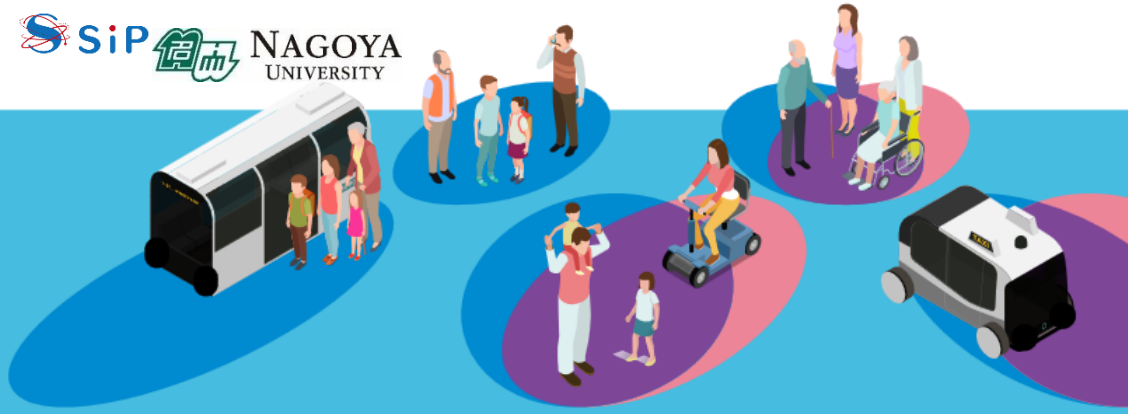
Nagoya University COI-NEXT
My-mobility Co-creation Center

SiP NAGOYA UNIVERSITY



Toward the Society of No Mobility Divide

Social Implementation Projects of Smart Local Mobility at Nagoya University

Takayuki Morikawa

Designated Professor and Professor Emeritus
Global Research Institute for Mobility in Society
Nagoya University

March 4, 2025

Research Background

~Current status of local public transportation in Japan~

- Most areas in Japan except for Tokyo and Osaka metropolitan areas are quite **car-dependent** and the service level of public transportation is low, resulting in that those who don't use private cars are forced to **low mobility**.
- The car-dependent transportation system also has social issues such as **congestion, accidents, air pollution and green-house-gas emission**.
- Even when autonomous vehicles become widespread, **mass transit is indispensable** to cities because of low capacity of automobiles.
- But public transportation except heavy rail in big cities has been facing the **continuation crisis due to decrease both in users and drivers**.

Still sustainable

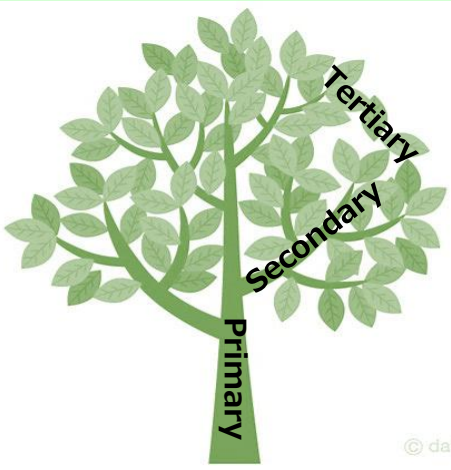
Difficult to maintain

No service by PT

Trunk : **primary**
e.g., commuter rail, subway, arterial bus

Branch : **secondary**
e.g., bus, taxi, drive/pick-up by family

Leaf : tertiary
e.g., walk, bicycle, drive/pick-up by family



Three National-funding Major Projects

1. **COI** (Center of Innovation) is a **9-year** academia/industry research program **funded by MEXT and JST** (Japan Science and Technology Agency).
   - NU COI started in 2013 granted about **¥500M/y**.
2. **COI-NEXT** replaced COI in 2021 as a **10-year** program.
   - NU COI-NEXT started in 2022 granted about **¥200M/y**.
3. **Cabinet Office** started **SIP** (Cross-ministerial Strategic Innovation Promotion Program) / **Building Smart Mobility Platform** in 2023 as a **5-year** program.

Mobility Innovation Center
～Empowering an aging society through advanced mobility～

Project Leader
Mr. Kuroyanagi, Shigeru (Toyota)

Research Leader
Dr. Morikawa, Takayuki (NU)

Information Platform Research

Daily Healthcare Platform Research

AGC Inc.

Mobility Research

ICT Infrastructure Research

KDDI Research, Inc.

名古屋大学 NAGOYA UNIVERSITY

Toyota Motor Corp.
Toyota Central R&D Labs
Aichi Prefecture
Nagoya City
AIST
Tokyo University of Agriculture and Technology
Aichi Prefectural University

Cooperative Research

Toyota City
Kasugai City
Kota Town

Sustainable Platform Research

Panasonic Corp.

FY 2013 – FY 2021

Technologies and Systems for Social Implementation

Infrastructure for drive assist and autonomous driving

Personal mobility using **vehicle location estimation technology** with **wide-ranging applications.**

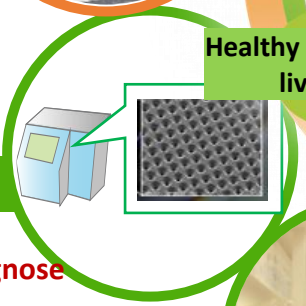
Driving safety and review systems

T-connect app to **analyze safety levels of driving and encourage behavioral changes.**

Elderly datasets

Dealer-installed pedal error prevention systems using **datasets** of **human traits such as aging vision and driving behavior.**

Intellectual Glass



A **bio-device** that can **easily diagnose cancer patients**
(→ applied to diagnostic equipment).

Walking Assistance Robot

A **well-designed walk training robot** that **automatically adjust to walking loads.**

(2) Slocal Autonomous Vehicle Legislation

Local **last-mile transportation services** (including **legislation**) **instituted in and created by the region.**

(1) Mobility Blend (MB)

MaaS to supplement existing modes of transportation with **new modes for the elderly in inconvenient areas.**

Creating a system with situations where **residents want to get out together.**

(3) Cyclic health span extension program

A **healthy activity promotion program** to **prevent frailty/decline in cognitive function** (incl. a system for **rotating senior human resources**).

(1) Mobility Blend

Mobility services in rural areas such as semi-mountainous areas, suburban areas and small towns.

- Improve local mobility by blending existing travel modes and newly introduced services with CASE technologies.
  - CASE : Connected, Autonomous, Shared, and Electric
- Combine CASE-type modes according to local circumstances such as the degree of aging, depopulation, and driver shortages

Realize innovation with low-cost, non-disruptive mobility improvements by blending CASE-type transportation with existing travel modes

(2) Slocal Autonomous Vehicles

Realize earlier implementation with SAE Level 2 - 4 autonomous vehicles that drive below 20 km/h in specific areas for better coordination with people and society.

- **Services**
  - Offers driverless transportation service mainly for the transportation-poor such as the elderly in rural areas.
    - The last-mile service from transit stops
    - Shared transporters within a community
  - Can also be used for advanced urban transportation systems
    - Automated redistribution for car-sharing systems
    - Automated valet parking
- **Driving Performance**
  - Cooperative movement with surrounding traffic
  - Communication with surrounding traffic and people

Slocal Autonomous Vehicle Platforms

Golfcart

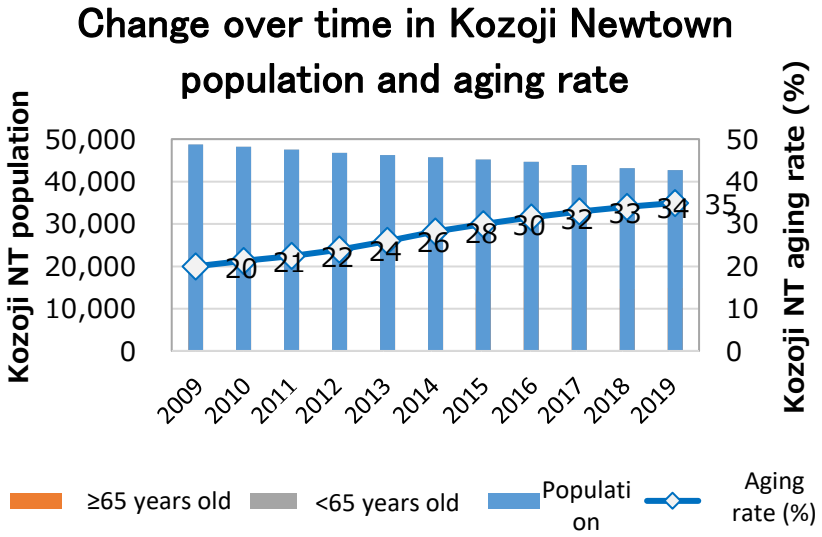
Minivan

Van

Minibus

Pilot Study in an "Aging Newtown"

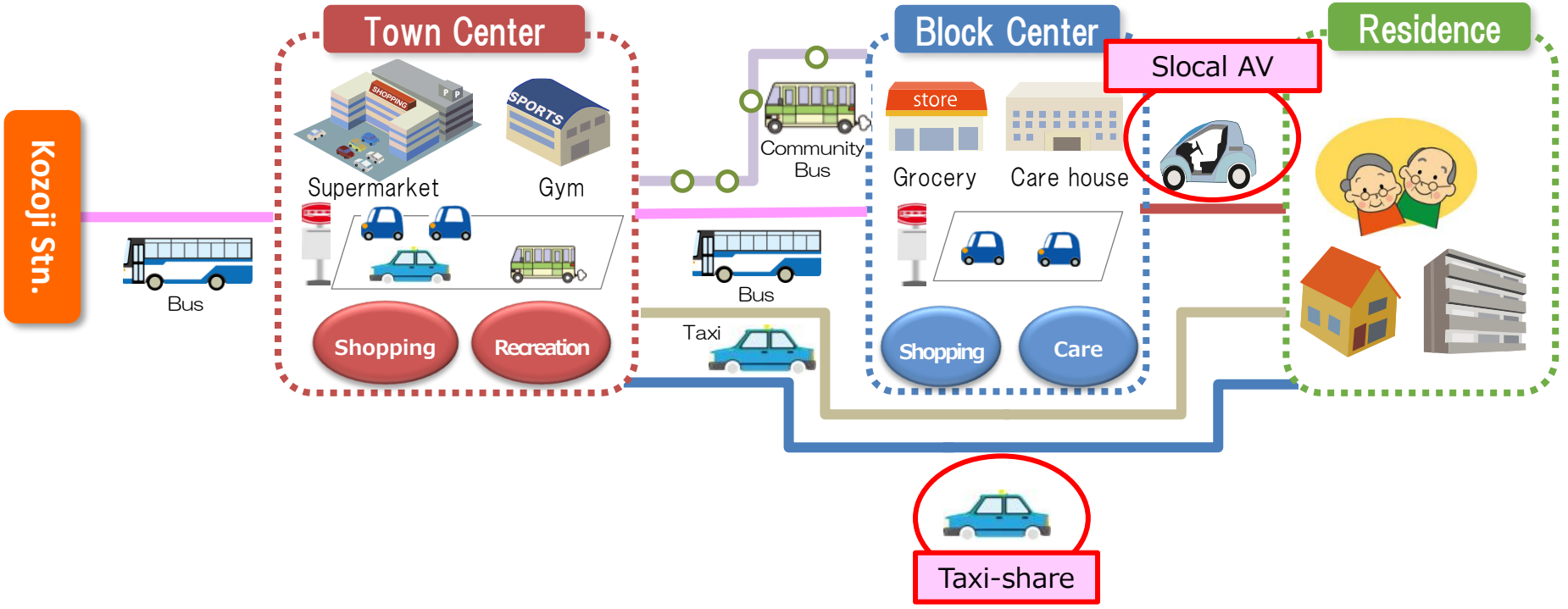
Kozoji Newtown in Kasugai City



- The town has no train station, and buses are the only public transportation available.
- Decreasing frequency of bus service, greater numbers of individual who have given up their drivers licenses, and a steep last mile are problematic
- Transportation operators face driver shortages.

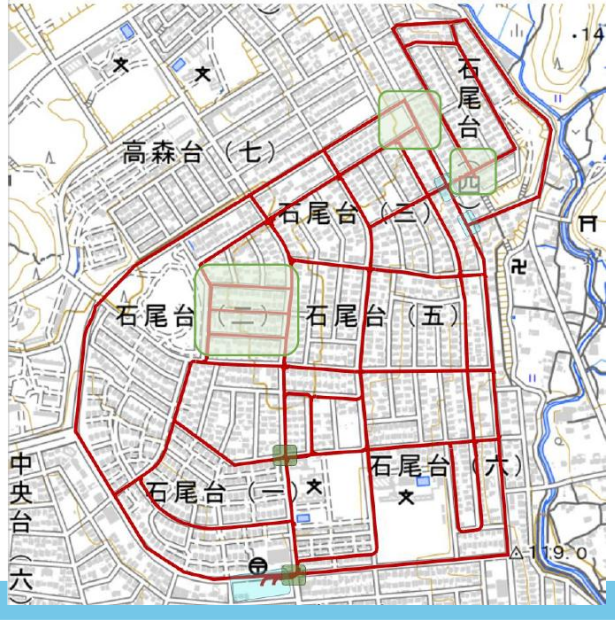
Deployment of Mobility Blend

① Introduce Slocal Autonomous Vehicles System for last-mile service.
② Introduce taxi-share system.



Slocal AV Operation by Residents' NPO

Started on February 1, 2023



(3) Evaluation of Mobility Services

How can we measure the increase in well-being by implementing the mobility services?

Well-being defined in social psychology

① **Life satisfaction**

e.g., being satisfied with life, life being ideal, not wanting to change anything even if you could

② **Positive relationship with others**

e.g., reliable friendships, empathy with others, a desire to share one's time with others

③ **Autonomy**

e.g., not relying on others to make decisions, privileging one's own values over social evaluation, not being bound by habits

Hard to observe the change of well-being by introducing mobility services in short term

Investigating indicators that can explain well-being and will change by introducing mobility services

QOML: A unique indicator by NU-COI

QOML (Quality of Mobility Life)=

$$\sum_{\text{life-space level}} \text{Life-space range (level 1-4)} \times \text{Frequency of movement (level 0-4)} \times \text{Quality of movement} \times \text{Contentment with movement \& activity}$$

Quality of movement
- safety and security
- usefulness
- affordability

(average of a 5-point evaluation)

Contentment with movement & activity
- autonomy
- relationships with others
- satisfaction

(average of a 5-point evaluation)

*Full score: 1000 points
Level 1: 100 pts Level 2: 200 pts Level 3: 300 pts Level 4: 400 pts

It is found that people with higher QOML have higher higher well-being.

Nagoya University COI-NEXT

FY 2022 – FY 2031

Project Leader: Dr. Takayuki Morikawa (NU)

Sub Project Leader: Dr. Akira Ando (Nikken Sekkei)

COI-NEXT and SIP Based on COI

NU-COI project proposed:

① **Mobility Blend**
as a concept of enhancing mobility services in regions with poor public transport by blending CASE type transport services to the existing public transport

② **Slocal Autonomous Vehicles**
Low-cost autonomous vehicles are very effective for MB considering the driver's cost and lack of drivers.

③ **QOML**
as a well-being-based evaluation indicator

We started new projects, COI-NEXT and SIP, to further pursue the society of no mobility divide.

Center's Name and Vision

My-mobility Co-creation Center for Sustainable Region

Vision

Super-mobile society where everyone can go, meet and participate

Innovation of Mindset, Technology and Institution

Mindset

- "My-mobility" mindset: the residents and local businesses commit to local mobility issues.
- "Micro MaaS (Mobility as a Service)": MaaS in a local area that is built by the residents, local businesses, municipality and transportation operator.

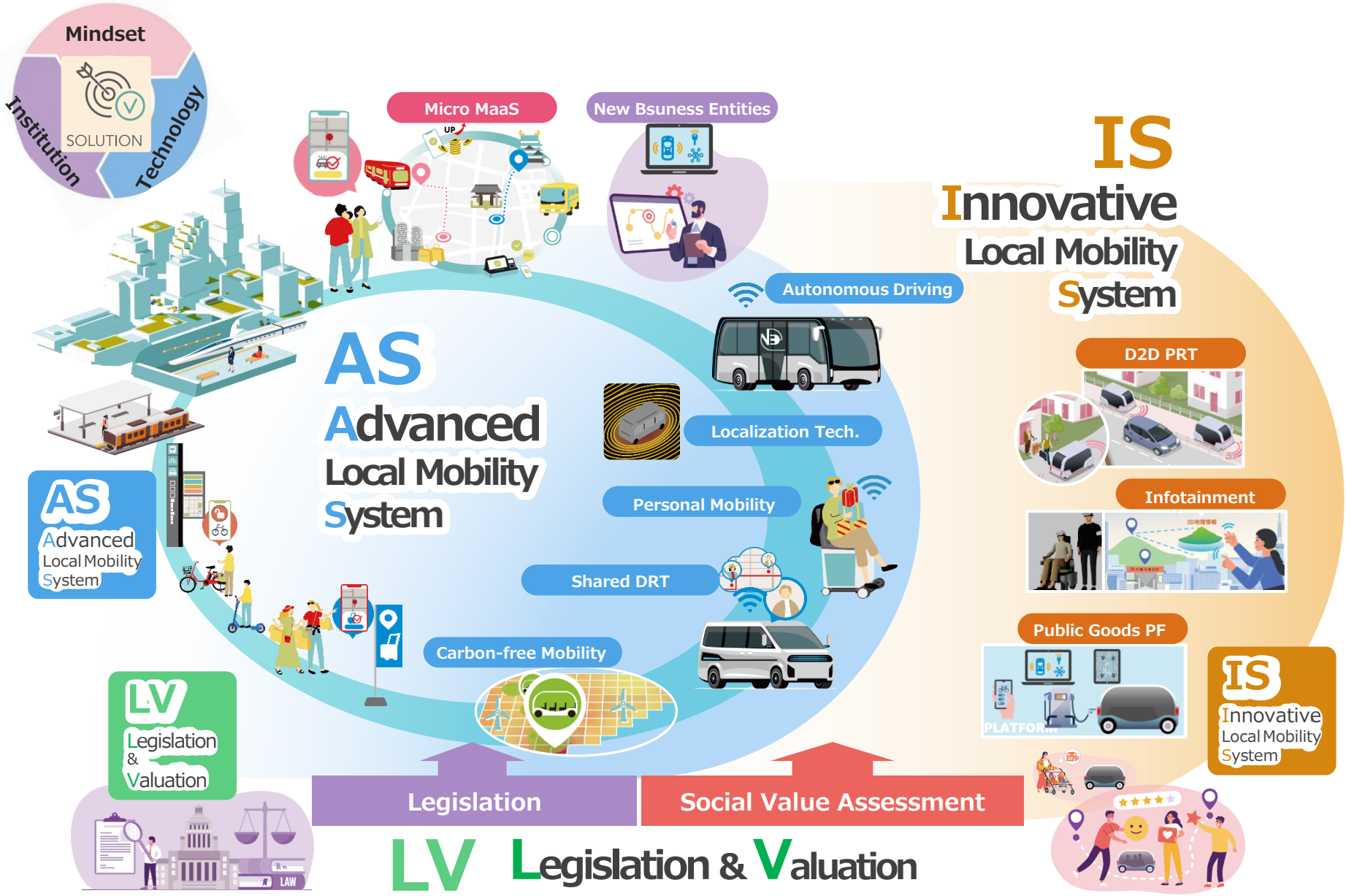
Technology

- Autonomous vehicles
- Data-driven agile update of mobility services
- "Infortainment system" that changes the quality of travel time

Institution

- New public services that enable rural areas to have public transport utilizing autonomous vehicles: "Public goods platform for smart local mobility"
- Legislation for driverless cars

AS, IS, and LV


Mindset
SOLUTION
Institution
Technology
Micro MaaS
New Bsuness Entities
IS
Innovative
Local Mobility
System
AS
Advanced
Local Mobility
System
Autonomous Driving
Localization Tech.
Personal Mobility
Shared DRT
Carbon-free Mobility
D2D PRT
Infotainment
Public Goods PF
AS
Advanced
Local Mobility
System
LV
Legislation
&
Valuation
IS
Innovative
Local Mobility
System
Legislation
Social Value Assessment
LV Legislation & Valuation

Test Fields to Implement AS

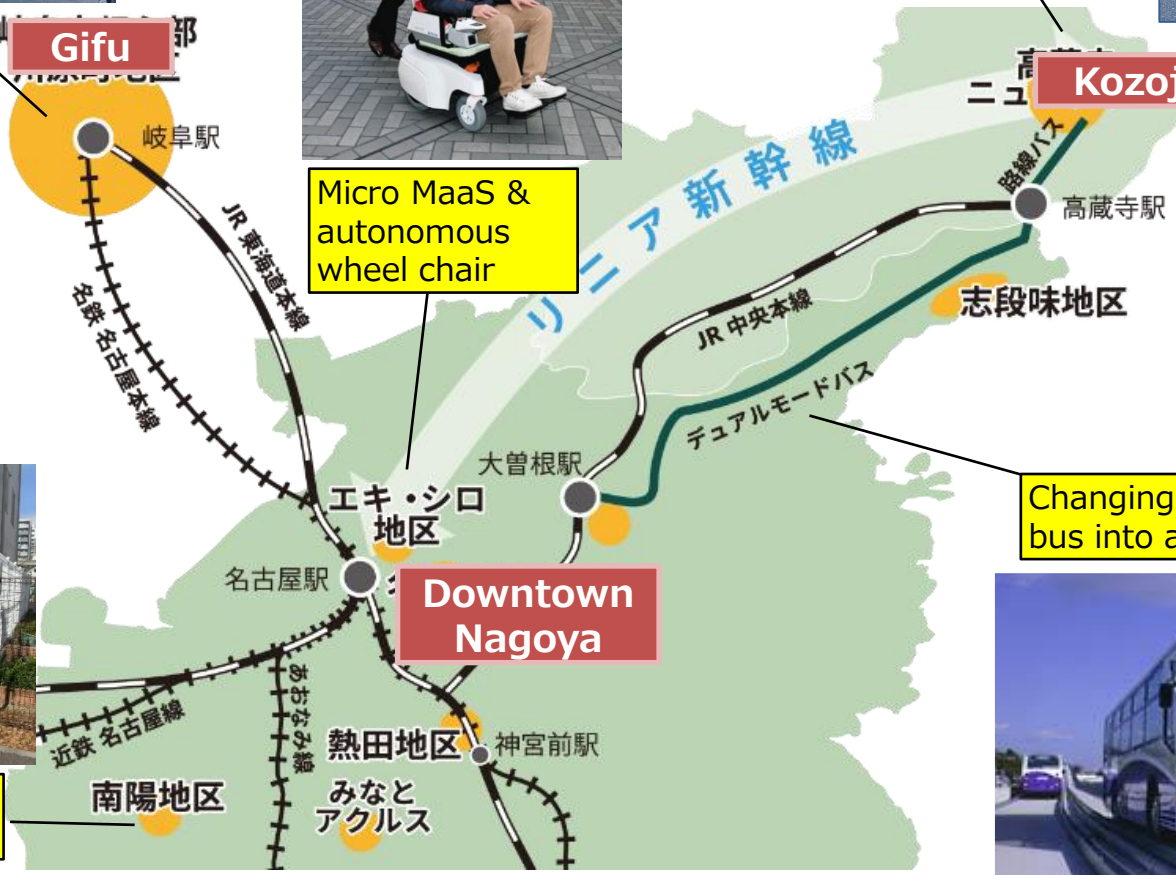
Autonomous bus

Micro MaaS & autonomous wheel chair

New business entity & faster autonomous car

Micro MaaS & shared DRT

Changing the guideway bus into autonomous



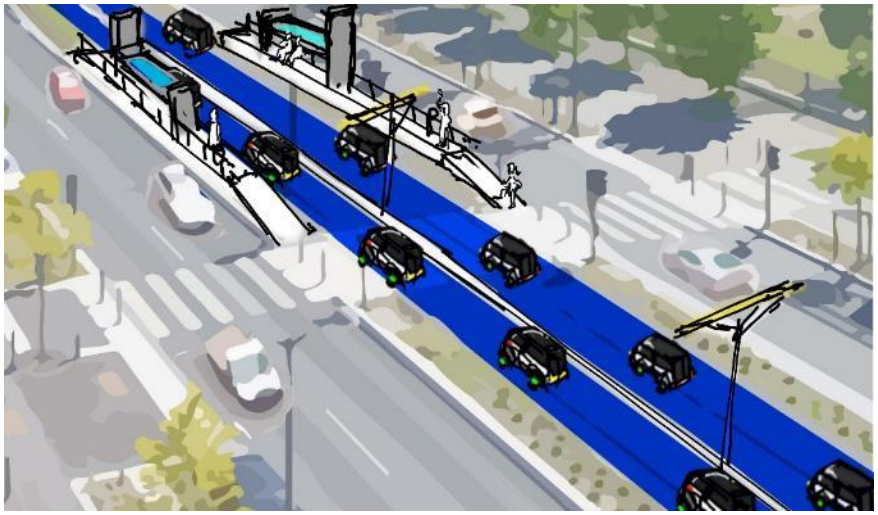
Technological IS: D2D PRT

Door-to-Door Personal Rapid Transit (D2D PRT):

① Small autonomous vehicles (2-4 seaters)

② Platooning on arterial roads

③ Slocal autonomous service on city streets



Platooned AV on arterial roads

Depot at terminal areas

Institutional IS: Public Goods PF

Public goods platform for smart local mobility

Building Smart Districts Utilizing Advanced Mobility Systems

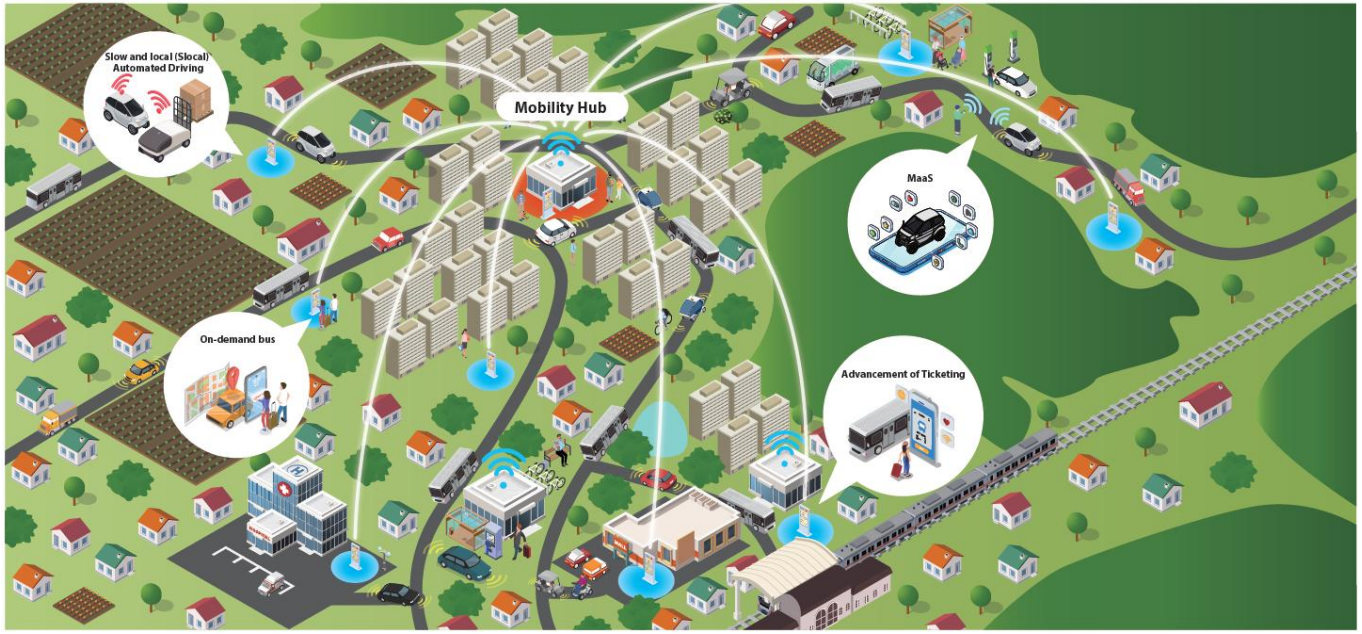
Project Leader : Prof. Takayuki MORIKAWA (Nagoya University)

FY 2023 – FY 2027

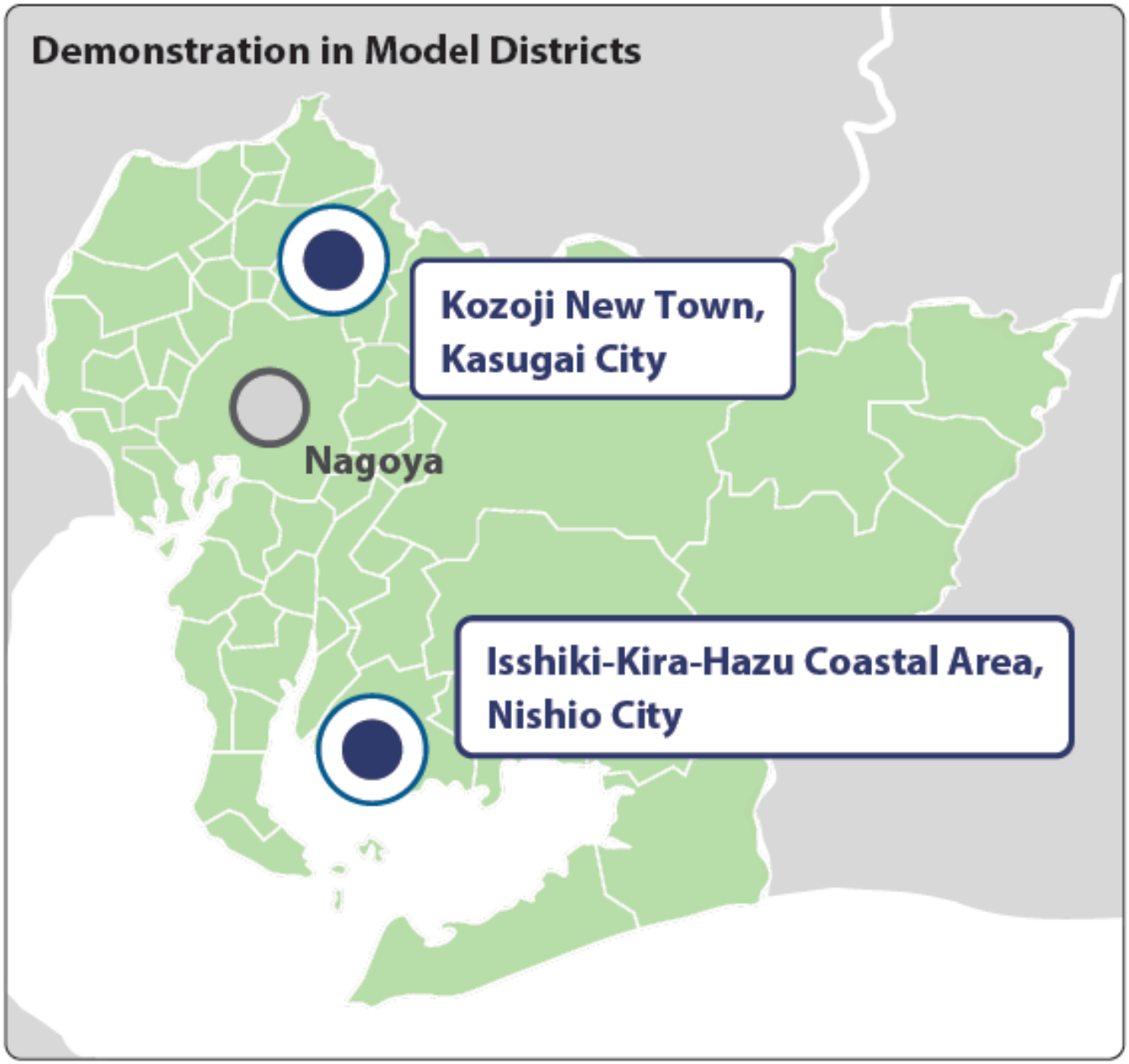
Research Focuses of NU-SIP

In addition to developing and implementing **local mobility services**, we focus on:

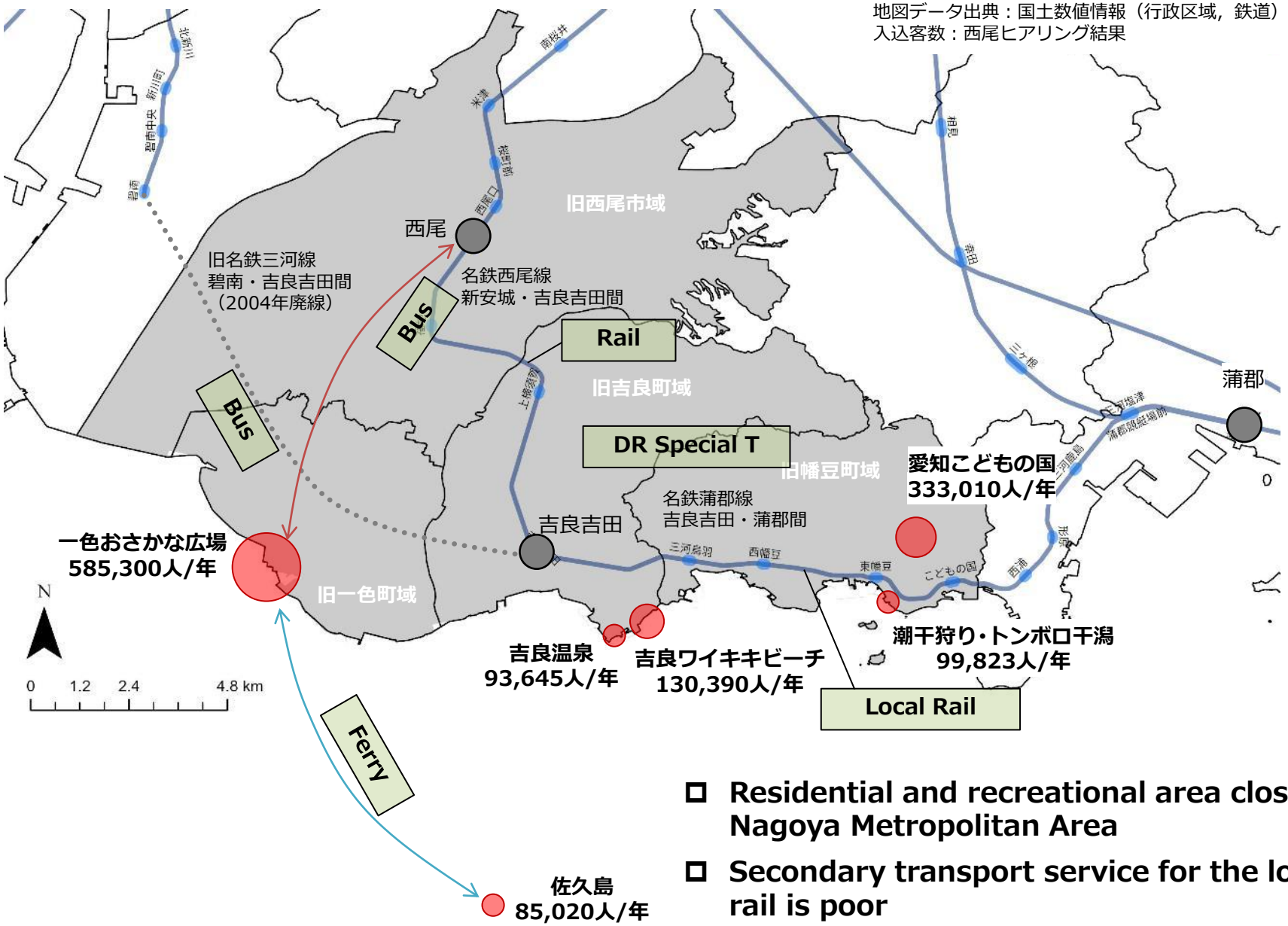
- **mobility hubs** which will serve as nodes for local mobility services and provide information and opportunities on various activities,
- **socialized autonomous vehicle system** which include standardized vehicles and systematic way of defining ODD, and
- **data-driven schemes** that help monitoring the mobility systems and developing the evaluation index.



Test Fields for NU-SIP



Transport Network in Isshiki-Kira-Hazu (IKH) Area



- Residential and recreational area close to Nagoya Metropolitan Area
- Secondary transport service for the local rail is poor
- Car trips are dominant

Fish market in Isshiki


Clam picking in Hazu


Port in Sakushima island


Tombolo in Hazu

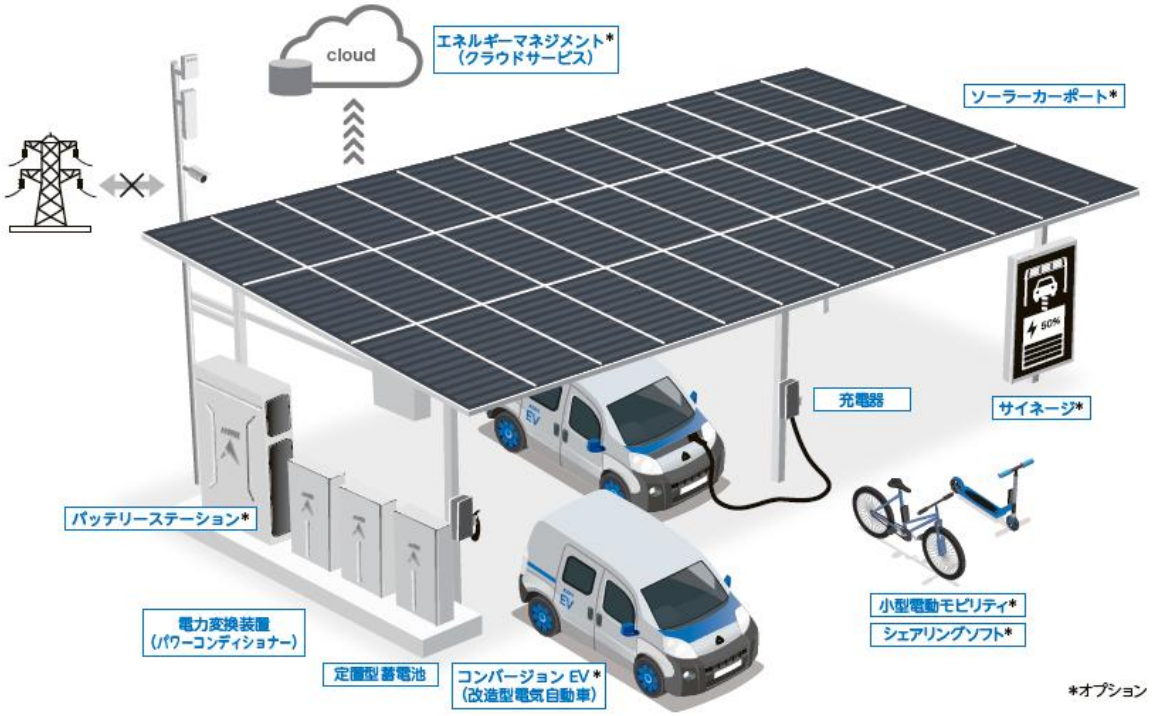
Transport Management at IKH Area

Building Smart District by Mobility Hubs and Smart Local Mobility

Mobility Hubs at Rail Stations

- Mobility hubs will be set to provide feeder services.
- The first experiment will start on January 27, 2025 by providing special transport using taxi cabs.

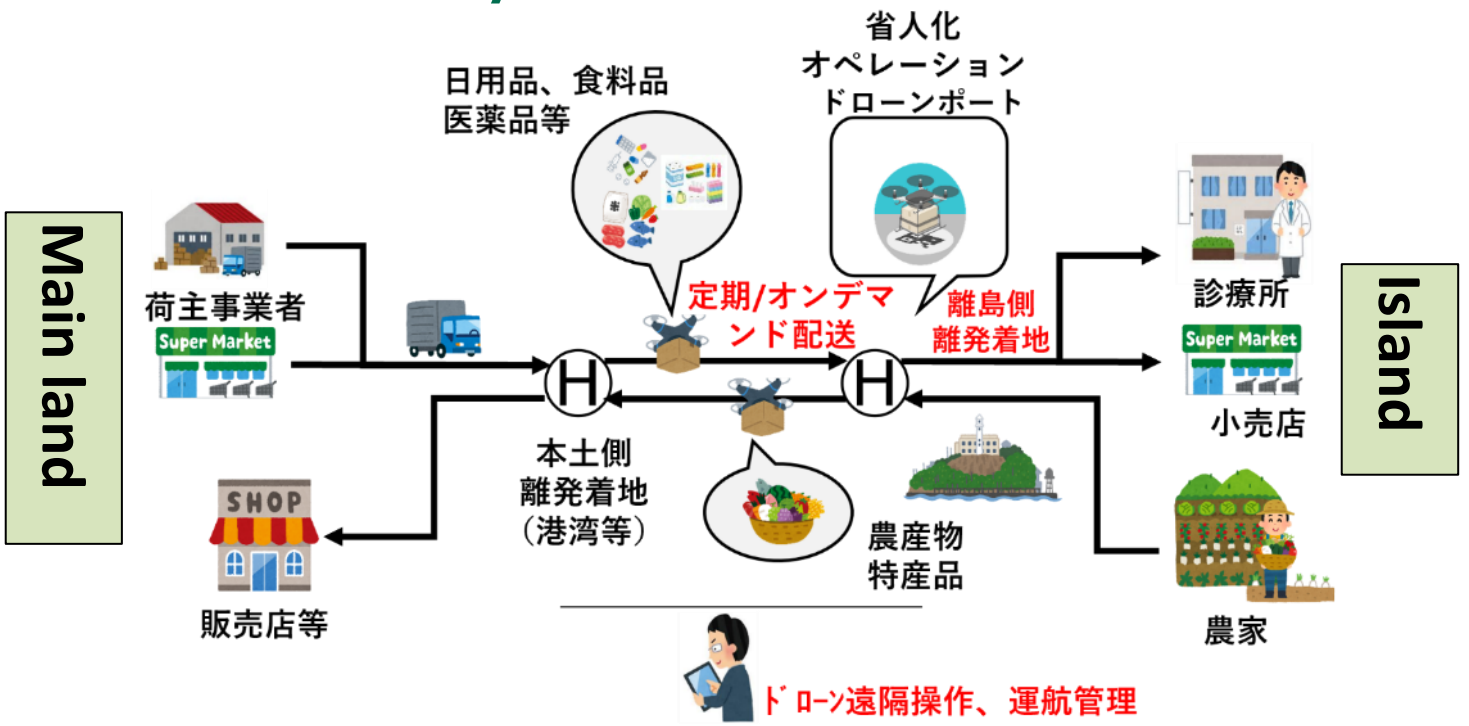
“E-STATION” at Mobility Hubs



- An “E-STATION” will be built at a mobility hub.
- EVs can charge from the PV panels and batteries at the E-STATION.
- The second experiment will start utilizing an autonomous EV for feeder service.

Goods Delivery by Drones

- Goods delivery by drones was experimented between Isshiki port and Sakushima island.
- A mobility hub with E-STATION may be build at the drone port in Sakushima island.
- Goods and passengers will be delivered throughout the island via the mobility hub.



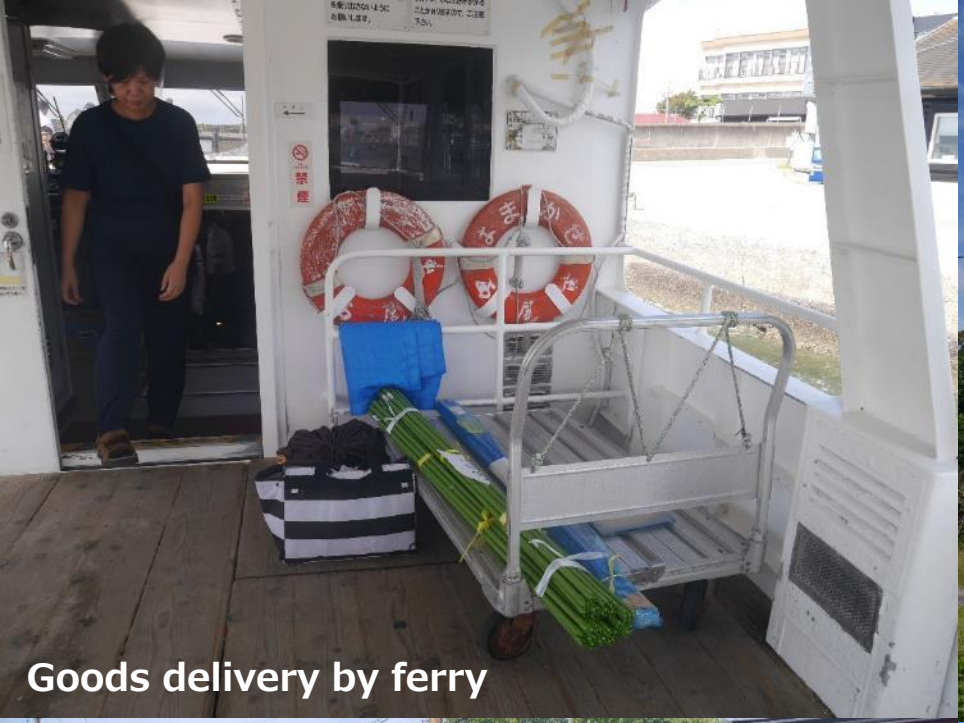
実験フロー画像出典　愛知県（発表者によって一部追記）　https://www.pref.aichi.jp/press-release/soramichi2024.html

Delivery Experiment between Isshiki and Sakushima Island for 1 Month

@一色港

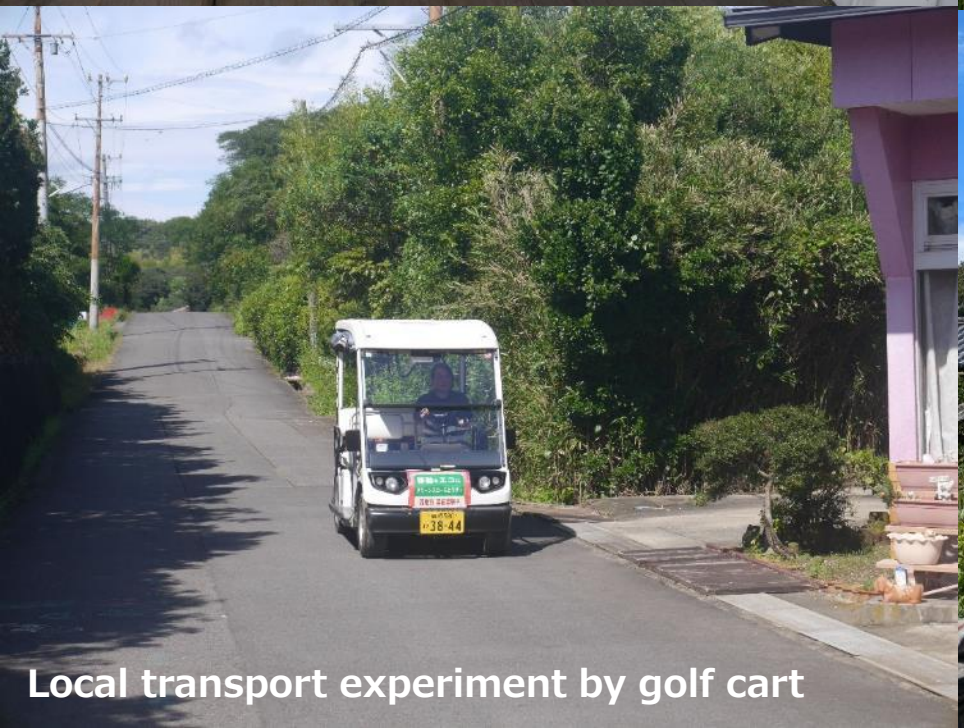
Sakushima Island

https://nishiokanko.com/wp-content/uploads/2019/10/sakushima_issiki_2019_03.pdf



Goods delivery by ferry

Drone port



Local transport experiment by golf cart

Local village

Livability Index by Public Transport

London's PTAL

Public transport service frequency around assessment point

London's ATOS

Travel time to facilities by public transport

Our LIPT

Feasibility of a return trip to facilities by public transport

LiPT

Livability Index by Public Transport

A simulator to assess accessibility of the spot using GTFS data

LIPT can assess the feasibility of making a return trip with reasonable activity time at the livability destinations, e.g., hospitals and shops.

International Collaboration

Why International Collaboration?

- Learn from overseas initiatives and case studies to enhance our R&D.
- Look for potentials to work with international research institutions on common challenges and technologies to achieve higher-quality research outcomes and enhance global presence.

Our activities so far

- **University Partnerships**
  - Joint workshops with **Chulalongkorn University & Kasetsart University (Thailand)**
  - Hosting short-term stays and joint workshops with **Pontifical Catholic University of Paraná (Brazil)**
- **Presentations at International Conferences**
  - Organized sessions and facilitated young researcher networking at **Mobility Innovation Week Japan**

Ideas for Next Step in Australia

Exploring a Japan-Australia Smart Mobility Workshop (Late this year – Early next year)

- Bringing together **SIP-affiliated Japanese universities & industry** and **multiple Australian universities**
- A platform to **share research progress, identify common challenges, and explore next steps**

Global Collaboration Network

Aim for today and Potential Ideas for Future

Aim for today

- This is our first visit to provide an introductory explanation.
- Today, we hope to hear about each other's interests and challenges.

Potential Ideas for Future

- If there is sufficient interest, we would like to explore the possibility of an expanded workshop.
- The workshop could take place in the latter half of this year or early next year.
- We aim to bring together our colleagues and additional partners from Japan.
- This would facilitate knowledge exchange and explore collaboration opportunities between Japan and Australia.