Hospital



[South Route] Total distance: Approx. 1.4 km with 7 stops
Takahata Hospital - Yamazawa & Ainomori Pharmacy - Takahata Hospital



Created using the GSI Map.

Created using the GSI Map.

This report documents the results of Cross-ministerial Strategic Innovation Promotion Program (SIP) 2nd Phase, Automated Driving for Universal Services (SIP-adus, NEDO management number: JPNP18012) that was implemented by the Cabinet Office and was served by the New Energy and Industrial Technology Development Organization (NEDO) as a secretariat.