Note that this is a provisional translation as of May 2024 at the publication of Mobility DX Strategy

Mobility Digital Transformation(DX) Strategy

May 2024

Mobility Digital Transformation Office, Automobile Division, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry

Engineering and Environmental Policy Division, Logistics and Road Transport Bureau, Ministry of Land, Infrastructure, Transport and Tourism

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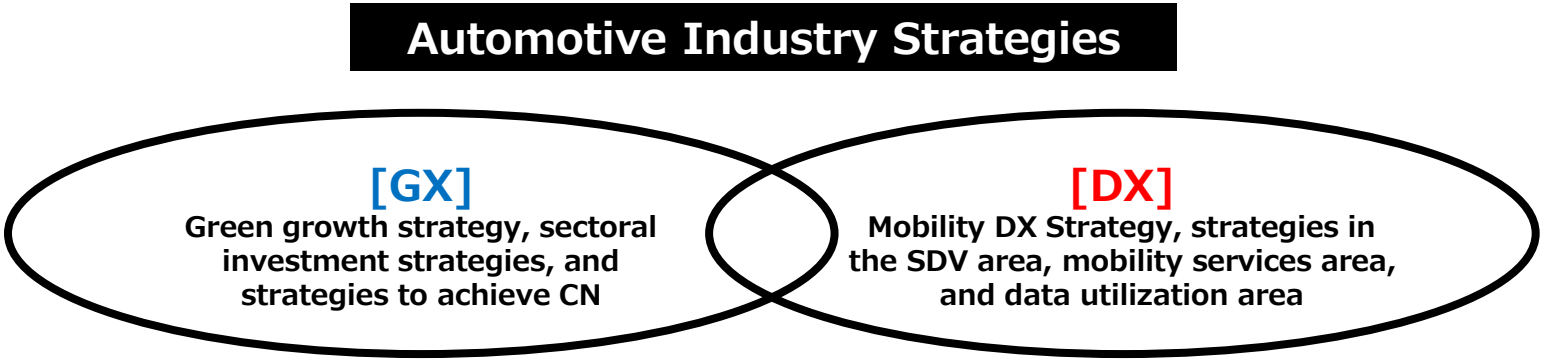
Need to Develop a Mobility DX Strategy

- In automotive and mobility, the **industry structure** is changing on **two axes centering on GX and DX** (Green Transformation and Digital Transformation).

- The GX strategy for the **automotive industry** was formulated in the **Green Growth Strategy for Carbon Neutrality in 2050** (formulated in June 2021) and the **Sector-specific Investment Strategy** (formulated in December 2023). In line with the three pillars of (1) promoting innovation, (2) securing domestic production bases, and (3) creating GX markets, **a package of measures has been developed,** including R&D support through the Green Innovation Fund and other means, as well as various subsidies.

- DX has so far been working mainly from the perspective of social implementation of automated driving, setting targets such as the realization of around 50 locations nationwide by FY2025, and the formation of individual demonstration projects. On the other hand, with the advancement of digital technology in the automotive industry, **DX will become a major axis of competition alongside GX in the** future.

- To this end, the mobility DX Study Group will **formulate a strategy to win the race toward 2030-2035,** based on **discussions in the public and private sectors, encompassing the entire DX, including** software-defined vehicles (SDVs), new mobility services such as automated driving and MaaS, and data utilization that transcends corporate boundaries.



Framework for Considering Mobility DX Policies

- Establishment of a public-private study system to discuss measures to innovate business together with diverse players through digital technology, create a mobility industry that provides new added value, and strengthen international competitiveness.

[The Mobility DX Study Group] (Organized and secretariat: Manufacturing Industries Bureau, METI; Logistics and Road Transport Bureau, MLIT)

Responding to the shift of vehicles to software (analysing SDV configuration techniques, promoting data linkage, etc.)

Construction of a mobile and logistics service model (establishment of business potential, improvement of social acceptability, etc.)

Environmental improvement for development and implementation (construction of development and safety evaluation environment through simulation, securing of personnel, legal system, etc.)

Reporting

[SDV and Data-linkage WG]

- Evaluating/mapping of each elemental technology that constitutes SDV according to the level of importance (technology, cost/player) x the level of urgency, and considering the direction of efforts for important technology among them
- In addition to the development of elemental technologies and the evolution of mobility, promoting the data collaboration across companies at the development, manufacturing, and availability levels

Collaboration

Reporting

[Social Implementation WG for Automated Driving and Logistics Services]

- Examining the materialization of solutions to four issues for social implementation of automated driving service cars ("business potential," "technology," "environmental improvement," and "social acceptability")
- Confirming the progress toward realization of approximately 50 unmanned driving services by FY2025, etc.
- Considering for the realization of new automated driving mobility services

Reporting

[Safety Assessment Strategic Sub WG]

- Construction of traffic scenario databases and simulation environments, and international harmonization of standards and regulations related to automated driving safety, etc. in order to establish efficient development and safety assessment methods

Reporting

[Personnel Strategy Sub WG]

- Promoting efforts to cultivate, acquire and discover personnel with a view to social implementation of new transportation systems such as automated driving

Collaboration

[Society of Automotive Engineers of Japan, Inc.]

- Automated driving AI challenges
- Software-area personnel study WG

Collaboration

[Green Innovation Fund]

- Construction of vehicle simulation model

Collaboration

[RoAD to the L4 Project-Promotion Committee] Secretariat: AIST[1]

- **Theme 1: Excluded eiheiji-cho Line (limited space, low speed)**
- **Theme 2: Hitachi BRT (medium-sized buses)**
- **Theme 3: Expressway truck level 4**
- **Theme 4: Ideal form of infrastructure collaboration**
- **L4 mobility Acceleration Committee (L4 Committee)**

(Note) 1. National Institute of Advanced industrial Science and Technology

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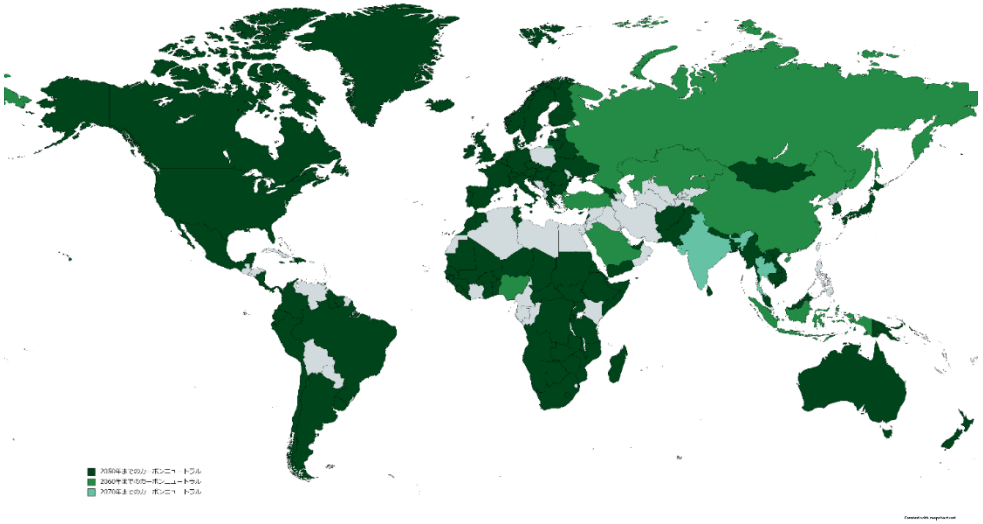
Carbon Neutral and Vehicles in 2050

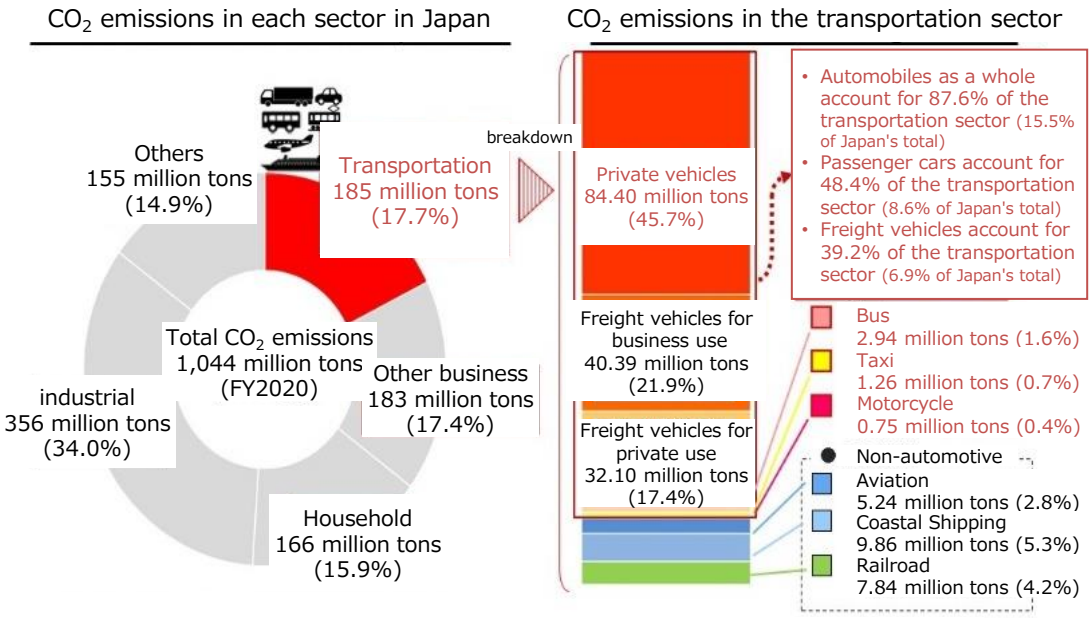
- All countries and regions, including Japan, announced their intention **to achieve carbon neutrality by 2050.**
- **Transport sector accounts for 17.7% of CO2 emissions** in Japan, requiring immediate action toward decarbonization.

Countries and regions that have expressed carbon neutrality



■ Carbon Neutral Countries by 2050
■ Carbon Neutral Countries by 2060
■ Carbon Neutral Countries by 2070

CO_2 emissions in the transport sector



*Figures may not add up to the total due to fractional processing.
*Emissions from power generation by electric utilities and emissions from heat generation by heat suppliers are allocated to the final demand sector in proportion to their respective consumption.
*Prepared by the Environmental Policy Division, MLIT, based on the Greenhouse Gas inventory Office's "Japan's Greenhouse Gas Emissions Data (FY1990-FY2020)"
*Motorcycles are included in the "Other business" until the 2015 preliminary figures.

<Domestic>MLit HP "Carbon CO2 Emissions in the Transport Sector"
https://www.mlit.go.jp/sogoseisaku/environment/sosei_environment_tk_000007.html

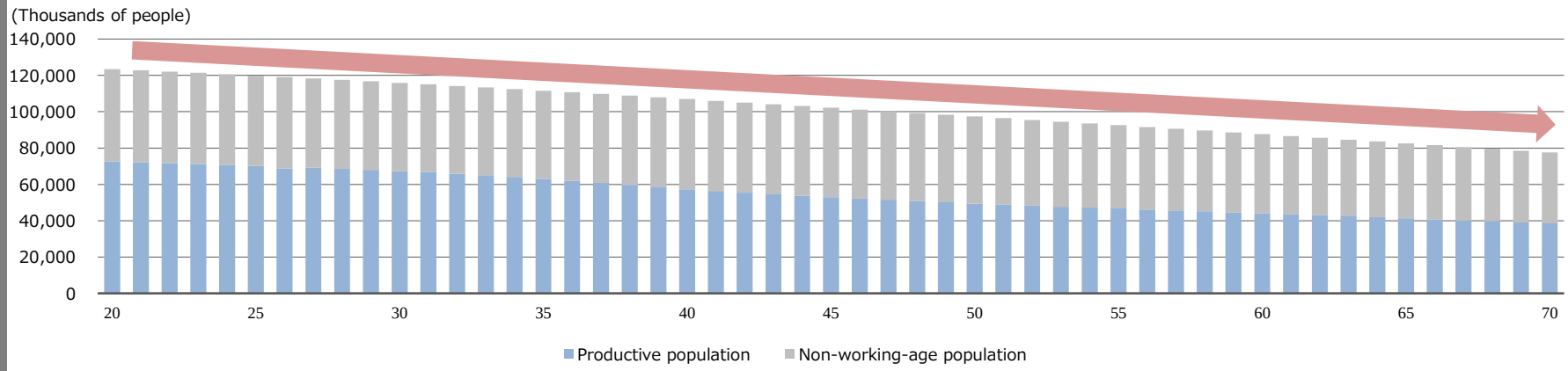
1) ① Countries participating in Climate Ambition Alliance, ② countries expressing CN for 2050 through the submission of a long-term strategy to the United Nations, and countries expressing CN for 2050 at the Climate Summit COP26 in April 2021, etc. are counted and prepared by METI (as of November 9, 2021)
①https://climateaction.unfccc.int/views/cooperative-initiative-details.html?id=95
②https://unfccc.int/process/the-paris-agreement/long-term-strategies

Population Decline and Population Concentration in Urban Areas in Japan

- Population problems in Japan in the future include **rapid population decline and unipolar concentration in urban areas.**
- As the effect, problems such as **the "2024 Problem" in Logistics** caused by the labor shortage and **maintenance of social infrastructure in the depopulated region** are emerging.

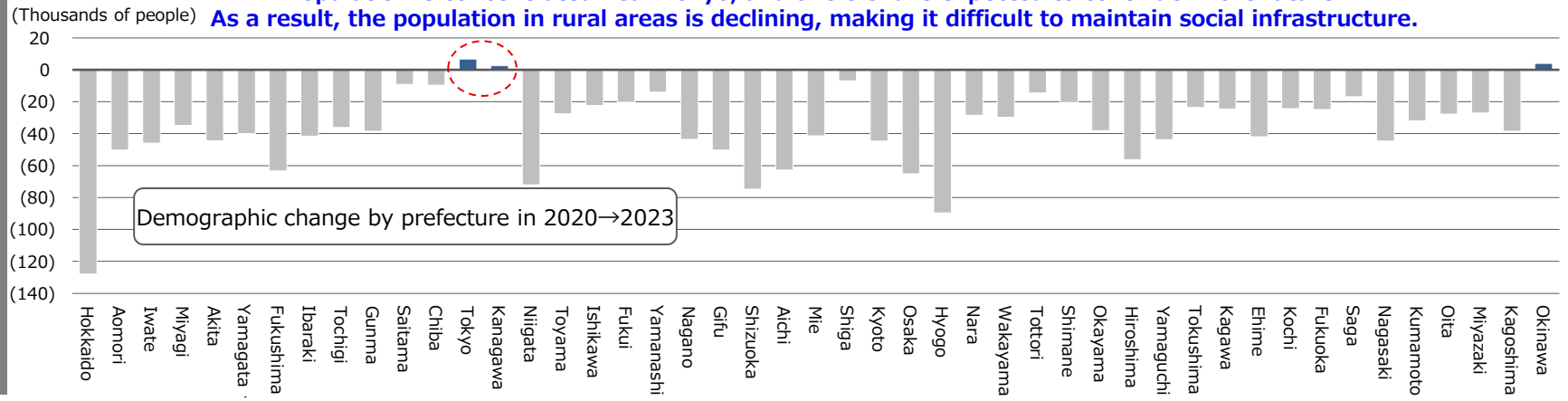
Future Population (Estimated) [1]

The working-age population in Japan is decreasing, and there are concerns that Japan will face a serious labor shortage in the future.



By prefecture Population Change

Population is concentrated near Tokyo, and this trend is expected to continue in the future.
As a result, the population in rural areas is declining, making it difficult to maintain social infrastructure.



Sources: National Institute of Population and Social Security Research, "Population projections for Japan (2023 estimates); Ministry of Internal Affairs and Communications, "Population, demographics and number of households based on fundamental resident register."
(NOTE) 1. Medium-birth (median mortality) estimates adopted

Decline of Transportation Options in Rural Areas

- In Japan, where the population is aging and depopulation is progressing, **access to the living functions (medical care, shopping, etc.) of the elderly and mobility impaired people is a serious social issue**, especially in rural areas where people rely on their own cars to move.
- The declining birthrate and aging population also **put pressure on the business environment of local public transportation, which is an important means of transportation for the elderly and students**.

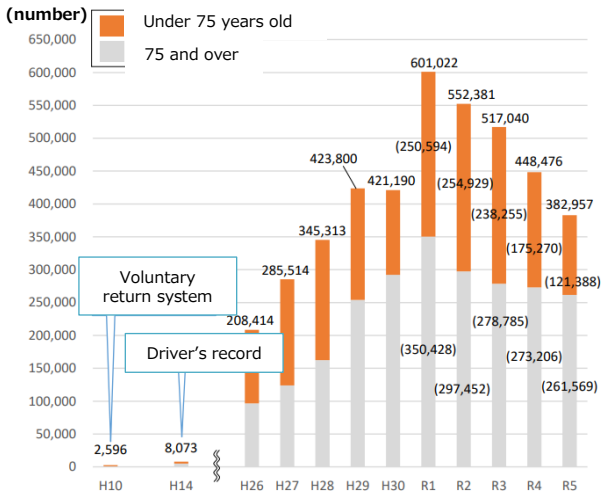
<Importance of securing Transportation Means in Regions>

- **In suburban and depopulated areas**, which account for the majority of Japan, ※1 **the share of private vehicle traffic is about 70%.**
- **The number of license returnees is on the growth.**

	Number of local government ※2	Private vehicle traffic sharing ※1
Large cities (over 0.5 million people)	29	22.7%
Suburban and depopulated areas (50,000 or less)	1,197	**67.5%**

※1 Statistics Bureau, Ministry of Internal Affairs and Communications "Census (H22)"
This survey refers to the share of transportation used during commuting and commuting to school.
※2 Statistics Bureau, Ministry of Internal Affairs and Communications "Population Census (H27)" The figures for wards and counties in Tokyo are 1 municipality.

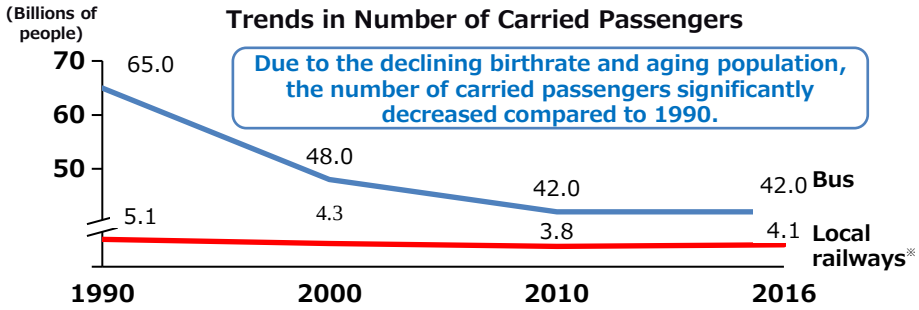
Number of voluntary refunds of driver's licenses



※Data from National Police Agency

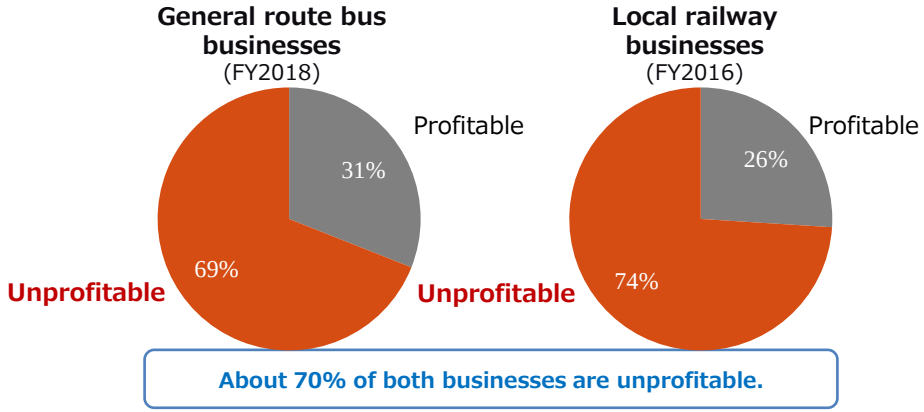
<The serious business environment of local public transportation>

Trends in Number of Carried Passengers



※Local railways: Lines other than Shinkansen, conventional and urban railways (as of the end of 2020.3, 95 companies nationwide)

Ratio of Profitable/unprofitable businesses in the current account



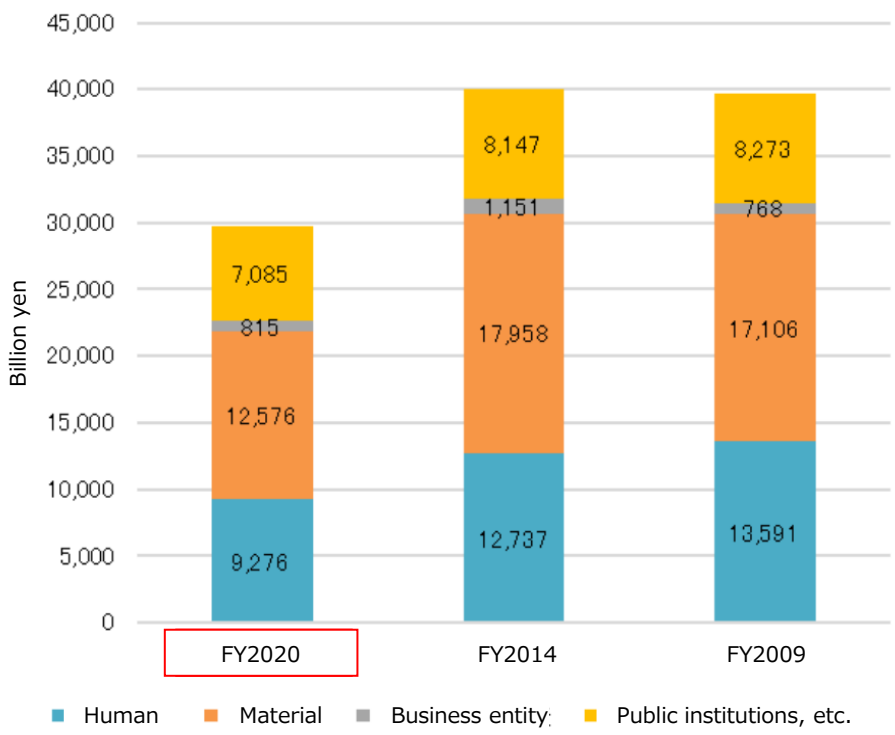
※Railway Statistics Annual Report, "Current Situation and Challenges of Regional Public Transport in Depopulated Areas" (Ministry of Land, infrastructure, Transport and Tourism), and "Urban and Transport Policies for the Next Generation mobility Society"
–Compiled from Integrated Public Transportation systems and Urban Design in Europe (Japan Urban Center), and various other public information

Economic Losses from Traffic Accidents and Congestion

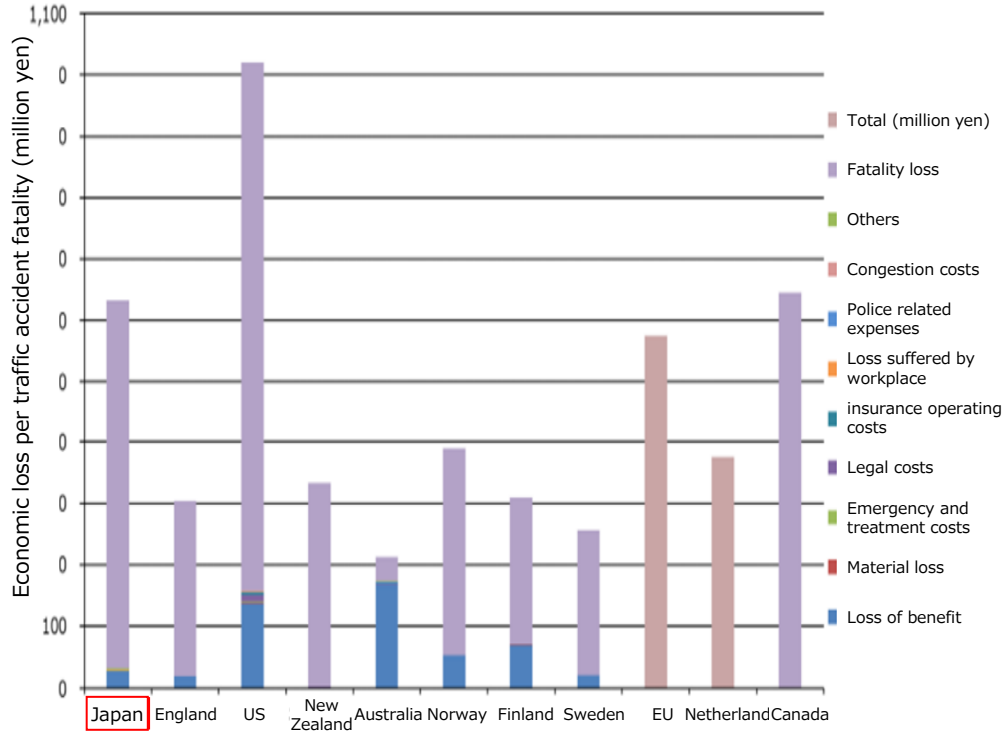
- **Approximately 96% of traffic accident fatalities** in Japan **are attributable to violations of driving vehicles**, and **the annual monetary loss due to traffic accidents is approximately 3 trillion yen**. **The amount of economic loss per traffic accident fatality**, including non-monetary loss (*), **is about 630 million yen.**
- These losses are at a high level at global, and **the prevention of traffic accidents by developing safe automated driving/driving support technologies and improving these performance are significant from a social perspective**.

*Losses due to physical distress of victims, mental distress of victims' families and friends, and psychological burden of perpetrators and their families and friends due to traffic accidents

Monetary losses from traffic accidents



Economic loss per traffic accident fatality



Sources: Prepared by METI from "White Paper on traffic Safety 2023" (Cabinet Office) June 2023 and "Survey on Economic Analysis of Damage and Loss of traffic Accidents in Fiscal 2022" (Cabinet Office) March 2023

The “2024 Problems” in Logistics

- To correct long working hours for truck drivers, **the upper limit on overtime work (960 hours a year) will be applied to truck drivers** from FY 2024.
- If logistics efficiency is not improved, **there is a risk of further tightening of logistics supply and demand due to labor shortages,** and it is estimated that a **transportation capacity shortage of up to 14.2% (400 million tons) compared to 2019** before COVID-19 will occur (*). In addition, there are concerns about a capacity shortage of 34.1% (940 million tonnes) in 2030.

*NX Research Institute, Limited (November 11, 2022)

Work style reform for truck drivers

Laws and details		FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024
Labour Standards Act	To apply the upper limit of overtime work (720 hours a year) [General Rules]		Applied to large enterprises	Applied to SMEs	→	→	→	→
	To apply the upper limit of overtime work (960 hours a year) [Automobile driving business]							Applied
	To apply the increase in overtime wages over 60 hours a month (25%→50%) to SMEs						Applied	→

		Current	April 2024 and thereafter (in principle)
Notification of improvement Standards (Extract)	Annual restricted time	3,516 hours	3,300 hours
	1 month of restricted time	293 hours	284 hours
	Daily restricted time	13 hours	13 hours
	Resting time	For more than 8 hours	Based on an 11-hour duration, 9-hour lower limit

Trial of transportation capacity shortage due to the impact of the “2024 Problem” in Logistics (NX Research Institute)

○Overall

Percentage of transportation capacity shortage (tons of commercial truck transported that is insufficient)
14.2% (400 million tons)

○By shipper (extract)

Industry	Transportation capacity shortage
Agricultural and marine products shipping group	**32. 5%**
Paper and pulp (Manufacturing)	**12. 1%**
Construction and construction materials (Manufacturing)	**10. 1%**
Automobiles, electricity, machinery, precision, metals (Manufacturing)	**9. 2%**

○By region (extract)

Region	Transportation capacity shortage
Chugoku	**20. 0%**
Kyushu	**19. 1%**
Kanto	**15. 6%**
Chubu	**13. 7%**

Sources: Prepared by METI based on various published materials, etc.

Expansion of the Sharing Economy

- As a new form of economic activity, **the sharing economy, where assets such as locations, goods, and skills are shared and utilized collaboratively**, is progressing rapidly.
- The sharing economy is not only contributing to solving regional issues, but is also a new business opportunity for companies.

Five types of sharing services

New industrials emerge in line with the expansion of the sharing economy.

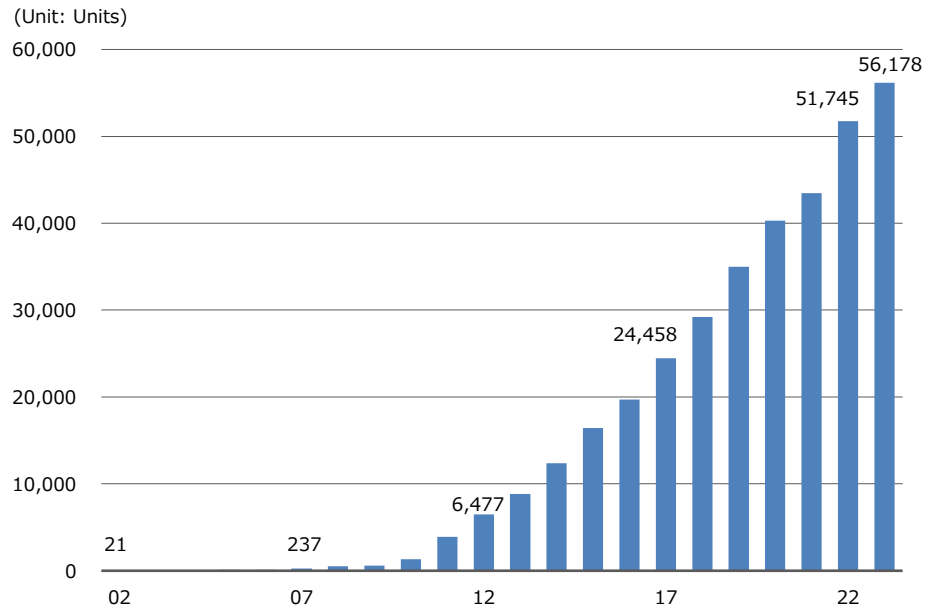
Five Sharing Services

1. **Share of space:** Conference rooms, parking lots, private accommodations
2. **Share of things:** Frima, rental
3. **Share of skills:** housework services, childcare, nursing care, tourism
4. **Share of moving:** Car Share, Synergy, Share Cycle
5. **Share of money:** Crowdfunding

Along with further expansion of the sharing economy, **there is ample potential for new sharing businesses to emerge.**
At the same time, **a business model that does not rely on selling ou is a business opportunity.**

<Reference> The number of domestic car sharing

Car sharing, where people share automobiles, is also rapidly expanding.



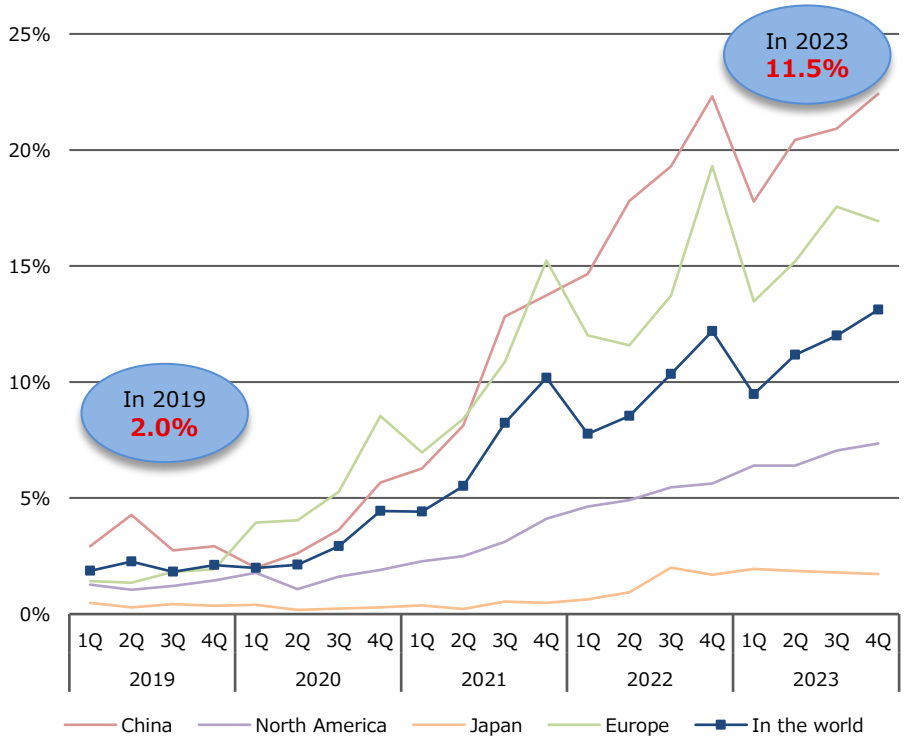
Sources: Consumer Affairs Agency, sharing Economy Availability Guidebook; traffic Ecology mobility Foundation, Car sharing Vehicle and Membership Trends in Japan.

Popularization of EV and Compatibility of EV and SDV

- **EV's market share expanded as a trend toward carbon neutral in the car sector.** Despite a sense of standstill, it expanded to 12% of global sales in 2023.
- **EV and SDV are good matches.** EVs, which can provide the large amount of power required for SDV conversion, and SDVs, which can reduce hardware costs by decreasing the number of ECUs, can complement each other's weaknesses.

Trends in the global EV sales ratio

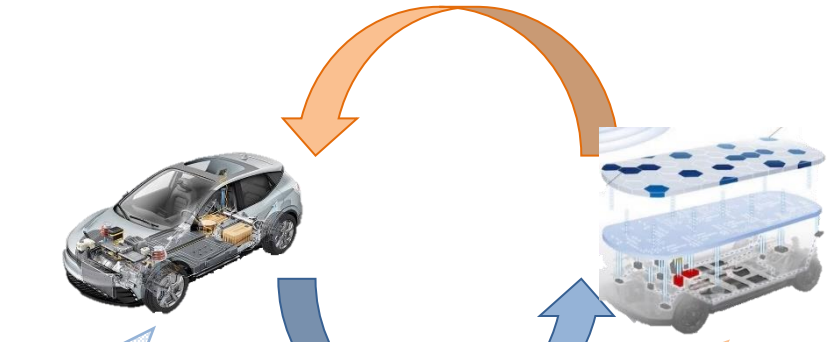
Despite fluctuations due to market demand and policies of each country, EV sales ratio is on the rise as a broad perspective.



Compatibility of EV and SDV

EV | **SDV**

Cost reduction of hardware through BMS and digital cockpit integration (Decrease in ECU)



- Strong cost-cutting pressure from the use of expensive storage batteries

Large amounts of electricity

- Increasing consumer needs for advanced digital performance

Sources: Marklines; Yoshida SKT HP; Honda HP.

Provision of New Services Utilizing Vehicles

- Offering new services such as **remote operation, vehicle management, and telematics insurance** using vehicles and apps has started.

Depending on the model and region, different functions are available										
Connected services	Fleet management	Monitoring, logging, operations, car sharing	Repair and fuel costs	API integration	Mobile services, tax credit	Shortening delivery time	Taxation, contract renewal	Financial services, drivers monitoring	■	■	Geo-fencing, fleet-linked SW
	Usage-based insurance (UBI)	Sending data to 3rd party insurers	In-house insurance	In-house insurance	In-house, mobile-based UX	■		Japan, the U.S., Europe, etc.	■	Send data to 3rd party insurers	■
	App service	Integrated with + Apple, Android	Integrating with Alexa, payment	Connected services	Century mode +3rd party app	Connection to Smartphone	Connected services, collaboration with Alexa	Connected services	Integrating with Alexa	Integrating with 3rd party apps	Vehicle analytics
	Automotive internet	eSIM, 5G for individuals	AT&T (USA)	■	AT&T + T-Mobile	Cubic Telecom (Europe)	Docomo (Japan), AT&T (U.S.), ORANGE (European)	Japan, the U.S., Europe, etc.	AT&T (USA)	Vodafone	■
	Diagnostics, security, repair	Drive recorder	Support for stolen vehicles, service tracking, automatic collision response, etc.								■
	Location information services (congestion, refueling, parking lot)	In-house	3rd party application (excluding navigation)	In-house	In-house	In-house	In-house	3rd party application (excluding navigation)	3rd party application (excluding navigation)	In-house	■
	Remote control of the car	HVAC control, lock, fuel status, remote personalization									
	OTA update (Additional HW/SW features are available through payments)	e.g. Symbolic engine noise	■	■	e.g. Rear seat heater	e.g. VW Personal Assistant	e.g. Map-update, SW update	e.g. Driver support update	■	e.g. Controlling batteries for EVs	■
	ADAS service (fee charged)	■ (L2) Purchase only once	■ (L2) Subscription model	■ (L3) Subscription model	■ (L2) Subscription model	■ (L2) During vehicle purchase Available	■ (L2) Subscription model	■ (L2) Available from the time of vehicle purchase	■ (L3) Available from the time of vehicle purchase	■ (L2) Available from the time of vehicle purchase	■ (L2) Available from the time of vehicle purchase

Alliance

Sources: Prepared by METI based on various published materials, etc.

Sophistication of Automated Driving (Service Car Area)

- In the service car area, automated driving L4 services are beginning to be realized, and competition is overheated.
- The U.S. and China are leading the way in the implementation of services, and Japan and Europe are working on demonstration.

	Buses, trucks, etc.	Taxis
The status of foreign countries	●Bus • Alexander Dennis (UK) began operating automated driving L4 buses in Scotland. • EasyMile (FR) obtains licensing for public road driving in automated driving L4. ●Track • Aurora (US) plans to mass-produce AD system from FY2027. • TuSimple (US) conducts unmanned demonstration runs. (2021.12～) • Plus.ai and Pony.ai (CN) also conducts demonstration tests on an automated driving L4 basis  	• Waymo (US) realizes automated driving L4 services (2020.10～) * 250 units (as of 2023.9) • Baidu (CN) realizes automated driving L4 services (2022.7～) * 1,000 units (as of 2023.8) • Demonstration and services are implemented in a more complex traffic environment  
The status of Japan	• Automated driving L4 through carts in Eiheiji-cho is realized (2023.5) • Automated driving L4 service in hitachi BRT is planned (FY2024) • Automated driving L4 on expressways such as Shin-Tomei Expressway is planned (FY2025) 	• Honda･Cruise is planning to provide automated driving L4 services (2026.1) * 500 units 

Progress in Mobility Services (On-Demand Transportation and MaaS Apps)

- The creation of **primary cases of MaaS × automated driving and cases in which OEM is conducting MaaS as a service-provider** are progressing**.**

Type of effort	**On-demand buses**	**Integration of search, reservation, and payment (wide-area provide of the entire country, etc.)**
Name of effort	**goMARTI**	**FREENOW**
Initiatives	**Public (Minnesota DOT, Grand Rapids City, etc.) × OEM(May mobility)**	**OEM(FREENOW: Joint venture between BMW and Mercedes-Benz)**
Region and phase	**Grand Rapids, Minnesota, U.S.A. (demonstration)**	**England, france, germany, austria, italy, spain Poland, Greece, Romania and Ireland (implementation)**
Content	**[Outline]** • On-demand bus with five automated driving vehicles (including three vehicles complying with ADA compatible with wheelchairs) (using TOYOTA SIENNA's Autono-MaaS vehicles) • Free rideshare service over a 17 square miles (44 square kilometer) area covering approximately 70 drop-off and pick up locations is provided 	**[Outline]** • Mobility reservation and allocation app available in more than 150 cities in nine European countries (catch copy is “Mobility Super App”) • In addition to taxi dispatch in each country, e-scooter, e-bike, car sharing, and some public transportation reservations and payments are possible • Established in 2019 as a joint venture between BMW and Daimler (now Mercedes-Benz) • Providing high added value by covering a wide range of public transportation in addition to taxis, and availability is firmly established in European countries 

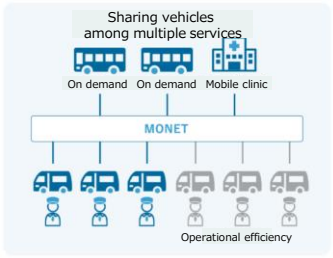
Sources: Prepared by METI based on various published materials, etc.

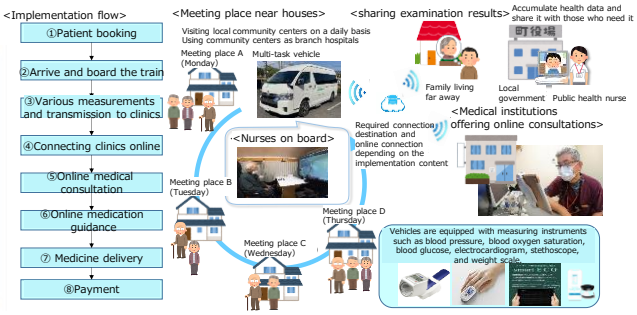
Progress in Mobility Services (Cross-industry Collaboration)

- Beyond its role as a means of transportation, **the examples of aiming to solve new issues and create value by multiplying mobility with other industries** are also being created.

Type of effort	**Mobility × cross-industry collaboration (× medical and welfare)**
Name of effort	**Medical MaaS**
Initiatives	**OEM(MONET Technologies) & different industries (Philips: Ina city, MRT: Odai town) [OEM: "Vehicle Provision"]**
Region and phase	**Ina city, Nagano prefecture (implementation: limitation area), Odai town, Mie prefecture (demonstration)**
Content	**[Outline]** • Using MONET's multi-tasking vehicles, dispatch medical facilities and nurses near patients' homes. On-line conversations with doctors in vehicles and Vital measurement, which is difficult for one-on-one online medical practice at home, etc. is also possible. Drugs are delivered separately under online guidance. • It is possible to change the personnel and service content dispatched, such as doctors, nurses, and laboratory technicians, according to the actual conditions of the region. • In addition, by using multi-tasking vehicles, it is possible to integrate medical MaaS with other service-based vehicles, thereby reducing the number of vehicles operated and expenses. • By utilizing "small bases" such as meeting centers, more efficient medical treatment may be possible.

Type of effort	**Mobility × cross-industry collaboration (× commerce and tourism)**
Name of effort	**Esashi MaaS project**
Initiatives	**Different industries (SATUDORA HOLDINGS)**
Region and phase	**Hokkaido Esashi town (demonstration)**
Content	**[Outline]** • Providing "mobility" × "shopping" services to local residents. • Collecting data by utilizing “EZOCA”, a point card shared by the entire region. • In addition to freight revenue, revenue from advertising and platform availability fees is expected. • Ensuring business continuity through comprehensive collaboration agreement between Satsudora and Esashi-cho.

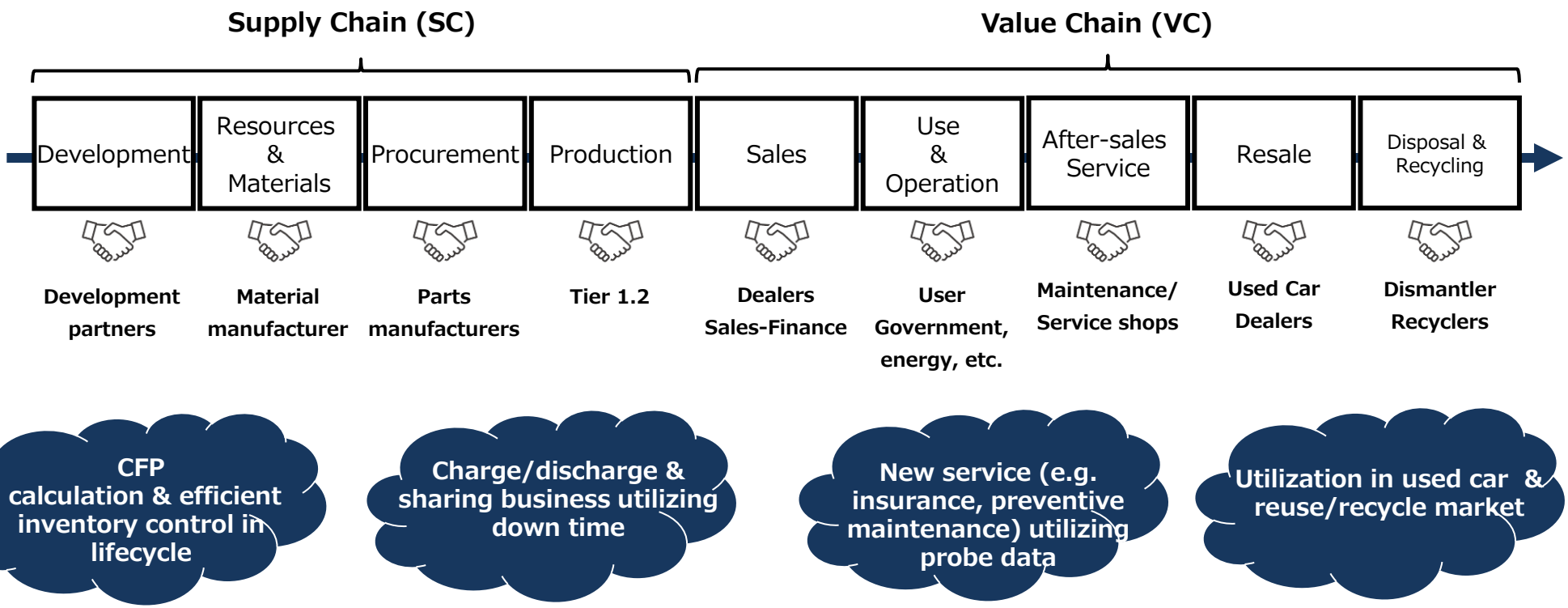




Data Utilization in the Vehicle Supply Chain

- **Data provide new social values & services** and **ensure traceability** (e.g. carbon neutral measure in lifecycle) through data collaboration with various partners in the supply & value chain including those in other industries.

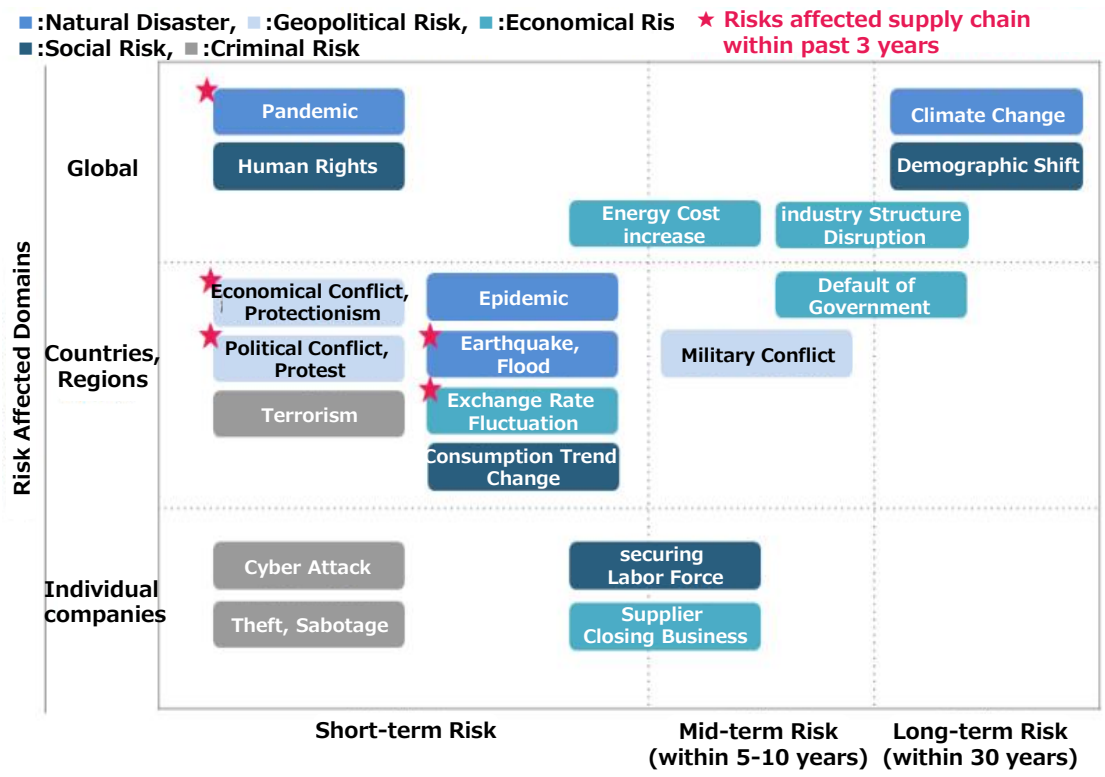
Data Utilization Use Cases in the Vehicle Lifecycle



Initiatives in the Supply Chain

- In recent years, supply chains have become increasingly **unstable** and **complex**.
- Both optimal decision-making with comprehensive view and prompt countermeasure are required by identifying change in early stage. To do so, **visualizing wide range value chain** and **obtaining capability on keeping data updated through data coordination** are needed.

Supply Chain Risks and Examples in the Automotive industry



[Improve resilience to emergencies]

- Suppliers' **status awareness and plan revision** during the plant ops. suspension and prod. adjustment caused by **earthquakes and other emergencies.**

Source: NHK

[Early detection of defective products]

- **Minimize the range of impact, causal analysis and quality improvements** when defective products are detected.

[Proof of product sustainability]

- **Regulatory compliance** including the **EU Battery Regulations**
- **Disclosing non-financial information** to the market, etc.

Sources: Created by METI based on "The Study Group on Advancement of Global Supply Chains" etc.

Initiatives in the Value Chain

- In Germany, a mobility Data Space was established in November 2019 by the German Federation as a part of its digital strategy. it aims to provide shared space for mobility real-time data held by the private sector, and to promote the security improvement and data utilization.
- Data utilizations such as hazard and optimal traffic info provision, and new service generated by combining weather and road infrastructure data which public agencies owns. These utilizations will be realized by facilitating data collection with aggregating owners and detail of probe data from vehicles and public transportations.

Overview on mobility Data Space

Mobility Data Space

Organizational Profile

Objectives and Overviews	Alliance to provide mobility-related real-time data sharing data space in Germany to improve mobility security, convenience, and sustainability
Established Date	November 2019
Managing Entity	(until 2021) German Academy of Science and Engineering (acatech) (since 2021) DRM Datenraum Mobilität
Participating companies	• 40+ companies (including founding partner companies) • OEM(BMW, Mercedes, etc.), suppliers (IBM, Mobileye), railway (Deutsche Bahn), data service providers (Geotab), navigation (TomTom), local governments (Hamburg City), etc. ※DENSO and Mitsubishi Electric participate from Japan.

Examples of Use Cases

[Provision of recommended transportation information combined with weather data]
Providing data and notifications in real time via an App for users to select the optimal transportation (e-scooter, taxi, etc.) according to the weather.

[sharing Local Hazard information with Probe Cars]
Hazard information such as downpour, breakdown car, and sudden braking points info detected by the vehicle can be shared through MDS, and the information can be obtained by other vehicles to avoid the hazard.
※Currently, data is limited to some German OEM models, such as Mercedes-Benz and BMW.

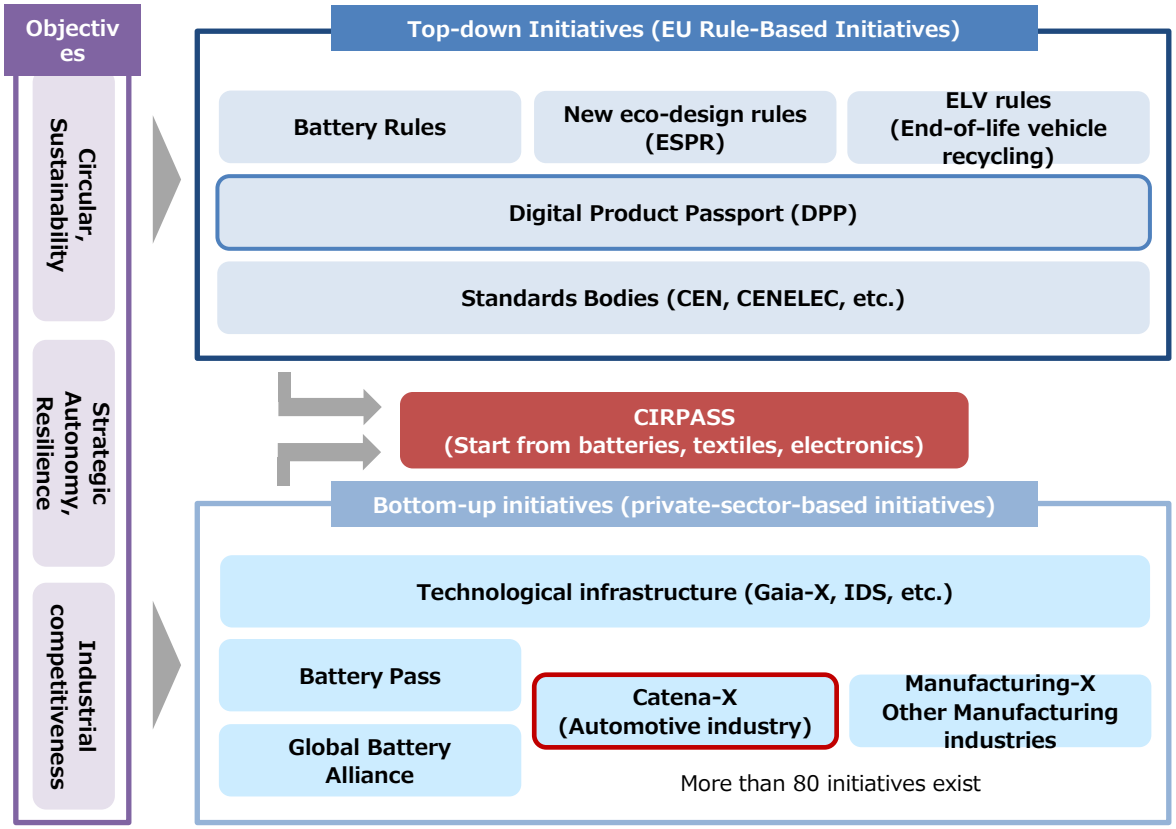
[sharing EV Battery Level and Range]
Forecasting charging station occupancy by sharing the battery-life and range of a EV through MDS.
※ Currently, data is limited to some German OEM models, such as Mercedes-Benz.

Sources: Created by METI based on various published materials, etc.

Trends on Data Utilization in Europe

- In EU, both **regulatory lead top-down approach** and private sector lead **bottom-up approach** are **effectively supporting the advancement of initiatives.**
- These are attempted to strengthening sustainability and the resilience of the supply chain while **minimizing business costs, promote innovation, and improve industrial competitiveness.**

Initiatives for Data Coordination in Europe (Overview)



Catena-X's Vision

■ Started to resolve the following common issues to the global automotive industry, and expanding use cases from 2024

- Master data service, unique corporate ID
- Decarbonisation and ESG reporting
- Resource circulation and product passport
- Demand and capacity management
- Traceability on parts
- Quality management and root cause analysis in Lifecycle

Participant's Benefits

■ The main benefits that participating companies that Catena-X foresees are as follows

<Provide/acquire Digital Sovereignty>
- Control of own data
- Selection of the provider
- Method of storing and operating data
- Self-management and trusts

<Minimize DX/ business costs>
- IT interfaces integration
- Service share in the industry
- Generate synergies between use cases

<Shortening time to value creation>
- Improving the organization's digital readiness
- Empowering business through use cases

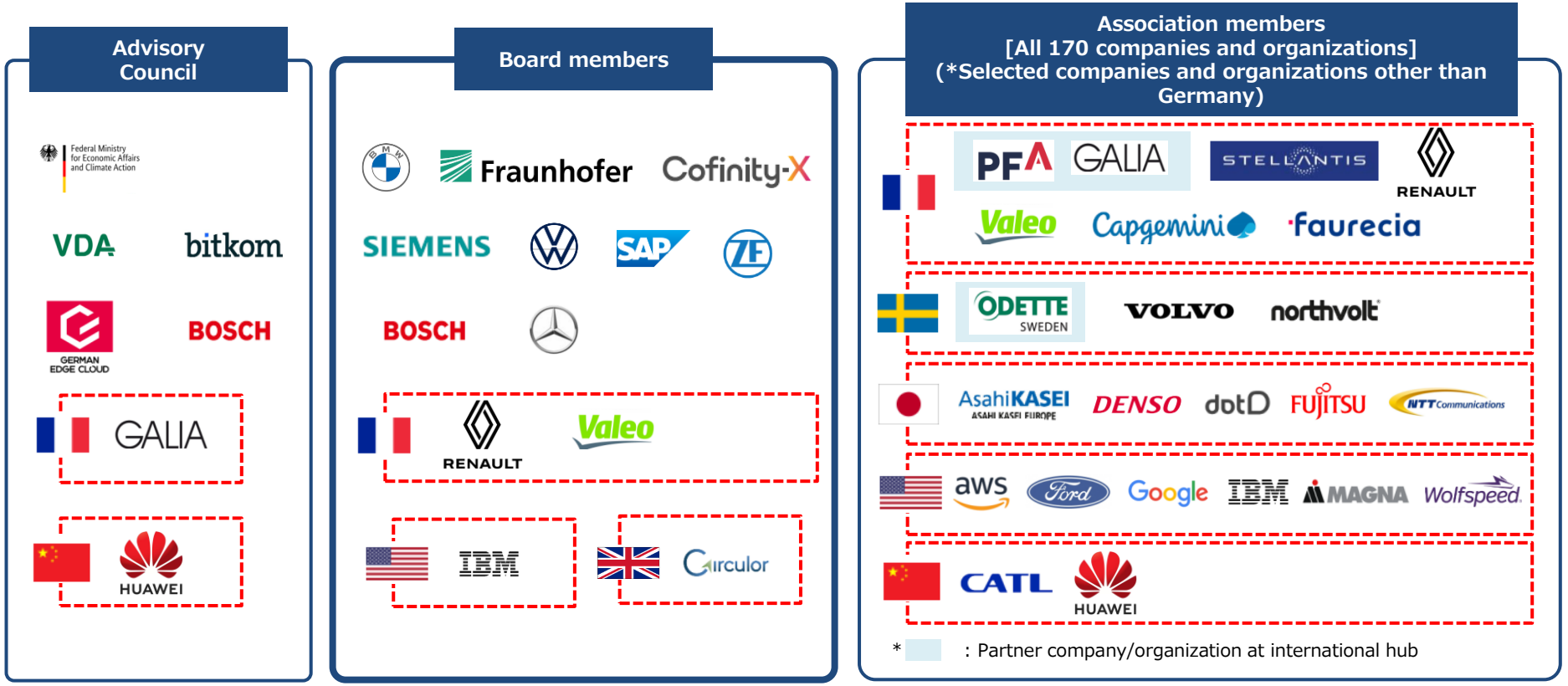
<promoting DX/ Innovation>
- Participate in new value pools and gain competitive advantage

Sources: Prepared from various public information

<Reference> Catena-X

- Catena-X drives federated platform that enables **safe dada exchange** by ensuring **data sovereignty**, **interoperability** between digital platforms, and **open source code.**
- It was **led by German entities** at the beginning, however, **Renault (FR), Valeo (FR) and IBM (US)** are now board members, and **GALIA (French Automobile Manufacturers Association) and HUAWEI (CN)** participate in the Advisory Council.
- Also, international hub opened in France (Nov. 2022) and Sweden (May 2023). Moreover, Catena-X is approaching to Japan, the US, and China – which has the keenest interest.

Major companies and Organizations Participating in Catena-X

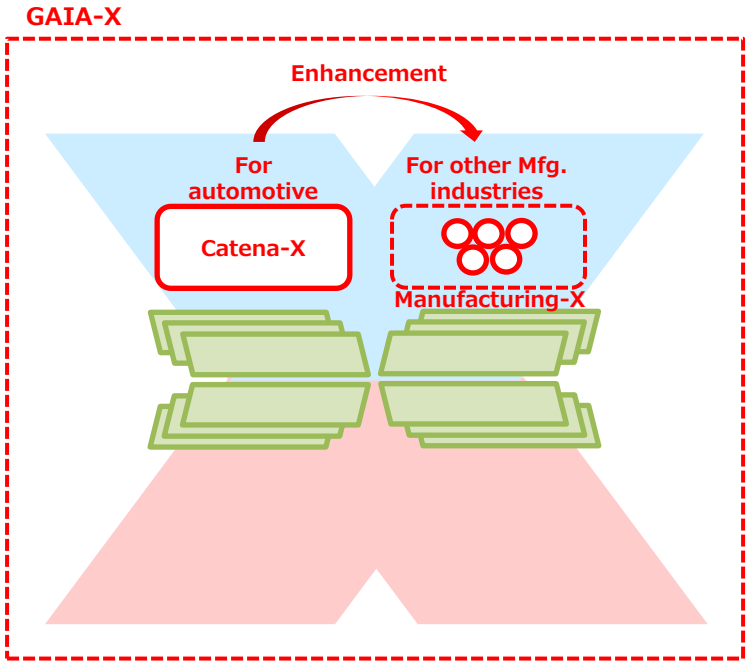


Sources: Created from Catena-X documentations.

<Reference> Relations Between Catena-X & Manufacturing-X

- In Oct. 2019, the **Franco-German governments** announced **GAIA-X initiative** as a project to build a unique European data infrastructure. In **Jan. 2021, GAIA-X was established by companies and institutions from both nations.**
- In May 2021, **Catena-X Association was established by BMW and SAP and others**. In the same year of Aug., the German government announced to support the initiatives as part of GAIA-X initiatives.
- In Aug. 2022, the German government **announced Manufacturing-X concept to enhance Catena-X's efforts to other manufacturing industries.** The detail planning is ongoing.

Relation of GAIA-X, Catena-X, Manufacturing-X



Data ecosystem	Standardized rules for building data spaces in each industries and fields, and collateral interoperability between different data spaces.
Federation services	Providing services such as digital ID control, data exchange with sovereignty, and compliance monitoring as technical requirements for the integration and operation of infrastructure and data ecosystems.
Infrastructure ecosystem	Ensuring interoperability, interconnectivity between network/interconnection/cloud providers. Moreover, ensure compatibility to avoid overreliance (lock-in) with particular provider.

Sources: Created from German Ministry of Economic Affairs and Climate Action.

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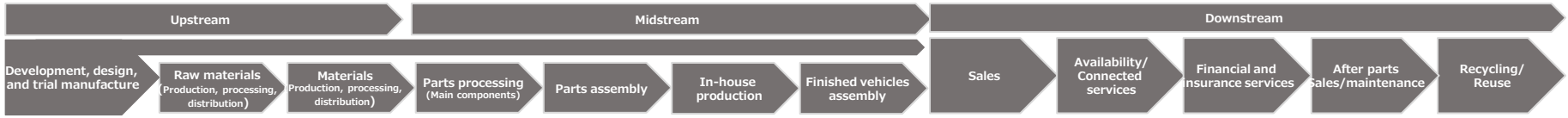
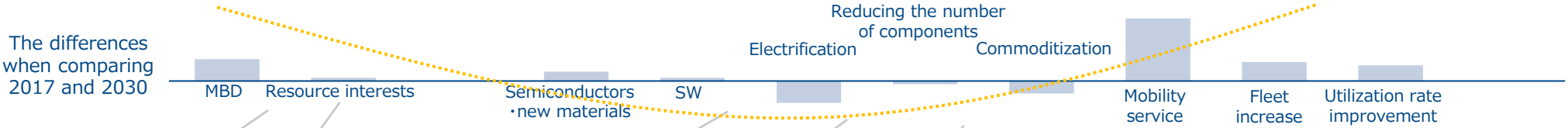
Changes in the Value Chain

- Amid these environmental changes, **the value chain is changing.** The value added in the midstream is relatively decreasing, while **the value added upstream and downstream is relatively increasing (forming a smile curve).**





MBD*	Resource interests	Semiconductors, new materials	SW	Electrification	Reducing the number of components through EV	Commoditization of mass vehicles	Mobility service	Fleet increase	Utilization rate improvement
• Wide-ranging techniques, such as EV and automated driving, are needed, making it difficult for OEMs to cover everything in-house. The ratio of outsourced R&D that OEM has been responsible for up to now tends to increase.	• Co, which is one of the raw materials used to make positive electrodes for batteries, has a concentration of reserves in the Congo. In anticipation of increased demand for batteries due to EV, it tends to be riskier to procure than other raw materials.	• The growing popularity of EV and automated driving has increased the importance of new materials related to weight reduction and semiconductors for automated driving, and has tended to increase the added value of manufacturers with these know-how.	• The proliferation of EV and automated driving increases the value of software for controlling power and driving, and the value added by software vendors tends to increase.	• In the past, OEM had gained added value from the development of internal combustion engines, but new and wide-ranging technologies, such as EV and automated driving, were required, and added value was lost due to the outsourcing of development.	• Compared to other electric vehicles and internal combustion engine vehicles, EVs have a simpler structure, resulting in fewer components and easier assembly. Consequently, the added value in assembly tends to decrease.	• The popularization of automated driving and sharing has strengthened the aspect of cars merely as a means of transportation, and the added value of dealers tends to decline as commoditization advances.	• The increase in sharing services and connected services, along with the creation of new services such as advertising, tends to significantly increase added value.	• Corporate demands increase due to the spread of sharing, and the sales finance market increases for leases, etc.	• The proliferation of sharing services increases vehicle utilization rates and driving distances, resulting in an increase in the added value of maintenance.

Sources: Interviews with experts, ADL based on historical knowledge
*:Model Based Development

Changes in Sales Structure Due to SDV

- According to the results of a survey of multiple companies, **sales from software will increase in the next 10 to 15 years**. it is estimated that **sales from software will also account for as much as 30% of total sales** including sales from hardware.

Accenture

Accenture estimates that OEM sales from software will **increase more than tenfold by 2040**, totaling USD 3.5 billion, or **40% of total automotive industry sales.**

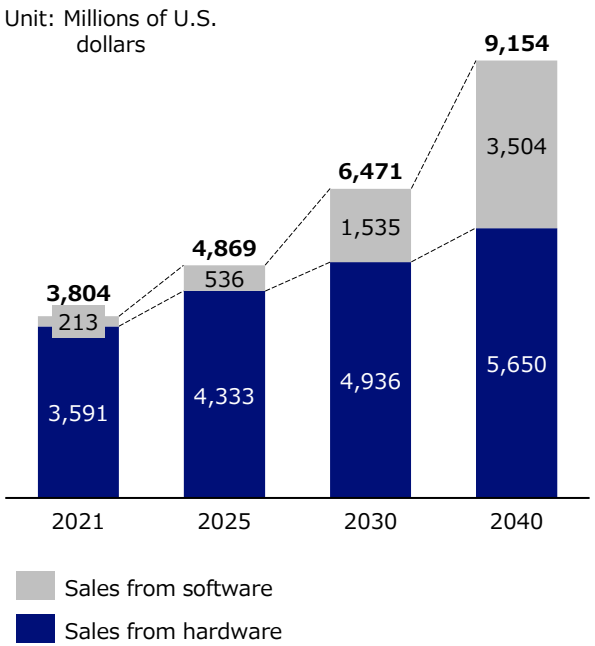
BCG

BCG analyzed that OEM sales from automotive software and electronics will **nearly triple between now and 2030, from $87 billion to $248 billion.**

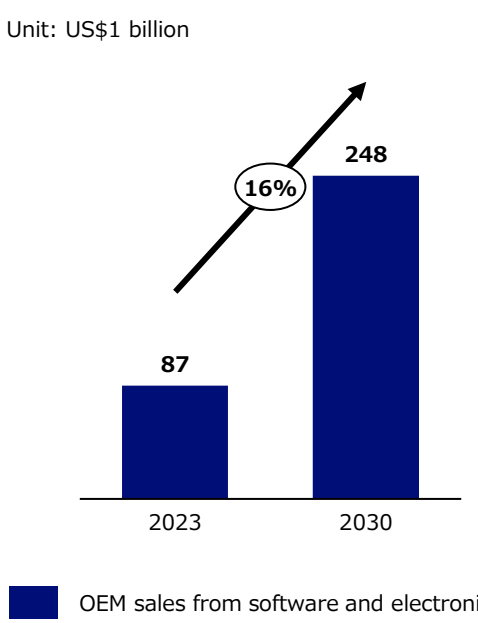
Deloitte

The majority of survey respondents conducted by Deloitte said that sales from SDV accounted for 15-20% of total sales, while 10% of respondents said that sales from SDV initiatives accounted for **almost one-third (25%-30%)** of total sales.

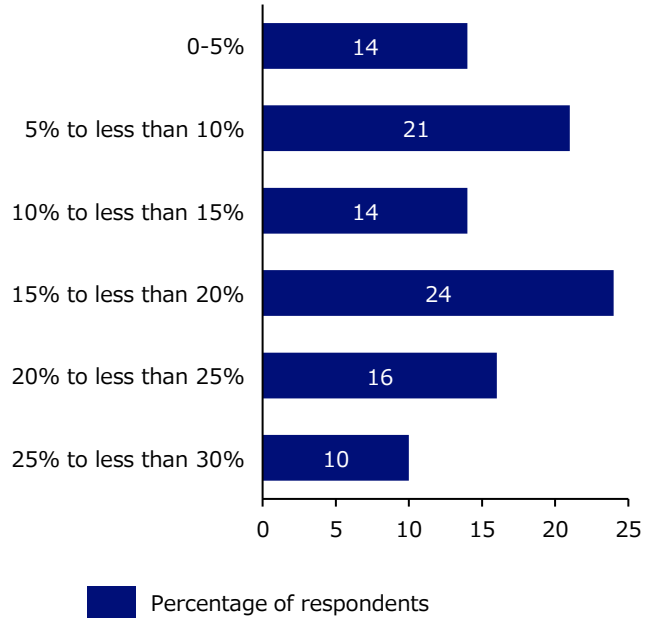
Sales Forecasts of OEM Hardware and Software



Sales Forecast of OEM software and electronics



SDV sales as a percentage of total sales

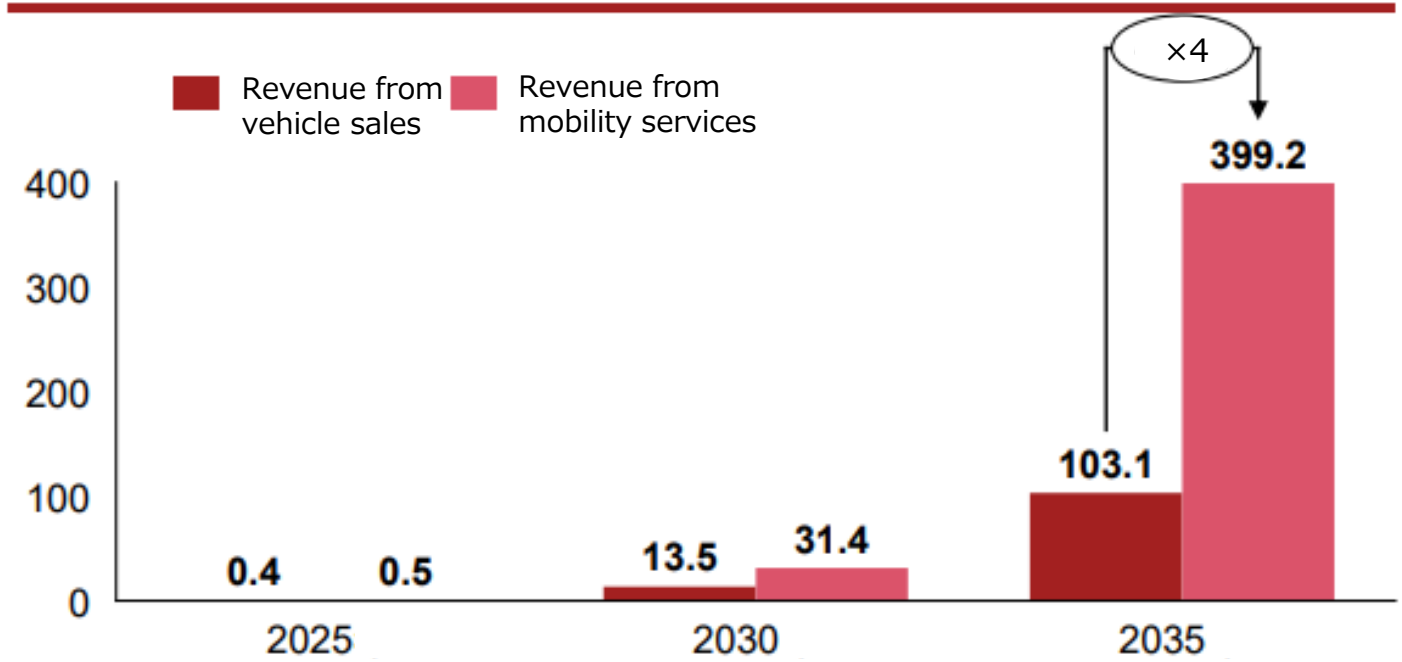


Sources: Prepared by METI based on various published materials, etc.

<Reference> Market Size Outlook for Robotaxis

- According to the trial calculation, based on several assumptions, revenues from robotaxis services amounted to approximately 80 trillion yen worldwide as of 2035, of which 80% were from services other than vehicle sales.

Worldwide Revenue of robotaxis (Metropolitan area, unit:€1 billion)

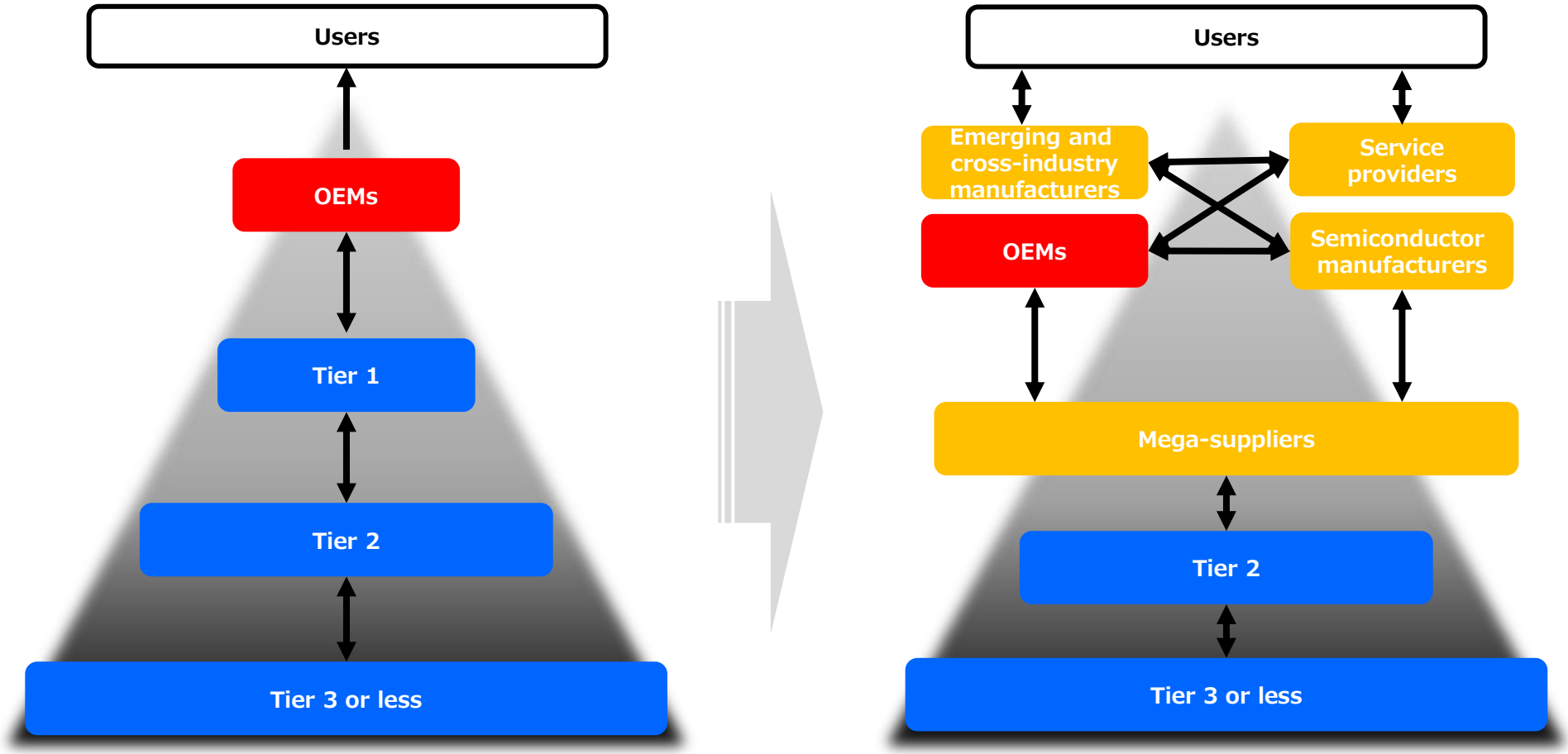


- The first mass production application is expected to be 2025, followed by a breakthrough around 2030.
- Robotaxi will replace existing taxis, but vehicles that can operate without encumbrances even with more robust technology and bad weather will be essential.
- The scenarios shown in the figure assume that there is sufficient supply of vehicles and parts.

Sources: PwC Digital Car Report 2022 Accelerate toward New Normal

Structural Change

- **The entry of new players driven by the transformation of how cars are made and used is leading to a competitive struggle for leadership in vehicle architecture** design (with increased presence of semiconductor manufacturers and suppliers), **accelerated development speed** (with the entry of IT startups and companies from other industries bringing agile development philosophies to the automotive sector), **and the evolution of vehicle service platforms** (with service providers focusing on content provision rather than vehicle manufacturing).



Sources: Prepared by METI based on materials prepared by the Hiroshima industrial Promotion Organization

Strengths of Emerging OEMs that Have an Advantage in a New Competitive Landscape

- **Both the development environment** capable of zero-based development and **the business thinking** of aggressively investing in projects that do not lead to short-term monetization are the sources of the competitiveness of emerging OEMs.
- On the other hand, existing OEMs are burdened by **legacies in their supply chains and models**, which require significant adjustments, creating a bottleneck when it comes to rapid and innovative development.

Gaps between the development capabilities of existing OEMs and emerging OEMs

	Existing OEMs	Emerging OEMs
Development environment	✓ Since the availability of supply chains is a prerequisite, there are many items to be adjusted and matched, and it takes time to develop. Major changes are also difficult. ✓ Fundamental renewal is difficult to carry out development based on existing models. There are also cases where the development and production environments of existing vehicles, such as ICEs and HEVs, have an impact.	✓ No legacy, such as SC or modeling, enables efficient and rapid zero-based development. ✓ Able to produce and develop innovative products without being constrained by eexisting ICE and HEV. it is also possible to specialize in the production of competitive vehicles.
Management environment	✓ **The achievements of existing businesses serve as obstacles,** making it difficult to implement bold shifts in thinking. ✓ Large-scale investment in projects that do not lead to short-term monetization is difficult due to the large number of employees and relationships with stakeholders such as shareholders.	✓ Holds flexible business thinking utilizing data and a management philosophy that enables aggressive investment of resources in new business areas that do not lead to monetization in the short term.

A development environment unbound by legacy systems, along with a management mindset and environment that can allocate significant resources to new businesses, becomes a source of competitive advantage over existing OEMs that hold many legacies.

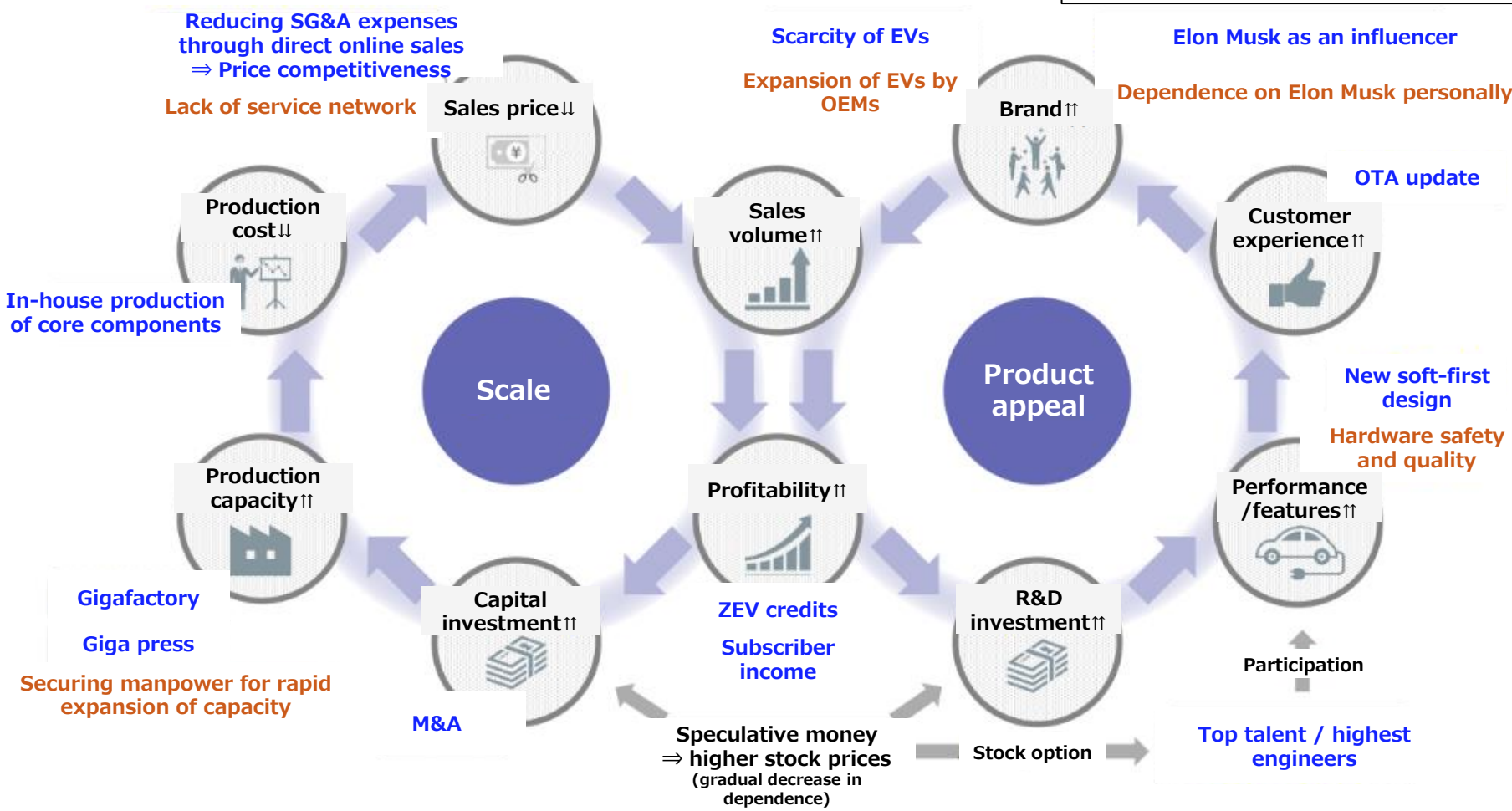
Sources: Prepared by METI based on various published materials, etc.

<Reference> Examples of Tesla

- Tesla launched its first AutoPilot hardware 1.0 in 2014, implementing a software-update feature with OTA. it has been **working to internalize software and hardware development, which was originally left to partner companies.**
- Tesla accelerates **the growth cycle of the automotive business, namely "scale" and "product strength,"** through unique strengths.

Tesla growth cycle

[Legend]
Sources of competitiveness Risks and issues



Sources: Created from materials from the industrial Research & Production Department of the Bank of Mitsubishi UFJ

<Reference> Examples of BYD

- In China, **the trend of intelligence is ahead**, and high-performance voice-recognition and OTA are installed in many vehicles.
- At present, while BYD still has some gaps in technology compared to top manufacturers in both software and hardware, BYD is advancing development with the aim of increasing **in-house production within China**. As a result, **competitive related companies are beginning to emerge.**

BYD's SDV functionality

Automated driving

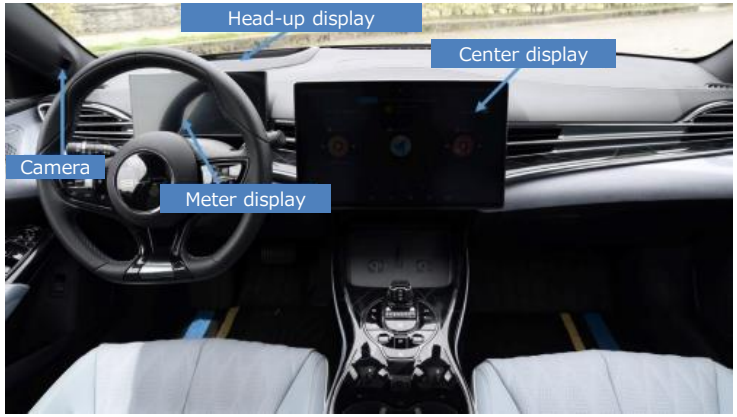
Implementing large-scale technological development and investment towards the deployment of automated driving.

- ✓ At the '2024 BYD Dream Day,' the company announced its plan to invest approximately 2 trillion yen in intelligent areas such as ADAS and automated driving.
- ✓ In addition to launching over 10 LiDAR-equipped models in 2024, they will also accelerate the development of Level 3 technology.

Smart cockpit

Providing a cockpit that meets the needs of consumers who prefer advanced features, such as voice recognition and entertainment

- ✓ By offering voice recognition that. accommodates various regional dialects across China and an entertainment space utilizing large displays, a new in-car environment has been created that is unlike anything seen before.



Reference

ADAS chips provided by Horizon Robotics

- ✓ Chinese company providing energy-efficient automotive chips for AD/ADAS.
- ✓ More than 20 OEM, including BYD, are partners. More than 150 models are equipped with on-board chip Journey.

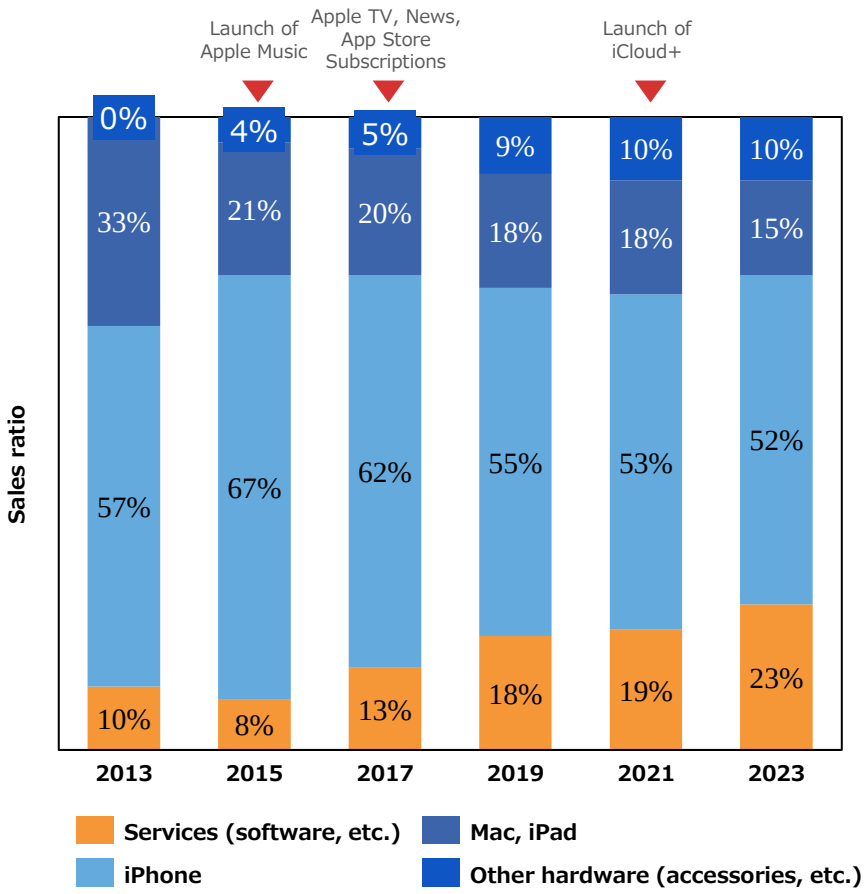
Sources: Prepared by METI based on published materials such as Marklines and various media reports

<Reference> Examples of Apple (Smartphone Industry)

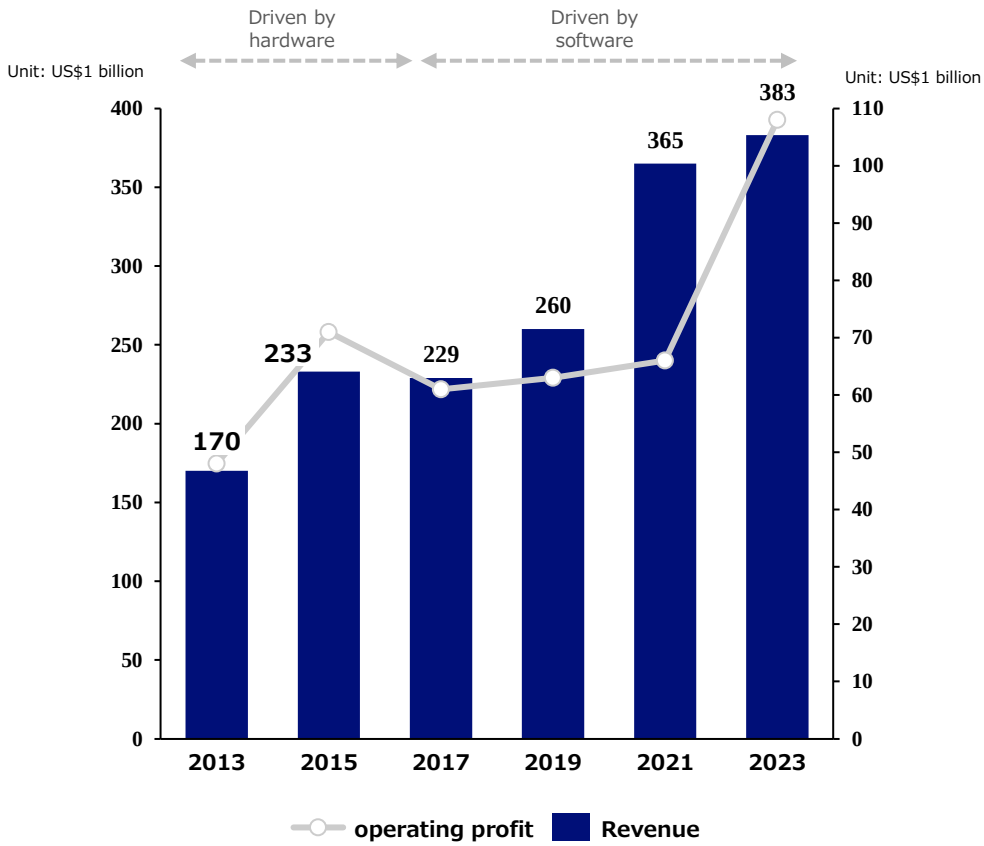
- Since 2017, **the diversification of software services has progressed**, and with the increase in the proportion of software sales, **operating profit has also grown**.

- Until now, Apple has produced unique products/technologies such as iPhone and Mac, and it has been working on the internalization of hardware by consistently carrying out all stages of manufacturing.
- On top of this, Apple is shifting to software and increasing sales through the provision of in-house subscription services such as Apple Music, Apple TV, iCloud.
- In addition, Apple has built a platform-Apple Store. By imposing high commissions on other app development players, the company aims to establish its own competitive advantage and realize an increase in diversified revenues.

Apple's sales ratio (hardware/software)



Apple's gross sales and operating income



Sources: Prepared by METI based on various published materials, etc.

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Three Main Areas Where Mobility DX Competition will Arise

- Given the needs of society and users, the progress of digital technology to meet those needs, and trends in other countries, we expect **to see game changers** in the form of **major global competition** and changes in value chains and industrial structures, **mainly in the following three areas.**
- **Overseas, emerging players without legacies have emerged, and investment with a sense of speed has become more active**. Japan, too, is making progress in this area, but while it is important to balance the need to secure profits from existing businesses, **Japan lacks the development resources (funds, personnel, etc.) to do so**. In order for Japan to compete **successfully**, we will formulate goals and **a roadmap to** achieve them, and mobilize **resources from the public and private sectors.**

(1) **Fundamental renewal of vehicle development and design (SDV-ization)**

- The concept of vehicle development and design has been fundamentally reformed, and software-driven vehicle development (SDV) has been accelerated. Development man-hours have been drastically reduced and speed has been improved.
- Beyond mere changes in vehicle structure, new value can be provided through software updates, integration with automated driving technology, etc.
- In Europe and the U.S., some companies have started the business of providing services through SDV-ization and OTA. International competition to secure competitiveness in the SDV market is accelerating, with semiconductor manufacturers and others entering the market from different industries.

(2) **Provide new mobility services** utilizing **automated driving, MaaS technology, etc.**

- Sustainable provision of mobility for people and logistics services is an urgent social issue, and there are strong expectations for social implementation of automated driving and on-demand services.
- Various challenges from slow mobility to robotaxis are being taken up around the world, but no business model has yet been established. In Japan, where the birthrate is declining and the population is aging, establishing a business model at an early stage could contribute to solving various social issues, and at the same time it could become a new business that can be deployed around the world.

(3) **Creation of new value** through the **use of data**

- Numerous data exist throughout the automobile lifecycle, from manufacturing to use to disposal. Integrated understanding of this data may lead to the creation of new value, such as the strengthening of supply chains and the use of data in other businesses.
- In Europe and the U.S., efforts to build data collaboration infrastructures that transcend corporate boundaries are already gaining momentum. This could be a source of great value in the future from the two aspects of (1) securing a data collaboration infrastructure and (2) creating new business through effective use of data.

⇒ To **overcome such competition**, we will develop **goals and a roadmap**, and **mobilize public and private resources to** address them.

The Significance of SDVs and the Value it Realizes

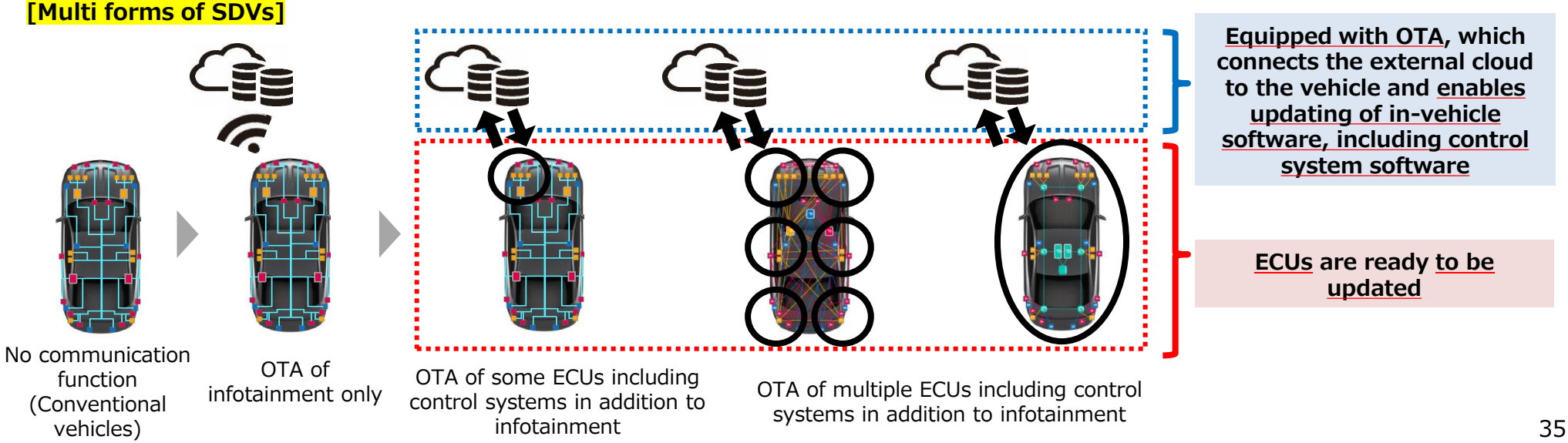
- The significance of SDVs is that they will enable the **continuous and speedy realization of** improved vehicle performance, the addition and expansion of functions, and the provision of **new added value**, such as services not confined to conventional vehicles, through **software updates**.
- On the other hand, the trend toward SDV-ization **has multiple phases**, including **communication functions**, **OTA functions**, and **vehicle OS***. In addition, not only BEVs but also **all powertrains including ICEs** will be converted to **SDVs**.
- Against this backdrop, it is important to **aim for "multi forms of SDVs" in terms of powertrains, functions, and price**, based on the target market and Japan's strengths (diversity of powertrains, ride comfort, etc.).

*Role in integrated ECU to separate hardware and software

[The value realized by SDVs]

- **Enhanced development efficiency by** separating hardware and software, **flexible software design** changes and **functional updates** after launch, **various monetization points in** collaboration with different industries (entertainment, interiors, charging, energy management, etc.).
- **Continuously updated with the latest** vehicle **safety and operability features**, and **customizable with** additional features, services, etc.

[Multi forms of SDVs]



Setting Goals for the Mobility DX Strategy

- **Through the implementation of the Mobility DX Strategy**, we aim to **realize a safe and convenient transportation society** and **acquire added value in new global markets.** In order to realize such a picture, it is important to **widely deploy and promote Japan's "multi forms of SDVs"** with **a range of functions and prices that** can accommodate multiple markets and users.
- From this perspective, the Mobility DX Strategy will **set a target "share of Japanese-affiliated companies in global sales of SDVs"** as a goal of its initiatives.

■ **Target: A 30% Japanese-affiliated share of global SDV sales (by 2030 and 2035)**

【2030: Establishing a new business model by integrating and implementing the infrastructure】

<Target Approach>

- Gradual expansion of SDV-ization from BEVs and luxury segments, where platform renewal is underway.
- By 2027, we will create a foundation to compete with the world through the development and demonstration environment and the establishment of elemental technologies, and establish a new business model through the integration and implementation of the results.
- Assuming global sales of SDVs in 2030 to be approximately 35 million to 41 million units, a 30% Japanese-affiliated share of global SDV sales corresponds to approximately 11 million to 12 million units.

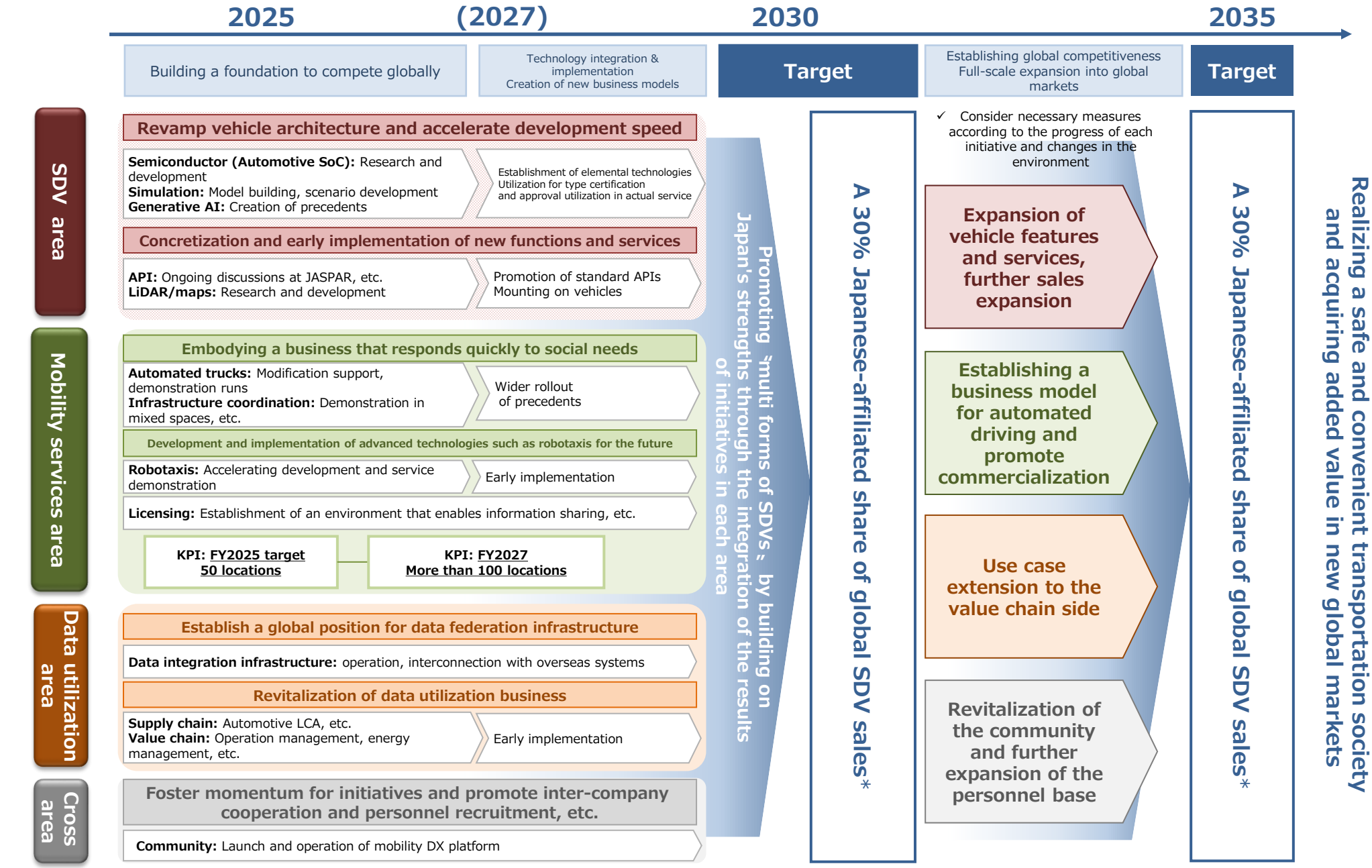
【2035: Full-scale global expansion】

<Target Approach>

- The SDV market expands further due to the spread of powertrains to PHEVs, HEVs, etc. and the broadening of segments.
- Further refine the established business model through standardization and scaling and expand it globally.
- Assuming global sales of SDVs to be approximately 57 to 64 million units in 2035, a 30% Japanese-affiliated share of global SDV sales corresponds to approximately 17 to 19 million units.

Note: The global sales volume of SDVs is assumed based on interviews and estimates by several experts.

Roadmap for Mobility DX Strategy



*Based on certain assumptions, a 30% share of the Japanese-affiliated market in 2030 is equivalent to approximately 11 to 12 million units, and a 30% share of the Japanese-affiliated market in 2035 is equivalent to approximately 17 to 19 million units.

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SDV Areas: Direction of Efforts to Achieve Goals

[Basic policy: In all powertrain products, including internal combustion engines, we will promote "multi forms of SDVs" with a wide range of functions and prices to meet the needs of multiple markets and users]

- In the SDV area, the key to competition is **(1) renewal of vehicle architecture and faster development speed** and **(2) early implementation of new functions and services as specific services**.
- To realize this goal, we **will quickly develop elemental technologies and cooperative infrastructure on the ground**, while **completing the provision and business implementation of vehicles integrating these technologies by around 2030**, which **will lead to the acquisition of future global markets**.

✓ It is essential for the development of competitive SDVs that the **technologies directly related to driving performance (automatic driving performance), such as semiconductors, LiDAR and high-precision 3D maps**, **reach the necessary and sufficient level**, and the development of such technologies should be promoted as soon as possible. For semiconductors in particular, it is important to **develop specialized semiconductors for applications such as automated driving**, to achieve both high performance and low power consumption.

✓ In addition, **speedy vehicle development and continuous updates by OTA are** important for SDVs in **terms of competition,** and it is necessary to **improve development efficiency by standardizing APIs and utilizing simulations,** and to **ensure ease of software development and updating**. **Data security and cyber security are also important to ensure reliability, safety and quality**, **so initiatives will be promoted through the use of the Ouranos Ecosystem, a secure and safe data utilization platform**. Through these measures, **users will be able to constantly update the safety, operability and other functions of their vehicles and utilize them with peace of mind.**

✓ **There is also a need for the implementation of services to improve the value of the experience of the user,** such as the effective use of leisure time during a ride in an automated vehicle, and a diversity of options for such services. To realize this, **there are limits to the services that can be provided by each OEM alone, and services should be provided in collaboration with third parties from different industries**, and **API standardization** is also important here.

✓ Furthermore, advances in **generative AI technology** will enable the generation and design of vehicle and component designs **that have never been seen before and the streamlining of development through these**, as well as the **implementation of new infotainment functions such as voice recognition**. In addition, the use of AI technology is also **advancing in the construction of a simulation environment for the enhancement of recognition and judgement** in driver assistance and automated driving, and for training them, and it is necessary **to create usage examples of generative AI in the automobile industry and provide assistance of computing resources**.

Mobility Services Area: Direction of Efforts to Achieve Goals

Basic Policy: We will promote the early actualization of businesses that respond to the demands of society and the development of advanced technologies with an eye to the future, with a dual focus.

- New mobility services include **various technological tiers**, from **slow mobility to robotaxis**, and the **optimal service varies according to local needs, demand, and characteristics, as** well as **cost and revenue structures**.
- In this environment, we will (1) **actualize businesses that quickly respond to social needs in terms of human flow and logistics**, and (2) develop **advanced technologies such as robotaxis with an eye to the future.** By around 2030, these results will be integrated to establish business models on various layers and contribute to solving global issues.

✓ Through automated driving and MaaS, in Japan, the project aims **to solve mobility issues and traffic accidents that have emerged in the region, to improve the value of the region and to realize a new transport society**. Globally, the aim is **to create attractive mobility and services and lead the world**.

✓ As various players are currently working on the development of automated driving, it is important to first **promote social implementation projects. In** addition, we will continue to **improve social acceptance and the environment** by continuously **disseminating information** and **fostering software-related personnel.**

✓ In addition, while more advanced technology is required, the **realization of robotaxis, which may be** commercially viable when combined with other services, will be **strongly promoted to encourage the advancement of technology and the creation of services in Japan. In addition, the** development of **elemental technologies (high-precision 3D maps and sensors) that** will lead to lower costs and higher performance in automated driving will also be promoted.

Data Utilization Area: Direction of Efforts to Achieve Goals

Basic policy: Establish a global position for Japan's data coordination platform and create new businesses utilizing data that were not achievable by individual companies.

- In order to create new businesses and services by **data utilization**, it is necessary to promote efforts on two aspects: (1) **developing data collaboration infrastructure itself**, and (2) **vitalizing data utilized businesses.**
- Regarding (1) developing data coordination platform itself, efforts will be put to establish a global position by **expanding the Ouranos Ecosystem use cases** and **connecting it to overseas systems.** For (2) vitalizing data utilized businesses, initial focus will be to **expand use cases on the supply chain side with high demands** following with **enhancing the initiative to value chain side by utilizing probe data.**

✓ It is necessary to increase the competitiveness of the Japanese automotive industry by **collecting, sharing, and utilizing countless data in vehicle lifecycle (manufacturing, usage, disposal), and strengthening the supply chain and create new services.** To this end, action will be taken on **development of data collaboration infrastructure** with the Ouranos Ecosystem and **establishing a mechanism for data utilization.**

✓ **The battery CFP calculation for compliance with the EU Battery Regulation is being addressed as a leading use case, as it is currently needed by the automotive industry.** The knowledge gained from the leading use case will initially be utilized to **expand use cases in the supply chain**, such as the **calculation of vehicle LCA, inventory management and production adjustments based on contingency detection, and the early detection of defective products.**

✓ As a next step, the efforts will be extended to **expand use cases on the value chain side**, which **will lead to the provision of high value-added services to users**, and **create and vitalize new data utilized businesses**.

Cross-Disciplinary: Direction of Efforts to Achieve Goals

- In order to accelerate and continue efforts in these key areas, it is **also** important to provide a **foundation for society as a whole to compete in the mobility DX race**.
- Specifically, the project will promote the formation of a **community** to **visualize and disseminate various public and private sector initiatives**, raise **awareness and increase momentum**, and within that community, promote the **acquisition and development of software personnel**, **promote information sharing and collaboration among companies**, and **study new initiatives.**

✓ **The formation of a community is also important for fostering momentum and enhancing the sustainability of initiatives** in which **various companies, personnel and information** such as OEMs, suppliers, start-ups, universities, research institutions, different industries, students and individuals can gather and exchange information, promote initiatives **to acquire and develop software personnel**, **promote information sharing and cooperation between companies**, and **consider new initiatives** in line with changes in the competitive and cooperative areas. it is important to promote information sharing and cooperation between companies, and to consider new initiatives in line with changes in competitive and cooperative areas. In particular, **in examining new initiatives, discussions will be held to generate cooperation** from new perspectives, such as **hardware and software, cyber and physical**.

✓ **A new community will be established** to provide such a venue.

✓ In particular, **software development is an important element in the** competition in new fields, and the **development and securing of personnel for software development is a common global issue**. However, **Japan has not made sufficient efforts in this area so far, and there is a notable shortage of software-related personnel**. Therefore, we will **categorize and identify important personnel**, and promote initiatives **such as Reskill course Certification system** for the purpose of personnel development and **Japan Automotive AI Challenge** for the purpose of finding and acquiring personnel.

Table of Contents

— Identifying Competitive Area and Coordination Area

— Efforts in the Coordination Area

— Efforts in the Competitive Area

<Reprinted>The Significance of SDVs and the Value it Realizes

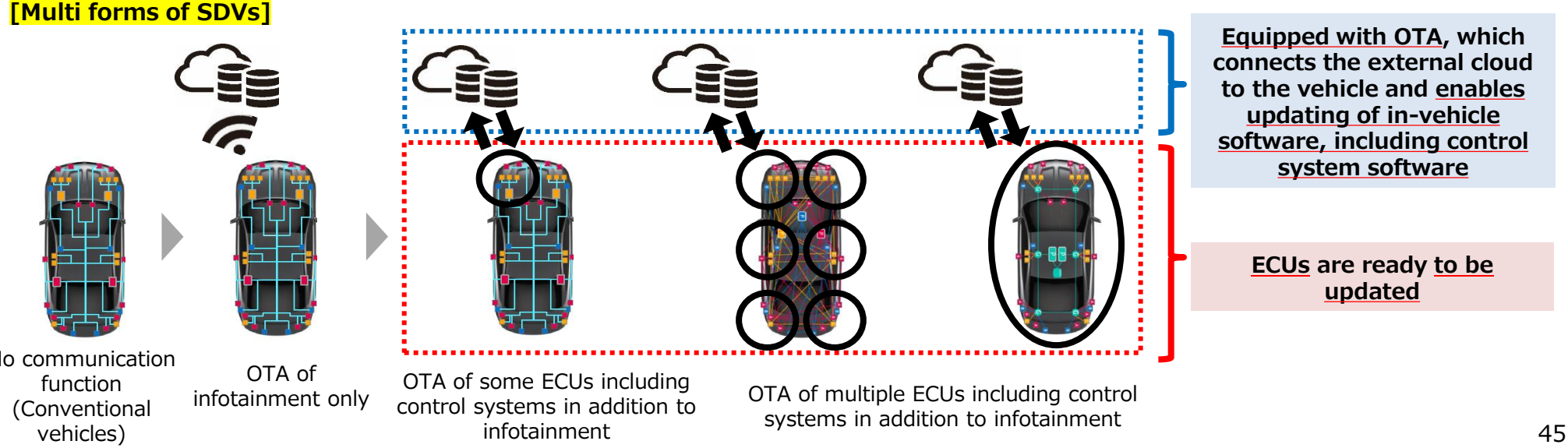
- The significance of SDVs is that they will enable the **continuous and speedy realization of** improved vehicle performance, the addition and expansion of functions, and the provision of **new added value**, such as services not confined to conventional vehicles, through **software updates**.
- On the other hand, the trend toward SDV-ization **has multiple phases**, including **communication functions**, **OTA functions**, and **vehicle OS***. In addition, not only BEVs but also **all powertrains including ICEs** will be converted to **SDVs**.
- Against this backdrop, it is important to **aim for "multi forms of SDVs" terms of powertrains, functions, and price**, based on the target market and Japan's strengths (diversity of powertrains, ride comfort, etc.).

*Role in integrated ECU to separate hardware and software

[The value realized by SDVs]

- **Enhanced development efficiency by** separating hardware and software, **flexible software design** changes and **functional updates** after launch, **various monetization points in** collaboration with different industries (entertainment, interiors, charging, energy management, etc.).
- **Continuously updated with the latest** vehicle **safety and operability features**, and **customizable with** additional features, services, etc.

[Multi forms of SDVs]



<Reference> Each Company's Understanding of the Components of SDVs

- Currently, there are differences in understanding among companies regarding the components of SDV, and there is no unified, clear definition.

Summary of each company's stance[1]

<Legend>「○」:Mentioned 「−」:Not mentioned/unknown

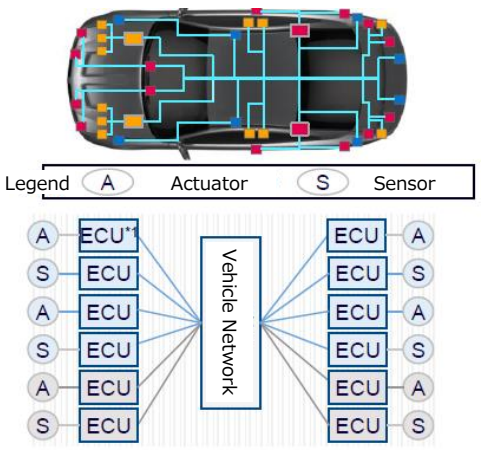
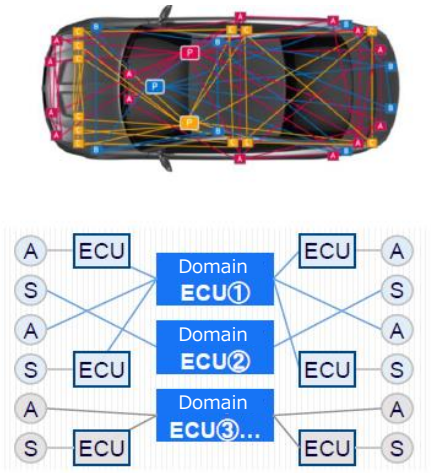
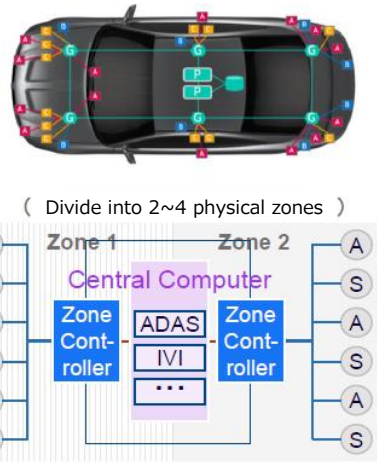
Extracted 13 components			Overview	Business Company			Consulting Company				Research/Media	
				A	B	C	D	E	F	G	H	I
Things / Technology	Software	In-vehicle OS, middleware	Software as the foundation for controlling the onboard computer	○	○	○	○	○	○	-	-	-
		Two-way communication	Two-way communication is possible between vehicle and outside	-	○	○	-	-	-	○	-	○
		SW[2] update	Update SW after the sale, including via OTA, to add new functions	-	○	○	○	○	○	○	○	○
		Cyber security	Ensure vehicle security	○	-	-	○	○	○	○	-	○
	Hardware	Separation of HW[2] and SW	Separate SW (abstract the HW) instead of embedding it in HW	○	○	○	○	○	○	-	○	-
		E/E architecture	system structures that connect SW and HW more efficiently, such as domain type and zone type	○	-	○	○	○	○	○	○	-
		Advanced Semiconductor	Chips using more advanced nodes which are essential for advanced electronic control	○	○	-	-	-	○	-	-	-
Service	User (UI/UX)	Personalize	Optimizing in-car entertainment and driving experience for each driver	-	○	○	○	-	-	-	○	-
		Infotainment	Providing both information and entertainment in one place	-	○	○	○	-	○	○	-	-
		Premium service	Make revenues from subscription and other membership services related to infotainment	-	-	○	○	-	○	○	○	-
		Seamless customer experience	Services that connect vehicles and users anytime, anywhere	-	-	-	○	-	-	-	-	-
	Manufacturer (DX)	Automated driving (Assistance)	Services that realize vehicle driving assistance functions	○	○	○	○	○	○	-	○	○
		Data analysis	Analyzes data collected by vehicles and utilizes it for maintenance, etc.	-	-	-	-	-	-	-	-	○

Note 1: There is no explicit announcement of definitions, rather than the main reports of each company. Any references to these are understood by the industrial Research & Production Department of the Bank of Mitsubishi UFJ.
Note 2: SW(Software/ software., HW(Hardware/ hardware.
Sources: Prepared by the industrial Research & Production Department of the Bank of Mitsubishi UFJ based on various published materials, etc.

<Reference> Changes in E/E Architecture

- E/E architecture has evolved from the conventional type, in which an ECU is installed for each function and the structure is complex, to the "domain type," which promotes integration of specific functions, and then **to the "zone central type," which divides the system into physical zones and implements central integrated control**.

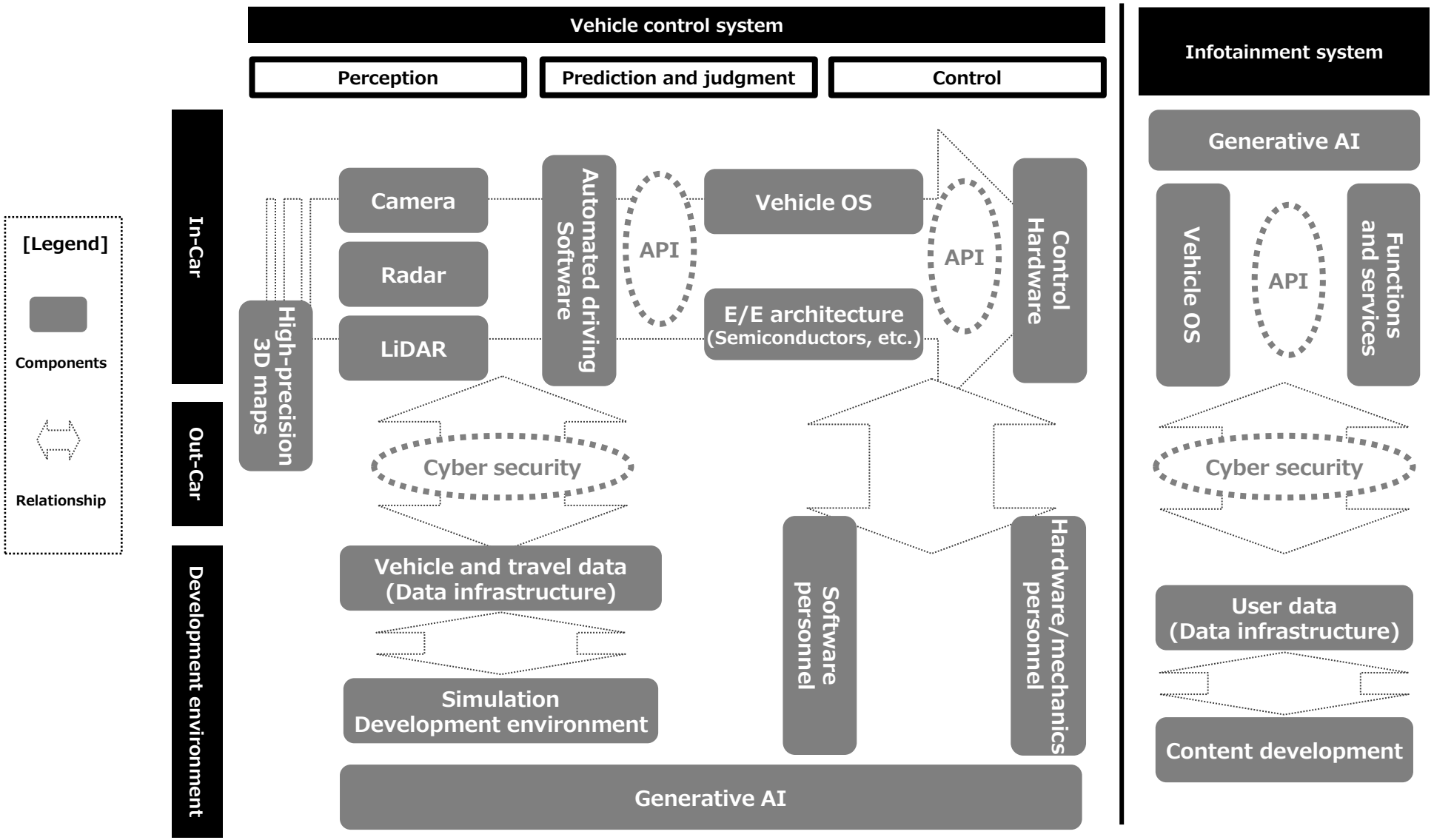
Changes in E/E architecture

	Traditional	Domain Type	Zone Central Type
Structural image			
Characteristics	**[ECUs exist for each function]** • **Competitive architecture of OEM** with hardware-software integration • **Difficulty of cross-sectional OTA** with dispersed functions • Complex structure, huge amount of harness (electronic wiring) and **high cost**	**[Integrate ECUs with specific functions (AD/ADAS, etc.) to improve functionality]** • Gradual change from the conventional model • **Enables OTA within an integrated domain** • Although the structure has been simplified and the number and cost of ECUs has been reduced, but **the amount of harness are still huge**	**[Divide into physical zones (front/back, left/right, etc.) and control each zone centrally]** • Central integrated control enables **efficient vehicle control and OTA in all vehicles** • **Cost reduction** by simplifying harnesses

Sources: Prepared by METI based on data compiled by Arthur D. Little

Segmentation of SDV Requirements

- The requirements of SDV can be divided into the following components **based on the domains (In-Car･Out-Car and development environment) and functionalities (vehicle control and infotainment systems).**

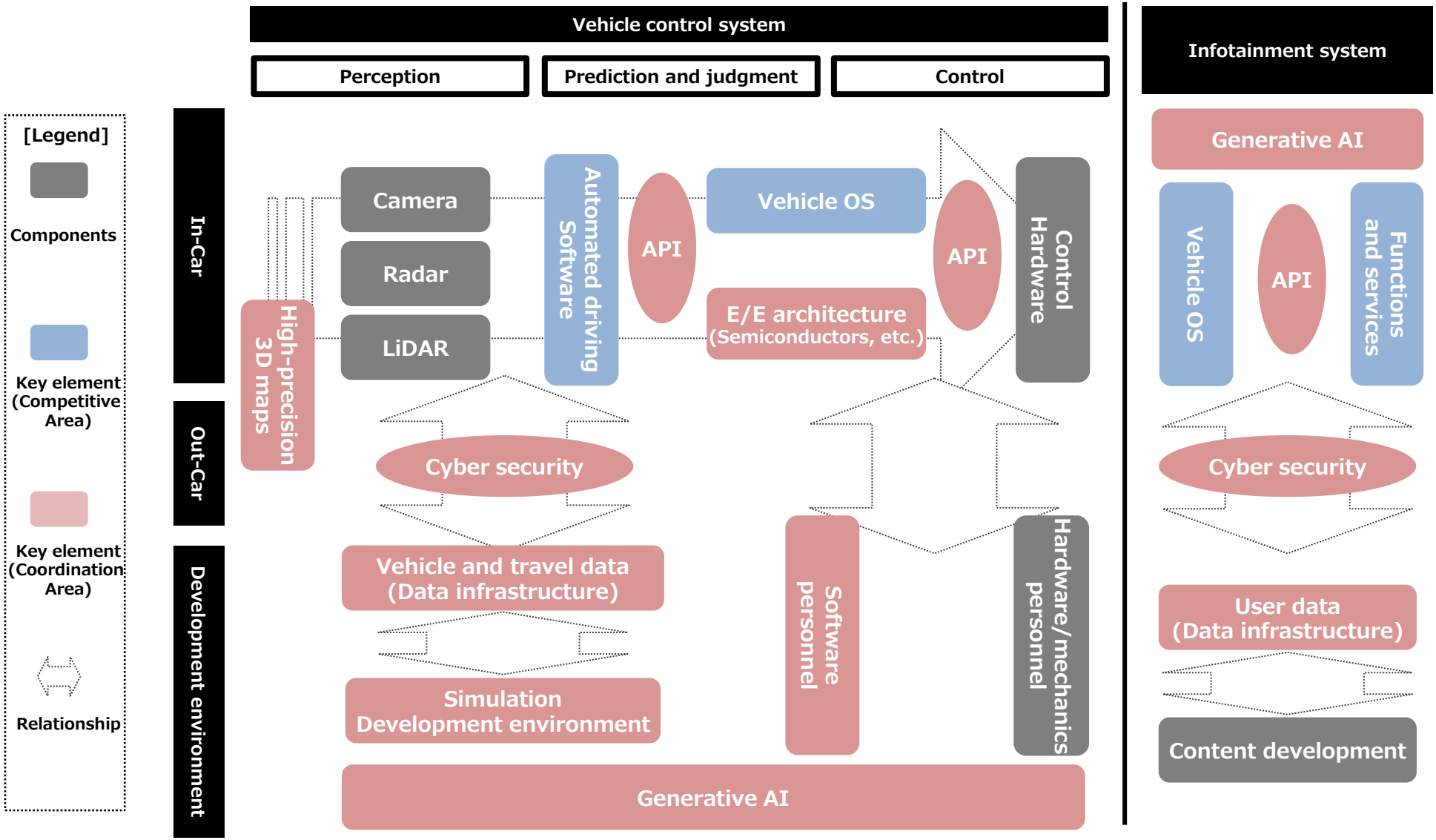


Approach to Evaluate Components

Evaluation sections		Content
Performance	High added value of functions and services	**How much impact does the element have on the final added value of the function or service?** (→ The more an element contributes to increased added value, the more important it is.)
	Efficiency of development and design	**To what extent does the element contribute to the efficiency of development and design?** (→ The more an element contributes to efficiency, the more important it is.)
Cost reduction		**To what extent does the element contribute to reducing vehicle costs?** (→ The higher the cost ratio and the greater the required reduction, the more important the element is.)
Energy efficiency		**How much energy efficiency can be improved by the element?** (→ The more an element contributes to improving energy efficiency, the more important it is.)
Degree of technological maturity (Global level)		**What is the technical maturity of the element?** (→ The lower the maturity of an element and the greater its future development potential, the more important it is.)
Position of Japan		**To what extent do Japanese companies differ from global standards in terms of their factors?** (→ The greater the difference, the greater the importance)
Economic security		**To what extent is the element necessary for economic security?** (→ The greater the need, the greater the importance)
Coordination area or competitive area		**When considering the medium to long term (10 to 15 years), to what extent is there room for these elements to work together as areas of cooperation?**

Re-establish Competitive and Coordination Area Based on Evaluation

- **The areas of cooperation** that will accelerate public/private initiatives are summarized below. However, there is a **gradation in the way areas are thought of**, and they will be continuously discussed and reviewed, taking into account **future technological trends and the concept of system of systems**.



— Identifying Competitive Area and Coordination Area

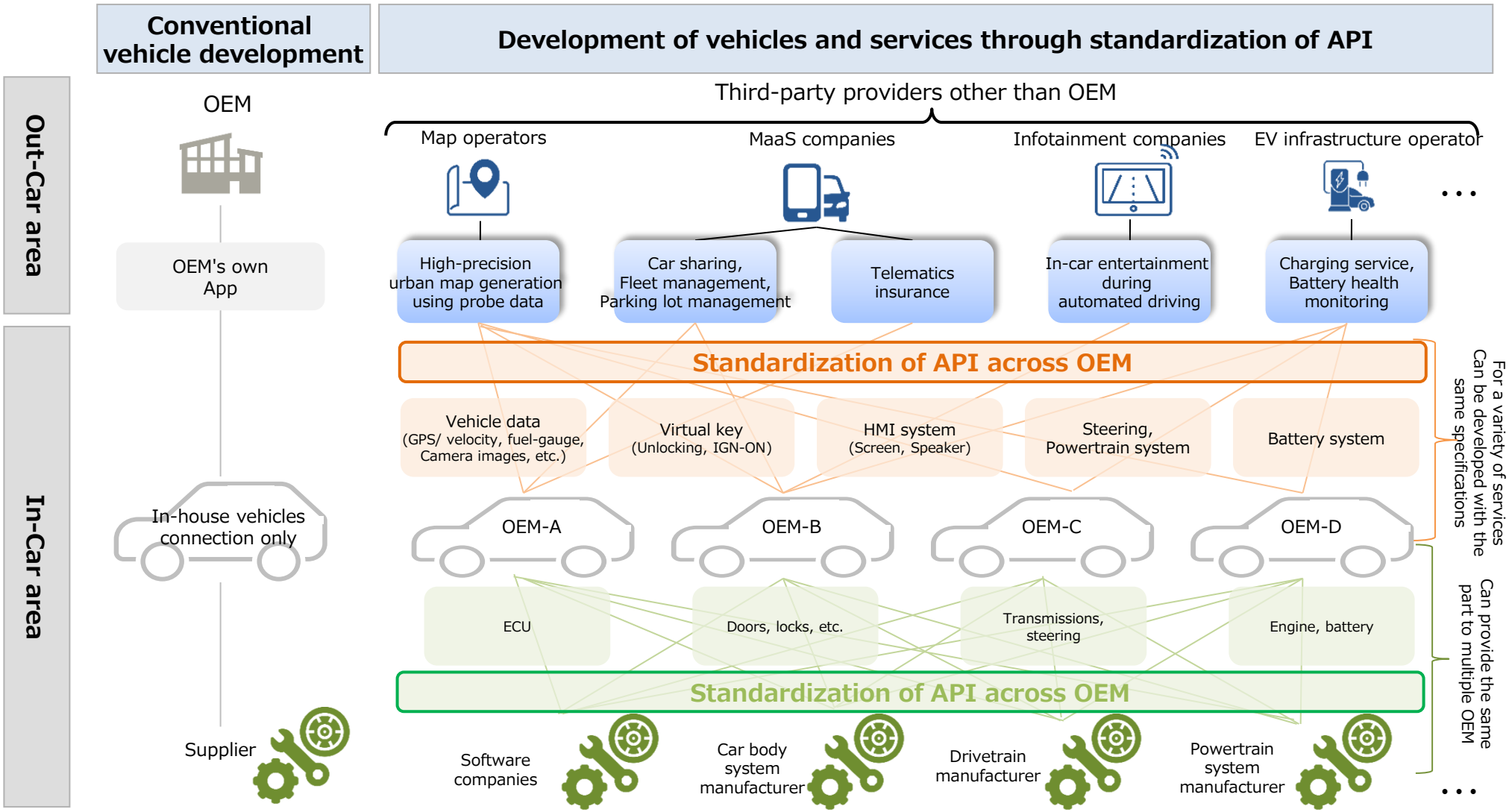
— Efforts in the Cooperative Area

— Efforts in the Competitive Area

The Benefits of API Standardization

API

- Standardizing APIs will encourage **third-party participation** and **expand vehicle-based services**. This will increase the reusability of software, leading to improved **efficienct development across the industry** and **contributing to the realization of a system of systems**.



Future Efforts

API

- Regarding API standardization, to materialize future efforts, it is necessary to **continue discussions** on the following points: **"the effects of standardization", "the process for advancing standardization", and "the timeline for future discussions and efforts".**
- Next, **JASPAR and others will identify issues related to standardization** and **reach a conclusion** by this summer.

[Points to be discussed to materialize future efforts]

<From the perspective of "the benefits of standardization">

- From the OEM's perspective, it is expected that standardizing APIs will require a certain amount of development effort, such as rewriting their own software, but will the benefits outweigh this?
- From the perspective of suppliers, including third parties, how attractive is standardizing APIs? In that case, what format and specifications would be desirable for standardization (e.g., making sample code publicly available, etc.).
- From the end user's perspective, how will the UX achieved change as a result of standardizing APIs?

<From the perspective of "the process of advancing standardization">

- Taking into account the concept of system of systems, etc., what are the specific areas in which APIs should be standardized? Also, how will this change over time?
- What players outside the automotive industry should be involved in advancing discussions on standardization?
- When using APIs already published by COVESA and CAAM, who will assess whether they can be used and how? Will the assessment differ from company to company?
- If each company already has APIs, how will they select them? Also, when each company makes its APIs public, what format and specifications are desirable for the publication (e.g., document level, source code level, etc.)?
- How will new APIs be developed and formulated (e.g., for CAAM, China's Neusoft will formulate them).

<From the perspective of "the timeline for future discussions and efforts">

- As the SDV ecosystem is being formed around the world, is there a risk that Japan will become isolated from the rest of the world if it falls behind in its efforts?

<Reference> List of API (Examples)

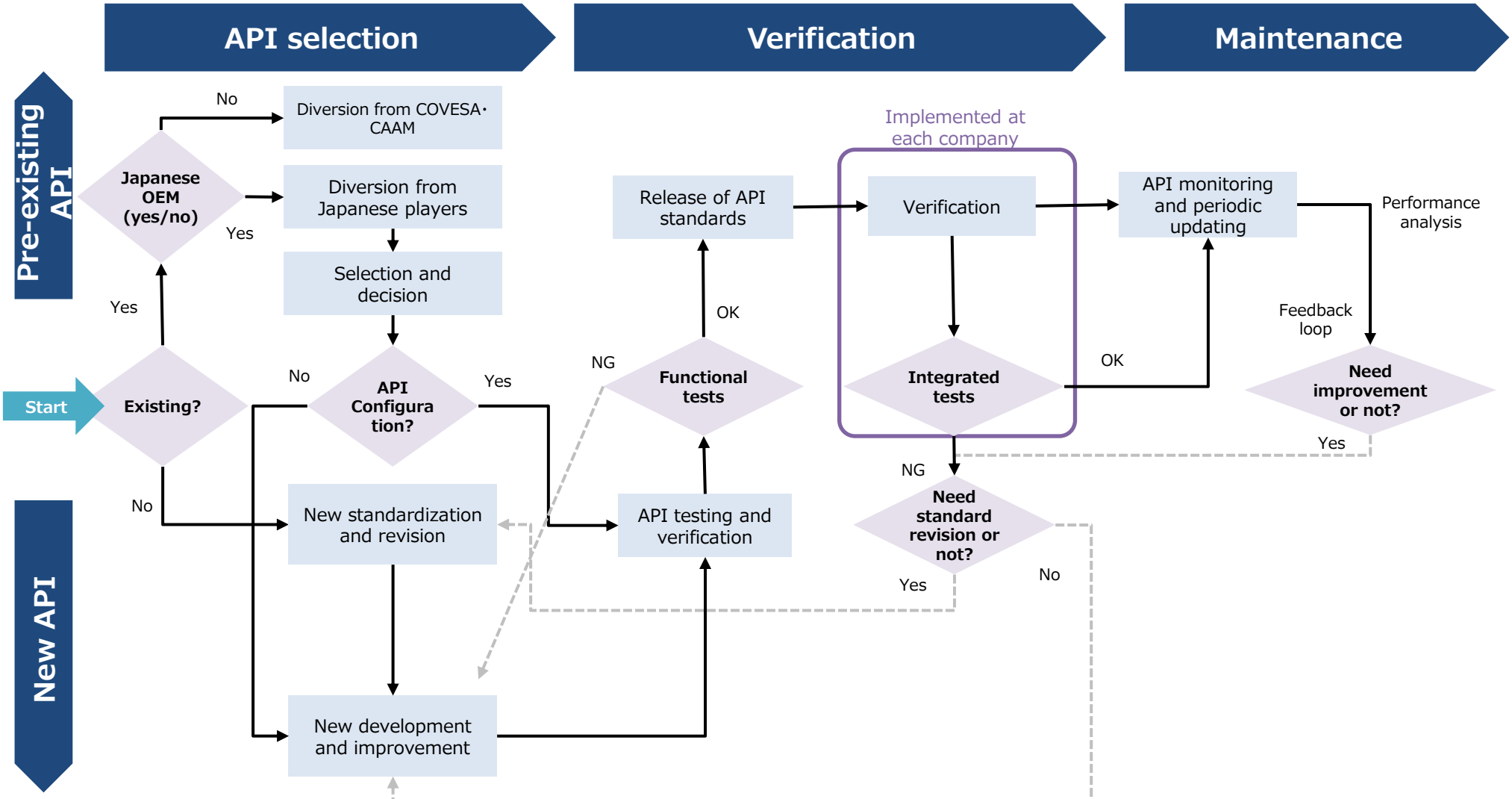
API

	For API (In-Car computing). CAAM=492API, COVESA=574API					API (for cloud computing)		
App/Vehicle OS	Body control	Thermal control	Vehicle movement control	Energy control	HMI control	OEM control	Third-party control	Data analysis
	Component deterioration	Thermal runaway detection	All-around recognition	Power detection	Multiple accounts	Linked to smartphones	Map and Position	traffic environment
	Unusual vehicle behavior	Air conditioning control	Drive control	Power control	Crew recognition	Fleet Management	Smartphone	Power consumption
	Driving	Air cleaner	Stop control	Power consumption	Speech recognition	Fleet status	High precision position	Hazard identification
	Chassis	Air ventilation	Route planning	Charge and discharge control	Switch	Chassis authentication	Battery	Road information
	Horn control	Dehumidifier	Steering control	Charging port	Personal identification		Traffic risk information	Face recognition
	Mirror control	Temperature detection	Parking control	Low voltage battery	Touch screen		Surveillance cameras	
	Drive	Humidity detection	Torque control	High-voltage battery	System security		Weather information	
	AVAS functionality		Slope detection		Privacy management			
	Vehicle status notification		Vehicle position recognition					
	Sun Roof		ADAS functionality					
API	API	API	API	API	API	API	API	API
M/W	Runtime environment							
API	For API (BSW) CAAM=343API							
	API	API	API	API	API			
BSW	Sensor abstraction	I/O device abstraction	Process abstraction	Storage and communication abstraction	Actuator abstraction			
	6-axis inertia measurement	Device port control	Cache memory management	Signal transmitter	Electrical-mechanical conversion			
	Door lock control	I/O control	Instruction reader	NVRAM	Door and motor			
	Temperature control	Touch detection	CPU Clock Timer	OTA	Electrical and electronic wiring			
	Pressure control	Device status	Data management	EEPROM	Sound monitor			
H/W	Sensor	I/O devices	Processing	Storage and Communications	Actuator			
	6-axis sensor	Antenna	ECU	WIFI router	Motor			
	Vehicle exterior recognition sensor	Touch screen	SoC	Flash memory	Air cooling fan			
	Collision detection sensor	Cabin and external speakers	Microprocessor	NAND memory	By-wire			
	Human detection sensor	Camera	Microcomputer	Bluetooth	AVAS			

Sources: Prepared by NRI based on various publicly available data

<Reference> Processes Required for Standardization of API

API



Source: Prepared by METI based on NRI analyses

Importance of Semiconductors (SoC)

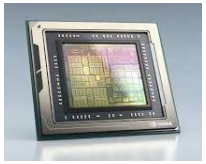
Semiconductor

- Vehicles use many semiconductors, including power and analog semiconductors. To realize SDV, **it is necessary to integrate ECUs and facilitate software development and updates. A high-performance SoC is essential for the integrated ECU**.
- While the design and manufacturing of high-performance SoCs is **increasingly dominated by a few suppliers such as NVIDIA and Qualcomm**, **miniaturization and dedicated semiconductors for specific applications** (such as automated driving) are **essential to achieve both high performance and low power consumption.**

◆ NVIDIA

- **Volvo EX90 SUV** adopts **Nvidia Drive Orin** and **Drive platform** (combined 280TOPS).
- **Mercedes Benz will form an alliance with NVIDIA,** and the company's **Drive Orin** (254TOPS) will be installed in **next-generation vehicles (Level 2 or higher).**

Volvo EX90 SUV



NVIDIA Drive Orin

◆ Qualcomm

- **GM Cadillac Celestiq 2023** was scheduled to be equipped with ADAS technology provide by **Snapdragon Ride**, now postponed to **2024.**
- At present, no vehicles are equipped with Snapdragon Ride, but this SoC will be widely installed to new **BMW** vehicles, in addition to GM.

Cadillac Celestiq

Snapdragon Ride

◆ Horizen Robotics

- **Journey 5**, supplied mainly to Chinese manufacturers, such as **BYD**, realize 4.3TOPS/W, 128TOPS chip performance.
- **VW group** established a joint venture with Horizen Robotics through its subsidiary CARIAD to develop solutions for the Chinese market.

◆ Black Sesame

- The AI SoC **Huashan-2 A1000 Pro** for automated driving achieves 5TOPS/W, surpassing competitors in computing power per calorie.
- collaborated with **BlackBerry** to jointly develop ECARX's Skyland ADAS Platform.

◆ Tesla

- **In 2019**, the company announced that it had **switched all SoC previously supplied by NVIDIA to those designed in-house**. Production is outsourced to Samsung Electronics Co., Ltd..
- In May 2023, we began producing **Tesla Model Y** equipped with HW4.0 using the latest **FSD chips**.
- The neural network accelerator of HW4.0 achieves **a maximum of 50 TOPS**. The processing speed is expected to be about **2 to 4 times faster** than HW3.0.

Sources: Prepared from various public information

Domestic Coordination Initiatives for In-house Production of SoC (ASRA)

Semiconductor

- In Japan as well, efforts have begun to collaborate on research and development of the cutting-edge SoCs necessary to realize SDVs, including highly automated driving.
- **The Advanced SoC Research for Automotive (ASRA) aims to establish the core technologies by 2028 and apply them to mass production in automobiles after 2030**. METI has also decided to provide 1 billion yen in support.

Outline of the Advanced SoC Research for Automotive (ASRA)

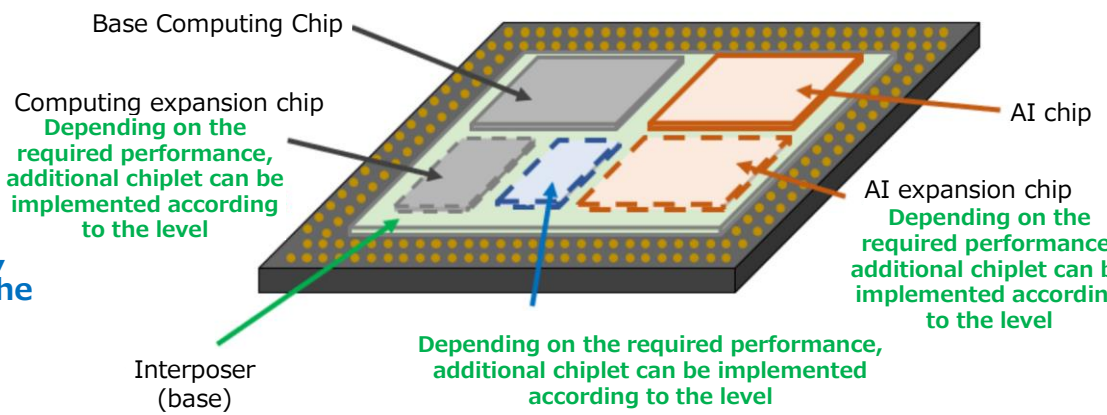
Date of establishment: December 1, 2023
Chairman: Keiji Yamamoto (Senior Fellow of Toyota Motor corporation)
[**Participating companies** (12 companies)]
Auto manufacturers: SUBARU corporation, Toyota Motor corporation, Nissan Motor Co., Ltd., Honda Motor Co., Ltd., Mazda Motor Co., Ltd.
Electrical parts manufacturers: DENSO corporation, Panasonic Automotive systems Co., Ltd.
Semiconductor related companies: Socionext Co., Ltd., Japan Cadence Design systems Co., Ltd., Japan Synopsys Co., Ltd., Millies Technologies Co., Ltd., Renesas Electronics Co., Ltd.
Overview of project: R&D of automotive SoC using chiplet technology that combines different types of semiconductors

■Advantages of chiplet technology

① **Capable for high performance and multi functions**

② **Possible to increase non-defective yields during production**

③ **Possible to commercialized SoCs in a timely manner, with optimal functions and performance that meet the requirements of end users (automotive companies)**



Source:s Prepared by METI based on ASRA HP and press releases

<Reference> Initiatives of Other Japanese Companies

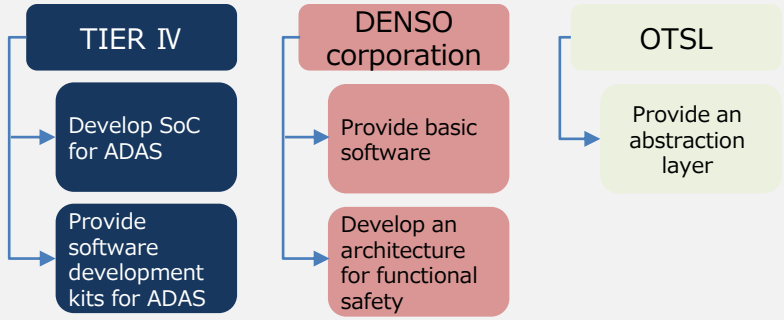
Semiconductor

- **TIER IV** developed SoCs in collaboration with Denso and OTLS, **utilizing the NEDO subsidized project (Technology Development project for Energy-Saving AI Semiconductors and systems/Development of Innovative AI Semiconductors and systems).**
- **TURING** is planning to develop SoCs for fully automated driving.

TIER Ⅳ:
Developed SoCs using in embedded platform

- TIER Ⅳ, DENSO and OTSL jointly developed prototypes of embedded platform.
- Utilizing NEDO "Technological Development project on Energy Conservation AI Semiconductors and systems/Development of Innovative AI Semiconductors and systems" (FY2023-FY2027).

Responsibility of each company for the built-in platform



Development Objectives: Acceleration of the development of semiconductors required for automated driving

Progress in Practical Application: OEM and others can develop ADAS applications using SoC software development kits

Timeline: Plan started on June 8, 2023

TURING:
Established a SoC developing team for fully automated driving

- TURING aim to develop a SoC with performance 500 times better than current SoC.

TURING's goal in developing SoC

Using SoC as an inference accelerator for internally developed LLM

Integrating self-developed AI and software infrastructure with SoCs to achieve fully automated driving

Development Objectives: Development of SoC that can provide the processing capacity required for fully automated driving

Directionality of practical application: Powering TURING's in-house LLM (Large Language Model) to identify objects with the speed and accuracy required for fully automated driving driving

Timeline: Development during the next five years

Sources: Prepared by METI based on various publicly available information

<Reference> International Trends in Standardization Toward Realizing SDV

API

- API standardization efforts are **gaining momentum globally**. **China's CAAM is making particular progress**, and at CES in January this year, **AUTOSAR, COVESA, SOAFEE, and Eclipse SDV have jointly formed the SDV Alliance**.
- In light of these global trends, it is necessary for Japan's automobile industry to consider its response.

Trusted Collaboration on Software Defined Vehicle*

AUTOSAR
Objective: Develop and establish standardized SW framework and open E/E system architecture for intelligent mobility

ASAM
Objective: Open Standards from Pegasus, Service Oriented Vehicle Diagnostics

Khronos
Objective: open standards for 3D graphics, Virtual and Augmented Reality, Parallel Computing, Machine Learning, and Vision Processing

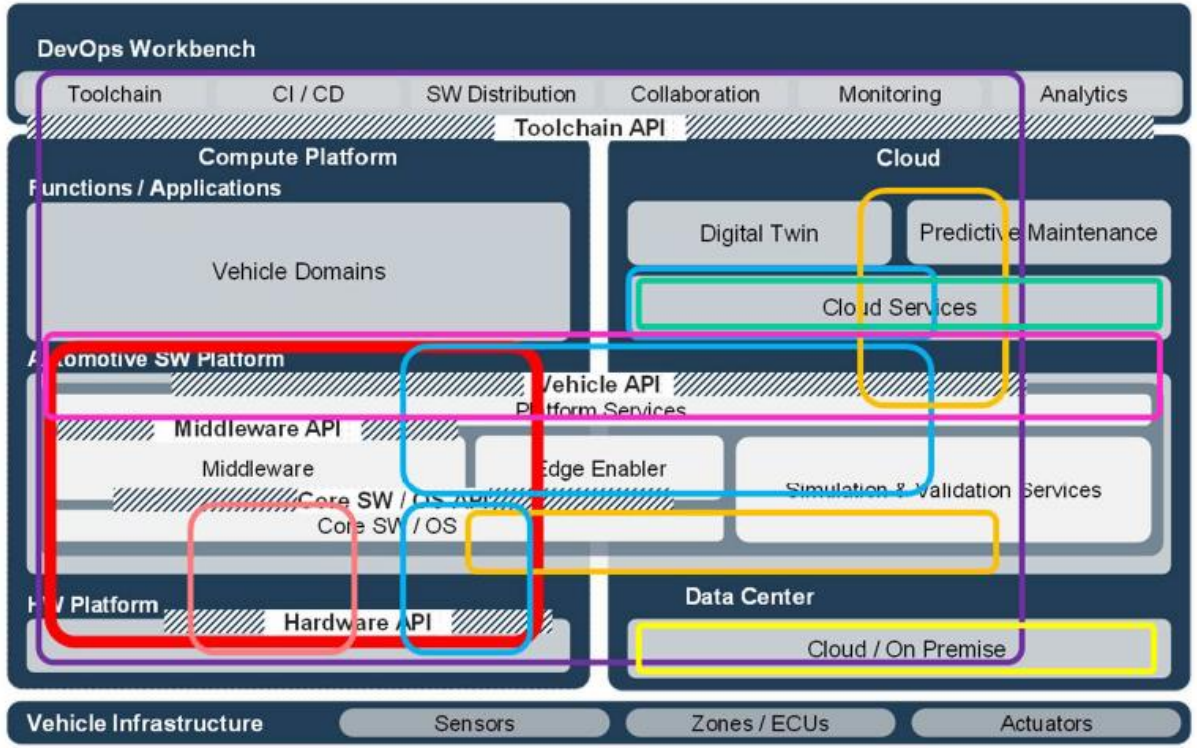
SOAFEE
Objective: Cloud-native architecture enhanced for mixed-criticality automotive applications; building on technologies which define standard boot and security requirements for Arm architecture

Eclipse SDV
Objective: Open technology platform for the SW defined vehicle of the future; focused on accelerating innovation of automotive-grade in-car software stacks using open source and open specifications

Gaia-X, Catena-X
Goal: Gaia-X European data infrastructure for Hyperscaler Catena-X tracability in supply chain

Cloud Native Computing Foundation (CNCF)
Objective: CNCF is the open source, vendor-neutral hub of cloud native computing, hosting projects like Kubernetes and Prometheus to make cloud native universal and sustainable.

COVESA (former GENIVI)
Objective: Connected vehicle systems including in-vehicle, at-edge and in-cloud services, interfaces and data exchange. Extension of W3C Common Vehicle Interface Initiative (CVII)



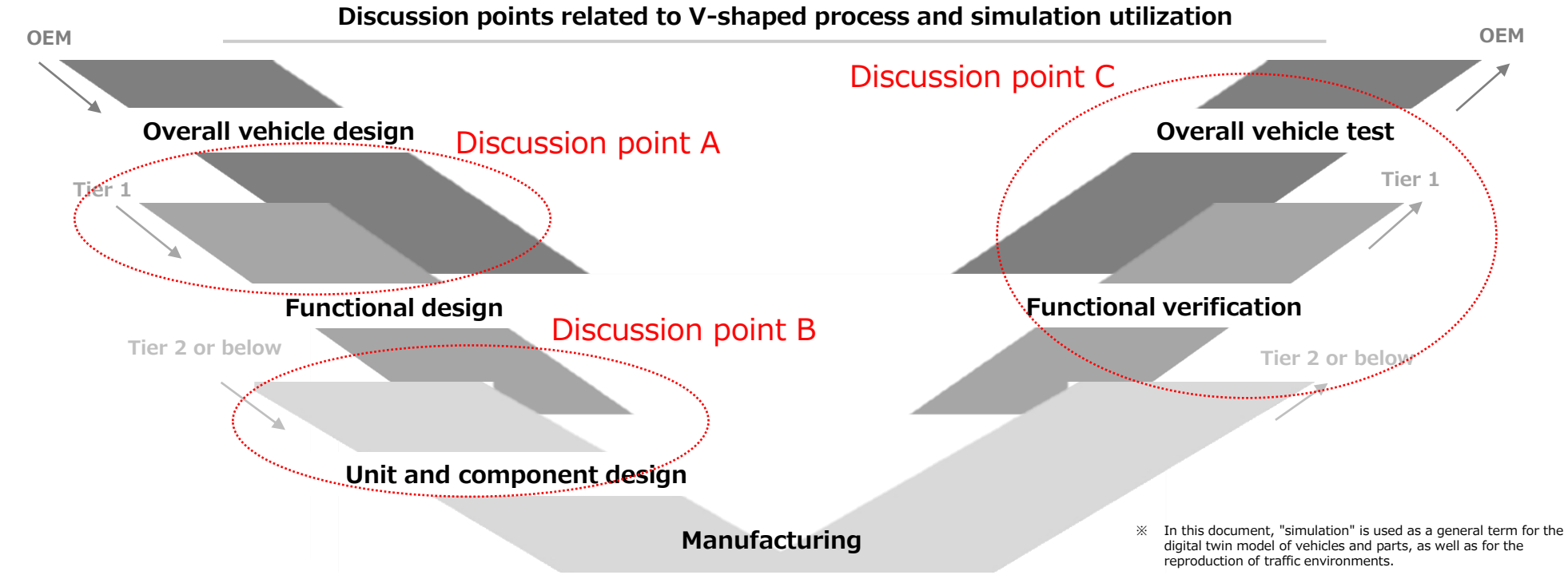
*Example view without being complete

Sources: Prepared by METI based on AUTOSAR documentations

Use of Simulation to Realize an Efficient Development Environment

Simulation

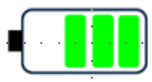
- To realize an efficient development environment, it is necessary to **replace the conventional actual process with a simulation environment as much as possible.**
- **The process and the assumed model/environment for which simulation is expected to be used** are organized into the following three points **as the flow of the V-shaped process and the expected points for using simulation**.



※ In this document, "simulation" is used as a general term for the digital twin model of vehicles and parts, as well as for the reproduction of traffic environments.

[Discussion point A]
1D modeling used between OEM and tier 1


Motor model


Battery model


Sensor model

[Discussion point B]
3D modeling used between tier 1 and tier 2 or below

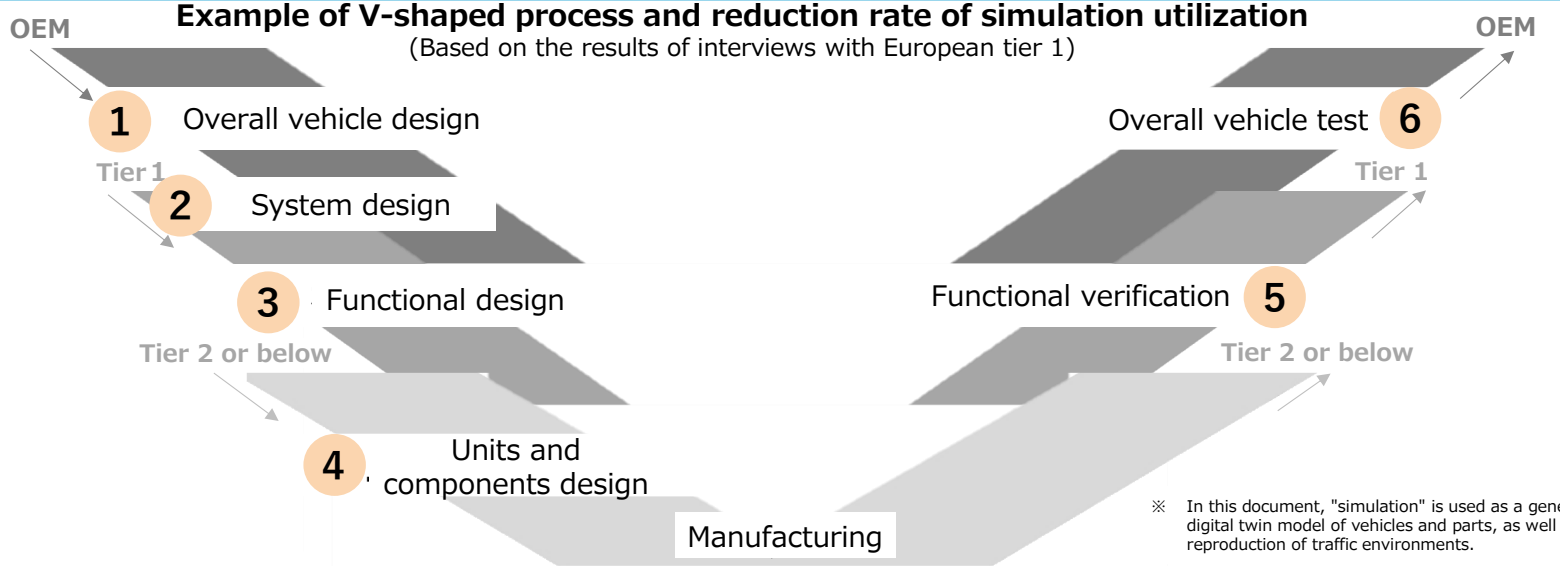
[Discussion point C]
Scenario databases and environmental reproduction tools

Example of Development Efficiency Improvement Effect by Using Simulation

Simulation

- Globally, vehicle development is **becoming faster through the use of simulations**. From the perspective of ensuring competitiveness, **it is important to consider systems and evaluation mechanisms that are premised on the use of simulations.**

Example of V-shaped process and reduction rate of simulation utilization
(Based on the results of interviews with European tier 1)



※ In this document, "simulation" is used as a general term for the digital twin model of vehicles and parts, as well as for the reproduction of traffic environments.

Step	Time required before	Time required after reduction	Reduction rate
①Overall vehicle design	Approx. 6 months	Approx. 3 months	50%
②System design	Approx. 12 months	Approx. 8.4 months	30%
③Functional design	Approx. 3 months	Approx. 1.8 to 2.1 months	30～40%
④Units and components design	Approx. 4 months	Approx. 2.4 to 3 months	25～40%
⑤Functional verification	Approx. 6 months	Approx. 5.1 to 5.4 months	10～15%
⑥Overall vehicle test	Approx. 6 months	Approx. 2.4 to 3.6 months	40～60%
Total (Simple sum)	**Approx. 37 months**	**Approx. 23.1 to 25.5 months**	**30～40%**

Sources: Prepared by NRI based on interviews with tier1 suppliers

Future Efforts on Design and Manufacturing (Discussion Point A and B)

Simulation

- Regarding **1D model** (Discussion point A) to be utilized between OEM ⇔ tier 1, we will proceed with the **construction of models compatible with electric vehicles and AD/ADAS**, which are not currently supported.
- Regarding **3D model** (Discussion point B) to be used between tier 1 and tier 2 or below, we will proceed with **identifying the actual status of model utilization and sorting out issues for dissemination, taking into account issues specific to small and medium-sized enterprises**.

Discussion point A:1D modeling

[Recognition of issues and past efforts]

- In the design process (performance allocation, etc.), the use of **1D models is effective in realizing efficient specification consideration and operation verification**. In order to expand the use of models, we will proceed with the **construction of common models and the standardization of interfaces between models**.
- The **General Incorporated Association MBD Development Promotion Center (JAMBE)** was established in 2021. Currently, **50** common models and guidelines have been formulated for **internal combustion engines and hybrid vehicles**.

[Future efforts]

- It is necessary to **build common models for electric vehicles and AD/ADAS**, which are not currently built.
- **JARI** will proceed with the construction in collaboration with JAMBE, utilizing **the Green Innovation Fund ("Development of in-vehicle computing simulation technology for energy saving of electric vehicles, etc.")**.

Discussion point B:3D modeling

[Recognition of issues]

- In the design and manufacturing process (mold design, process design, etc.), we will shift from a method of repeated trial and error on actual machines based on the craftsman's intuition, experience, courage, etc., to **a method of logical and efficient verification using models**.

[Future efforts]

- We will work with JAMBE and individual companies to grasp **the current state of model utilization**.
- Based on that, in order to expand the use of models in the future, steps such as **① understanding the benefits of model utilization ⇒ ② training personnel who can utilize models ⇒ ③ introduction of tools** are considered to be necessary. Based on the above understanding of the actual situation, we will identify bottlenecks and consider necessary support measures.

Future Initiatives to Utilize Simulation Evaluation (Discussion Point C)

Simulation

- In the future, **vehicle development will be accelerated by the progress of SDV and the efficiency of function verification and safety evaluation by using generative AI. In addition, continuous updates after the sale of vehicles, such as software updates via OTA**, are also important factors for competition.
- Internationally, based on Japan's proposal, **WP29 is discussing the standardization of evaluation methods that link simulation evaluation and actual vehicle evaluation**, and in parallel, **the public and private sectors in Japan are also moving toward accelerating the concretization of evaluation methods**. On the other hand, since simulation environments are linked to OEMs' design concepts, development is being carried out by each company.
- For this reason, in order **to improve and speed up development efficiency and reduce the evaluation burden, including for vehicles and automated driving systems**, **discussions will begin this year in the Safety Evaluation Strategy SWG on the ideal simulation environment and safety evaluation scenarios that can be flexibly used under various design concepts**.

Goal: Significantly expand the use of simulation evaluations in safety evaluations.

Factors to Consider

Method (Scenario and Evaluation Process)

- ✓ Harmonizing with Global Discussions (WP29, etc.)
- ✓ Completeness and likelihood of scenarios
- ✓ Certainty and transparency of the evaluation process

Procedures (Evaluation tools)

- ✓ Consistency with the real environment
- ✓ Vehicle model (OEM, ADS)
- ✓ Model of other traffic participants
- ✓ Approach to data-based utilization based on new technological trends such as generative AI

Policy

- ✓ Safety assessment of automated driving
  - RttL4PJ, all-digital
- ✓ Research and development of elemental technologies
  - GI Fund /K Pro (Sensor)
  - SBIR/BRIDGE (Mapping)

[Methods] : Complying with JAMA guidelines, SAKURA's scenario-based DB, which has a track record of issuing ISO34502, will be utilized as a shared platform.

[Procedures] : Currently, it is difficult to narrow down to one tool. Assuming the availability of DIVP and several other tools, linkage with SAKURA will be made.

[Policy] : Strengthen collaboration with surrounding businesses and projects related to SAKURA, DIVP to accelerate improvement in simulation-environment precision

⇒ **Based on these, the Safety Assessment Strategy SWG will discuss the ideal simulation environment and safety assessment scenarios that can be flexibly used by each company.**

<Reference> Issues for Sharing Data Held by Each Company

Simulation

- Regarding data sharing to improve the sophistication and accuracy of simulation environments, there are **issues such as the need to offer benefits to data providers and reduce obstacles of providing data**. In addition, there are **high expectations for the use of safety evaluation results from simulations in type certification and approval**, further consideration is needed to promote the use of simulation environments.

Discussions on Simulation Utilization and Data sharing

Realizable value

- Improving development efficiency and speed
- Safety evaluation in scenarios that are difficult to verify in the real world
- Use for authorization and authentication

etc.

Expectations for the government

- Setting certain standards and target guidelines for safety evaluation (convergence of the number of scenarios by establishing a process that includes standards)
- Lowering the barrier to open-sourcing data (ensuring data accuracy is one of the obstacles)

etc.

Issues to consider

Data provider

- ✓ Benefits of providing data
- ✓ Ensuring data confidentiality
- ✓ Reducing the obstacles for providing data

Data user

- ✓ Identifying needs (use cases, required data items, etc.)

Infrastructure rules etc.

- ✓ Reliability as a data infrastructure
- ✓ Guarantee of a secure environment
- ✓ Necessity of arbitration function
- ✓ Concept of responsibility and license
- ✓ Formulation of guidelines, etc. to improve the convenience of data utilization

<Reference> Functions of SAKURA Scenario Database and Their Responding Status

Simulation

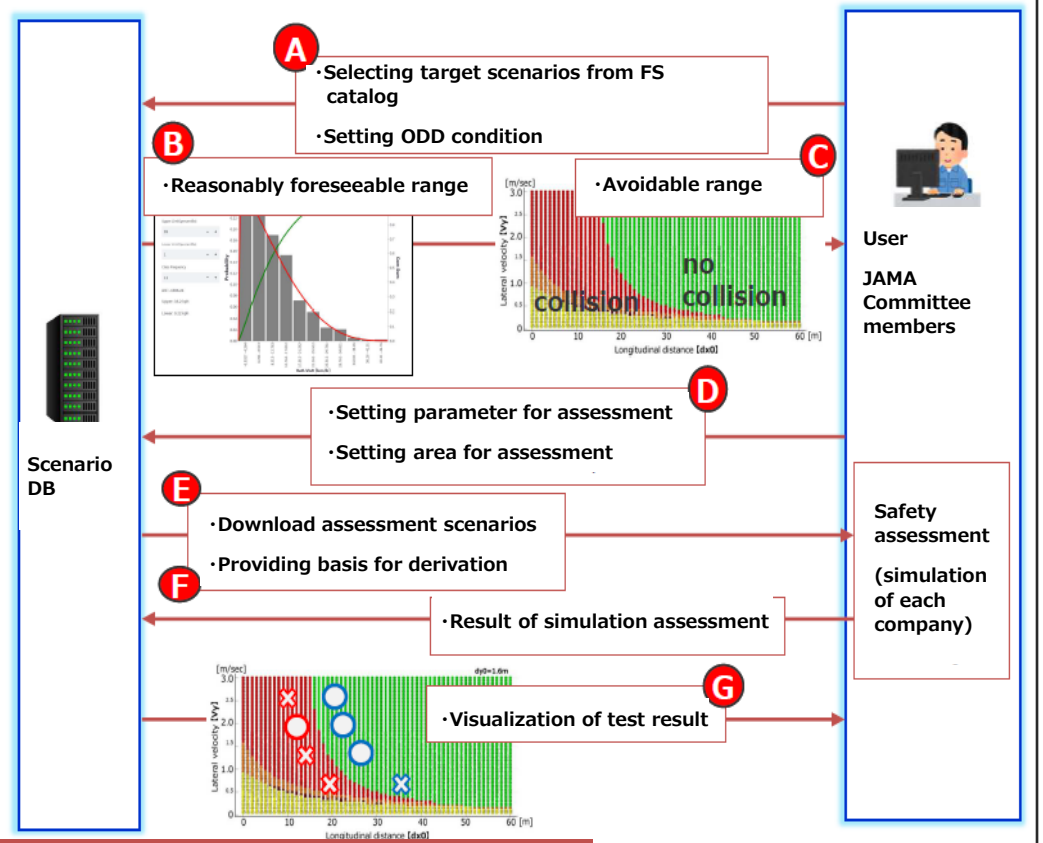
- We have been developing scenario DB in areas of higher user needs and priorities, and responses to main functions have been completed.
- In the future, we will strengthen collaboration with peripheral projects to expand and renew scenarios and provide scenarios for accidents and near miss cases.

■ Development of scenario DB which is useful for development and assessment of automated driving (including response to general road scenario system)

Development and implementation of functions with high development needs

implementation and publishing scenario functions	priority	user needs	gap from overseas	2023
• Extraction of assessment scenarios from an exhaustive scenario system	High	High	No	A
• Continuous scenario updates in response to changes in the traffic environment, etc.	Mid	High	No	
• Establishment of judgment criteria using C&C Driver Model, etc.	Mid	High	No	C
• Scenario generation using OpenSCENARIO/DRIVE	High	High	No	E
• Providing basis for deriving assessment scenarios	High	High	Yes	F
• Creation of assessment scenarios consistent with ODD (vehicle speed, curvature, etc.)	High	High	Yes	B
• Providing scenarios for robustness verification (Strict criteria)	High	High	No	D
• Providing scenarios of accidents and near miss cases (Calculation of accident reduction effects)	High	High	Yes	
• Quantification of reasonably foreseeable range	High	High	Yes	B
• Quantification of avoidable range (setting upper and lower limits for assessment scenarios)	High	High	Yes	C
• Analysis for each country/prefecture (setting scenarios considering regional differences)	Mid	High	No	
• Superposition of Reasonably Foreseeable & Preventable	High	High	No	G
• Visualization of Sim results equivalent to E-NCAP actual vehicle evaluation report	High	Mid	Yes	

Use cases for published DB



Implementing functions with high development needs

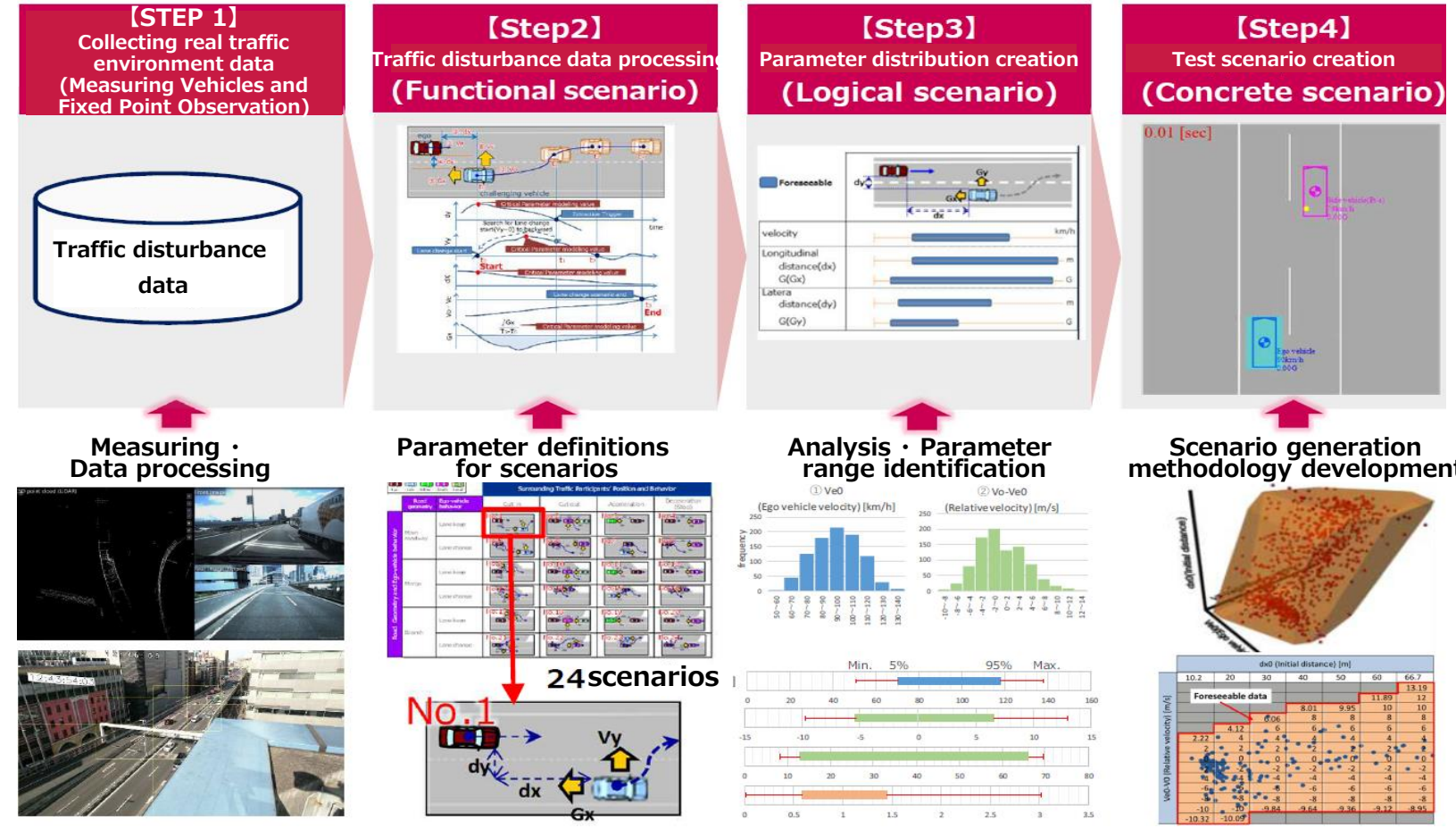
Sources: Prepared by METI based on FY2023 SAKURA project Reporting Documentations

<Reference> About SAKURA Scenario Database

Simulation

- Though it is necessary to correspond to traffic disturbance scenario of all 58 patterns in the collateral of safety in the automated driving, first of all, 24 scenarios on high ways, where the number of scenarios to be considered is less than public roads, have been made into a database.
- Although the construction of a database for an additional 34 scenarios is under way to extend to the public roads, the existing deductive scenario generation method has limitations in terms of time and cost, and it is also necessary to generate scenarios based on the inductive approach.

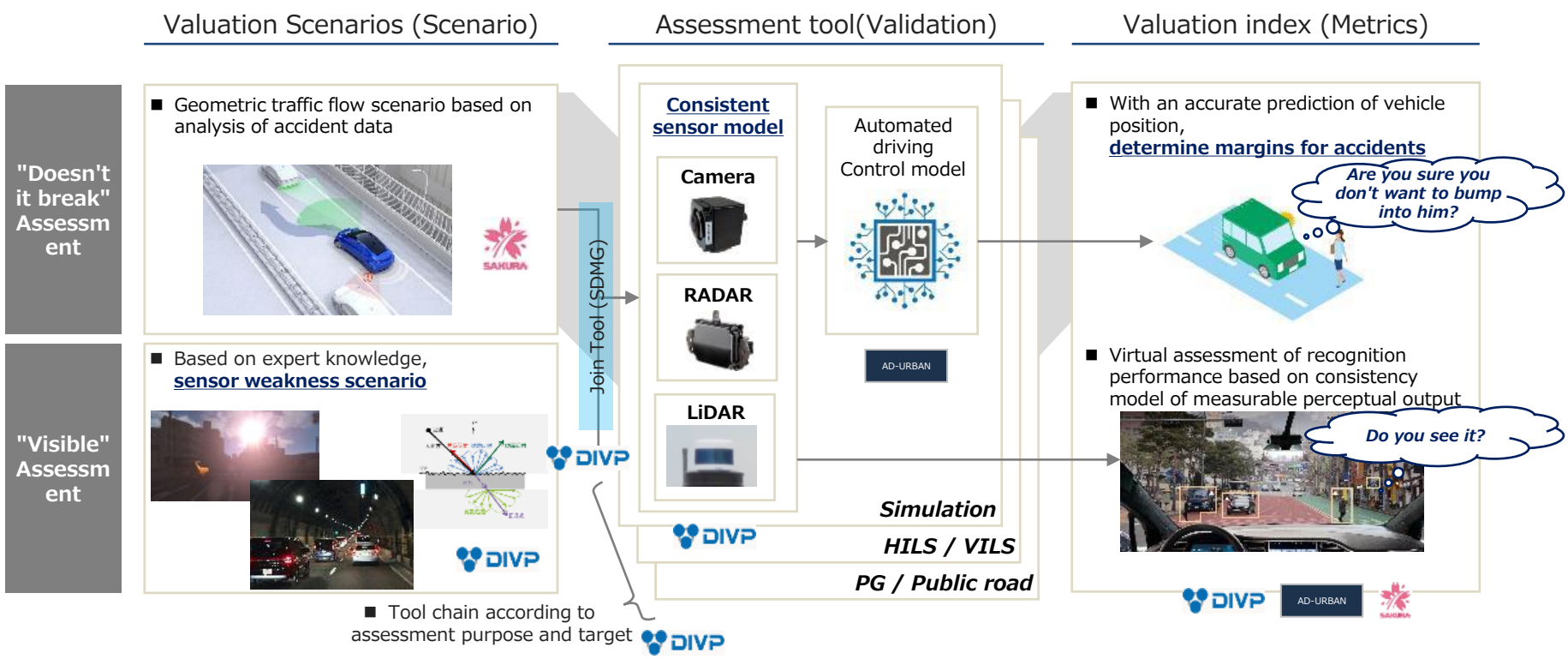
Scenario-generating process in SAKURA



Sources: Prepared by METI based on SAKURA project-reporting materials, etc.

<Reference> DIVP (Driving Intelligence Validation Platform) Outline

- DIVP aims at the **construction of a safety assessment environmental of automated driving in a virtual space**, and it can **confirm** the sensor response of an automated driving vehicle, etc. **on a simulated basis**.
- This enables the **cases which do not occur or rarely occurs in the real environment to be reproduced**, and the **efficient automated driving demonstration** expected to be possible.
- One of SIP-adus projects is implemented by Kanagawa Institute of Technology, BIPROGY, sensor manufacturers, etc. Based on the research results to date, **a new company was established in July 2022 and commercialized it in September**.



Sources: Prepared by METI based on DIVP report materials, etc.

<Reference> Outline of AD-URBAN Projects

- We are working on improving the accuracy of recognition models in the environment with blind spots using multi-sensors and of object recognition models by sensor fusion of LiDAR cameras using deep-learning in order to construct a safety assessment environment on public roads.
- In the future, we will also strengthen coordination between SAKURA project's scenario DB and DIVP's virtual environment. We will aim to establish a comprehensive and efficient assessment method for the security of AD systems that combine real and virtual.

AD-URBAN:FOT project of **Automated** **D**riving system **u**nder **R**eal city environment **b**ased on **A**cademic Researcher's **N**eutral knowledge

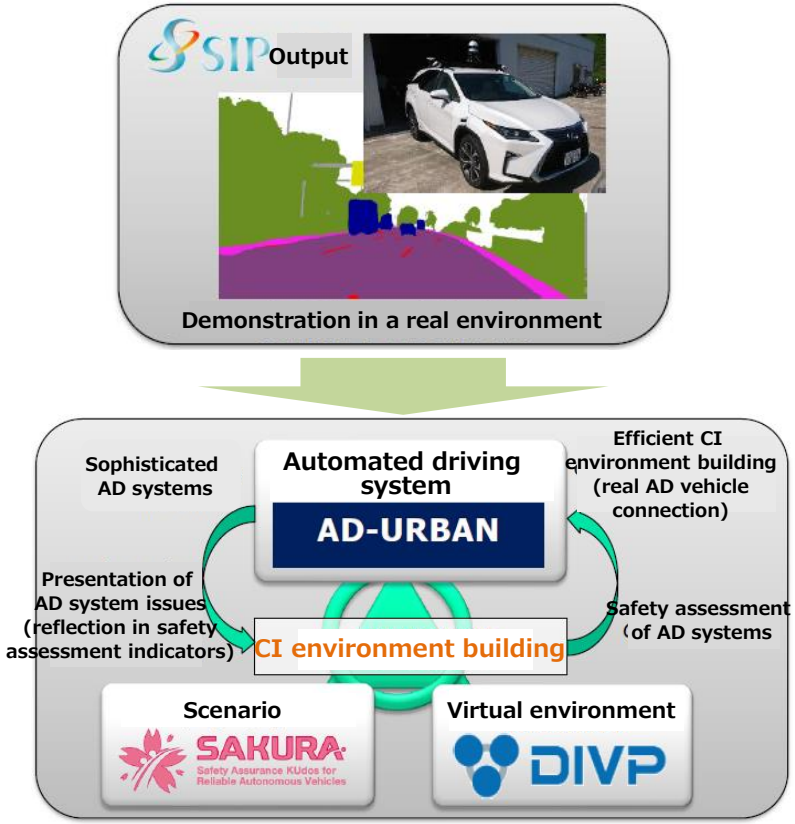
Summary of past efforts

■Demonstration experiment
- ✓ Implementation demonstration tests of AD systems in the Tokyo Coastal Area, etc.
- ✓ Understanding the issues of perceived technology and evaluating the effectiveness of the infrastructure coordination system

■Assessment of marginal performance specific to recognize
- ✓ Collaborating with DIVP projects to build assessment environments in virtual environments

■Promote collaborative efforts among industry, academia, and government on safety assessment
- ✓ Collaboration with SAKURA projects, the Japan Automobile Manufacturers Association (JAMA), etc.
- ✓ Participation in meetings of the Joint Committee for the Promotion of the Safety Assessment infrastructure

Project Collaboration for Building an effective safety assessment environment



Sources: Prepared by METI based on AD-URBAN report materials, etc.

Importance of AI

Generative AI

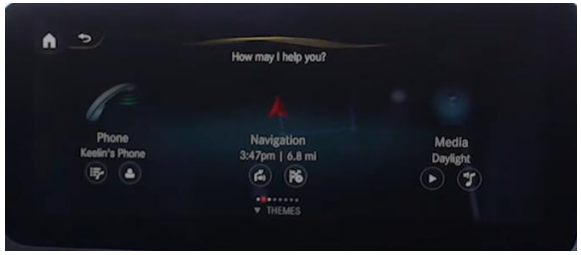
- In recent years, there has been a movement to **improve the quality and efficiency of business and services by utilizing AI, including generative AI**, and there are **various use cases for AI in the automotive industry** as well.
- **It is used for vehicle design generation, IVI (in-vehicle infotainment)**, recognition and judgment in AD/ADAS, and the **creation of simulation environments** to train them.

◆ Utilization for vehicle design generation

The US company Czinger Vehicles plans to deliver the Czinger 21C, a hyper car designed using generative AI, from the end of 2023. The model was **developed using 3D printing technology**.

◆ Utilization in IVI domains

Mercedes Benz's IVI system is equipped with a **personal assistant that uses AI for voice recognition**, **combining natural language processing (NLP) and ML**, and has recently **added support for ChatGPT**.



◆ Utilization in building simulation environment

NVIDIA is using generative AI technology in its automated driving simulation platform DRIVE Sim to **generate a simulation environment using materials obtained from actual driving data**.

Create a virtual environment

- ✓ **Build driving environments from real driving data. it is also possible to extend the real world and make the scene more complex**

Create a scenario

- ✓ **Generate scenarios (events) that occur within the generated environment**
- ✓ **In the real world, scenarios that are dangerous to reproduce and have little data can be generated and their difficulty can be manipulated**

Sources: Prepared from various public information

Creation of Advanced Examples of Utilizing Generative AI

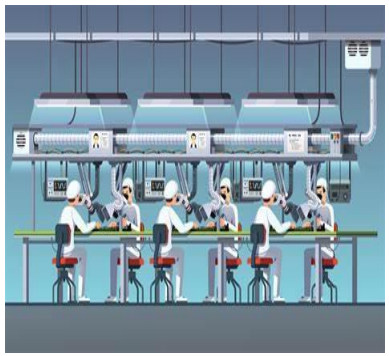
Generative AI

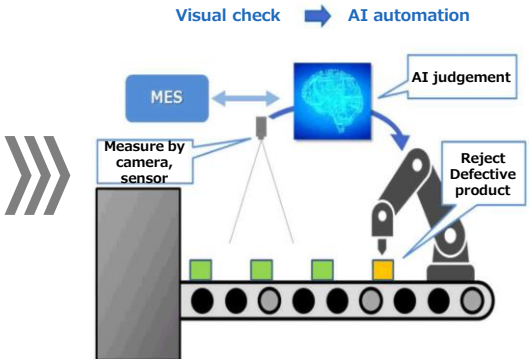
- Generative AI has begun to be used in dialogue systems, image and video generation, automatic composition, etc., and it is thought that **it will have a major impact on industrial activities and people's lives** because **it has the potential to perform creative tasks on behalf of humans that were impossible with conventional AI**. On the other hand, **building a generative AI model requires large-scale computing resources**.
- In the automotive industry, each company is currently in the stage of identifying its use cases. Given this background, the government will support the creation of **advanced examples of generative AI** use in the automotive industry.

[Assumption case ①] Reduction and automation of inspection work

■ How to utilize the generative AI
- Developed using AI generated from a dataset of images of defective or near-defective products for each part of a car
- By generating digital limit samples on the web, it is possible to set defect standards in advance not only for existing products but also for future new products

■ Expected effects
- Reduce losses by optimizing appearance inspection standards.
- Reduce the burden of inspection work by unifying the standards of each OEM to the industry standard
- Depersonalize quality control work and ensure sustainability of the entire automotive industry

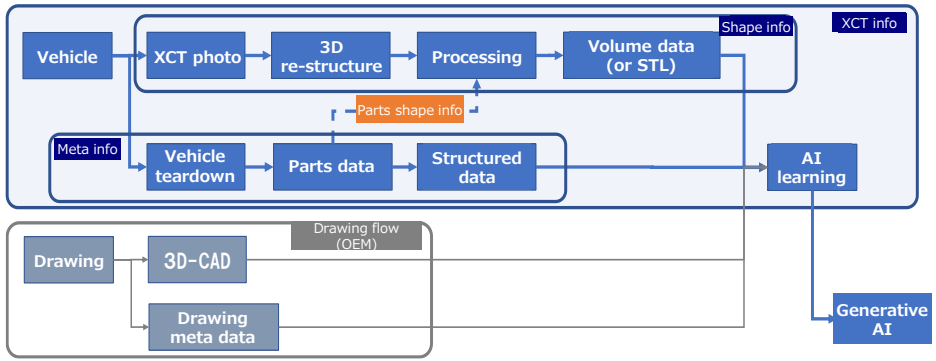




[Assumption case ②] Digitization and automation of safety evaluation processes during product development

■ How to utilize the generative AI
- Analyze vehicle structure data and vehicle components, and digitize and generate the functional relationships between each part and the entire vehicle. AI development
- From product development to manufacturing, it is now possible to derive answers to verification items digitally without the need to conduct verification using actual equipment in in-house regulatory compliance evaluations, performance evaluations, and pre-manufacturing confirmations

■ Expected effects
- Significantly shortening design and development time and streamlining
- Mechanical verification prevents fraud and eliminates human error
- Ultimately, by deploying this to the entire automobile development process, the entire process of design considerations will be automated



<Reference> Efforts to Strengthen generative AI Development Capabilities (FY2023 Supplementary Budget)

Generative AI

- **The development and utilization of generative AI requires large-scale computational resources (supercomputers) and data**. Globally, only a few players who can secure sufficient computational resources are able to develop competitive AI. We will **provide intensive support for securing computational resources for AI**, which will determine the competitiveness of countries in the future.

- **Domestic development of an overwhelmingly insufficient AI computing resource [¥156.6 billion]**

The largest in Japan is operated by AIST, which has a scale of 0.8 EFLOPS. In order to expand, it has been decided to use the Economic Security Fund to subsidize the provision of computing resources.

→ It continues to be overwhelmingly insufficient, and **subsidies to the private sector are expanded [¥116.6 billion (Economic Security Fund)]**. In addition, **AIST's computational resources are expanded to 4.25 EFLOPS* [¥40 billion (included in AIST facilities equipment subsidies)]**.

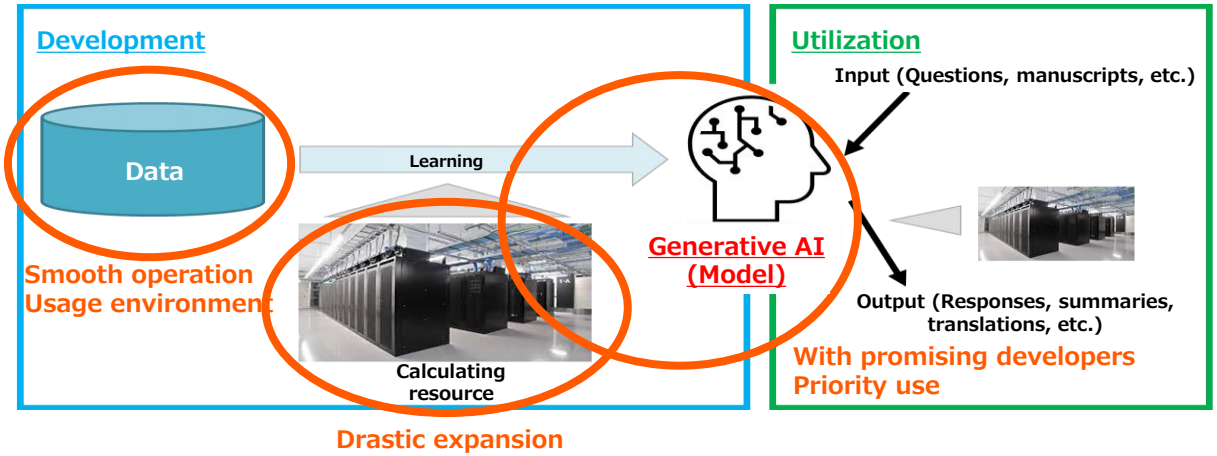
※When using generation AI, a maximum computing performance of 8.5 EFLOPS is achieved.

- **Accelerated support for developing AI [¥29 billion] (Post 5G Funds)**

Although there are startups and other organizations that have the desire and ability to develop AI, securing computing resources and data remains a challenge.

→ Accelerate development by **subsidizing the use of computing resources for a certain period of time for promising startups**.

In order to improve the performance and promote the use of AI, it is important to utilize data held by companies, etc. in addition to data on the web. **Demonstrate collaboration between data providers and AI developers** to solve issues such as information leaks and regulations.



Issues of LiDAR and Radar

LiDAR

- LiDAR has high resolution, but **miniaturization and cost reduction** are issues. Research and development of new **light source technologies** such as **photonic crystal lasers (PCSELs)** is progressing.
- Radar is small and low-cost, but **improving resolution** is an issue. **The use of silicon materials** and the market introduction of **4D imaging radar** are progressing.

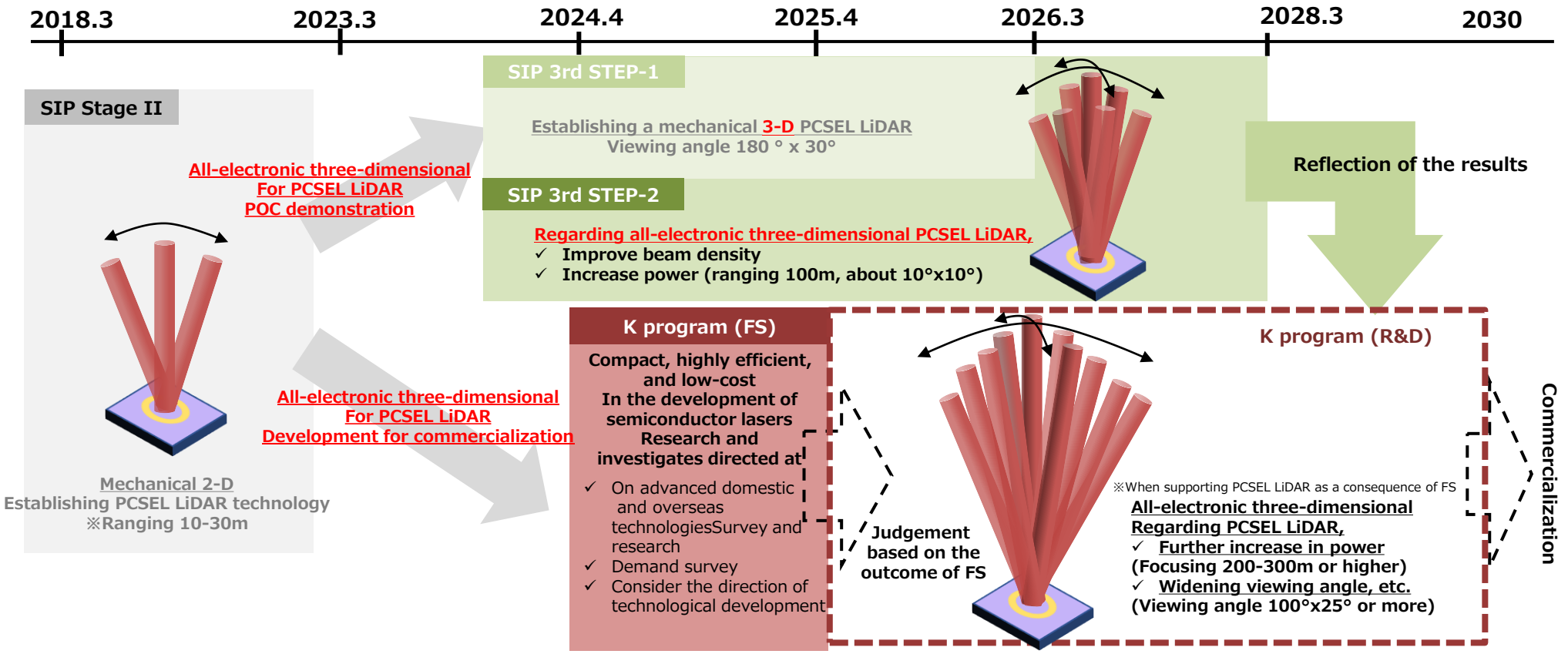
	LiDAR	Radar
Latest trends (high-profile technologies)	PCSEL (Photonic Crystal Laser)	4D imaging radar
Characteristics	Downsizing Have high vertical angular resolution	Achieve cost reductions (15-20% of LiDAR) Can be adapted to all weather conditions, even those behind an object can be detected
Development Stage	R&D (The Chinese University of Hong Kong, Ferdinand Braun Institute/Germany, and Kyoto University are focusing on)	Introducted to the market
Main Player	VECTOR PHOTONICS	arbe, APTIV, NXP, BOSCH, Continental
Customers	None ／ Currently R&D stage	HYUNDAI, WEFU威孚, BAIC, DiDi, MAGNA, 恒润科技, autox (Robot taxi) / Motional (Robot taxi) / NIO / – / dallara (Automated driving Racing car)
	• While LiDAR boasts the highest resolution, measurement range, and accuracy, it is large and expensive, but its price is expected to fall in the future • In the future, it is expected that photonic crystal laser (PCSEL) technology, which has advantages in resolution, measurement distance, and size, will be established and introduced to the market	• Its high performance in harsh weather conditions has led to its increasing adoption in autonomous vehicles and in the future, it can be used as a standalone sensor • Bosch and ZF are moving from LiDAR to 4D imaging radar • Many Chinese OEMs and robotics companies are also using 4D imaging radar

Sources: Prepared from various public information

Future Efforts

LiDAR

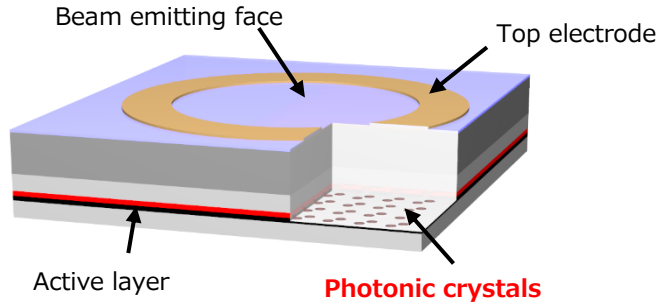
- **LiDAR is an important technology for realizing automated driving that supports SDV**, and we will work on the development of the necessary elemental technologies as a collaborative area.
- In particular, **for PCSEL LiDAR, which is expected to be small and low-cost**, we will **further promote basic research in the third phase of SIP** and **provide support for final commercialization in the Economic Security Key Technology Development Program (K Program)**.



<Reference> Details of "Photonic Crystal Laser"

- A photonic crystal laser is a laser that has a photonic crystal layer placed near the active layer that amplifies light.
- Photonic crystals with fine periodic structures enable extremely efficient generation of laser light.

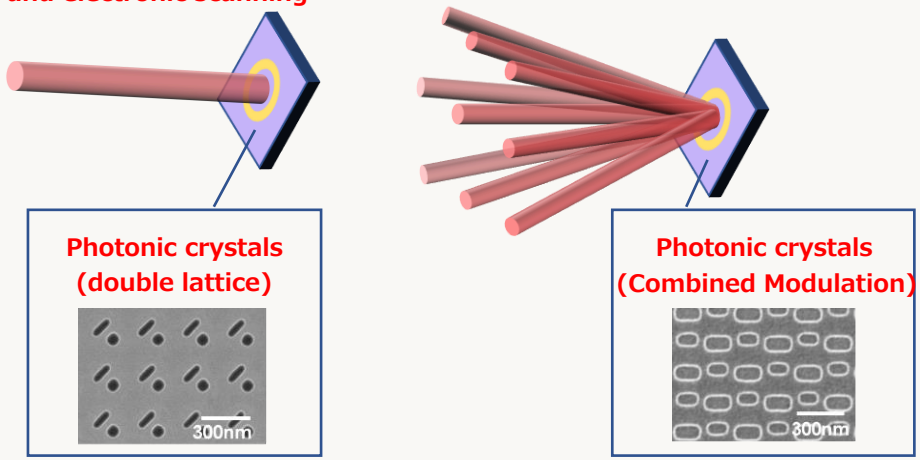
<Structure of the photonic crystal laser>



Operating principle

- By placing photonic crystals with a periodic lattice structure in the structure, only light of a specific wavelength is effectively amplified and oscillated

One chip with no external optical system (no lenses or mechanical drive required) that can emit narrow divergence angles, multi-point beams, and electronic scanning



Downsizing of LiDAR

✓ Photonic crystals enable light control, eliminating the need for rotation mechanisms (such as mechanical scanners) or complex lens systems.

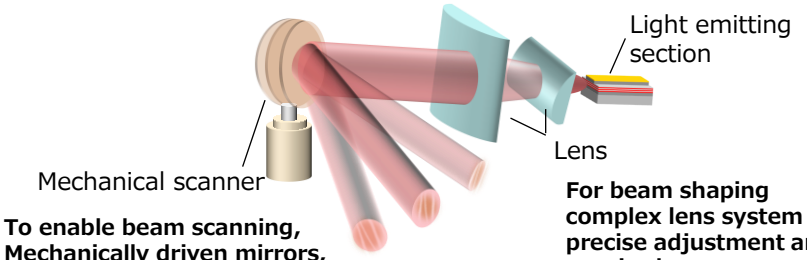
Realization of high resolution

✓ Since light of a specific wavelength is effectively amplified even over a large area while light of other wavelengths is suppressed, beam divergence is extremely small.

Free beam scanning possible

✓ The structure of the photonic crystal enables free beam scanning.

Ordinary semiconductor laser



To enable beam scanning, Mechanically driven mirrors, etc. are required

For beam shaping complex lens system and precise adjustment are required

Source: Provided by Kyoto University

Technical Approach to "Maps" for Automated Driving

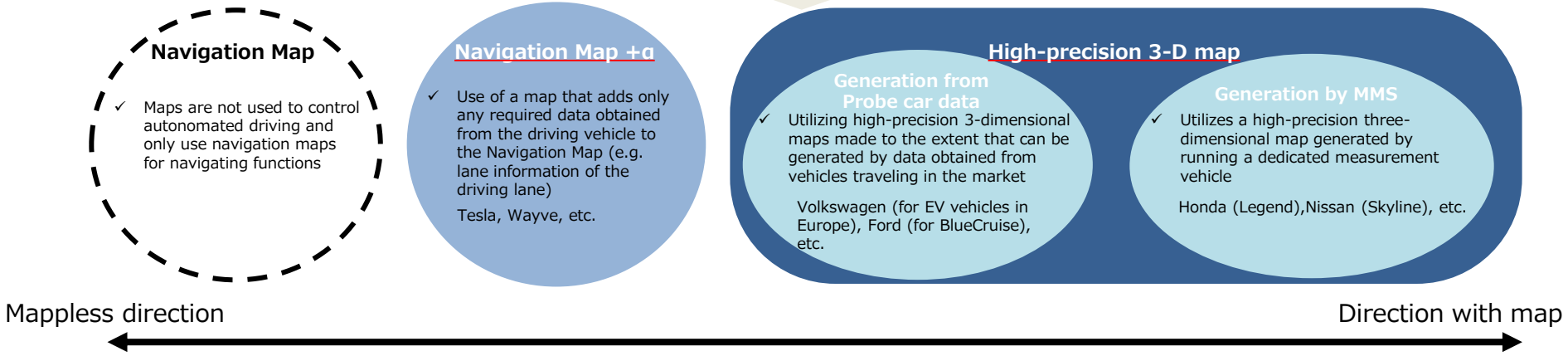
High-precision 3-D map

- Currently, there are **two technical approaches to automated driving: "navigation map + α" (adding a certain amount of information to the navigation map) and "high-precision 3D map"**. Tesla and other companies that promote mapless technology take the former approach.

Summary of issues related to the necessity of installing high-precision 3D maps

	Equipped	Not equipped
Safety	✓ Advanced self-position estimation and sensor complement during bad weather enable safe and secure driving	✓ Though there is room for improvement of future sensor and software technology, it is difficult to realize Lv4 by the current sensor technology precision
Driving area	✓ In the case of development and design based on map data reference, limitation to areas that have already been developed	✓ The driving range is not affected by map coverage
Cost	✓ Cost increase by the amount of map installation and updating	✓ Reduce the cost of carrying and updating a map

Segmentation of "Map" in automated Driving

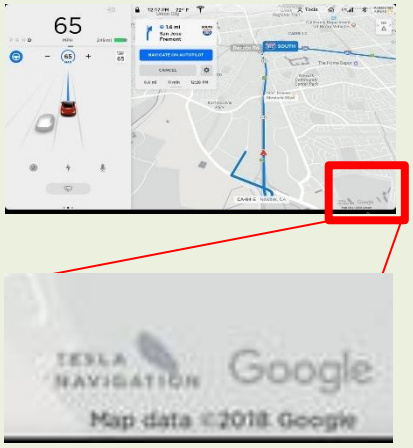


<Reference> Usage of Map (Tesla)

High-precision 3-D map

- Tesla uses a combination of commercially available solutions and proprietary technology to create its own maps for vehicle navigation.

Use of Base Map

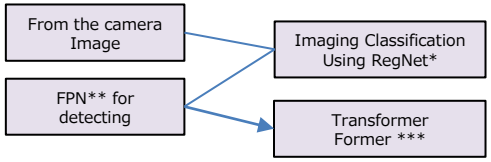


- Instead of using other HD maps, Tesla uses Google Maps as a base map for key locations and landmarks
- Tesla has applied a variety of tools and technologies to this base map to support automated driving

Using tools and technologies to support automated driving with the base map

1 mapbox **Mapbox** provides a **Valhalla API** for maps, which includes up-to-date data on road layouts, specific points on maps, etc.

2 **Vision Components and Real-Time Processing:**
Tesla's vehicles use vision components built from vehicle camera data. The vehicle on-board neural network processes this data in real time to dynamically derive lane connections



3 **Automatic labeling and neural network training:**
Training by neural networks and automatic labeling (a technique for automatically annotating and labeling data, which contributes to neural network training)

4 **Vehicle data for training:**
Tesla uses data from over 2 million vehicles. This massive data set is used to train neural networks so that vehicles can learn and adapt to different driving conditions

5 **Real-time traffic condition and route updates:**
Tesla's vehicles use on-board GPS to detect traffic conditions and suggest alternative routes to avoid delays

***RegNet:** Self-regulating networks for image classification (used in convolutional recurrent neural networks)
****FPN(Feature Pyramid Networks):** A feature pyramid network is a feature extractor that takes as input a single-scale image of any size and outputs a proportionally sized feature map
*****Transformer:** Used for deep learning models for processing tasks

Added when subscribing to Premium Connectivity Package

Sources: Prepared by NRI based on various publicly available data

<Reference> Usage of Map (Wayve)

High-precision 3-D map

- Wavye's automated driving software, "Wayve AI Driver," uses AI to navigate unknown locations without the need for high-precision 3D maps.

Technical details

① Data Collection

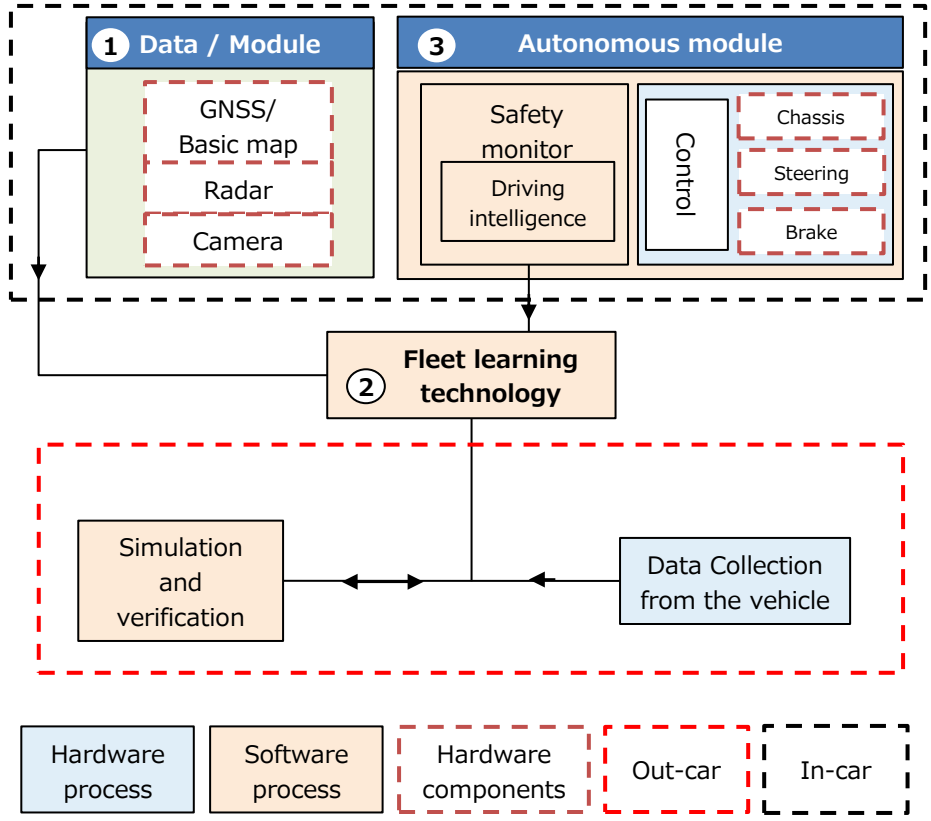
- Wayve AI Driver software **collects data from sensors** such as cameras and radars
- The data is then **processed to detect objects or obstacles** around the vehicle

② Fleet learning technology

- Data is processed using **fleet learning technology**
  ※A proprietary **ML platform** analysis by combining driving experience on the road and data from simulated environments
- Regularly **learn and improve** Wavye AI Driver softwares
- **Generalization** so that AI software can operate in unknown environments (generalization: The ability to apply what AI have learned to new, previously unseen situations)

③ Decision making

- Wayve's AI Driver software predicts how other road users will behave and executes safe driving maneuvers



Sources: Prepared by NRI based on various publicly available data

Types and Main Applications of Maps

High-precision 3-D map

- Navigation maps + α and high-precision 3D maps used to control automated driving each **have their own advantages and disadvantages** in terms of coverage, accuracy, content, update frequency, etc., and **their uses vary depending on their characteristics**.
- Therefore, rather than narrowing down to one of these technologies to **support the automated driving function in SDVs, it is important to pursue a variety of options and steer in a direction that can respond to any future technological trends**.

	Navigation Map	Navigation Map +α *1	High-precision 3-D map	
			Generation by Probe car data (PD)	Generation by MMS
Coverage	All area	Almost all area	Wide driving area	Limited
Dimension	2D	2D	-	3D
Accuracy	1m (some cities) ~ 10m	Degree of 50cm	< 10 cm	< 10cm
Update frequency	1 week to a few years	About a few months	Almost real-time	A few months
Cost	Low cost	Low cost	Low in cost	Expensive
Main usage	-	Do not limit the driving area Advanced Driving Assistance and automated Driving	Advanced automated driving in the driving area where probe car data can be acquired	Advanced, area-limitation automated driving
Use case	✓ Directions to destinations and traffic information ✓ Location information for a particular point	✓ ADAS functions (such as Lane keeping assistance, Collision Avoidance, and Adaptive Cruise Control)	✓ Keeping the vehicle in the center of the lane on highways with median strips or in places where lane markings are not visible, and recognizing road signs ahead	✓ Advanced self-position correction, sensor complement, and look ahead ✓ Utilize for a variety of applications, including automated driving, infrastructure maintenance and management, and disaster prevention and mitigation measures

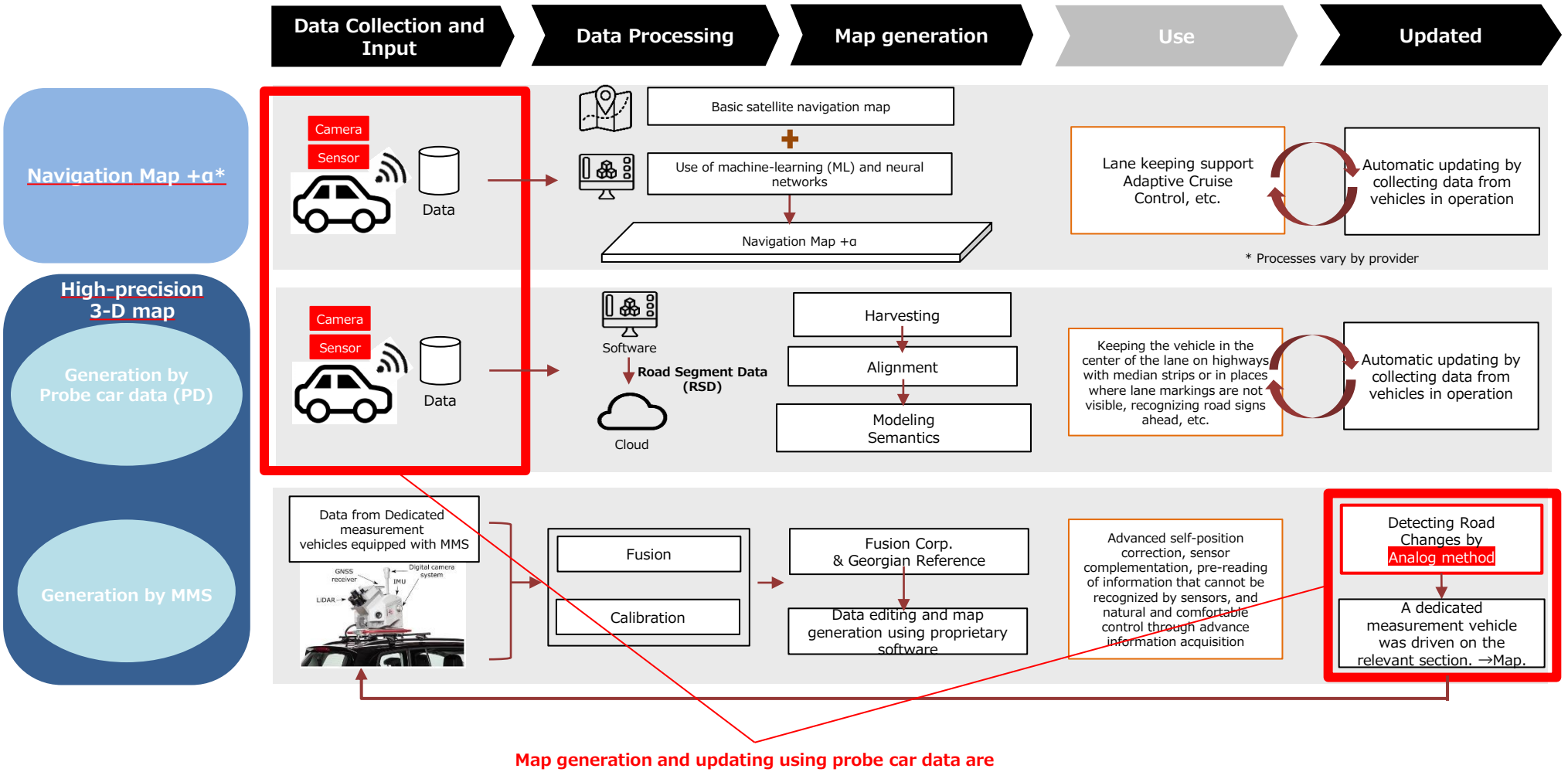
Sources: Prepared by NRI based on IEEE (American Society of Electrical and Electronics) and various publicly available data

*1 May differ among companies *2 Traffic congestion, etc. in almost real time

Flow and Issues from Generation to Updating

High-precision 3-D map

- The flow from generation to update for each map is summarized below.
- Regardless of a navigation map + α or a high-precision 3D map, **it is important to be able to generate and update the map using camera and sensor data (probe car data) obtained from vehicles running on public roads**.



Sources: Prepared by METI based on various publicly available information

Future Efforts

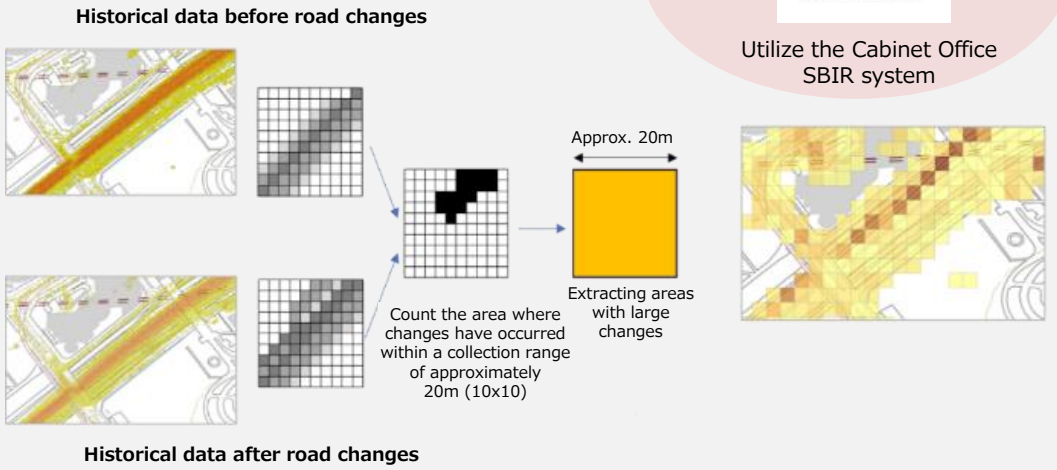
High-precision 3-D map

- Since last year, we have been using the Cabinet Office's SBIR program to demonstrate high-precision 3D map update technology using probe car data.
- In this project, **we will demonstrate update technology, including detection of change points and subsequent updates, using probe car data for high-precision 3D maps developed by using MMS, which has the highest accuracy and content** and develop it for deployment.

Efforts in the Government (Demonstration of technology for updating high-precision 3D maps using probe data)

<Operation>

- ✓ Demonstration of whether it is possible to detect road changes that should be updated on a high-precision 3D map from probe car data such as location information and camera sensor data (① change detection), and whether it is possible to update the high-precision 3D map itself using information obtained from that data (② automatic updating)
- ✓ Through these demonstrations, a technical evaluation will also be conducted to what extent the current probe car data can be used for maps



Utilize the Cabinet Office SBIR system

<implementation schedule>

2023	2024	2025
Drafting action plan Development of PD analysis tools	Develop PD analysis tools [TRL5～6]	★ Stage gate Develop PD analysis tools [TRL7]

Importance of Cyber Security and Data Security

Security

- Regarding cyber security, **UN-R155 and 156 are being applied to new vehicles equipped with OTA**, and efforts are being made to **achieve international harmonization**.
- Regarding data security and data distribution, **there are moves in some countries that impede the free flow of data**.

Data distribution situation

Localization Cross-border transfer	• Each country has responded by **establishing regulations on cross-border transfer restrictions and domestic storage and retention obligations, primarily from the perspectives of personal information protection and national security**. • On the other hand, **the specific content of regulations**, such as the information subject to cross-border transfer restrictions and the requirements for cross-border transfer to be permitted, **varies greatly from country to country.** • Currently, the focus of privacy protection is on personal data, but in the future, it is expected **that safety and security standards will be applied to various types of data, including non-personal data**.
DFFT *1	• **Developing automated driving (high-precision 3D maps, sensors, software, etc.) requires huge amounts of learning data.** • From the perspective of promoting the development of technologies and services, it is also important to widely distribute the acquired data beyond countries, regions, and companies. **Opaque and arbitrary cross-border transfer regulations go against the principles of DFFT**.
Government access*2	• **Fair access based on warrants is implemented** in each country.

Situation related to cybersecurity

Compliance with laws and regulations	• Discussions are also progressing at WP29, and cybersecurity regulations **"UN-R155"** and **"UN-R156"** that require measures to avoid the threat of cyberattacks on automobiles are being implemented one after another. Japan and Europe have introduced them in type approval. The United States and China have independently established equivalent regulations (US: Federal Motor Vehicle Safety Standards, China: China Compulsory Certification system, Cybersecurity Law). • Specific standards for realizing UN-R155 and 156 are stipulated in the international standards **ISO/SAE21434 (vehicle-specific cybersecurity) and ISO/SAE24089 (software updates)**.

Sources: Prepared from various public information *1 Reliable and free data distribution, *2 Mandatory access to private data by the government, etc.

<Reference> Outline of CEV Subsidy (FY2023 Supplementary Budget: ¥129.1 Billion)

Security

- **The government supports consumers who purchase EVs, PHEVs, FCVs, etc**. in order to build a domestic electrification market. The amount of the subsidy is calculated considering the degree of contribution to GX in the automotive sector.
- In detail, from the perspective of "**building an environment in which electric vehicles can be used sustainably**," the subsidy amount is determined by **comprehensively evaluating the efforts of manufacturers based on "the value necessary to realize GX in the automotive sector," such as the development of charging infrastructure and securing after-sales service systems in addition to vehicle performance**.

Subsidy amounts ※

Subsidy amounts are applied in multiple stages depending on the evaluation.

	Subsidy amounts
EV	¥150,000 to 850,000
Light EV	¥150,000 to 550,000
PHEV	¥150,000 to 550,000
FCV	Upper limit: ¥2,550,000

※ For EVs, PHEVs, and FCVs with a manufacturer's suggested retail price (excluding tax) of ¥8.4 million or more, the calculated subsidy amount will be multiplied by a price coefficient of 0.8
※ For micro mobility, mini-cars, and electric motorcycles, the subsidy amount will be determined based on the previous system

Value required to realize GX in the automotive sector

① Improving product performance

- Improvement of power expenses and flight distance
- Be subject to TR system of the Energy Conservation Law

② Creating an environment where users can drive safely and securely

- Charging infrastructure development
- Ensuring after-sales service systems and training of maintenance staffs
- **Cyber security measures for vehicles**

③ Ensuring sustainability throughout the lifecycle

- Reducing CO2 Emissions throughout the lifecycle
- Appropriate implementation of reuse and recycling and the effective use of resources

④ Contributing to other fields through the use of automobiles

- Provision of external power supply functions and cooperation with local communities in case of disaster

— Identifying Competitive Area and Coordination Area
— Efforts in the Coopereative Area
— Efforts in the Competitive Area

Green Innovation Fund project/Development of In-vehicle Computing and Simulation Technology for Energy Saving of Electric Vehicles

Project Objective and Description

- While ensuring Level 4 automated driving functionality (including safety and reliability) in major driving environments, we are conducting R&D to improve energy efficiency in in-vehicle computing, particularly in automated driving software and sensor systems that affect power consumption (reducing power consumption by 70% or more compared to current technology).
- At the same time, in order to strengthen the competitiveness of the entire supply chain, which requires a transformation in development structures amid the electrification and automation of automobiles, we are developing a standard simulation model of the entire electric vehicle compatible with automated driving (dynamics simulation accuracy of 90% or more).

[R&D project 1] Open platform software for automated driving
[R&D project 2] automated driving sensor system
[R&D project 3] Electric vehicle simulation platform

Implementation system

[R&D project 1] ①TIER Ⅳ corporation
[R&D project 2] ②Sony Semiconductor Solutions corporation
[R&D project 3] ③Japan Automotive Research Institute

Operation period

①FY2022-FY2030 (9 years)
②FY2022-FY2030 (9 years)
③FY2022-FY2028 (7 years)

Business scale, etc.

- Business scale: ① 160.9 billion yen, ② 200.2 billion yen, ③ 6.5 billion yen
- Scale of support※: ① maximum of 17.5 billion yen, ② maximum of 19.5 billion yen, and ③ maximum of 5 billion yen

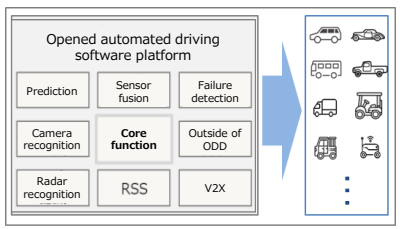
※Includes incentive amounts. There is a possibility that changes may be made in the future depending on the progress of the operation in such areas as stage gates.
Subsidy rate, etc.:
① (2/3 subsidy → 1/2 subsidy → 1/3 subsidy) + (1/10 incentive)
② (2/3 Aid → 1/2 Auxiliary → 1/3 Auxiliary) + (1/10 Incentive)
③ (9/10 consignment) + (1/10 incentive)

Business image

[R&D project 1]
TIER Ⅳ corporation
Microautonomy
～Collectively Creation of Scalable automated Driving systems～
Operation period: FY 2022 to FY 2030 (9 years)

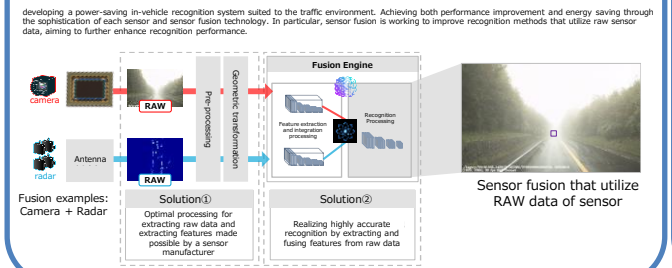
The following three elements of logic, time, and power are implemented optimally and efficiently in terms of R&D content, with the aim of achieving output targets.

1. Automated driving algorithm that adapt to wide-area operational designing area (ODD)
2. Real-time warranty of component software
3. Open system dependability for a wide variety of hardware and driving environments
4. Edge-oriented Agile CI/CD Pipeline



[R&D project 2]
Sony Semiconductor Solutions corporation
Development of in-vehicle recognition technology for energy saving of electric vehicles
Operation period: FY 2022 to FY 2030 (9 years)

Develop a power-saving in-vehicle recognition system suited to the traffic environment. Achieve both improved recognition performance and energy savings through the sophistication of each sensor and sensor fusion technology. In particular, improve sensor fusion recognition methods that utilize raw sensor data to further enhance recognition performance.



[R&D project 3]
Japan Automotive Research Institute
Development of a Digital Technology infrastructure that accelerate electric and automated driving vehicles
Operation period: FY2022 to FY2028 (7 years)

We will build a digital technology foundation that will accelerate the development of electric and automated vehicles, and through evaluation technology that combines models, we will work to realize efficient development of electric and autonomous vehicles.
Section 1: Development and verification of high-precision simulation technology using digital twin
Section 2. Define of typically occurring events to evaluate
Section 3: Development of a method to construct highly accurate vehicle models with different structures

Real environment　　Digital environment

Table of Contents

Vision for Mobility Services such as Automated Driving

- First, **by early implementation as a local service**, including MaaS format, we will strengthen our infrastructure by **improving social acceptance** and **environmental improvement**.
- At the same time, in order to realize services in a more complicated traffic environment, **advances in technology** and **commercialization** will be promoted, leading to the full-fledged spread of mobility services such as automated driving.
- **The results obtained from each interact** and support each other.

➢ Realizing businesses that quickly respond to social demands in human flow and logistics

Rapid implementation of MaaS and level-2 or higher automated driving services will improve social acceptance and environments

Pursuing the possibility of commercialization by value interaction

Current situation

- ✓ Automated driving has high initial/running costs
- ✓ In MaaS, apps/systems are mixed in various regions. traffic participants and potential users in the vicinity are not familiar with new travel services
- ✓ Efforts for data collaboration to secure added value on the value chain side have not progressed sufficiently

Demonstration that prioritizes the resolution of issues other than business value

Short-term and small-scale demonstrations do not penetrate much

Searching for use cases for data collaboration

Integrate results and establish business models in various layers

➢ Development and implement of advanced technologies such as robotaxis for the future

Technologies are becoming more sophisticated and commercialized through large-scale development to realize automated driving (robotaxis, etc.) business that can be driven even under complex conditions

Current situation

- ✓ Development of automated driving vehicles that can drive freely in complex traffic environments has not advanced much in the domestic market

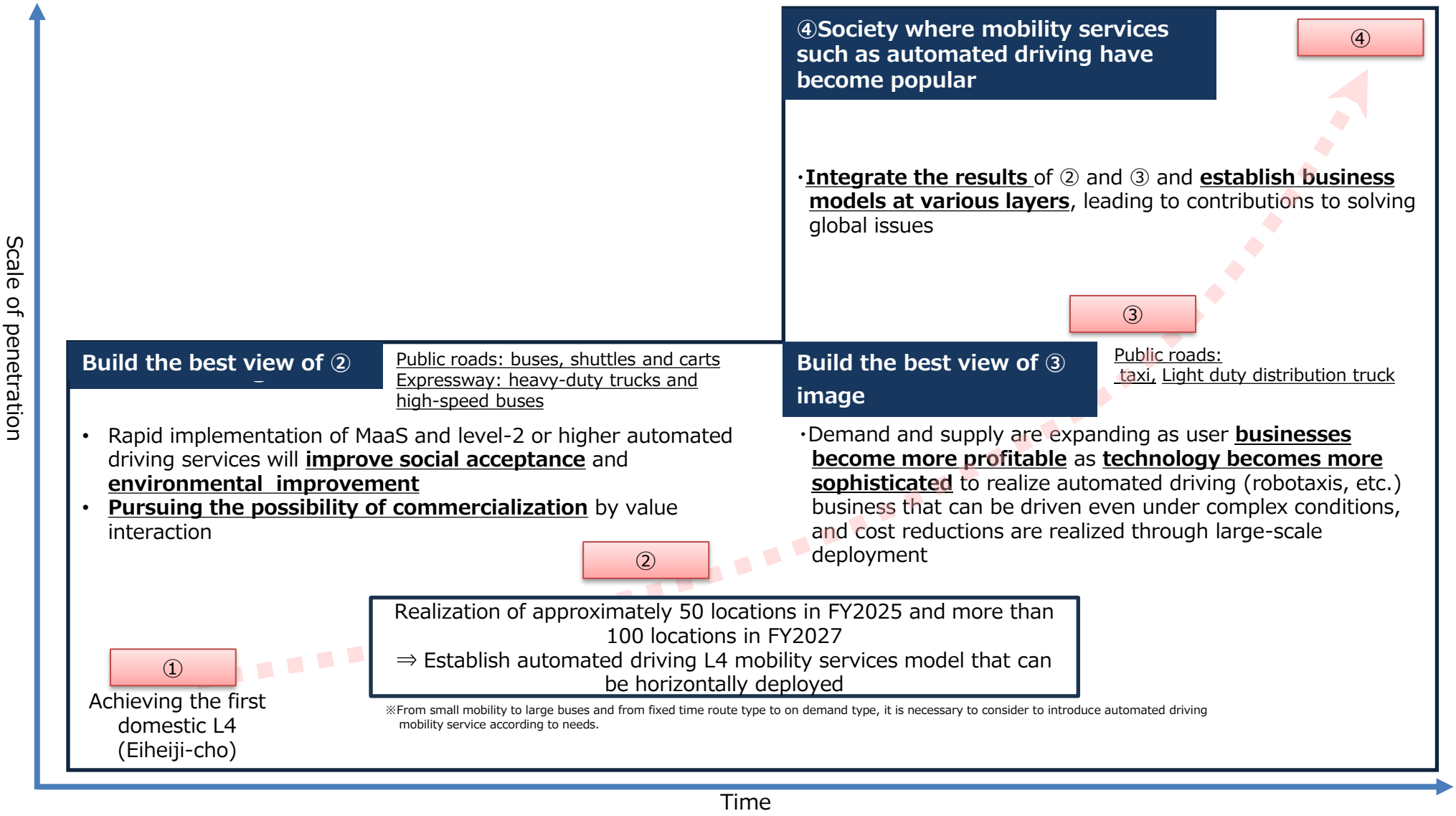
Shortage of development funds, software personnel, etc.

Expansion of foreign development players into Japan

Lack of development capability due to lack of public road driving experience, etc.

Scenario for the Spread of Mobility Services such as Automated Driving

- There is a multipathway to reach proper business model in each ①－④ as a service.



Demonstration of Infrastructure-cooperative system in Mixed Space
Efforts for Early Social Implementation through Demonstration Runs on Expressways

- To **achieve automated driving in mixed spaces is necessary for the wider rollout of precedents** created by public-private projects. One of the options is to strengthen the **demonstration of infrastructure-cooperative systems to set basic goals and requirements for cooperative systems** and solidify the foundation for nationwide implementation.
- **From the viewpoint of early social implementation, it is** necessary to promote implementation on **expressways, which** have characteristics intermediate between closed spaces and mixed spaces. **Development and** improvement **of infrastructure and data infrastructure, and the actualization of use cases**, etc., should be promoted, and not only mobility of people but also logistics should be handled.

Enhanced demonstration of infrastructure-cooperative systems

Accelerate efforts through further utilization of expertise of private organizations and collaboration with relevant ministries and agencies

NGOs

Examine use cases for utilizing the various information that can be obtained from the infrastructure

ITS Japan

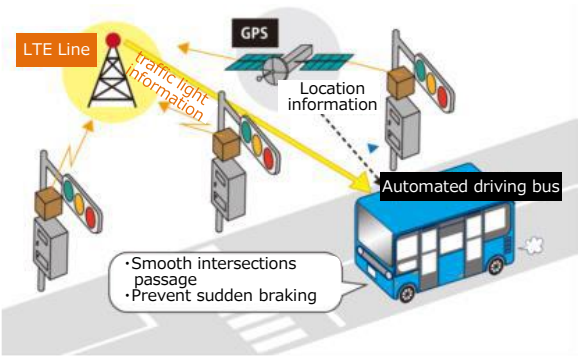
Smart mobility infrastructure Technology Research Association

Transportation infrastructure DX Promotion Consortium

cooperation

The ministries and agencies that are relevant to the matter at hand

The state of infrastructure coordination
The state of roadside-to-vehicle communication
…

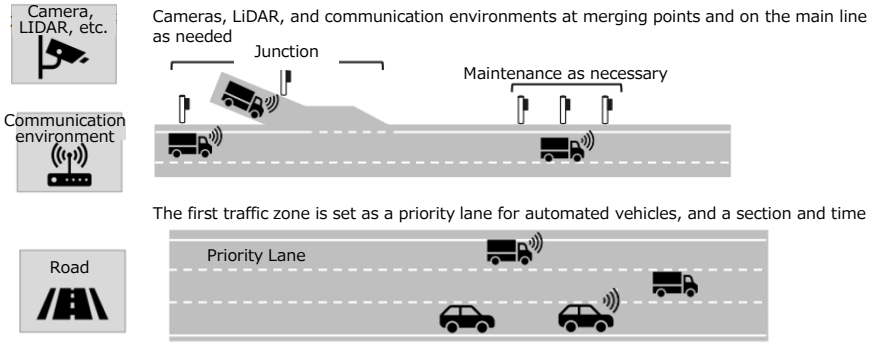


RoAD to the L4 Project

Focusing on utilization for Level 4 automated driving. Public road demonstrations are underway

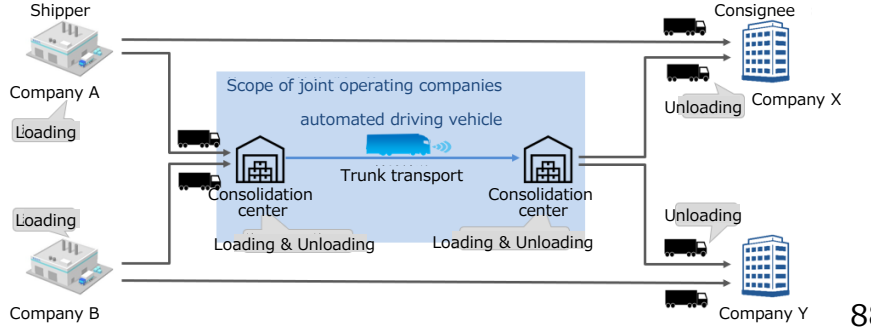
Digital lifeline efforts linked to early harvest project

Maximize the effect of various demonstration projects in the priority lanes for automated driving vehicles by linking the public and private sectors



Consideration of a joint operation company (tentative name) for automated driving trucks

Creating a framework to demonstrate economies of scale for automated trucks



RoAD to the L4 Project

- In collaboration with relevant ministries and agencies, **the project for R&D and social implementation of advanced mobility services, such as automated driving L4 (RoAD to the L4)** is being promoted.
- With the aim of **realizing unmanned automated driving services at around 50 locations as of fiscal 2025, and for practical use of level-4 trucks on expressways, the services will be expanded to spaces mixed with pedestrians and other vehicles, such as urban areas.**

Theme 1: Realization Level 4 mobility Services @Limited Space

Promotion of demonstration projects aimed at realizing automated driving services (Level 4) with remote monitoring only
[Service started]

(Image) Eiheiji-cho: Remote automated driving system

Theme 2: Realization Level 4 mobility Services @BRT Routes

Efforts to realize automated driving L4 services in exclusive roads, etc., including public road crossings

(Image)
Automated driving bus

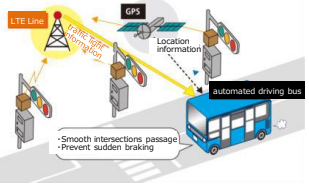
Theme 3: Realization Level 4 logistics services @Expressway

Efforts to commercialize high-performance trucks on expressways

(Image)
Automated driving on expressways

Theme 4: Realization Level 4 mobility Services @Mixed Space

Efforts to realize automated driving L4 services utilizing infrastructure coordination in mixed spaces

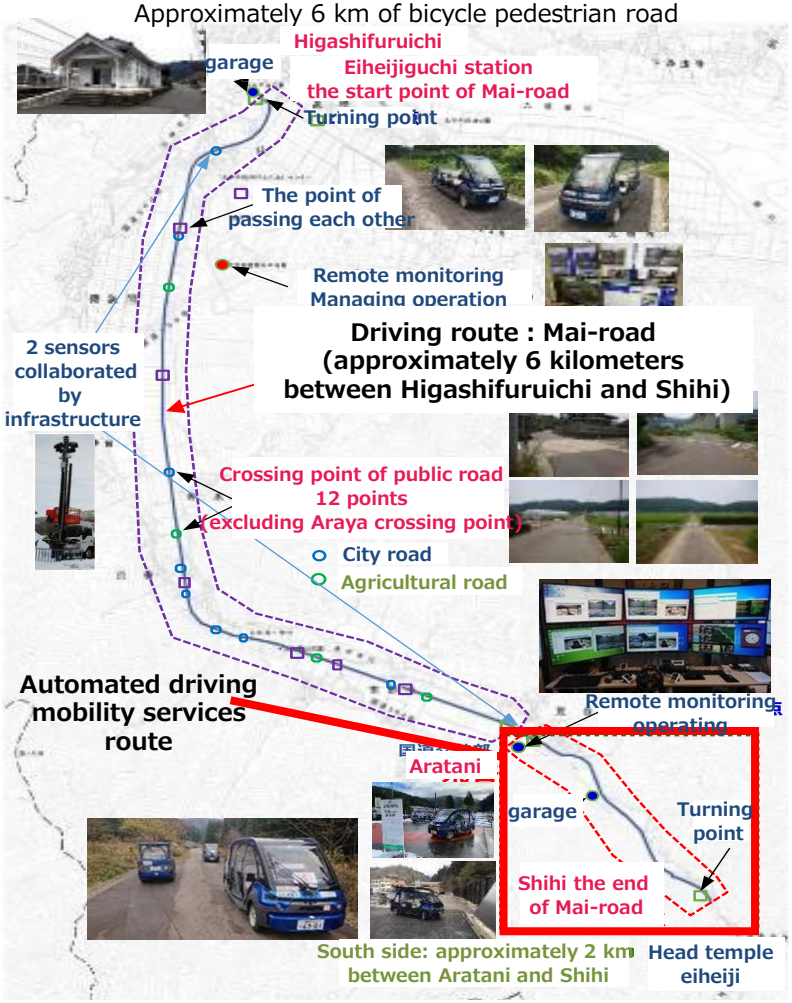


(Image)
Support for driving from infrastructure

Automated Driving L4 Mobility Service in Eiheiji-cho, Fukui Prefecture

- In May 2023, an automated driving mobility service was launched as **the first domestic level 4 project**. **Knowledge** on service operations **is continuously being generated**, including troubleshooting.

Eiheiji Mai-road (the site of the former Keifuku Electric Railroad Eiheiji Line)
Approximately 6 km of bicycle pedestrian road



Examples of knowledge generated by automated driving mobility services in Eiheiji-cho:(Contact with bicycles parked on the course, address to improvements, and resumption of operations)

○On October 29, 2023, the left front bumper of the automated driving vehicle in operation came into contact with the right pedal of an unmanned bicycle parked on the general road. No injuries or damage.

○**The main cause of the accident investigated** were: ① **an unmanned bicycle could not be recognized by the camera**; ② in the scene, detection by each sensor and recognition by the camera were integrated to control the brake in order to suppress false detection by the oncoming automated driving vehicle, etc. (**although an object was detected, it was not judged to stop**).

○As **measures for each cause**, ① **an additional learning of an image of an unmanned bicycle** was made, and **control was changed so that an obstacle whose type was judged to be unknown** by the camera **would be automatically braked if it was detected** by another sensor, and ② an additional signboard was installed to indicate that an automated driving vehicle would pass through.

○As **the effectivenesses of these measures were confirmed through test driving**, **the operation was resumed** on March 16, 2024. **Continuous test for safety improvement will be continued**, not limited to the cause of this contact.


Level 4 automated driving vehicle

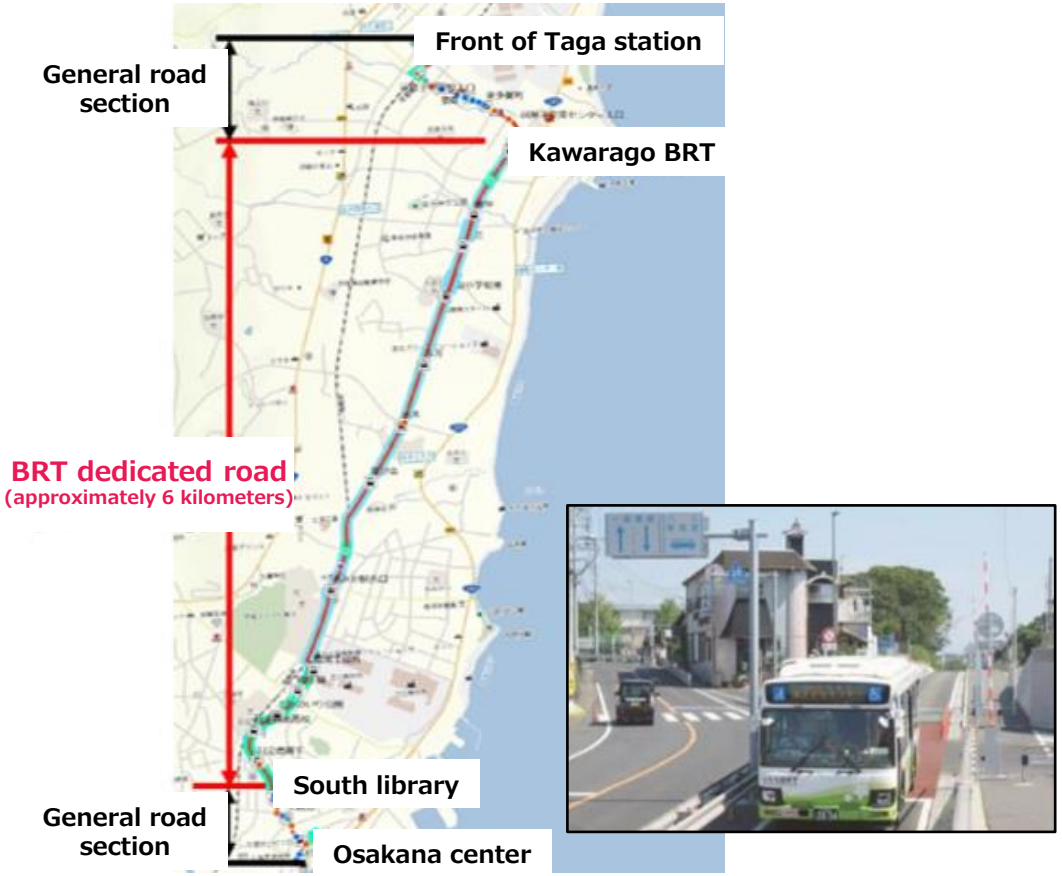
A scene of a remote monitoring room

Automated Driving L4 Mobility Service in Hitachi BRT

- **The Hitachi BRT in Hitachi City, Ibaraki Prefecture** (a dedicated road) **is preparing for the launch of automated driving L4 mobility services**. **Demonstration of automated driving buses** is also expected **on public roads adjacent** to BRT.

Outline of Hitachi BRT

Driving section



Main efforts

2021
- Consider safe driving methods for major use cases (passing parallel pedestrians/passing crossing) on Hitachi BRT driving roads and organize their roles
- Modification and evaluation of effectiveness of medium-sized bus vehicles

～2022
- Study on ODD of driving routes
- Experimental driving in Hitachi area with a modified medium-sized bus vehicle

～2025
- Social implementation of Level 4 (manned) in the Hitachi BRT and social implementation of Level 4 (unmanned)

Expansion of regions where automated driving (Level 4) system are introduced

Social Implementation of Automated Driving L4 Trucks

- **Efforts are underway to realize distribution services using automated driving trucks on expressways**. In the National Comprehensive improvement Plan for Digital Lifelines, **the development of the driving environment by setting the automated driving car priority** lane has been also studied.

efforts Based on Four Perspectives

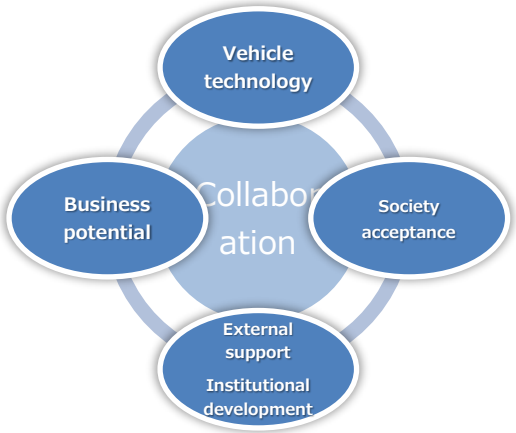
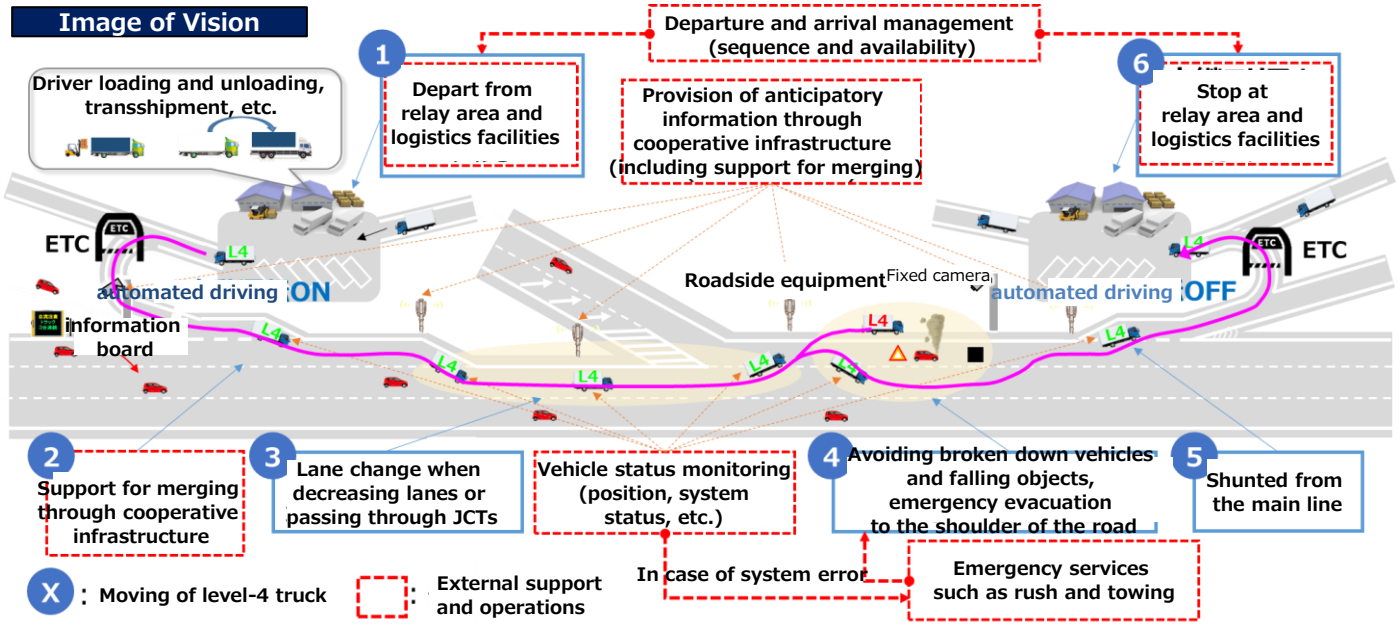


Image of Vision



2021

- Consider business model (major logistics companies)
- Identification of risks and consideration of avoidance measures, assumed ODD, and drafting of driving scenarios
- Develop vehicles/systems for level-4 ODD test

~2023

- Deepen study of business model (small and medium logistics companies)
- Consideration and verification of risk avoidance difficult to cope with with automated driving systems for large vehicles (merger support, etc.)
- Implementation and verification of risk avoidance scenarios in vehicles for verification

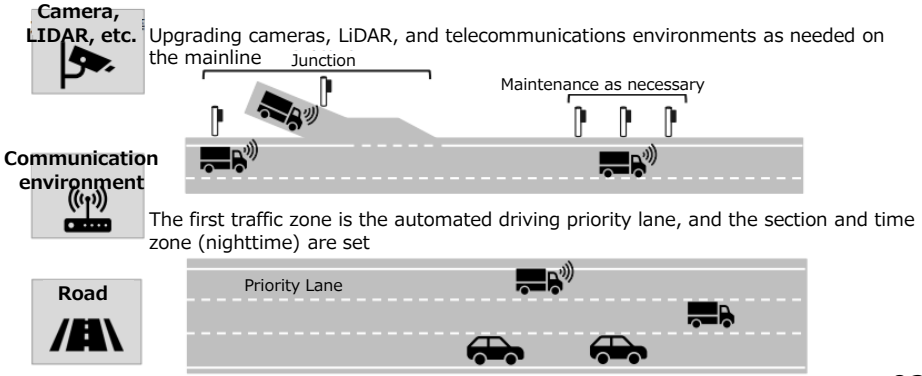
~2025

- Empirical assessment of business models
- Development of vehicle systems by the private sector and market development
- Demonstration and assessment of multi-brand coordination driving

Realization of expressway automated driving L4 truck

National Council for Comprehensive Development of Digital Lifelines

Regarding the “automated driving car priority lane", spreading scenarios,
Discussions on roles and definitions, management entities, and plans

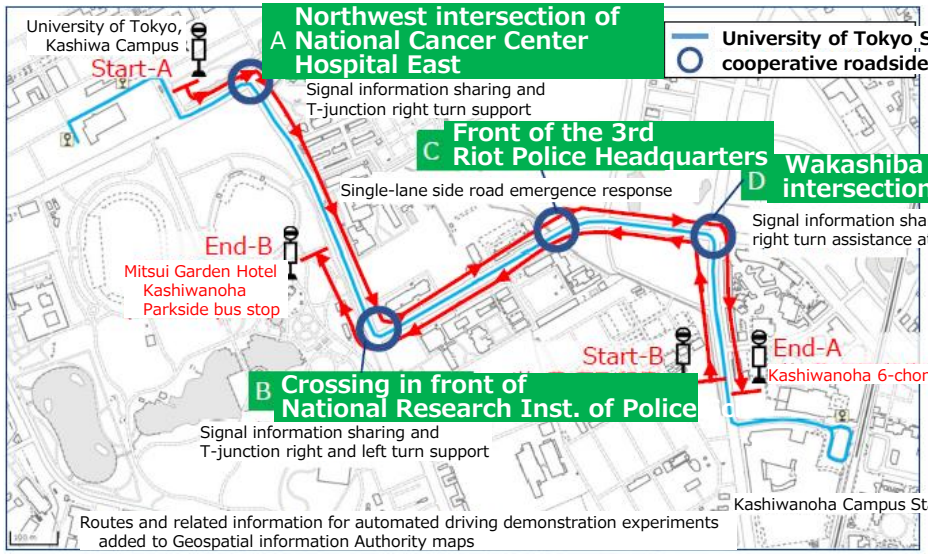


Efforts to Realize Level 4 Automated Driving Services in Mixed Spaces

- In the Kashiwa-no-ha region of Kashiwa City, Chiba Prefecture, to **realize an automated driving L4 service utilizing a cooperative system in mixed spaces by around 2025**, **requirements arrangement and technology demonstrations required for cooperative systems are conducted**.

Outline of 2023 Technology Demonstration

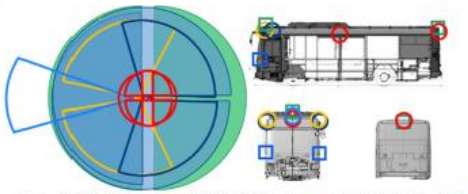
Driving section



Experiment vehicle

Front and Rear Side Cameras

Recognition system structure (camera, LiDAR)



Camera: Front long-range ×1 ○, Mid-range × 4 ○○, Short-range × 4 ○
LiDAR : Front and rear long-range × 2□, Left and right neighbors × 2 □

Image of cooperative infrastructure

Assessment item	・Verification of automated driving recognition performance ・Verification of recognition and communication performance of cooperative roadside units ・Verification of effectiveness of infrastructure information utilization , etc.

Main effort

2021

・Use case identification under mixed traffic, requirements arrangement for cooperative system
・Creation of basic design proposal for data collaboration infrastructure
・Considering multiple business model proposals based on regional characteristics

~2023

・Requirements arrangement for cooperative systems and drafting of design plans
・Design of the data collaboration infrastructure
・Building a business structure in model regions
・Test course in Kashiwa-no-ha campus of Tokyo University and technology demonstration on public roads

~2025

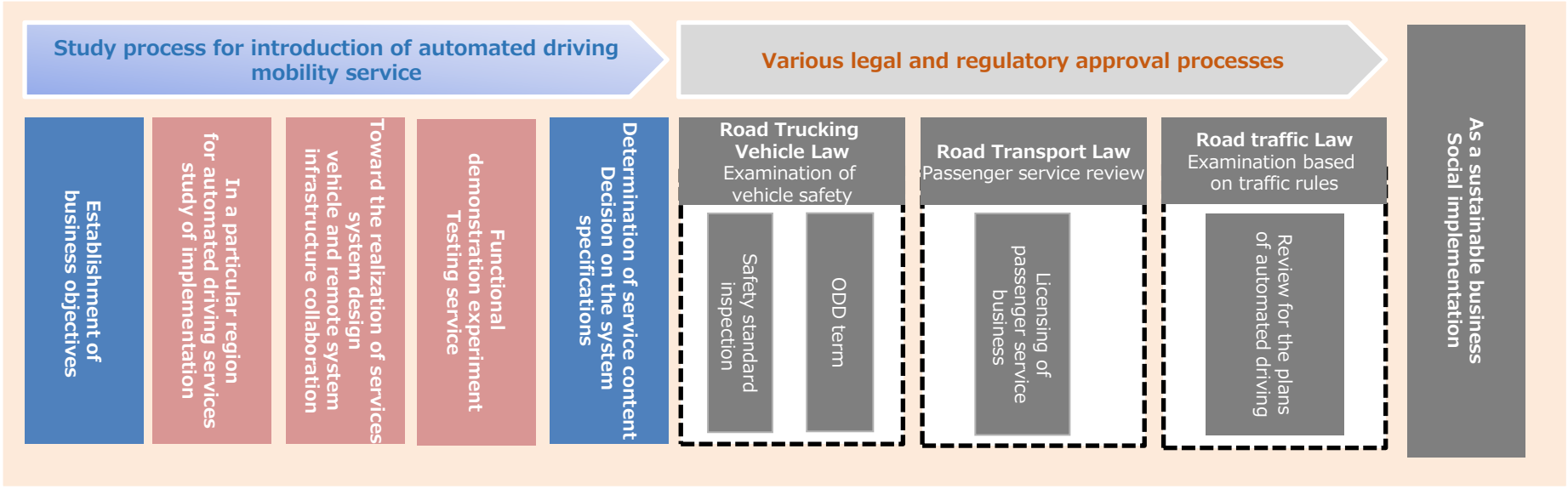
・Demonstration toward realizing automated driving L4 in mixed space
・Implementation of the data collaboration infrastructure
・Building a business structure in model regions

Realization of automated driving L4 services in a mixed space

“Guide” for Implementing an Automated Driving Mobility Service Society

- Knowledge is shared as a reference book for businesses and local governments to support the social implementation of automated driving mobility services as a sustainable business.
- **Include items to be understood by businesses and local governments involved in the project in an integrated manner**, from **the establishment level of business objectives based on regional migration issues** to **the sustainable social implementation stage.**

<Image of Process for Social implementation>



Points of Introduction of automated Driving Transportation Service (Example)
①Set business objectives: Identify issues and areas to be solved by automated driving.
(Example: Shortage of driver, securing means of movement)
②Establishment of promotion system: In order to realize and continue services, it is important to form consensus among stakeholders.
③Consideration of sustainable business models: Vehicle prices, operating expenses, maintenance and management expenses, revenue securing, etc.
④The licensing process of various laws and regulations: The licensing criterion of the Road traffic Act is to be determined after hearing the opinions of the chief.

Launch of the Level 4 Mobility Acceleration Committee (L4 Committee)

- To develop an environment for the realization of new automated driving and mobility services by fiscal year 2025, **Level 4 mobility Acceleration Committees were launched in October 2023** in cooperation with the Ministry of Land, infrastructure, Transport and Tourism, and others.
- In the future**, information sharing and points of discussion** will be organized in order to **smoothly advance the procedures for licensing based on the relevant laws and regulations**, while **businesses and relevant ministries and agencies will collaborate closely**.

[Purpose of establishment]

- The government is aiming to realize unmanned automated driving mobility services at about 50 domestic locations by the end of fiscal 2025, and expects to launch a new automated driving mobility service in larger and more complicated traffic environments in the future. For the early realization of such services, it is necessary to promote the proper sharing of information among businesses and relate ministries and agencies and to develop environments that enables information sharing related to licensing.
- From this perspective, the Level 4 mobility Acceleration Committee was newly established under RoAD to the L4, a project to develop and implement automated driving, which is being promoted by METI and MLIT.

[Agenda of the Committee]

- Business outline and schedule explanation from the company
- Summary of issues in relevant ministries and agencies
- Sharing of the progress of projects and the status of licensing and approvals by relevant ministries and agencies

[Members of the Committee]

Ministry of Economy, Trade and industry; Ministry of Land, infrastructure, Transport and Tourism; National Police Agency; Ministry of Internal Affairs and Communications; related local governments

Unmanned Automated Driving Development/Demonstration Support Project to Promote Mobility DX

- **Robotaxis are already in operation in the U.S. and China**, and **the Japanese market may lose its power if this situation continues.** Therefore, **by accelerating the development of automated driving systems in Japan**, it is aimed to establish automated driving services that can compete with the world. However, even overseas, it has not yet established business models to recover huge investments, and competitive is still in the process.
- **In the logistics area, there are high expectations for automated driving trucks due to a serious labor shortage. The development of mass-produced cars is still underway**, and the loading of automated driving function by remodeling to factory production cars is supported, and **the implementation on the Shin-Tomei Expressway is aimed at** at first. **Large-scale driving data acquisition** is also implemented and used for further development by heavy-duty truck manufacturers.

Robotaxis

Automated driving trucks

Imaging source: HP of each company, etc.

Projects to Promote the Implementation of an Automated Driving Society

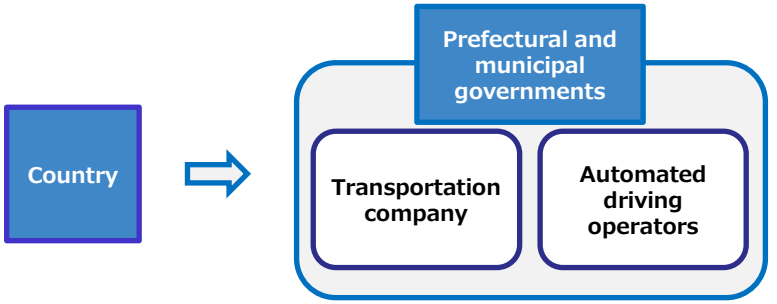
国土交通省

● **In order to support the social implementation and commercialization of L4 automated driving, such as bus services as part of community development, support for efforts for automated driving carried out by local governments.**

<Target Businesses (Image)>

Local governments (prefectural and municipal governments) and road transport operators

※ **Should be companies who are expected to be realized L4 automated driving services in the future**



○Key points of project

- Building local mobility through automated driving and enhancing social acceptance
- Year-round operation of automated driving rooted in local communities
- Enhancing technologies based on the assumption that drivers will be absent in order to achieve Level 4, etc.

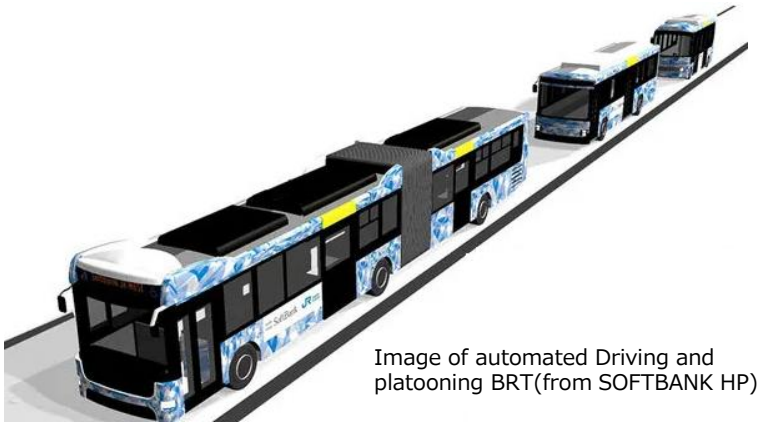


Image of automated Driving and platooning BRT(from SOFTBANK HP)

<Image of target business>

・BRT automated driving mobility service using dedicated roads

・Automated driving mobility service of fixed time route type

・Demand-type automated driving mobility services operating between specific points , etc.

<Expenses Subject to Subsidy>

・Vehicle renovation cost

・Expenses for construction of automated driving system

・ Expenses for investigating risk assessment, route selection, etc.

Promotion of Automated Driving in Regional Public Transportation

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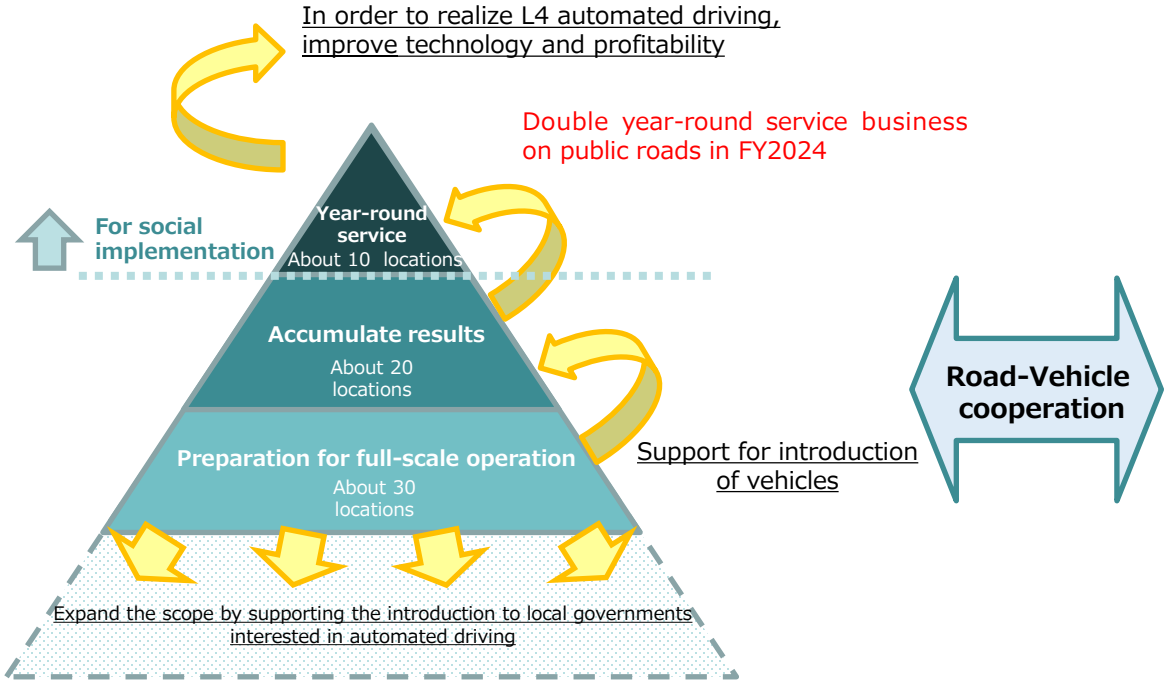
- **Support the automated driving efforts undertaken by local governments for social implementation in order to achieve the target of about 50 areas in FY2025 and more than 100 areas in FY2027 and expand and implement the target nationwide.**

※Comprehensive Strategy for the National Concept of Digital Garden City (approved by the Cabinet in December 2022)

- **Support from the road side is also being promoted, such as the development of "Road Vehicle cooperative system" to support smooth operation at crossings, etc.**

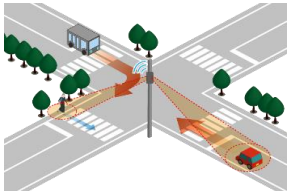
⇨ Promote introducing available **"automated driving bus and taxi at any time and with ease"** in various parts of the country and **"visible"** automated driving from local residents.



※Number of sites in the chart indicates the number of sites implemented in fiscal 2023.

Implementation of support through projects to secure, maintenance, and improve local public transportation

Maintenance of Driving Environment (Road infrastructure)



Roadside vehicle coordination system

Electromagnetic induction wire/magnetic marker

Driving space

Maintenance of driving environments such as the "roadside vehicle cooperative system" was also implemented

Efforts to Develop Automated Driving Services in All prefectures

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- In order to realize unmanned automated driving mobility services nationwide by fiscal 2025, it is necessary to develop an environment in which local governments, businesses, and related administrative agencies work together to support local efforts.
- For this reason, “Level 4 mobility Regional Committee” will be established jointly with local governments with the aim of supporting the commercialization of automated driving in all prefectures.

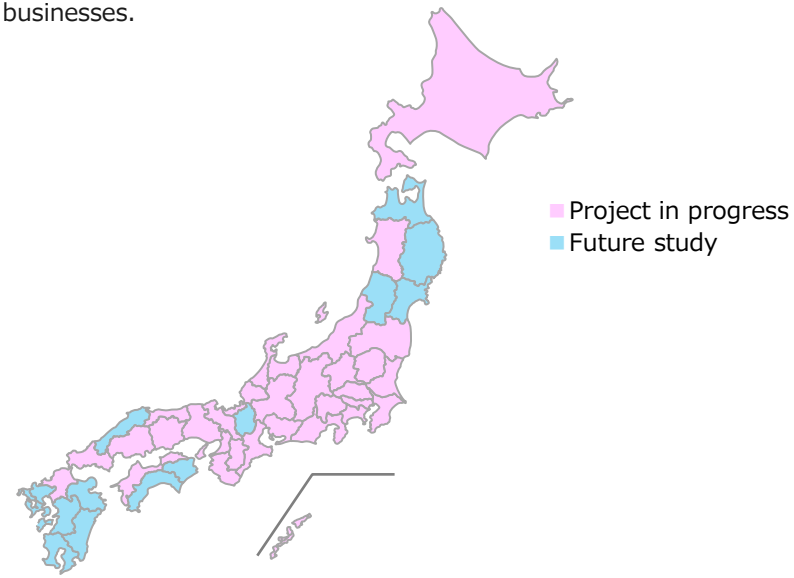
Issues for developing automated Driving Services

1 Fostering the acceptance of the region

Amid a variety of regional characteristics, such as depopulated areas and urban areas, it is necessary to increase the acceptance of local communities with the cooperation of local governments.

2 Ensuring Transparency and Fairness in Audit Procedures

it is necessary for national local institutions and local administrative agencies to promptly proceed with procedures such as licensing, while ensuring transparency and fairness, based on the technological level of businesses.



Toward level 4

"Level 4 mobility Regional Committee" Establishment

■ The "Level 4 mobility Regional Committee" will be established jointly with local governments to ensure the transparency and fairness of audit procedures while fostering acceptance of the regions by closely coordinating local governments, businesses, and relate administrative agencies.

<Members>

○Local governments
○Business operator
　Operational entity
　Vehicle provider
○Relevant administrative agencies
　・Local Transport Bureau
　・Regional development bureau
　・Regional Bureaus of Economy, Trade and Industry
　・Prefectural Police, etc.

Accelerate social implementation of automated driving and AI: "From dots to lines and faces" and "From demonstration to implementation"

Outline of the National Comprehensive Development Plan for Digital Lifelines

- In order to **spread digital benefits throughout the country despite the ongoing population decline, the National Comprehensive Development Plan for Digital Lifelines has been formulated for approximately 10 years.**
- **In accordance with the principle of digital completion,** the public and private sectors will intensively make large-scale investments. **By developing a digital lifeline of hardware, software, and rules that conform to common specifications and standards, we will urgently implement innovations in automated driving and AI** and resolve social issues such as labor shortages, thereby contributing to **the formation of a community living area*** that integrates digital and real.

* Work closely with the National Spatial Planning

Digital solutions to social issues and industrial development

Maintain essential services and functions by eliminating labor shortages

Human flow crisis	Logistics crisis	Catastrophe severity
In mountainous areas difficult to move...	With a lack of drivers difficult to deliver...	To disaster response it takes time...

Early harvest project

Support measures for implementation from FY2024

Drone route	Automated driving service support road	Infrastructure-management DX
Over 180km	**Over 100km**	**Over 200 sq. km**
[Transmission line] Chichibu area of Saitama Prefecture [Rivers] Hamamatsu city, Shizuoka prefecture (Tenryu river system)	[Expressway] Shin-Tomei Expressway between Suruga Bay Numazu SA and Hamamatsu SA [Public Roads] Hitachi City, Ibaraki Prefecture (near Omika Station)	Saitama City, Saitama Prefecture Hachioji-shi, Tokyo

Development of digital lifelines

Infrastructure for hardware, software, and rules will be established

Hardware

- ✓ Telecommunications infrastructure
- ✓ Information Processing infrastructure, etc. (Smart Takoashi)
- ✓ Mobility Hub (Terminal 2.0, Community Center 2.0), etc.

Software

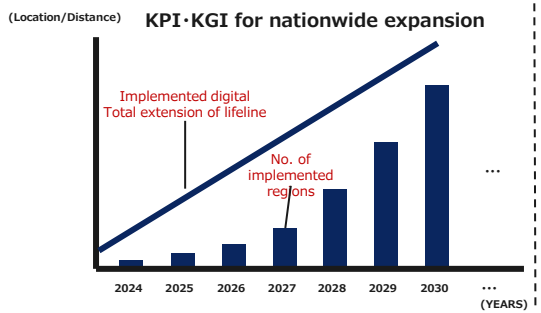
- ✓ 3D maps
- ✓ data collaboration system (Ouranos Ecosystem, etc.)
- ✓ Common data model identifier (spatial ID, etc.)
- ✓ Software development kits, etc.

Rule

- ✓ Certification system for digital utility platform operators
- ✓ Model rules for availability the data collaboration infrastructure
- ✓ Agile governance (Accident responsibility theory in AI Era), etc.

Medium to long-term social implementation plan

Formulated a 10-year plan for public-private social implementation



Leading regions (lines and faces)

For related national projects

1. Intensive **priority adoption**
2. Long-term **continuity support**
3. Common **specifications and standards**

"How to Create Smart Mobility"-Everyone's Guidebook-

- To **promote the horizontal development** of new mobility services**, a guidebook aimed at creating an environment in which "each region can tackle on its own"** was prepared based on the knowledge gained through the five-year demonstration.

Background

- There are already many "Explanations" and "Collections of Case Studies" of Smart mobility and MaaS within and outside this project.
- On the other hand, local governments and business operators have voiced that they “do not know the specific procedures or the degree of granularity of consideration,” application materials for this project are also in a condition of mixture of good and bad (there are proposals which have such as unrealistic concepts and ambiguity of the purpose of demonstration).

Purpose of creation

- By presenting the types of smart mobility efforts and the specific study procedures and study granularity in the form of a guidebook based on the findings from demonstrations for five years, the state will be created in which "newly tackling regions can conduct a certain level of study on their own.“

Outputs

80-page guide

①Knowledge Edition

- The esoteric concept of "smart mobility" have been had systematized, so that what kind of policy menu is conceivable, and how Illustration of whether the menu should be chosen.

②Creation Edition

- In addition to explaining the points to be controlled in the formulation of concepts and demonstration plans and precedents, present worksheets that can be used in actual consideration in accordance with the review procedures.
- In addition, research findings such as the Health Promotion Effectiveness of Smart mobility are also included in the column.

(Reference) https://www.mobilitychallenge.go.jp/knowledge/(Link)

Outline of METI's "Project for Promoting New MaaS Creation in Various Regions"

- METI provides ① **demonstration support** for about 10 advanced cases every year with **regard to new mobility services that lead to the resolution of mobility issues and the revitalization of regional economies**, and ② promotes **efforts to horizontally expand** case studies through the effort of symposiums in various parts of the country.

[Project Outline for FY2023]

<① Demonstration support for advanced cases> Odai-cho and Watarai-cho, Mie Prefecture

- Conducted **demonstration tests of new vehicles and equipment to reduce the human and operational costs** of medical MaaS at a clinic in Odai-cho.
- In Watarai-cho, **demonstration tests are conducted to form a temporary service base by gathering vehicles with various service functions** at public halls, etc. in the town.

①Mobility services x medical (further deepening healthcare MaaS)

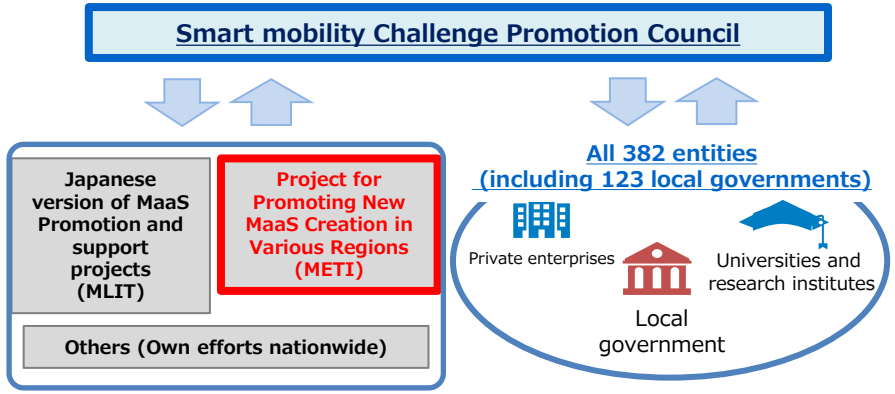
■Utilize regular cars (labor-saving)
⇒ Test of reductions in personnel and operating costs

②Mobility services × Regional service bases (Eliminate mobility issues in hilly and mountainous areas)

Regional bases centered on public facilities

<② Horizontal Expansion> Smart mobility Challenge Promotion Council

- Launched **the Smart mobility Challenge project** to encourage ambitious challenges through collaboration between local communities and ventures. The number of member is **382 entities**.
- efforts will be made to promote **stronger ties between local communities and companies**, such as **disseminating information** on MaaS, **matching members**, and **holding symposiums**. **Symposiums are scheduled to be held in nine regional bureaus** this fiscal year.



<Reprinted> Future Efforts

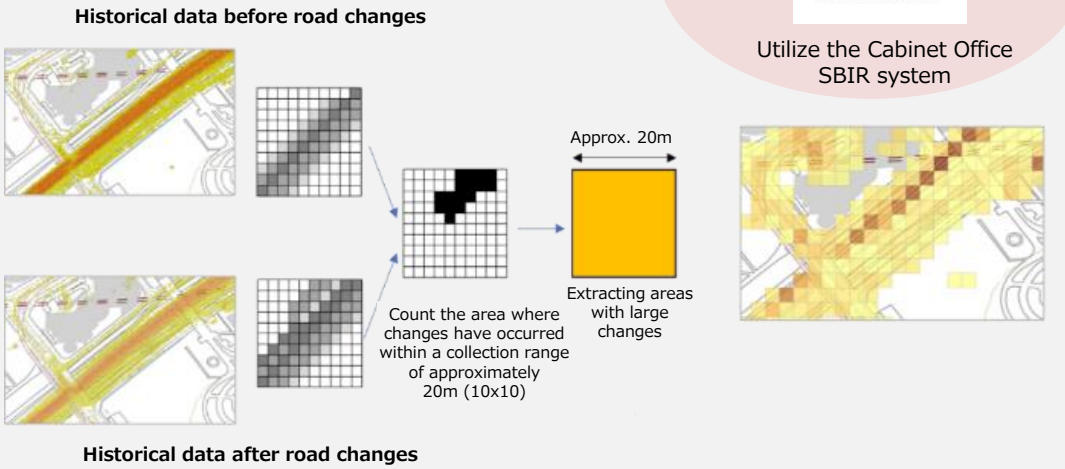
High-precision 3-D map

- Since last year, we have been using the Cabinet Office's SBIR program to demonstrate high-precision 3D map update technology using probe car data.
- In this project, **we will demonstrate update technology using probe car data for high-precision 3D maps using MMS, which has the highest accuracy and content, including detection of change points and subsequent updates**, and develop it for implementation.

Efforts in the Government (Demonstration of technology for updating high-precision 3D maps using probe data)

<Operation>

- ✓ Demonstration of whether it is possible to detect road changes that should be updated on a high-precision 3D map from probe car data such as location information and camera sensor data (① change detection), and whether it is possible to update the high-precision 3D map itself using information obtained from that data (② automatic updating)
- ✓ Through these demonstrations, a technical evaluation will also be conducted to what extent the current probe car data can be used for maps



SBIR
Small Business Innovation Research

Utilize the Cabinet Office SBIR system

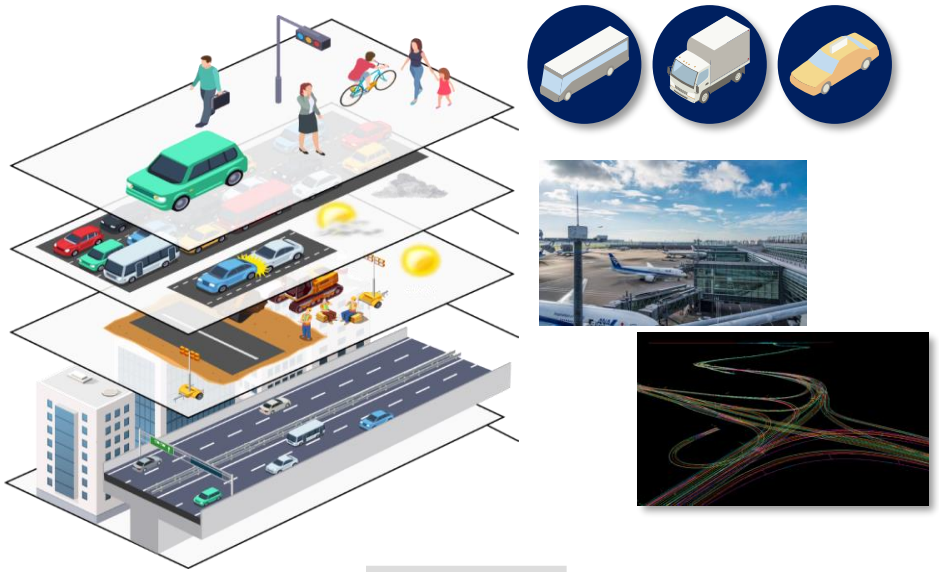
<Implementation schedule>

2023	2024	2025
Drafting action plan Development of PD analysis tools	Develop PD analysis tools [TRL5～6]	★ Stage gate Develop PD analysis tools [TRL7]

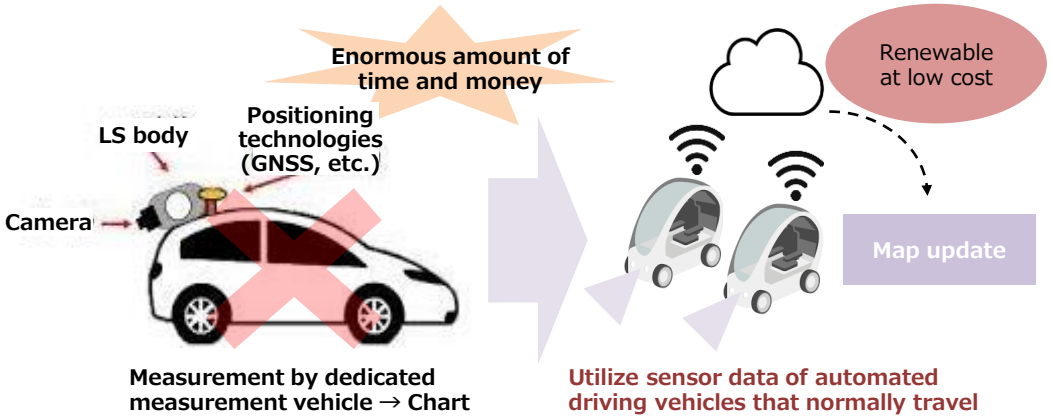
Outline of BRIDGE “Developing Dynamic Maps for Public Areas"

- As a technological development required for the expansion of coverage, the development of high-precision 3D maps and dynamic maps in restricted areas such as airports and ports (public areas) will be tackled, and technologies will be established in areas that address to unrecognized by satellite areas and partially mixed areas that will become issues in the future.
- And, as theme 2, this paper carries out the establishment of the renewal method of high-precision three-dimensional map using the on-board sensor information, and it leads to the real-time property security and cost performance improvement of high-precise three-dimensional map.

Theme 1
Development of dynamic maps for public areas



Theme 2
Efficient map update by in-vehicle sensor information



Expansion of coverage to public roads and beyond

Real-time updates and improvement of cost performance

<Reprinted> Future Efforts

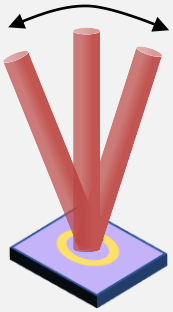
LiDAR

- **LiDAR is an important technology for realizing automated driving that supports SDV**, and we will work on the development of the necessary elemental technologies as a collaborative area.
- In particular, **for PCSEL LiDAR, which is expected to be small and low-cost**, we will **further promote basic research in the third phase of SIP** and **provide support for final commercialization in the Economic Security Key Technology Development Program (K Program)**.

2018.3 — 2023.3 — 2024.4 — 2025.4 — 2026.3 — 2028.3 — 2030

SIP Stage II

All-electronic three-dimensional
For PCSEL LiDAR
POC demonstration



Mechanical 2-D
Establishing PCSEL LiDAR technology
※Ranging 10-30m

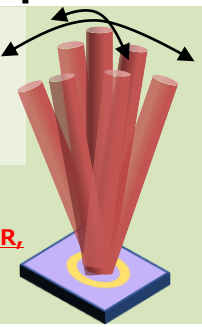
All-electronic three-dimensional
For PCSEL LiDAR
Development for commercialization

SIP 3rd STEP-1

Establishing a mechanical 3-D PCSEL LiDAR
Viewing angle 180 ° x 30°

SIP 3rd STEP-2

Regarding all-electronic three-dimensional PCSEL LiDAR,
- ✓ improve beam density
- ✓ increase power (ranging 100m, about 10°x10°)



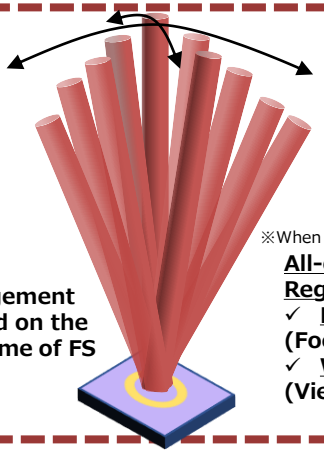
Reflection of the results

K program (FS)

Compact, highly efficient, and low-cost
In the development of semiconductor lasers
Research and investigates directed at
- ✓ On advanced domestic and overseas technologiesSurvey and research
- ✓ Demand survey
- ✓ Consider the direction of technological development

Judgement based on the outcome of FS

K program (R&D)



※When supporting PCSEL LiDAR as a consequence of FS
All-electronic three-dimensional
Regarding PCSEL LiDAR,
- ✓ Further increase in power (Focusing 200-300m or higher)
- ✓ Widening viewing angle, etc. (Viewing angle 100°x25° or more)

commercialization

<Reprinted> Green Innovation Fund project/Development of In-vehicle Computing and Simulation Technology for Energy Saving of Electric Vehicles

Project Objective and Description

- While ensuring Level 4 automated driving functionality (including safety and reliability) in major driving environments, we are conducting R&D to improve energy efficiency in in-vehicle computing, particularly in automated driving software and sensor systems that affect power consumption (reducing power consumption by 70% or more compared to current technology).
- At the same time, in order to strengthen the competitiveness of the entire supply chain, which requires a transformation in development structures amid the electrification and automation of automobiles, we are developing a standard simulation model of the entire electric vehicle compatible with automated driving (dynamics simulation accuracy of 90% or more).

[R&D project 1] Open platform software for automated driving
[R&D project 2] Automated driving sensor system
[R&D project 3] Electric vehicle simulation platform

Implementation system

[R&D project 1] ①tier Ⅳ corporation
[R&D project 2] ②Sony Semiconductor Solutions corporation
[R&D project 3] ③Japan Automotive Research Institute

Operation period

①FY2022-FY2030 (9 years)
②FY2022-FY2030 (9 years)
③FY2022-FY2028 (7 years)

Business scale, etc.

- Business scale: ① 160.9 billion yen, ② 200.2 billion yen, ③ 6.5 billion yen
- Scale of support※: ① maximum of 17.5 billion yen, ② maximum of 19.5 billion yen, and ③ maximum of 5 billion yen

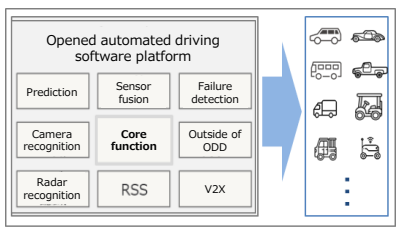
※Includes incentive amounts. There is a possibility that changes may be made in the future depending on the progress of the operation in such areas as stage gates.
Subsidy rate, etc.:
① (2/3 subsidy → 1/2 subsidy → 1/3 subsidy) + (1/10 incentive)
② (2/3 Aid → 1/2 Auxiliary → 1/3 Auxiliary) + (1/10 Incentive)
③ (9/10 consignment) + (1/10 incentive)

Business image

[R&D project 1]
TIER Ⅳ corporation
Microautonomy
～Collectively Creation of Scalable Automated Driving systems～
Operation period: FY 2022 to FY 2030 (9 years)

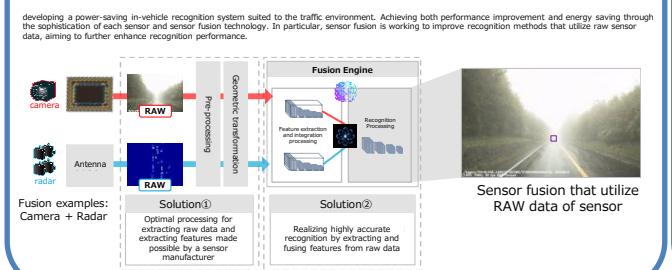
The following three elements of logic, time, and power are implemented optimally and efficiently in terms of R&D content, with the aim of achieving output targets.

1. Automated driving algorithm that adapt to wide-area operational designing area (ODD)
2. Real-time warranty of component software
3. Open system dependability for a wide variety of hardware and driving environments
4. Edge-oriented Agile CI/CD Pipeline



[R&D project 2]
Sony Semiconductor Solutions corporation
Development of in-vehicle recognition technology for energy saving of electric vehicles
Operation period: FY 2022 to FY 2030 (9 years)

Develop a power-saving in-vehicle recognition system suited to the traffic environment. Achieve both improved recognition performance and energy savings through the sophistication of each sensor and sensor fusion technology. In particular, improve sensor fusion recognition methods that utilize raw sensor data to further enhance recognition performance.



[R&D project 3]
Japan Automotive Research Institute
Development of a Digital Technology infrastructure that accelerate electric and automated driving vehicles
Operation period: FY2022 to FY2028 (7 years)

We will build a digital technology foundation that will accelerate the development of electric and automated vehicles, and through evaluation technology that combines models, we will work to realize efficient development of electric and autonomous vehicles.
Section 1: Development and verification of high-precision simulation technology using digital twin
Section 2. Define of typically occurring events to evaluate
Section 3: Development of a method to construct highly accurate vehicle models with different structures

Real environment　Digital environment

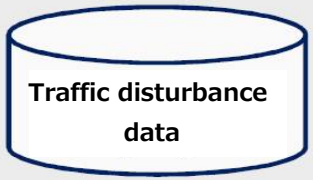
<Reprinted> About SAKURA Scenario Database

Simulation

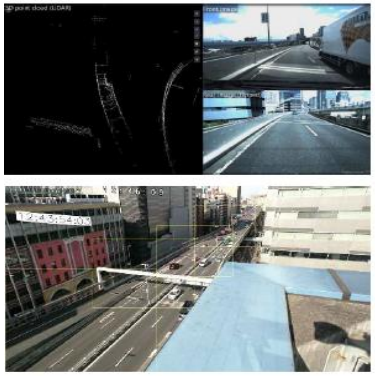
- Though it is necessary to correspond to traffic disturbance scenario of all 58 patterns in the collateral of safety in the automated driving, first, the number of scenarios to be considered is less than public road, and 24 scenarios in the car dedicated way are made into a database.
- Although the construction of a database for an additional 34 scenarios is under way to extend to the public roads, the existing deductive scenario generation method has limitations in terms of time and cost, and it is also necessary to generate scenarios based on the recursive approach.

Scenario-generating process in SAKURA

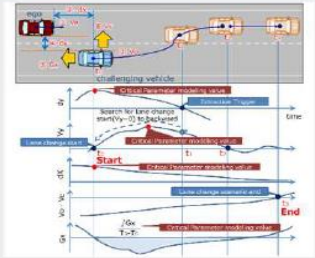
【Step1】 Collecting real traffic environment data (Measuring Vehicles and Fixed Point Observation)



Measuring・ Data processing

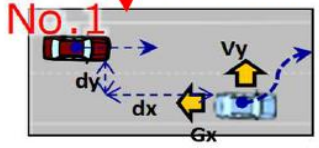


【Step2】 Traffic disturbance data processing (Functional scenario)

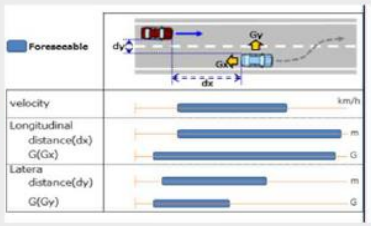


Parameter definitions for scenarios

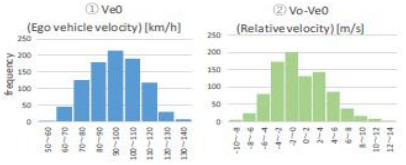
24scenarios



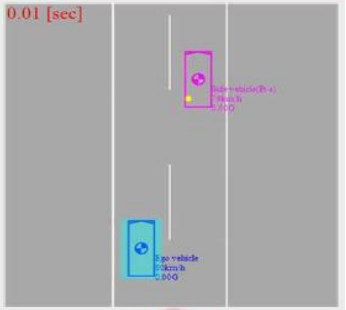
【Step3】 Parameter distribution creation (Logical scenario)



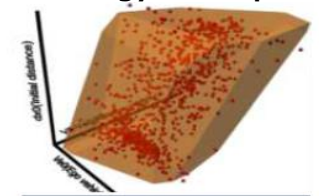
Analysis・Parameter range identification

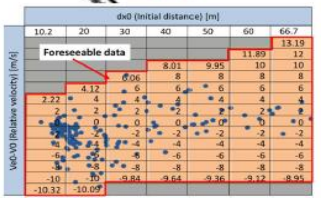


【Step4】 Test scenario creation (Concrete scenario)



Scenario generation methodology development

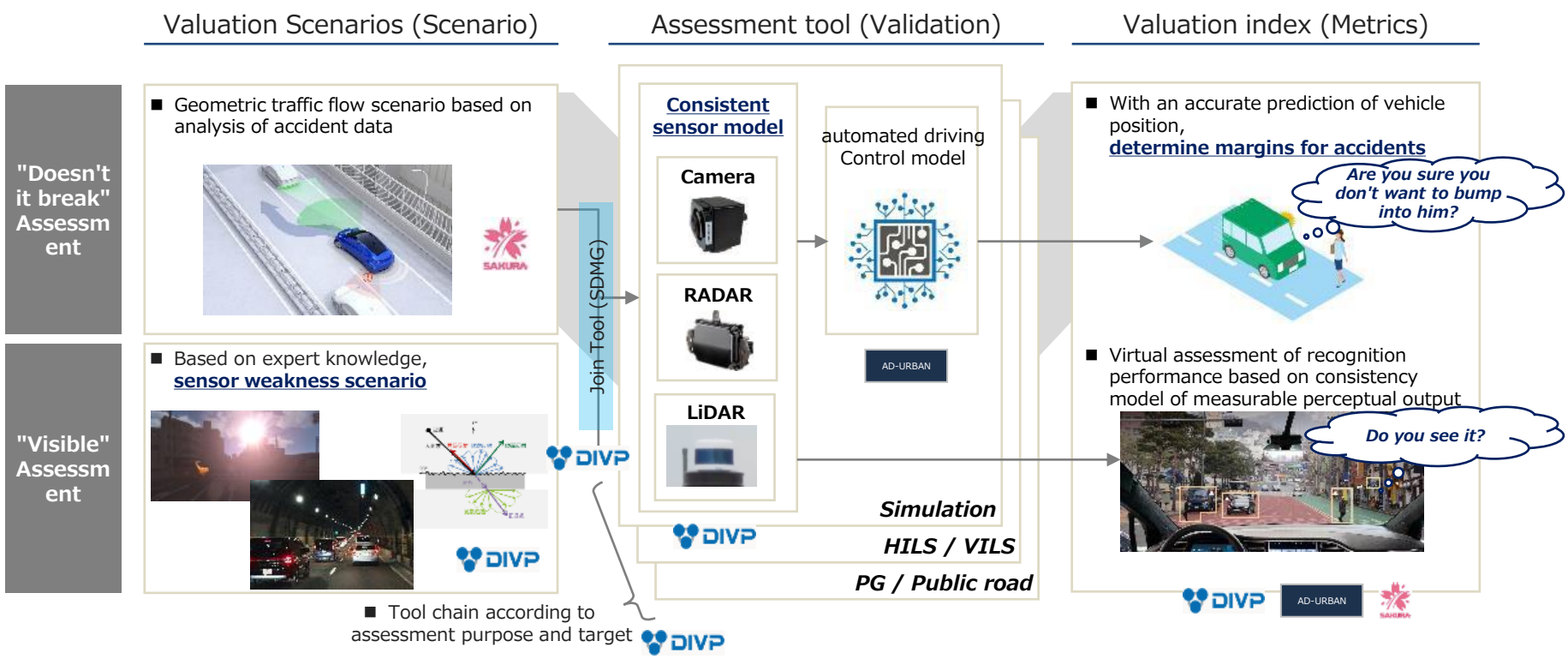




Sources: Prepared by METI based on SAKURA project-reporting materials, etc.

<Reprinted> DIVP (Driving Intelligence Validation Platform) Outline

- DIVP aims at the **construction of a safety assessment environmental of automated driving in a virtual space**, and it can **confirm** the sensor response of an automated driving vehicle, etc. **on a simulated basis**.
- By this, it is expected that the **environment which does not occur in the real environment**, **which is difficult to happen**, **can be reproduced**, and that the **efficient automated driving demonstration** becomes possible.
- One of SIP-adus projects is implemented by Kanagawa Institute of Technology, BIPROGY, sensor manufacturers, etc. Based on the research results to date, **a new company was established in July 2022 and commercialized it in September**.



Sources: Prepared by METI based on DIVP report materials, etc.

<Reprinted> Outline of AD-URBAN Projects

- We are working on improving the accuracy of recognition models in the environment with blind spots using multi-sensors and of object recognition models by sensor fusion of LiDAR cameras using deep-learning in order to construct a safety assessment environment on public roads.
- In the future, we will also strengthen coordination between SAKURA project's scenario DB and DIVP's virtual environment. We will aim to establish a comprehensive and efficient assessment method for the security of AD systems that combine real and virtual.

AD-URBAN:FOT project of **A**utomated **D**riving system **u**nder **R**eal city environment **b**ased on **A**cademic Researcher's **N**eutral knowledge

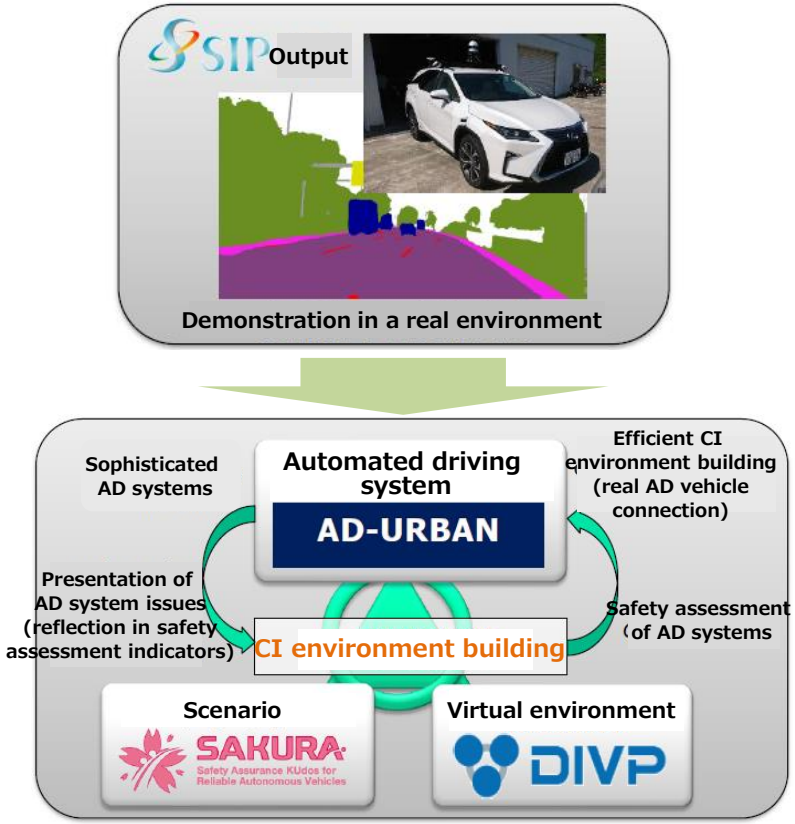
Summary of past efforts

■Demonstration experiment
- ✓ Implementation demonstration tests of AD systems in the Tokyo Coastal Area, etc.
- ✓ Understanding the issues of perceived technology and evaluating the effectiveness of the infrastructure coordination system

■Assessment of marginal performance specific to recognize
- ✓ Collaborating with DIVP projects to build assessment environments in virtual environments

■Promote collaborative efforts among industry, academia, and government on safety assessment
- ✓ Collaboration with SAKURA projects, the Japan Automobile Manufacturers Association (JAMA), etc.
- ✓ Participation in meetings of the Joint Committee for the Promotion of the Safety Assessment infrastructure

Project Collaboration for Building an effective safety assessment environment



Sources: Prepared by METI based on AD-URBAN report materials, etc.

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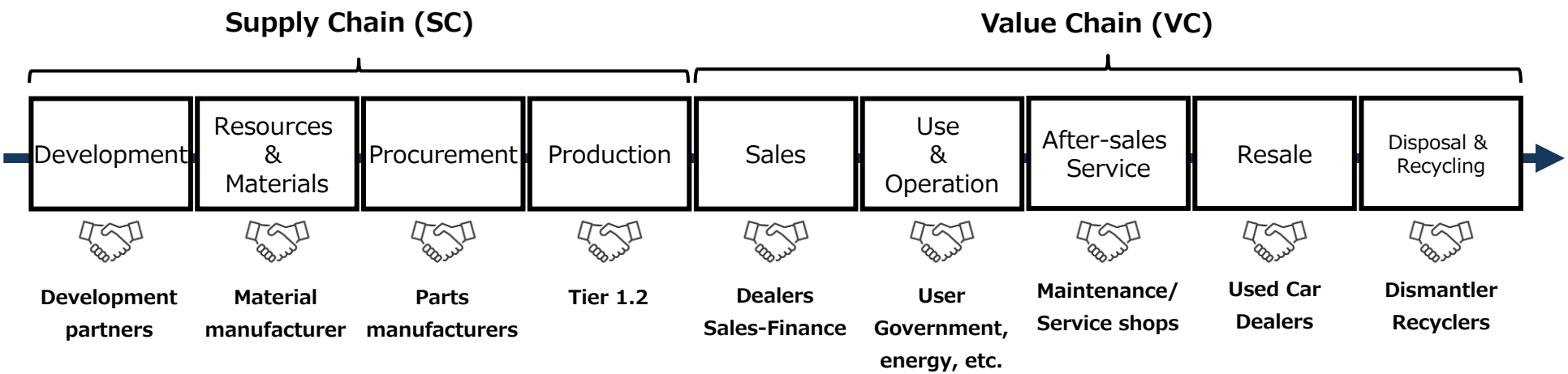
<Reprinted> Data Utilization in the Vehicle Supply Chain

- **Data provide new social values & services** and **ensure traceability** (e.g. carbon neutrality measure in lifecycle) through data collaboration with various partners in the supply & value chain including those in other industries.

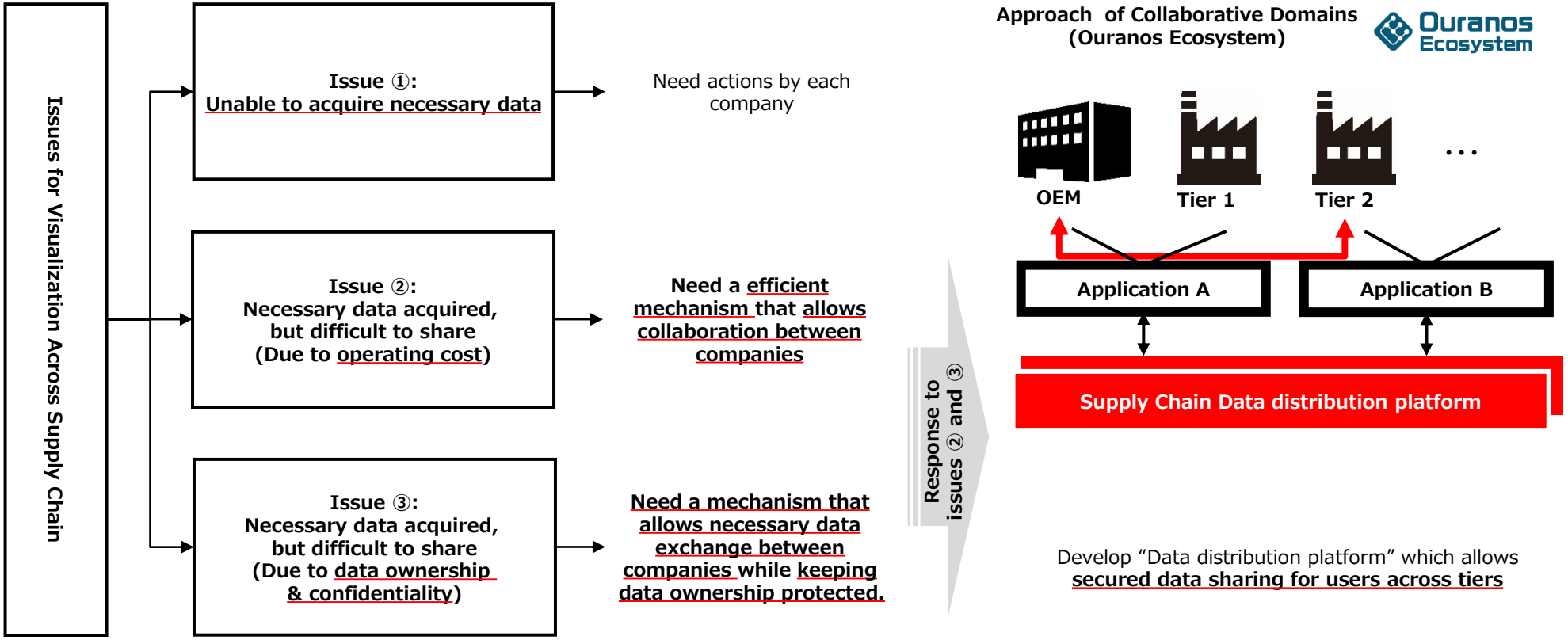
Data Utilization Use Cases in the Vehicle Lifecycle



Issues for Visualization Across Supply Chain and Approach of Collaborative Domains

- **Data acquisition by each company** and **data exchange among them** are necessary for visualization across supply chain.
- **Data exchange are common challenge across every companies**, and it is an **area that needs to be solved by collaboration**.

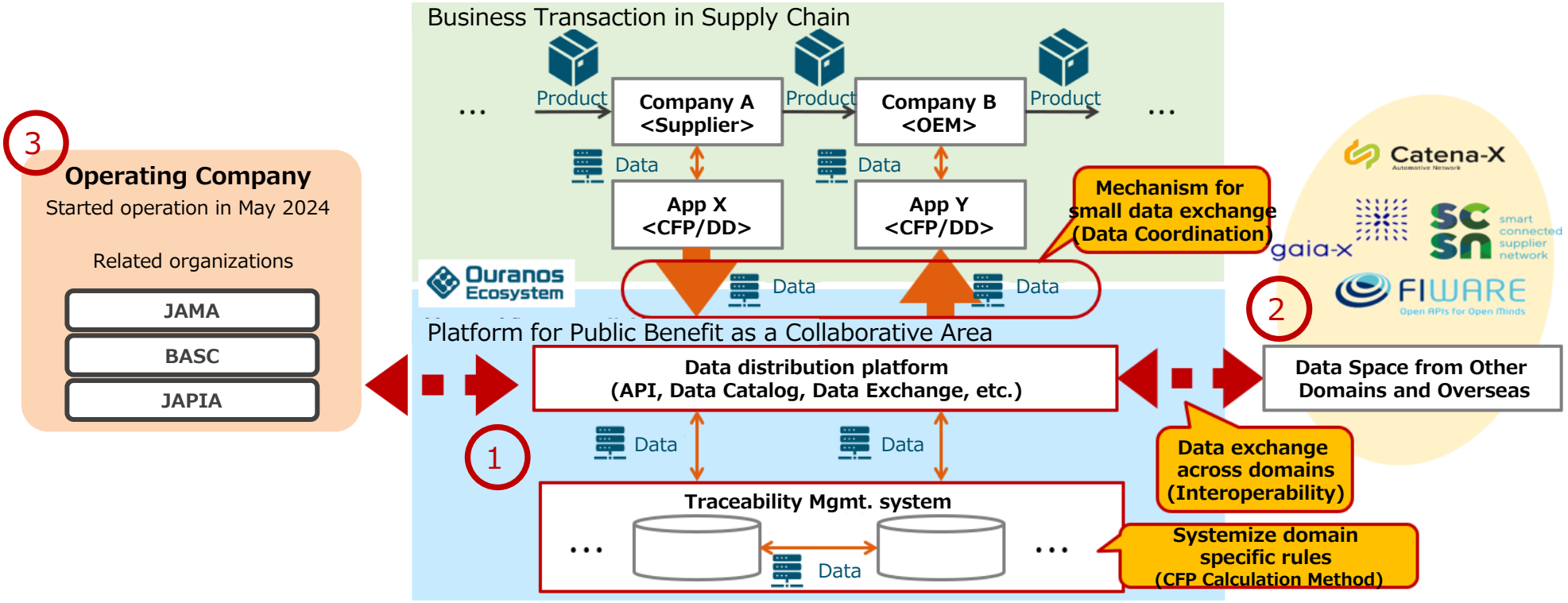
Issues for Visualization Across Supply Chain and Approach of Collaborative Domains



Status on Efforts in Supply Chain Side as an Initial Use Case (Battery CFP, DD)

- Promoting ① **development of data distribution platform and traceability management system**, ② **interconnection with overseas data platforms**, and ③ **establishment of platform operating company for battery CFP and DD** as initial use case.
- **Developed a data exchange platform and a traceability management system** to comply with EV battery disclosure staring form 2025 mandated by the EU Battery Regulation. **Started system operation from May 2024 by the newly established operating company: Automotive and Battery Traceability Center (ABtC).**
- **Started discussion with Catena-X** as an initial step for interconnection with overseas data platforms.

Current Status of Measures Related to the Storage Battery CFP･DD



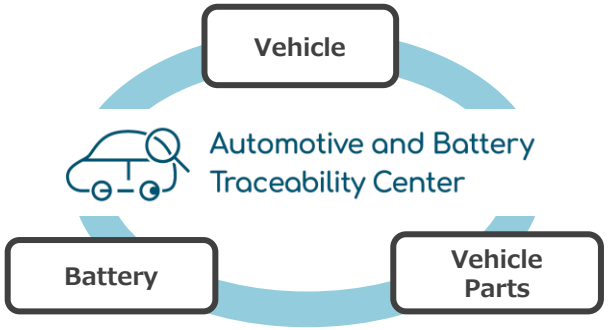
System started operation in May 2024

<Reference> Automotive and Battery Traceability Center (ABtC)

- Complying with CFP stipulation mandated by the EU Battery Regulation and the visualization of the supply chain are urgent issues for the automotive industry.
- Thus, **"Automotive and Battery Traceability Center (ABtC)"** was established as managing company providing data collaboration service for vehicle and battery traceability.

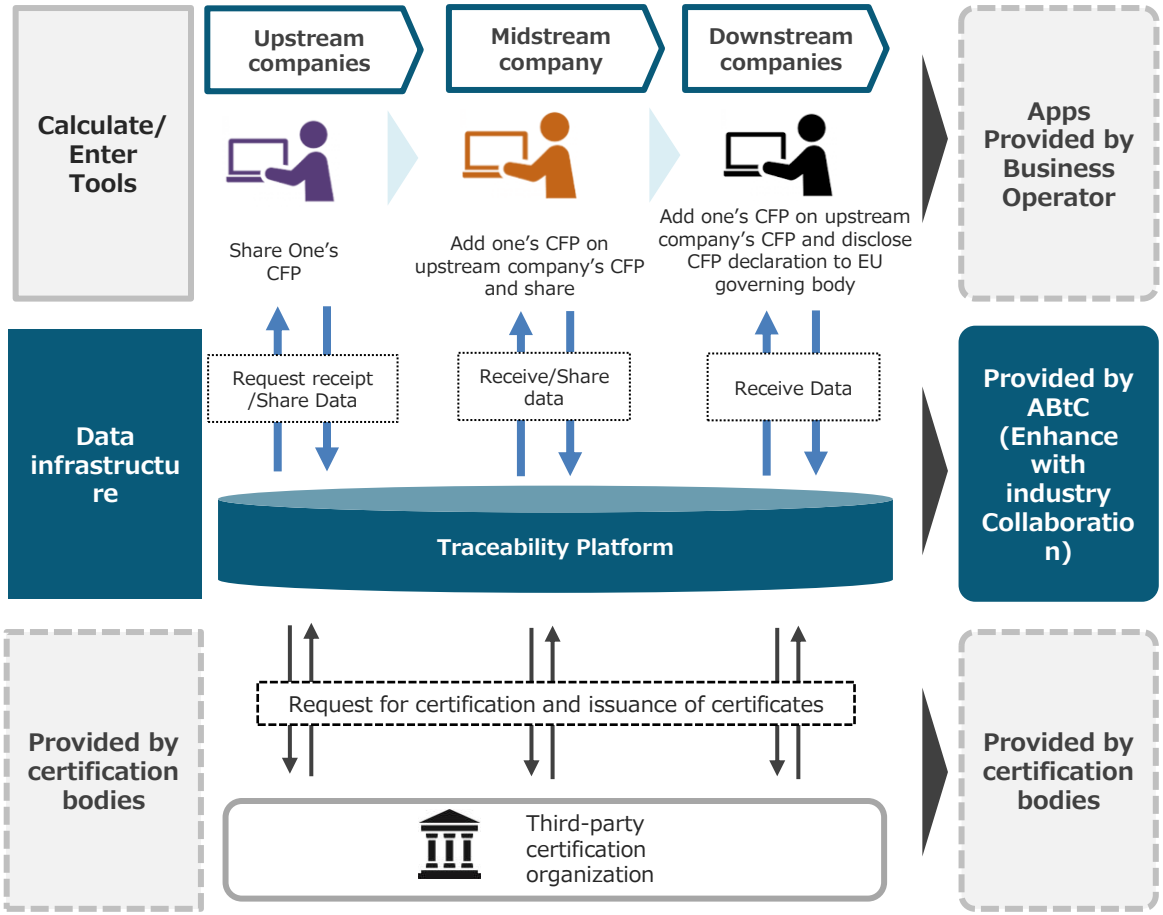
ABtC

Name	**Automotive and Battery Traceability Center**
Established	**February 19th, 2024**
Members	**OEMs, Battery and Parts Suppliers, etc., Specialist members from various fields**
Business Overview	Relate to automotive and battery traceability ➢ Management of services to distribute data ➢ cooperative activities with industry and government in expanding use cases, etc. ➢ Interconnection with foreign PF



Enhance the competitiveness of the industry as a whole by distributing data securely and safely among companies in the vehicle and battery supply chains, and cooperating in responding to environmental and social matters.

Provided Service (image)



Approach on Future Use Case Enhancement

- Considering the industry demand, potential **future use cases** are shown below. Further actions will be taken after detail plan is discussed with stakeholders.

Use Cases	JAMA			JAPIA		
	Material Cycle for Vehicle Batteries	**Mobility Smart Passport Initiative**	**Logistic and Operation system Streamlining and Standardization**	**Vehicle LCA Calculation**	**Inventory Mgmt. and Prod. adjustments based on Contingency Detection**	**Early Detection of Defective Products**
Issues and Background	• OEMs and suppliers need to comply with the EU battery regulations (by FY2026) • Used battery outflow	• The relationship between users and mobility is complex and diverse due to the introduction and development of various types of mobility	• Tight transportation resources due to labor shortages, etc.	• Increasing importance of evaluating LCA not only during driving, but also from material-acquisition to discard • Discussions on LCA calculation rules have become more active in WP29	• Suppliers are unable to grasp the impact of an emergency quickly, resulting in inventory management losses	• Suppliers are unable to confirm the condition of parts supplied by the company after being equipped with vehicles
Coordinating Data	• Battery's material usage, origin of production, SoH, usage history, etc.	• User ID info (license, insurance card info, etc.) • Vehicle ID info	• Vehicle operation management information, etc.	• Amount of input, emission factor, etc. at each stage from material acquisition to discard	• Disaster impact of each supplier • inventory information, production plans, etc. for each part	• Parts and vehicle installation information • Parts operation status, status information, etc.
Ideal State	• Improve used battery collecting rate and recycle rate	• Smartization of government and private sector authentication procedures related to mobility • Building an ecosystem that originates mobility and creates new services	• Improvement of transportation efficiency through digitization of all logistics flows and joint transportation, etc.	• Calculate LCA on a low-cost basis in accordance with global accounting rules	• Suppliers quickly grasp the impact of disasters and realize efficient inventory management and production adjustments	• Suppliers grasp the state of their products after they are installed in vehicles, and quickly detect indications of failures
Benefits	• Establish supply base for storage batteries that does not depend on specific countries	• To reduce social costs, such as authentication procedures, and create highly convenient services	• Reduce transportation costs by saving labor and maximizing transport volume	• Achieve low-cost LCA calculation ahead of schedule while ensuring confidentiality	• Reduce unnecessary inventory control losses	• Reducing OEM's testing burden and making use of it for future OTA
Urgency	-	-	**High** (Address the 2024 Problem, etc.)	**High** (Pushing into discussions in WP29, etc.)	**High** (Issues emerge due to recent earthquake)	-
Future Direction (draft)	**Continue Consideration**	**Continue Consideration**	**(Looking ahead to commencement of demonstration in the second half of this fiscal year) Continuous study on priority**	**From the first half of this fiscal year Start of demonstration**	**(Looking ahead to commencement of demonstration in the second half of this fiscal year) Continuous study on priority**	**Continue Consideration**

Extended Use Cases for Supply Chain Data Linkage

- **Vehicle LCA was started** as **the second use case of the Automotive Supply Chain Data Collaboration infrastructure (operated by the Automotive and Battery Traceability Center)** in the **Ouranos Ecosystem**, which is aimed to implement by FY 2025.
- Meanwhile, as **candidates for the third phase,** a detail planning will be conducted for '**Logistic and Operation system Streamlining and Standardization', 'inventory management and Production adjustments based on Contingency Detection', and 'understanding the supply chain of semiconductors and other critical components' are considered.**

Second Use Case (Vehicle LCA)

- There are plans for demonstrations for defining application requirements in FY2024 and application development and service implementation by each vendor in FY2025.

<Outline of the Demonstration Project>

① Through trial calculation work using Excel, etc., organize the workflow for LCA calculation and identify the functions required for the application.
② Prototyping and functional verification of applications based on ①.
③ Create requirements definition document* based on ②.

* Vehicle LCA calculation methods are currently under discussion in Japan and abroad; the design will be a generic tool that can handle multiple calculation methods.

Candidate use cases for Phase 3 (logistics, BCP support, supply chain understanding)

- In FY2024, a detail planning for initiatives will be done through hearings, issue identification, hypothesis testing, etc., and plan to launch a verification experiment in FY2025.

<Reference> Usage Case Study in Catena-X

- Catena-X is working not only to comply with the EU Battery Regulations, but also **to examine 10 use cases to solve various problems common to the automotive industry.**

Grasping CO2 Emissions in the Entire Value Chain

- Sustainability (Identify CFP)
  - Providing methods and standards for calculating emissions throughout the value chain of vehicle manufacturing
  - CFP calculation software, including OEM and suppliers, to be completed by the end of 23
- Traceability (retrospective)
  - Expand traceability to the entire value chain and allow retroactive coverage of hardware, software, from manufacturing to recycling
  - Clarify production responsibilities, improve safety, and facilitate discovery of product/data forgery

- Transition to a recycling-oriented economy
  - Creation digital twin for all products and all processes of vehicle manufacturing. Each company provides its own information to the data chain and also shares information on other companies in real time
  - Improvement of parts recycling rate and decrease of waste volume in the automobile industry

Flexible production methods and partner data management

- Production as a service
  - Manufacturing as a Service(MaaS) App completed by 24
  - Manufactures that need parts will place orders for production through platforms if their own capacity is not sufficient, and other companies will produce if prices and conditions are agreed

- Business Partner Data Management
  - Integrated management of partner data through a system called Golden Record
  - Understand companies that have experienced problems in the past, such as compliance violations, through 'value added system' risk management application based on the Supply Chain Control Law of Europe

Early detection of parts defects and optimize of production processes

- Quality control
  - By quality control based on data sharing that transcends corporate boundaries, parts defects are discovered at an early stage, and the root-causes are investigated
  - Protection against leakage of important internal data of each company is also taken
- Modular production
  - When there is a discrepancy between the orderer, raw material, production process information, etc. and the actual production status, Catena-X automatically determines and implements alternative measures

Early detection of supply chain issues and countermeasures

- On-line control and simulation
  - Derive countermeasures using supply chain disruption scenarios utilizing AI
  - Manufacturers are improving processes and resilience based on simulation results, and are also sharing countermeasures with parts supplier companies

- Demand and capacity management
  - Participating companies in the data chain can grasp supply and demand trends in real time
  - Ability to take early action among participating companies in the event of a supply chain problem

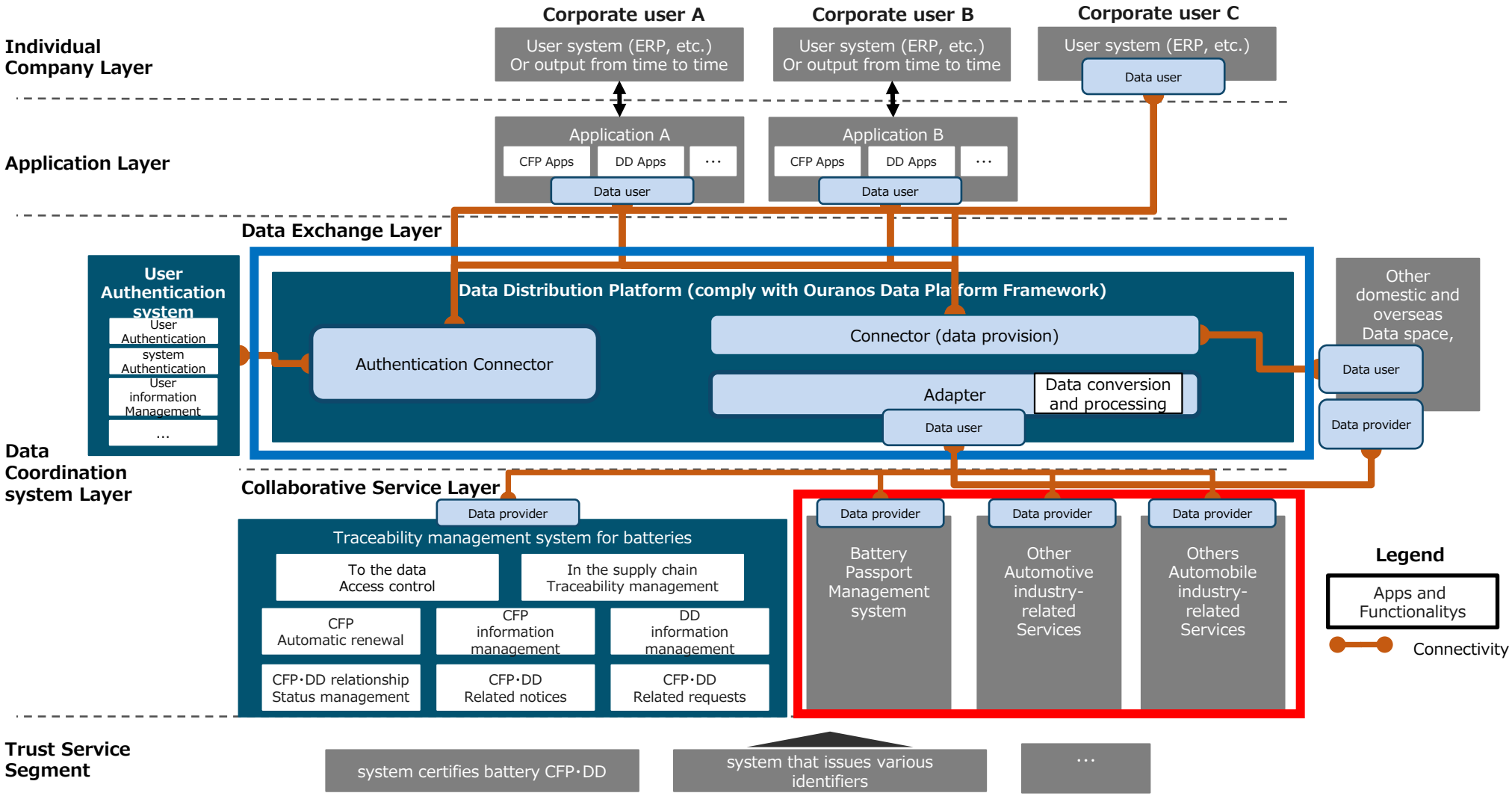
Digital twin test and analysis

- Digital twins of behaviour
  - Generates digital twins for vehicles and components and opens up to Catena-X participants
  - Contributing to reducing test and analysis costs through simulations in virtual spaces, improving traceability, and shifting to a recycling-oriented economy

Sources: Prepared by METI based on various publicly available information

<Reference> Ensuring Scalability in System Architecture under Initial Use Case Development

- The system architecture under development in the initial use case (battery CFP, DD) is **designed to scale use cases by dividing the systems for data coordination and the use case specific functions.**
- For future use cases, **systems (red frame) for each use case will be developed** while utilizing **a common data coordination system (blue frame).**



R&D for Optimizing Operational and Energy Management (Green Innovation Fund Initiative)

[R&D Areas] Managing EV, FCV Operations and Building an Integrated Energy Management system to Form a Smart mobility Society

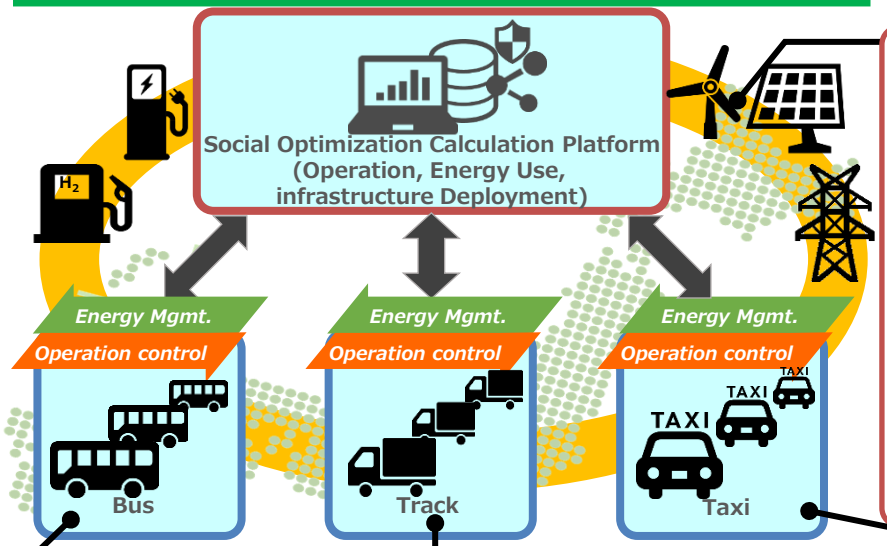
Initiative Objective and Description

[Objective]
promoting the use of commercial EV to realize carbon-neutral transportation.

[Outline]
Research and development of a system for integrated energy management and operation management, with a focus on the systematic operation of commercial vehicles with high operating rates and high energy consumption.
Commissioned Initiative: Work on optimization of charging and filling infrastructure improvement and optimization of society as a whole by linking driving data and external environmental data of commercial vehicles in various business categories.
Subsidized Initiative: Development of a system for optimizing operation and energy use through demonstration experiments on commercial electric vehicles mainly by transportation operators.

Initiative Image

: Commissioned Initiative　: Subsidized Initiative



◆ **National Institute of Advanced industrial Technology and Technology,**
Automotive Technology Organization traffic Safety and Environment Research Institute, Central Institute of Electric Power Research, Dynamic Map infrastructure Co., Ltd.

Utilizing data obtained from recipients of subsidized projects and transport and energy-related data, the following are implemented.

- R&D on the basis of management, analysis, and collaboration of operational data
- Research and development of operation management simulation and optimization technology
- Development of Evaluation Method for improvement of Charging and Filling infrastructure
- Development of electric power information data
- R&D of various information gathering and updating systems
- Survey of foreign trends toward electrification of commercial vehicles

※Bold: Managing company/institution

◆ **Michinori Holdings Co., Ltd.,** TEPCO Holdings Co., Ltd., Ibaraki Kotsu Co., Ltd., Kanto Automobile Co., Ltd. and Fukushima Kotsu Co., Ltd.

Demo vehicles: Approx. 200 EV route buses
Demo areas: Fukushima, Tochigi, Ibaraki
Notable Point: Operation Planning and Supply-Demand adjustment Management by Bus companies and Electric Power companies

◆ **Kansai Electric Power Co., Inc.,** Osaka City Expressway Electric Railway Co., Ltd., Daihen corporation, Obayashi corporation, and East Japan Expressway Co., Ltd.

Demo vehicles: Approx. 100 EV route buses (some of which are compatible with power supply during operation)
Demo area: Osaka City
Notable Point : Domo in Osaka Expo site, Domo of in-service power supply vehicles

◆ **Japan Post Co., Ltd.**

Demo vehicles: Approx. 900 light van EV and approx. 1800 electric motorcycles
Demo areas: Hokkaido, Akita, Tokyo, Fukuoka, Niigata, Gifu, Okinawa
Notable Point : Integrated energy management and operational management of motorcycles and automobiles based on weather and driving conditions in each region

◆ **Yamato Transport Co., Ltd.**

Demo vehicles: Approx. 850 EV light trucks and approx. 850 battery-replaceable EV light trucks
Demo area: Entire Gunma Prefecture
Notable Point : Large-scale demonstration of EV vehicles throughout the prefecture, optimize of vehicle operation using replaceable batteries, and power interchange between bases

◆ **Commercial Japan Partnership Technologies Co., Ltd.,**
Sagawa Express Co., Ltd., Seino Unyu Co., Ltd., Nippon Express Co., Ltd., Japan Post Co., Ltd., Fukuyama Transporting Co., Ltd., Yamato Transport Co., Ltd., Seven-Eleven Japan Co., Ltd., FamilyMart Co., Ltd., and Lawson Co., Ltd.

Demo vehicles: Approx. 300 FC trucks, approx. 210 EV trucks, and approx. 70 light van EV
Demo area: Tokyo, Fukushima, Tohoku-Kanto-Kansai (trunk transport)
Notable Point : Highly accurate estimation of energy consumption and optimize of charging/filling timing. Large-scale demonstration of FC vehicles

◆ **Daiichi Kotsu Sangyo Co., Ltd.** Denko Kotsu Co., Ltd.

Demo vehicles: Approximately 150 EV taxis
Demo areas: Hiroshima and Wakayama
Notable Point: Optimize distribution vehicles and power supply timing to meet taxi demand in local cities with long drives

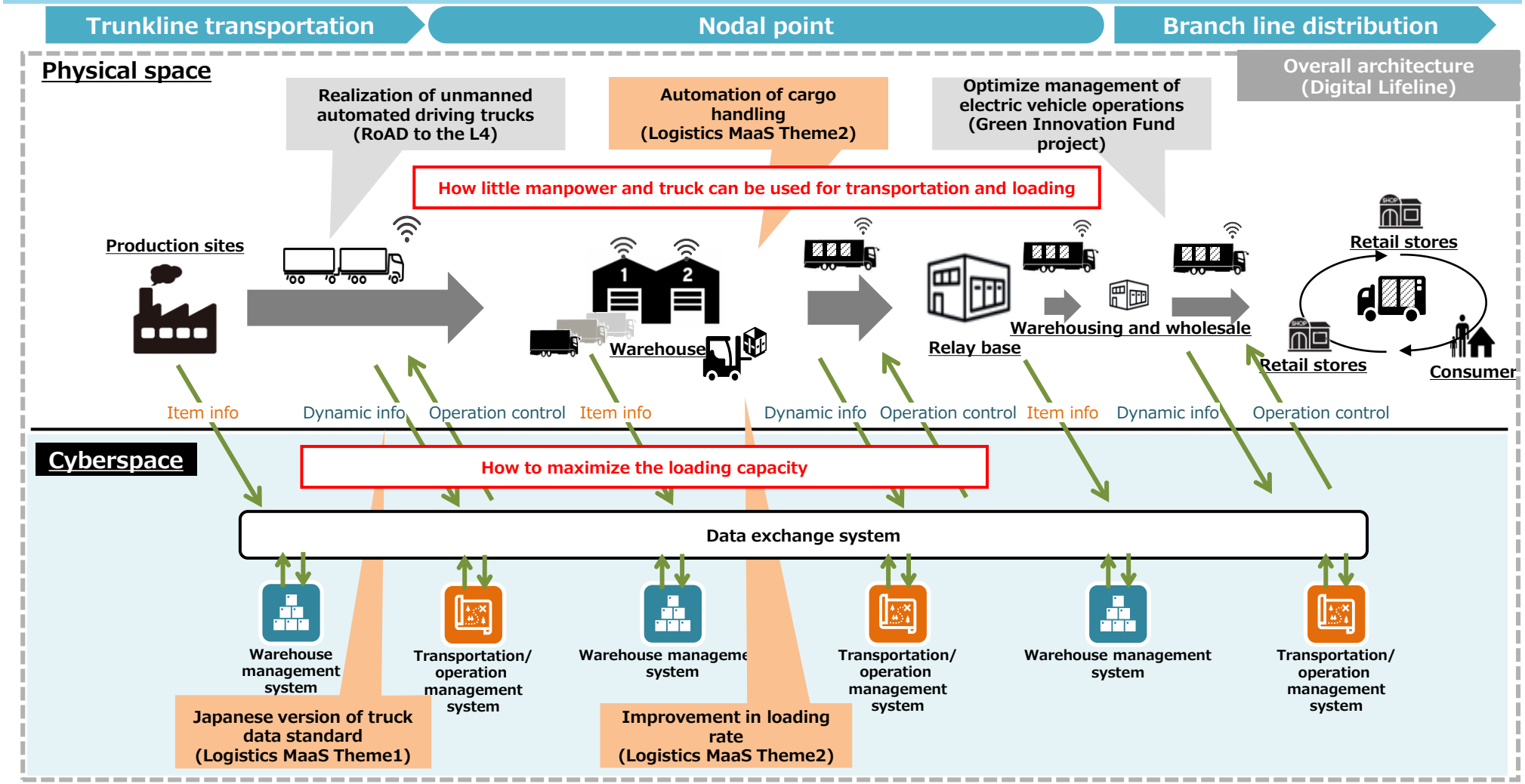
◆ **mobility Technologies Co., Ltd.**

Demo vehicles: Approximately 2500 EV taxis
Demo area: Tokyo metropolitan area, Keihanshin are, Nagoya area, etc.
Notable Point : Using AI techniques to generate and communicate charging plans that take into account crew breaks in large metropolitan areas with a large number of taxis

Operation period: Fiscal 2022 to fiscal 2030 (up to nine years)
Commission Initiative scale of initiative/support: Approx. 11 billion yen/Approx. 11 billion yen
Subsidized Initiative scale of initiative/support: Approx. 152.3 billion yen/approx. 102 billion yen. Subsidy rate, etc.: fixed rate subsidy (2/3 → 1/2 → 1/3) + expenses for electric vehicles, incentive rate of 10%

Demonstration Initiative (Logistics MaaS) to Streamline Logistics

- **Labor saving (automation of transportation and cargo handling)** and **maximizing transportation volume (improvement of loading ratio)** are necessary to solve recent logistics issues in **"transportation at trunk lines and branch lines"** and **"cargo handling at nodal points"** from production sites to the delivery destinations.
- In realizing this, logistics MaaS initiatives will be promoted while further deepening the collaboration with related measures in the future.



Logistics MaaS: Initiatives for Truck Data Collaboration

- Track Data Standard of Japan aims at effective utilization starting with the identification and standardization of data items based on use cases.
- Starting with use cases such as safety and security, automation, and electrification, with **standardized API guidelines that can be used in other businesses.**

Truck data standard of Japan

■Track data standardization

- The standard specifications for items shown in the table were defined based on the use case of the safety and security ※1. Formally agreed within the Distribution MaaS last fiscal year.
- Data items to be standardized in automation will be continuously examined in ※2 of FY2024.

1	Date and time information	5	Windshield Wiper ON/OFF
2	Position information (latitude and longitude)	6	Headlight ON/OFF
3	Vehicle type	7	Distance between vehicles
4	Sudden braking (deceleration 0.25G or higher, etc.)	8	Speed
(Provide after standardization is not considered in this initiative)		9	Outdoor temperature sensor information

※1 Use cases that contribute to improving operational safety using data that can be obtained from vehicles
※2 To be considered within 3 2 RttL4 topics

■Standardized API Guidelines

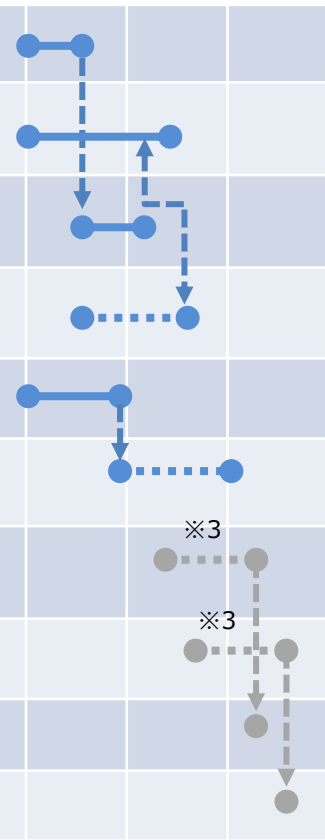
Consider API specifications/rules that can be acquired according to use cases, such as safety and automate, and create guidelines (first edition in FY2024)

■Approach to Formulating the Japanese Track Data Standard

	Japan	Europe
	Use case-based track data standardization	Standardization of a wide range of track data
	Background: Provide FMS servicing mainly by manufacturers →Data specification design appropriate for the service	Background: Open the data to 3rd Party and provide FMS servicing
Approach	Identify use cases requiring track data linkage → Specification of data items associated with use cases	Standardization of data items in accordance with specifications → Expansion of standardization areas after confirming standardization value

Future schedule

No.	Considerations	Use Case	Due
1	Identify truck data items to be standardized	①Safety and security	FY2023
		②Automation	FY2024
2	Decide Standard Track Data definition	①Safety and security	FY2023
		②Automation	FY2024
3	Create Japanese truck Data Standardization API development guidelines	①Ver0.5	FY2023
		②Ver1.0	FY2024
4	Update Standard Track Data Definition (Different timing of responses by manufacturers)	①Safety and security	FY2024 ~2025
		②Automation	FY2025
5	Implementing Standard Track Data	①Safety and security	FY2024 ~2025
		②Automation	FY2025



※3 Renovation and implementation of track data specifications is as short as fiscal 24 (items requiring adjustment)

Logistics MaaS: Initiative to Streamline Shipping through Automated Loading/Unloading and Joint Transportation

- Efforts to improve the efficiency of shipping through visualization, automated cargo handling, etc. have been implemented since FY2020, and various technology demonstrations have been implemented for four years.
- Since the tightening of regulations on labor hours for truck drivers will start next fiscal year, the **effort will be centered on initiatives that can be implemented at an early stage and that contribute to improving the efficiency of transportation and delivery.**

<Directional for the current fiscal year and beyond>

<Output of Logistics MaaS Theme2>

◆ Start of automated loading and unloading [Start by next fiscal year]
- ➢ Started automated cargo handling under specific conditions (packing style, time zone, etc.) at specific distribution bases
- ➢ Creation of a guide for its horizontal development

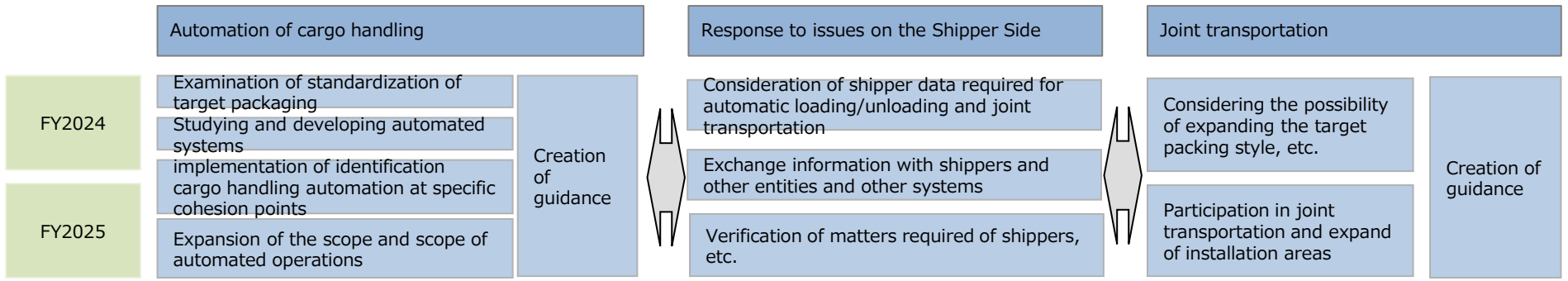
◆ Expansion of the actual operation range of joint transportation [successively expanded in the next fiscal year and next fiscal year]
- ➢ Expansion of corresponding industries and corresponding business formats (e.g., home delivery logistics)
- ➢ Creation of a guide for its horizontal development

<Necessary action for realization>
(Efforts for the current fiscal year and beyond)

- ➢ **Automation of cargo handling**
  - Development of automated systems and mutual with other systems within the cohesion point
  - Expansion of the scope and scope of automated operations
- ➢ **Joint transportation**
  - Implementation of joint transportation using double-coupled vehicles
  - Expanding the scope of joint transportation routes and cargo
- ➢ **Responding to issues on the Shipper's Side to Realize Above**
  - Consideration for standardization of corresponding pallets
  - Early data linkage of packaging style information from shippers to logistics companies
  - Verification of other items required by shippers

⇒ Plans to organize these demonstration results and knowledge as a guide

<Timeline>



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— Realizing Flexible and Speedy Management
— Acquiring and Developing Software Personnel
— Promoting Corporate Tie-ups
— Development of "Communities"

Need for Organizational Structure and Business Model Transformation

- Emerging OEMs in the U.S. and China are **realizing flexible and speedy management** in SDV areas based on the following strengths: ① they have few models and are **able to develop and invest capital that is not constrained by existing assets or businesses**; ② they **have sufficient resources, such as abundant software personnel**; and ③ they have **flexible business ideas that utilize data and a management philosophy that allows them to aggressively invest resources in new business areas that do not produce profits in the short term.**
- The challenge for the existing OEMs, including Japan, Europ, and the U.S., **is how to invest resources in new business areas and compete with emerging OEMs while maintaining many existing businesses**, such as vehicle models and powertrains.

Need for organizational structure and business model transformation based on environmental changes

Japanese OEMs

- Variety of vehicle models
- Internal combustion engines and other existing powertrains
- Lack of data utilization business and software personnel

⇒ Flexible decision-making and investment in new businesses will be hampered

OEMs and startups in the U.S. and China

- Small number of vehicle models, allowing zero-based development and centralization investment of capital
- Abundant software personnel and aggressive creation of data utilization business
- Large number of startups, accelerating open innovation

⇒ Able to make speedy decisions and actively invest in new businesses

Traditional hardware areas where Japanese OEMs have strengths

+

Capital investment in new business areas that will lead to the creation of new value

- ✓ Aggressive investment in the software field
- ✓ Providing solutions that combine software and hardware
- ✓ Accelerate open innovation
- ✓ Restructuring of business portfolio through the above

<Reference> OEMs in the U.S. and China are promoting active initiatives

- TESLA: Acquised Deep Scale to develop AI for automated driving
- BYD: Acquired Sanying Precision Instruments, medical MaaS related company

<Reference> Examples of Initiatives in Other Industries

- Industrial companies in the U.S. and Europe are **positioning themselves as new growth drivers by acquiring software companies that will lead to hardware differentiation, while capturing the high growth potential of the software business.**
- Although Honeywell, Schneider, and Siemens have different driving forces for their digital businesses, they all share the same commitment to strengthening software, building IIOT (industrial IOT) platforms, and creating solutions that integrate hardware and software.

Examples of business model transformation for European and American industrial companies

Traditional hardware areas with strengths

+

Investments in software that differentiates hardware and creates new value

Common points in promoting the software business

- ✓ Acquisition of high-multiple software companies
  - –expanding business scale through cross-selling
  - –capturing high growth potential of software
  - –contributing to enhance corporate value
- ✓ Continuing to acquire software companies to strengthen functions
  - –investing in technology companies using CVC
- ✓ Providing solutions that combine hardware and software
- ✓ Building a IIOT platform

Differences in software business initiatives

Honeywell	**Cross-organizational contribution** Established subsidiaries as a cross-divisional organization
Schneider Electric	**Subsidiary-driven** Subsidiay AVEVA expanded its business while also maintaining its market reputation
SIEMENS	**Business company-driven** Internal company Digital industries drives software business

Pursuing new growth drivers and promoting the conversion to a business model that integrates hardware and software

Sources: Prepared by METI based on various published materials, etc.

Importance of Improving Corporate Value

- In order to continue to prevail in an increasingly competitive environment, **it is important not only to change the organizational structure and business model, but also to procure and secure the funds necessary to execute the strategy.**
- Although financial performance continues to be an important indicator**, the transparency and social significance of management and business strategies have tended to be more important in recent years, and it is necessary to create a growth story** for the market (investors) **that combines social contribution and corporate value enhancement through organizational and business transformation.**

Corporate strategy and KPI

Financial performance

+

Strategic disclosures and transparency (KPI setting)

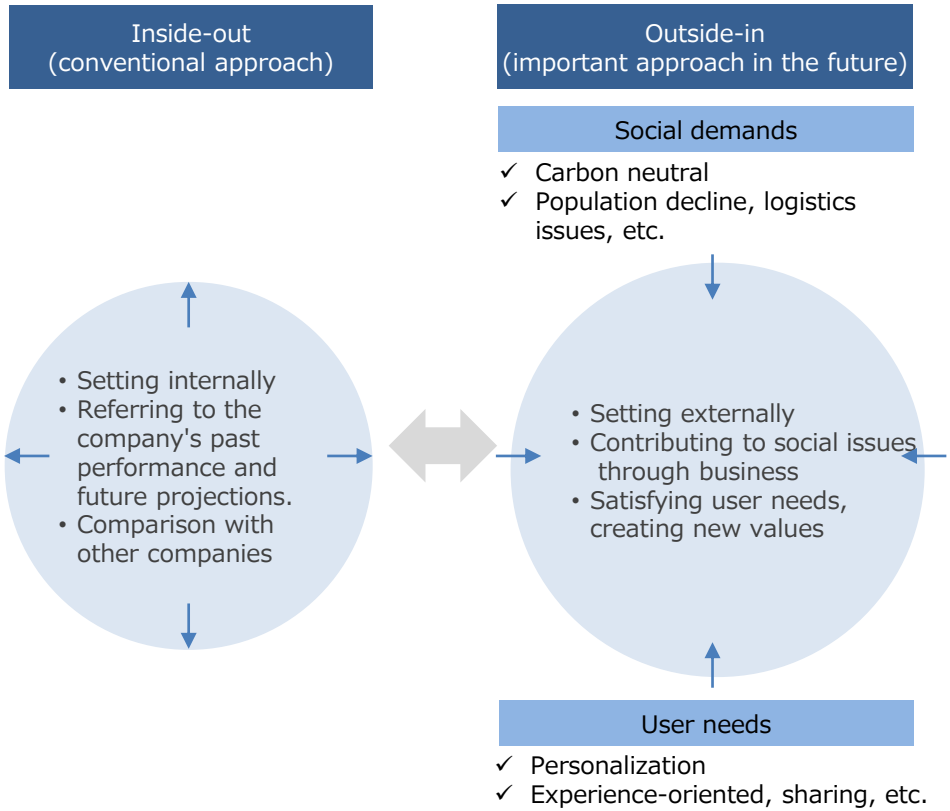
Strategy (medium-to long-term)

- Securing and strengthening management resources
- Initiatives for sustainability
- Initiatives for DX(SDV)
- Allocation of management resources (portfolio management)

Perception of the cost of capital

Corporate value enhancement (securing necessary funds)

Viewpoint of strategy-making and KPI setting



<Reprinted> Strengths of Emerging OEMs that Have an Advantage in a New Competitive Landscape

- Both **the development environment** capable of zero-based development and **the business thinking** of aggressively investing in projects that do not lead to short-term monetization are the sources of the competitiveness of emerging OEMs.
- On the other hand, existing OEMs are burdened by **legacies in their supply chains and models**, which require significant adjustments, creating a bottleneck when it comes to rapid and innovative development.

Gaps between the development capabilities of existing OEMs and emerging OEMs

	Existing OEMs	Emerging OEMs
Development environment	✓ Since the availability of SC is a prerequisite, there are many items to be adjusted and matched, and it takes time to develop. Major changes are also difficult. ✓ Fundamental renewal is difficult to carry out development based on existing models. There are also cases where the development and production environments of existing vehicles, such as ICEs and HEVs, have an impact.	✓ No legacy, such as SC or modeling, enables efficient and rapid zero-based development. ✓ Able to produce and develop innovative products without being constrained by eexisting ICE and HEV. it is also possible to specialize in the production of competitive vehicles.
Management environment	✓ **The achievements of existing businesses serve as obstacles,** making it difficult to implement bold shifts in thinking. ✓ Large-scale investment in projects that do not lead to short-term monetization is difficult due to the large number of employees and relationships with stakeholders such as shareholders.	✓ Holds flexible business thinking utilizing data and a management philosophy that enables aggressive investment of resources in new business areas that do not lead to monetization in the short term.

A development environment unbound by legacy systems, along with a management mindset and environment that can allocate significant resources to new businesses, becomes a source of competitive advantage over existing OEMs that hold many legacies.

Sources: Prepared by METI based on various published materials, etc.

Initiatives of Major OEMs

- Major OEMs also view SDVs as a source of future earnings and are investing and developing them.

Toyota (Japan)

Accelerating investment to develop **"SDVs that are unique to Toyota"**

- ✓ Raising "realization of the multi-pathway strategy" and "acceleration of investment in the creation of the infrastructure of SDVs that is unique to Toyota" at the FY2023 financial results announcement
- ✓ Announced the **investment of 1.7 trillion yen (+0.5 trillion-yen YOY) in growth areas**, including SDV, in a single year of FY2024

Nissan (Japan)

Announced a policy to expand SDV from 2025 in the long-term business strategy

- ✓ **Planning to introduce SDVs with new in-house software in 2025**
- ✓ Planning to **expand the functionalities of OTA** to enable updating of driving assistance technologies, e-powertrains, and other functions in 2025

Honda (Japan)

Announced a plan to double the amount of investment to strengthen the competitiveness of EVs and SDVs in 2024

- ✓ Announced **a 10 trillion-yen investment plan over 10 years through FY2030** to expand EVs and strengthen software development for automated driving, etc.
- ✓ Planning **to realize Honda's unique SDVs** with newly developed electronic PF in addition to newly developed EVPF

VW (Germany)

Established CARIAD, a subsidiary specializing in software development, to bring software PF in-house

- ✓ **Actively collaborating with other companies to promote development**, including establishing a joint venture with a Chinese AI semiconductor company, in addition to its business alliance with Bosch
- ✓ Recently, there have been reports of a reduction in the workforce of thousands, and some say that development has been delayed

Renault (France)

Established Ampere, a subsidiary specializing in EVs and software, to promote SDV development

- ✓ **Developing efficiently** by separating from the internal combustion engine operation and **specializing EVs and software**
- ✓ **Actively forming alliances with core companies such as Qualcomm and Google, in** addition to investments from Nissan and Mitsubishi Motors

GM (US)

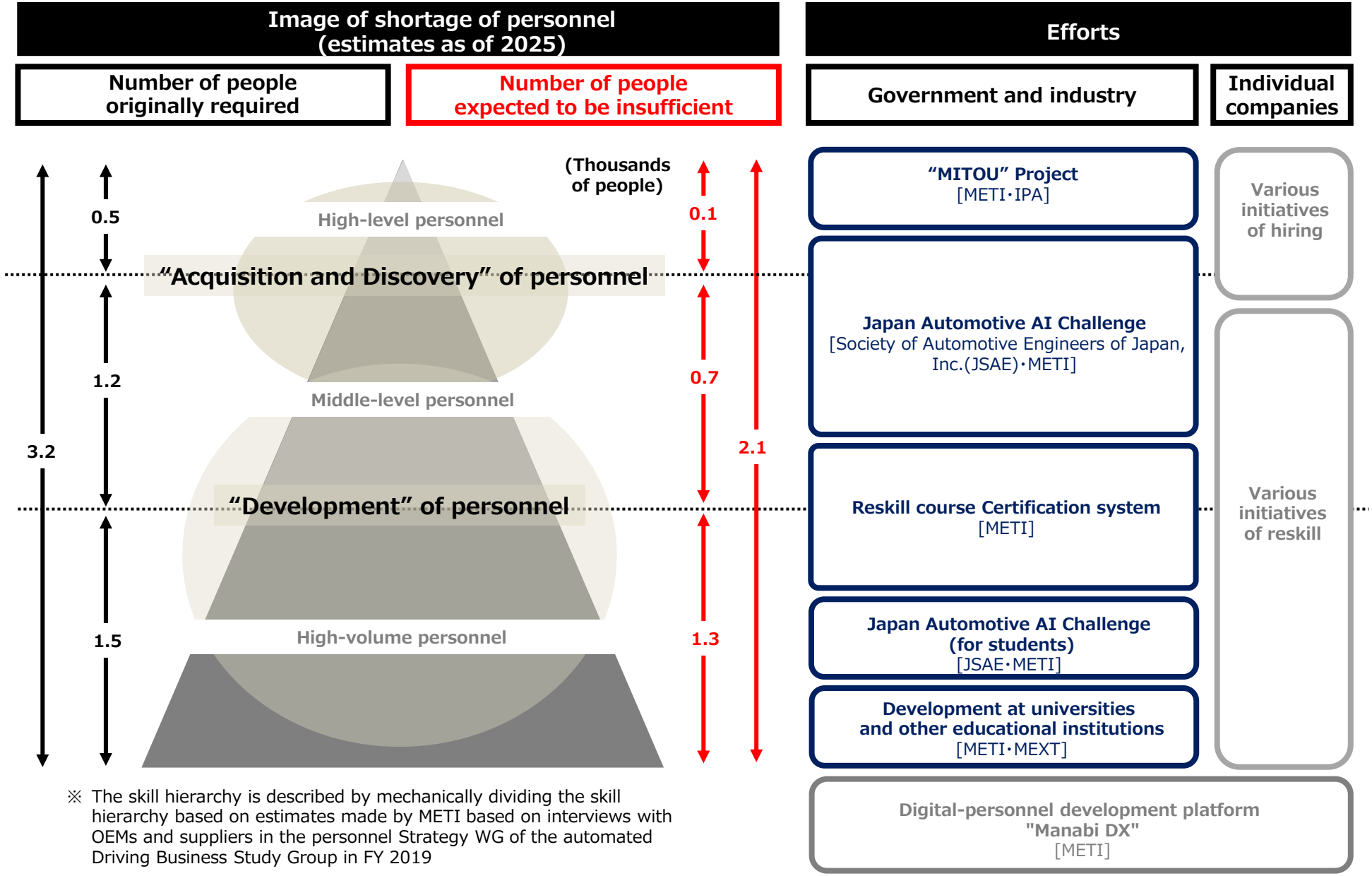
Partnered with pioneering providers **to promote software PF development**

- ✓ Partnering with Red Hat **for continued development of GM's Ultifi software PF**, planned for market launch in 2023
- ✓ Investing 27 billion USD in EV and automated driving in the five-year period from 2021 to 2025

Sources: Prepared by METI based on Marklines and various published materials such as IR and press releases of each company

— Realizing Flexible and Speedy Management
— **Acquiring and Developing Software Personnel**
— Promoting Corporate Tie-ups
— Development of "Communities"

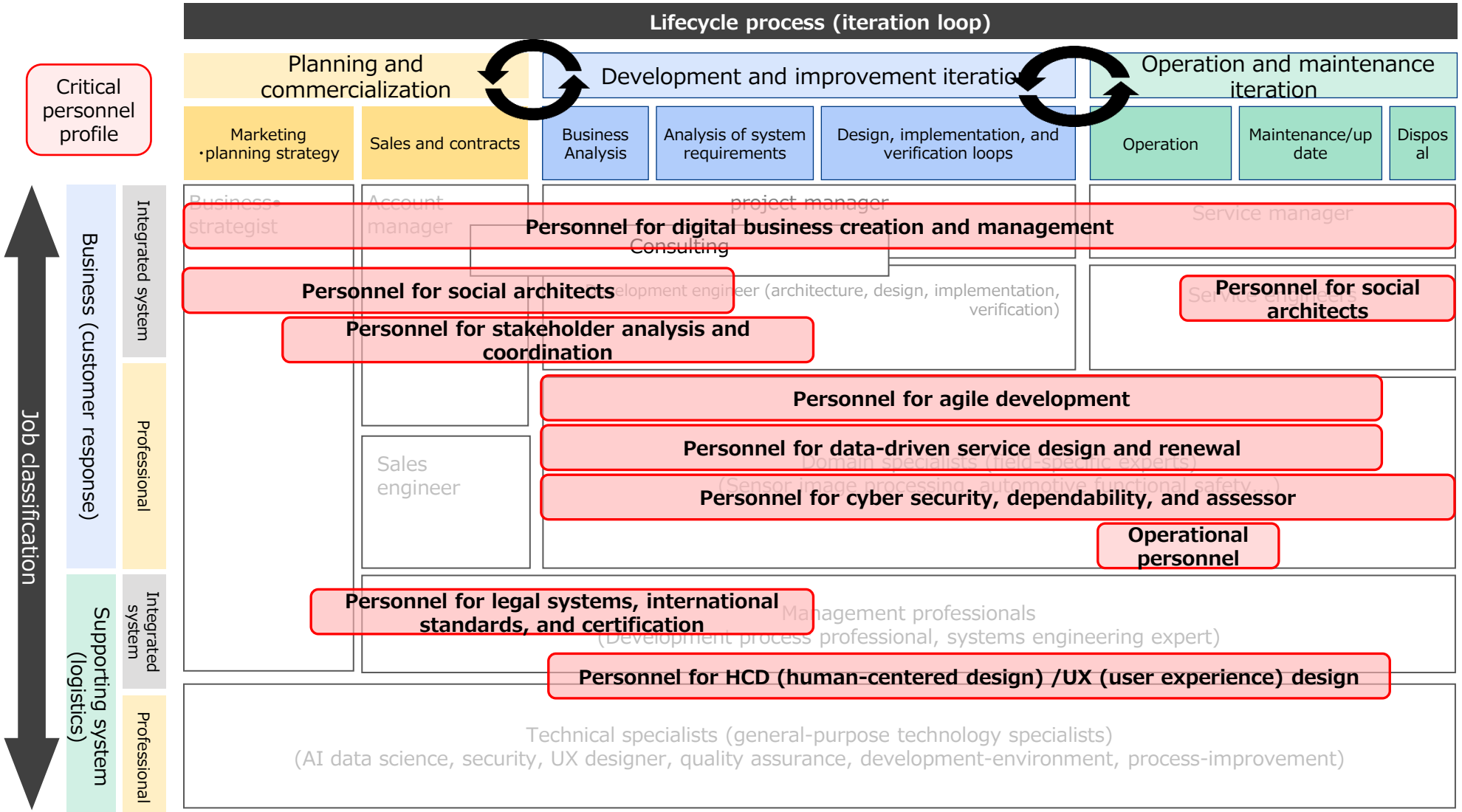
Securing (Acquiring and developing) Software Personnel in the Automotive Industry



※ The skill hierarchy is described by mechanically dividing the skill hierarchy based on estimates made by METI based on interviews with OEMs and suppliers in the personnel Strategy WG of the automated Driving Business Study Group in FY 2019

<Reference> Types of Software Personnel

- Among software personnel, new personnel who do not fit into the traditional personnel profile (job type and task) but are **particularly necessary and urgent are organized as "critical personnel profile.**



※The horizontal axis is the entire lifecycle process based on systems engineering, etc., and the vertical axis is a framework classified based on job types based on ETSS, etc. The background is an example of existing common job types.

<Reference> Detailed Explanation of “Critical Personnel Profile”

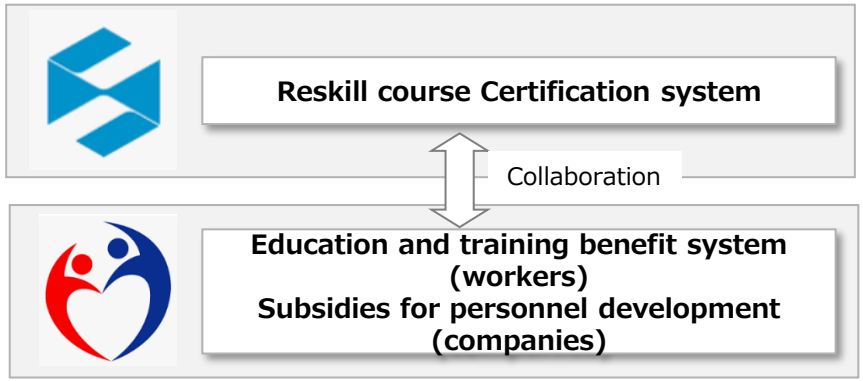
"Critical personnel profile"	Tasks (businesses and roles)	Required skill set (examples)	issues and disabilities
Personnel for digital business creation and management	Based on social needs, plan and conceptualize projects that utilize digital technology, and unite necessary stakeholders to promote the entire project.	Business model design, service engineering, service revenue analysis, service operation design, system thinking, service design, stakeholder analysis, business system construction and management	There is a lack of personnel with comprehensive capabilities that combine broad knowledge of social needs, technological seeds, and business planning and promotion with digital skills.
Personnel for social architects	Design the architecture of the whole society based on the consistency and constraint of the whole user, town, service, legal system, etc.	Stakeholder analysis, urban design, modeling, simulation, optimization, regional resource analysis, existing traffic service impact analysis, user requirement definition, legal system information	There are few personnel who can see the overall structure from a bird's eye view that includes not only the system, but also users, society, and the legal system.
Personnel for stakeholder analysis and coordination	Identify stakeholders such as users and related businesses, analyze relationships, design business models, and coordinate to ensure social acceptability.	User modeling, stakeholder communications, regional needs extraction, risk communication, UX design, user requirements analyse, and architectural design	Small and medium-sized local governments have few personnel who can negotiate and coordinate with external stakeholders.
Personnel for agile development	Separate systems into areas requiring security and agility, and for agility, maximize user satisfaction by repeatedly developing and improving service systems to meet user needs.	User needs analysis, stakeholder analysis, business model design, design thinking, devOps, UX design, test drive development, de-grade testing, continuous integration and delivery, hypothesis verification, development environment construction, security management, refacterization, site reliability engineering	There are few agile development personnel in the mobility area, and it is necessary to eliminate gaps in development culture.
Personnel for data-driven service design and renewal	Develop and continuously update new services by utilizing and analyzing data obtained through new sensors and operation management.	Data platform construction, AI/ data science, service engineering, agile and DevOp	Few personnel have both domain knowledge of diverse operation data and expertise in advanced AI/ data analysis.
Personnel for cyber security, dependability, and assessor	Ensure overall safety and security not only on the system side but also on the user's understanding, misuse, etc.	Coordinated safety, functionality safety, SOTIF, security management (CSMS), functional of collaborative multiple systemssafety (IEC syc active assisted living), usability, accessibility, user model analysis, security threat analysis, stakeholder analysis	・Security is essential to ensure safety. ・Response to mandatory requirements by type certification by 2024 ・Few personnel are capable of handling both security and functionality safety.
Operational personnel	Within the operational business in the automated driving service, the work related to remote monitoring, remote operation, and emergency response can be carried out. Monitoring multiple vehicles in real time from a remote monitoring center to confirm the safety of passengers’ getting on and off and remotely operate them as necessary.	Remote safe operation, remote monitoring terminal operation such as vehicle operation, remote vehicle operation, safety management response such as passenger safety assurance and accident prevention, traffic service management such as autonomous operations, and peripheral service management such as regional services	Though it is not technically difficult, it is a new job type, and it is necessary to secure personnel as soon as possible.
Personnel for responding legal systems (To be confirmed)	By grasping the trend of the legal system and making the approach to the revision, the requirement definition and future plan required for the system and service are prepared. (to be confirmed)	Functional safety, type certification, security laws and regulations (UNR155, ISO/SAE21434), criminal liability for automated driving vehicle accidents, road traffic laws (to be confirmed)	Legal systems are underdeveloped, and skills are not determined. (to be confirmed)
Personnel for HCD (human-centered design) /UX (user experience) design	Collect information on needs and satisfaction from users through service operation provide, and design for improvement value from the viewpoint of user interfaces (UI, user experience (UX), and human-centric design (HCD).	Stakeholder analysis, user needs extraction and analysis, user modeling, cognitive gap analysis, ergonomics, software engineering, quality modeling (ISO/IEC25000 series), quality assurance, usability, claim management, user requirement definition, infrastructure cooperative design, architectural design, HMI design, scientific and technical communications, regional development planning, regional characteristics and needs analysis, ELSI (ethical and social issues)	There is a shortage of skills, essentially, required for all of both system providers and system users.

Examples of Personnel Development: Reskill Course Certification System (METI and MHLW)

- **Established the automated driving field in the "Reskill course Certification system,"** in which the METI Minister certifies excellent educational courses. In cooperation with the MHLW, **up to 70% of the cost of attending an accredited course will be subsidized.**
- Currently, **two courses are certified in the automated driving field**. In the future, they will continue to expand the number of certified courses and **improve the environment for software personnel development.**

[Overview of the system]

- A system in which the METI Minister certifies practical educational courses to acquire a high level of expertise.
- Growth fields such as IT are targeted, and the automated driving field was established.
- The program is linked to subsidies from the MHLW, and up to 70% of the course cost is subsidized.



[Outline of reskill courses]

<Complete course for construction of automated driving system>

- **zero to one Co., Ltd. opened in collaboration with TIER Ⅳ,Inc. and Nagoya University.**

- By using the automated operation system "Autoware", the practice of automated driving system construction such as self-position estimation, outside world recognition, route planning, operation control, etc. is comprehensively studied.

<IoT practical course: automated driving system production course>

- **Embex Education Co., Ltd. opens.**
- Learning Python and Web Technologies. Students will learn the knowledge necessary to design services with a view to social implementation, such as controlling robot car driving and acquiring remote control technology, as well as making a virtual city development plan and devising requirements for automated driving services to realize the plan.

Personnel Acquisition and Identification Efforts: Japan Automotive AI Challenge (JSAE and METI)

- "Japan Automotive AI Challenge" is an initiative sponsored by JSAF to **discover outstanding personnel from different industries and doctoral and graduate schools with advanced AI and IT skills in the software domain**, including automated driving, and to **promote the attractiveness of software development in the automotive industry.** Participants compete to see **how fast and safe they can drive on a specific course** using open-source software.
- **"Integration Games"**, where vehicles equipped with the developed software run on site, and **"Simulation Games"**, where vehicles run on a simulation environment that reproduces actual identification areas, are held.

[Last year's results]

<Integration Games>
- Schedule: July and August 2023 (preliminary), November 2016 (final)
- Location: Kashiwa Campus, Institute of industrial Science, the University of Tokyo
- Participants: 174 teams, 254 people
- Awardees belong to: the University of Tokyo, Nagoya University, etc.

<Simulation Games>
- Schedule: December and January 2023
- Location: Online, Tokyo Culture Center (award ceremony)
- Participants: 108 teams, 171 people
- Awardees belong to: the University of Tokyo, Nissan Motor Co., Ltd., etc.

A scene from the competition

Award ceremony

Sources: Prepared by METI based on various published materials, etc.

Efforts in FY2024

- **Securing (acquiring and developing) software personnel is an urgent issue** in order to respond to future SDV and automated driving services.
- The company will promote efforts **in both cooperative areas**, such as the development of skill standards and the expansion of courses for critical personnel and the expansion of the base of personnel, **and efforts by each company**, such as the development of skills specific to each company and partnerships with outside firms. At the same time, **efforts will be made to address the shortage of personnel by developing more efficiently and reducing the number of personnel** by improving the reusability of software and utilizing simulation environments.

Two-pronged efforts

Direction of efforts in FY2024 (efforts in the coordination area)

<Reference> Efforts made by companies

Securing software personnel

Acquisition of outside personnel

① Japan Automotive AI Challenge

- The outline of the competition was renewed from FY2023 with the aim of improving appeal to targeted personnel (students, young adults, etc.) and upgrading required skills.
- The competition site will be changed from Kashiwa Campus, the University of Tokyo to Odaiba City Circuit Tokyo Bay, the running cars will be changed from golf carts to go-karts, and the content of the competition will be changed to medium speed range running (40km). Consideration will also be given to the utilization of each company for selection.

② New "Automotive CTF Japan"

- A new security hacking competition will be held to expand the base of cybersecurity personnel in cars and to detect and accumulate vulnerability information. Knowledge gained will be also provided to J-AUTO-ISAC.

Development of internal personnel

③ Expansion of the reskill course for the development of security and social architect personnel

- Leveraging the skill standards of "security personnel" and "social architects" developed in FY2023, the courses in the METI's Reskill course Certification system will be expanded.
- As a candidate for the course, cyber security courses of JASE, etc. are assumed.

④ developing skill standards for cybersecurity assessors

- To meet UNR-155 and UNR-156, it will be important to have personnel (= cyber security assessors) who evaluate and certify personnel who meet the skills required of security personnel, such as security threat analysis, at automobile-related companies and external support companies.
- New skills standards for cybersecurity assessors based on cybersecurity skill standards will be developed.

<Reference> Efforts made by companies

- **Honda**
  - Tie-up with SCSK in Japan. Expanded to 1000 employees by 2030
  - Tie-up with KPIT in India. Expanded to 2,000 employees by 2030
- **Toyota**
  - Increase SW personnel ratio of career recruitment to 50% in FY2022

- **Toyota**
  - Increase the number of listing trainees to 9,000 by 2025
- **Nissan**
  - Approximately 500 employees have been trained at the Nissan Software Training Center (opened in 2017).

Sources: Prepared by METI based on various published materials, etc.

<Reference> Efforts in Europe and the U.S.

- Efforts to identify personnel through competitions are also progressing in Europe and the U.S..

Type	Initiatives	Region	Details
Challenges	Waymo Open Dataset Challenge	The U.S.	Innovation in AD and ML was promoted through the public of diverse data sets, competition, and prizes to top-ranking individuals. (From 2020, participants: 100 teams (1-10 persons each) (2020))
Challenges	Stellantis Hackathon	The U.S.	Participating university teams developed a game-based driving application that promotes safety and fuel efficiency by utilizing cloud-based Stellantis SDK* and vehicle data. (2022, participants: 5 selected teams (4-6 persons each))
Challenges	Eclipse SDV Hackathon Challenge	Europe	A coding marathon was held to bring together people who love automotive software to build innovative features and explore technology with guidance from key industry leaders. (2023, participants: 75)
Challenges	Porsche NEXT OI Competition	Europe	Developers were invited and given the opportunity to access prizes , diverse tools and platforms through the development of innovative apps for Porsche's sports cars using a simulated API. (2018-2019, participants: 749 (2019))
Workshops	NVIDIA workshops	Global	Workshops on AD, ML, and AI were held to promote interest and involvement in the automotive industry among attendees, including students and young professionals.
Campus school programs	Volkswagen Group of America and the Urban League Future Leaders in mobility Program	The U.S.	Programs in software development and technical fields were provided to young talent, offering opportunities for significant achievement and career growth. (2021~)
Campus school programs	Bosch Student Ambassador Program	Global	Through Campus Ambassadors, students were better prepared for the industry by increasing their interest in engineering and collaborating on future solutions.
Campus school programs	Continental Ambassador Program	Global	Brand ambassadors served as intermediaries between the company and the public, providing potential candidates with insight into the organization while gaining valuable experience and expanding their networks.

* Stellantis SDK refers to Stellantis Software Development Kit

Motive

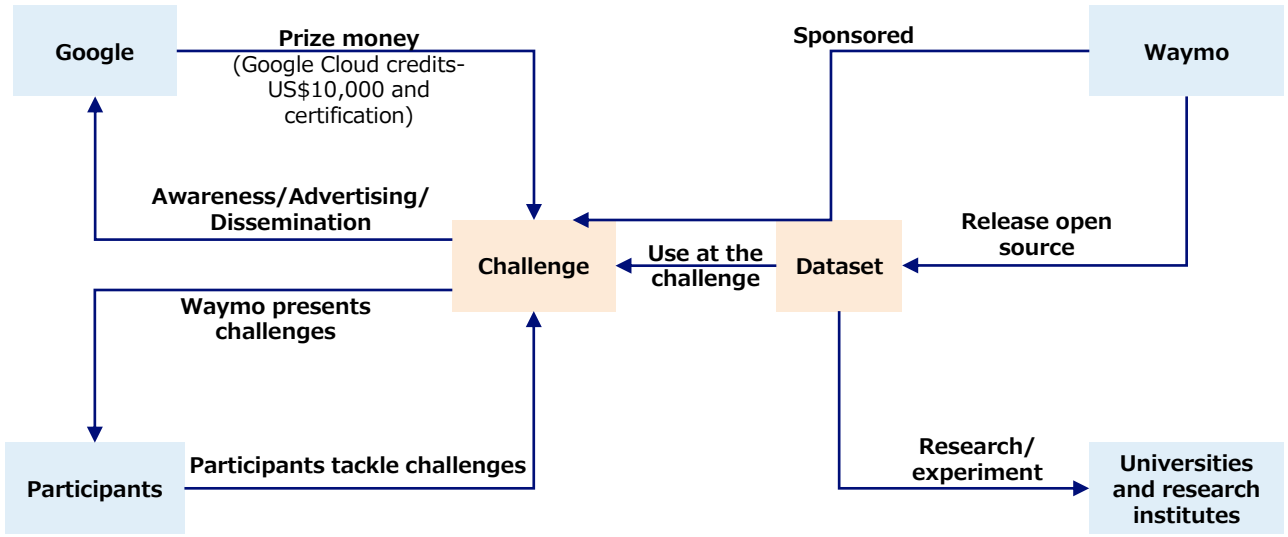
- Attract young talent to the car software sector
- Promote collaboration in industry by involving multiple stakeholders, including OEMs, tier1 suppliers, technical players, universities, specialists, and students
- Solving existing problems in the software area by releasing datasets to the public
- Recognize talented personnel in the software area and educate them about potential opportunities in the industry

Sources: Prepared by METI based on various published materials, etc.

<Reference> Efforts of Waymo

- Through its Open Dataset Challenge, Waymo is seeking to attract talented young people in the industry. At the same time, it is seeking to resolve established problems by publishing data sets for research.

Waymo Open Dataset Challenge



Through its Open Dataset Challenge, Waymo attracts talented young people who participate in and engage in the car software sector.

The winners include participants from Xi'an Jiaotong University (China), Nanyang Technological University (Singapore), Max Planck Institute (Germany), Carnegie Mellon University (USA), DiDi automated driving (China), Northeast University of China, Chinese Academy of Sciences University (China), and Alibaba (China).

Details of Challenge in 2023

① 2D videos panoptic segmentation*	② Attitude estimation (pose estimation)	③ Behaviour forecast (motion prediction)	④ Simulation agent
Create a set of panopic segmentation labels for each pixel, and ensure that the instance labels are consistent across all images in the sequence	Predict 3D key points (coordinate points) for pedestrians and bicycles in the scene, within 25m of the automated vehicle	Predict the position of up to eight agents (vehicles, pedestrians, etc.) to eight seconds ahead	Simulate 32 realistic joint futures for all agents (objects such as cars and pedestrians) in the scene

*Panoptic segmentation is a method that identifies each object in a single image individually and accurately depicts each boundary, and is one of image recognition techniques.

Sources: Prepared by METI based on various published materials, etc.

— Realizing Flexible and Speedy Management
— Acquiring and Developing Software Personnel
— Promoting Corporate Tie-ups
— Development of "Communities"

Developments in Collaboration Between Enterprises

- **It is vital to further promote inter-enterprise collaboration aimed at utilizing external resources/know-how, such as collaboration with OEM and IT companies.**

Honda Motor co., Ltd. × SCSK

Summary

- In July 2023, Honda Motor co., Ltd. Reached a basic agreement with SCSK on a partnership for software development.
- In response to the increasing importance of software development for accelerating the development of software-defined mobility, partnerships have been formed.
- Efforts will be made to accelerate software development in areas such as operating systems for next-generation electronic platforms, electric powertrains, advanced safety and automated driving, and in-vehicle infotainment (IVI).

Aim of collaboration

- Aiming to maximize synergies between engineers and develop next-generation competitive software-defined mobility products and services, they will continue to cultivate software engineers.

Items provided by honda motor

- **System control technology and safety control technology**

Items provided by SCSK

- **IT technologies**
- **IT engineers: planning to increase the number of IT engineers for Honda to 1000 by 2030**

Honda Motor co., Ltd. × KPIT Technologies

Summary

- In March 2023, Honda Motor co., Ltd. Reached a basic agreement with KPIT technologies (India) to form a software development partnership.
- Working together to accelerate software development in the domains of next-generation electronic platform operating systems, electric powertrains, advanced safety, automated driving, and ivi and connected devices.

Aim of collaboration

- For realizing new value created by software

Items provided by honda motor

- **Software architecture and control and safety technologies**

Items provided by KPIT technologies

- **Software development capabilities**
- **Development personnel: plan to expand the number of vehicle system software development experts to 2,000 by 2030**

Mazda × Unity

Summary

- In March 2024, Mazda formed an alliance with unity to strengthen its user interface (HMI) and graphic user interface (GUI).
- The aim of this collaboration is to develop functionalities and introduce these functions into mazda's automotive os from 2025 onward.

Aim of collaboration

- In car designing and engineering, they will promote HMI and GUI development and utilize unity tools to reduce businesses and improve efficiency.

Items provided by mazda

- **Test environment: mazda provides a test environment for unity's GUI solutions in a real environment.**

Items provided by unity

- **Technical expertise: provides software development tools and reduces the cost-of-in-house development**
- **Cross-platform support: can be deployed in various models, reducing the need for redevelopment**

Renesas × EdgeCortix

Summary

- In October 2023, Renesas formed an alliance with EdgeCortix, a company specializing in energy-saving AI treatment solutions at edge.
- Renesas invested in EdgeCortix's most recent round of financing.
- The alliance aims to provide renesas with unique access to EdgeCortix technologies.

Aim of collaboration

- Streamline and unify AI/ML developer experience across renesas MCU and MPU. It also delivers back-end tiers that support heterogeneous architectures, ultimately reducing customer development risk, time, and cost

Items provided by rRnesas

- **IP: Offers EdgeCortix the ability to leverage its existing IP and hardware.**
- **AI expertise: Provides expertise in solutions for embedded processors and other ai**

Items provided by EdgeCortix

- **Embedded technologies: provides key technologies such as apache TVM and compiler development**
- **Hardware expertise: provides hardware expertise utilizing arm and other**

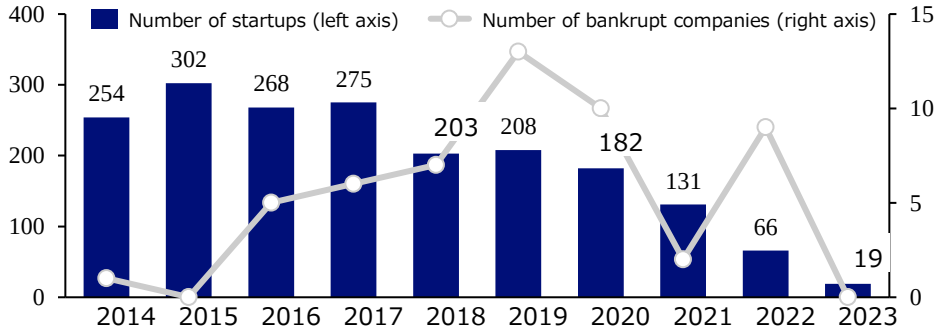
Sources: Prepared by METI based on various published materials, etc.

Mobility Startup Trends

- It is also important to **create startups** with high technological capabilities and flexible business ideas.
- While hundreds of startups have been created worldwide each year, they are still single-digit in japan.

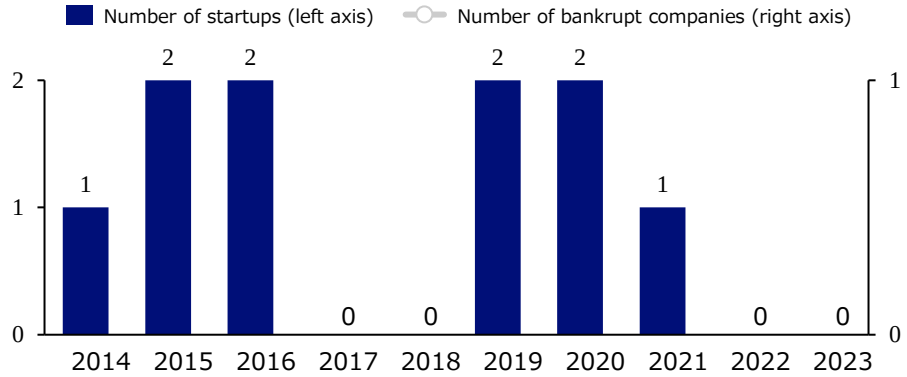
Number of automated driving startups (worldwide)

- In the latter half of the 2010s, several hundred automated driving-related startups were born every year in the world.



Number of automated driving startups (Japan)

- In Japan, 1-2 companies for automated driving-related startups have been born each year.



Automated driving startups (japan)

Company name	Business Overview	Year of establishment
FUTU-RE	Provides technology and research and development support specialized in the field of automated driving for domestic companies and government agencies	2014
TIER Ⅳ	Provides solutions for the development and operation of automated vehicles	2015
SIRIUS PLUS Ltd	Develops a holographic operating system that functions on the windshield	2015
BOLDLY (Former SB Drive)	Conducts development and demonstration tests related to the introduction and operation of automated vehicles	2016
U-MaP	Engages in the development and manufacturing of heat dissipation materials related to thermal management functions for EVs and other applications	2016
Vehicle Energy Japan	Develops and manufactures automotive lithium-ion batteries and battery management systems	2019
Idriverplus	Develops and manufactures onboard lithium-ion batteries and battery management systems	2019
ASF	Engages in the planning, development, manufacturing, and sales of EVs	2020
Zatitech	Develops automated driving vehicle control system and HD map-based automatic generation SW	2020
TURING	Develops and manufactures fully automated driving EVs	2021

Sources: Prepared by METI based on CrunchBase, and tracxn

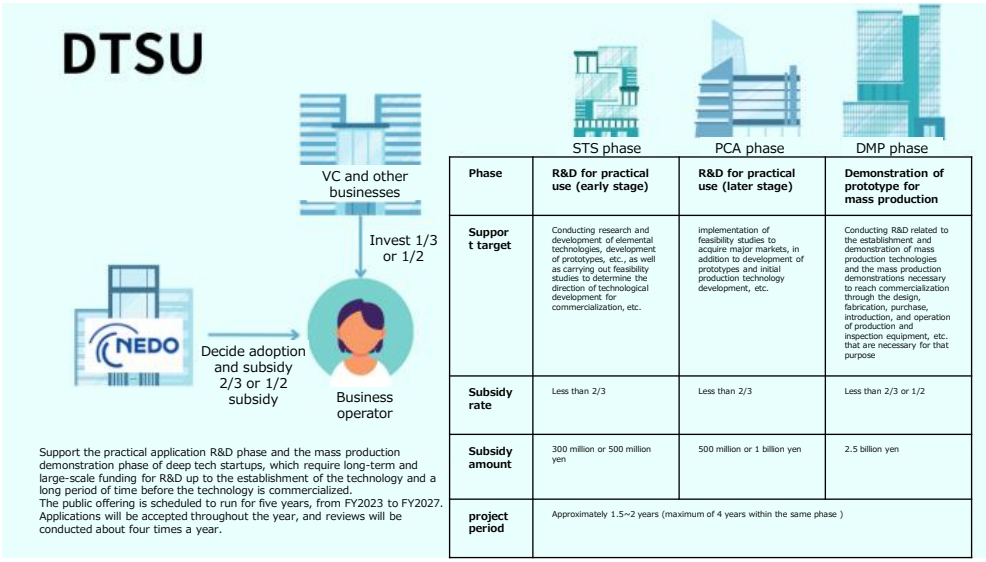
Examples of Startup Support Measures (Deep-Tech Startup Support Program)

- The government implemented various support measures to create startups. For example, **support is provided through NEDO projects for long-term R&D and "deeptech" R&D that requires large-scale funding before technology is established, commercialization, or social implementation.**
- **TIER Ⅳ** utilizes this project to **develop modules necessary for automated vehicles.**

Outline of the Deep-Tech Startup Support Program

[Overview]

- Provide support for research and development and commercialization to startups engaged in deep tech development during the phases of business development research and development and mass production verification.



Phase	R&D for practical use (early stage)	R&D for practical use (later stage)	Demonstration of prototype for mass production
Support target	Conducting research and development of elemental technologies, development of prototypes, etc., as well as carrying out feasibility studies to determine the direction of technological development for commercialization, etc.	implementation of feasibility studies to acquire major markets, in addition to development of prototypes and initial production technology development, etc.	Conducting R&D related to the establishment and demonstration of mass production technologies and the mass production demonstrations necessary to reach commercialization through the design, fabrication, purchase, introduction, and operation of production and inspection equipment, etc. that are necessary for that purpose
Subsidy rate	Less than 2/3	Less than 2/3	Less than 2/3 or 1/2
Subsidy amount	300 million or 500 million yen	500 million or 1 billion yen	2.5 billion yen
project period	Approximately 1.5~2 years (maximum of 4 years within the same phase)		

Support the practical application R&D phase and the mass production demonstration phase of deep tech startups, which require long-term and large-scale funding for R&D up to the establishment of the technology and a long period of time before the technology is commercialized.
The public offering is scheduled to run for five years, from FY2023 to FY2027.
Applications will be accepted throughout the year, and reviews will be conducted about four times a year.

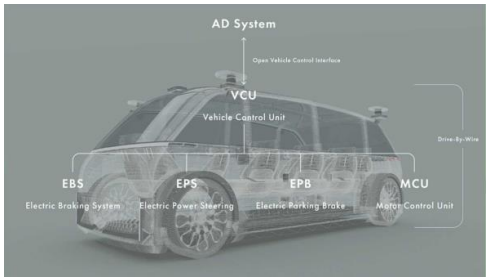
Outline of TIER Ⅳ adopted program

[Objectives]

- Progressing the development of four integrated modules (software, steering, braking, and sensors) as a software-integrated electrification module that meets the requirements for Level 4 automated driving, thereby establishing a foundation for future mass production and achieving early social implementation of automated driving.
- Major customers are OEM･ODM manufacturers planning the development of automated vehicles, tier 1 suppliers responsible for the development of automated driving equipment, and others.

[Overview]

- Develop modules composed of three core technologies in accordance with the electrification module requirements for Level 4 automated vehicles. Provide the necessary modules for safe automated vehicles, regardless of vehicle type or class.



Sources: Prepared by METI based on various published materials

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Launch of the Mobility DX Platform

- **The formation of a community is** also important for **fostering momentum and enhancing the sustainability of initiatives,** and the **mobility DX Platform** will be launched **this fall** as a **community to gather and allow interaction among various companies, personnel, and information** related to SDV and automated driving to **(1) acquire and train personnel, (2) share information and promote collaboration among companies**, and **(3) study new initiatives. The mobility DX Platform** will be launched this fall.

METI

Management → **Mobility DX study group**

Mobility DX platform (new community)

Main Activities: (Start with SDV and automated driving initiatives, and gradually expand to data utilization, etc.)

① **Organize competitions** and **provide learning courses to** attract and develop personnel
② **Regular information dissemination**, **events and workshops to** promote information sharing and collaboration among companies
③ **Discussion of new initiatives** and **sharing of trends in existing projects to** promote R&D, demonstration, and standardization

~Specific examples of ~activities~

<Legend> New Initiatives existing initiatives

(1) personnel acquisition and development	(2) Promote information sharing and collaboration	(3) Consideration of new initiatives, etc.
Organizing competitions (Automated Driving AI Challenge, Cyber Security Competition, etc.)	**Regular information dissemination** (E-newsletters, talk sessions, etc.)	**Considering initiatives in new areas where existing projects do not exist** (API standardization, data utilization, etc.)
Provision of study courses (Reskill course Certification system, etc.)	**Organizing events and workshops** (Networking events, etc.)	**Sharing trends of Existing projects** (Road to the L4, etc.)

Existing communities (Examples)

Continue activities of existing communities in each community, while promoting information collaboration

- **RoAD to the L4** (R&D and social implementation of automated driving)
- **Smart mobility Challenge** (MaaS demonstration project)
- **Digital Agency mobility Roadmap**
- **Digital Lifeline Comprehensive National Development Plan (1962-)** Note: cooperation in the future
- **SIP** Note: cooperation in the future

Etc.

Various players will have centralized access to the above activities (1) to (3) through participation in this platform.

Different type of businesses | **Startups** | **OEMs/ suppliers** | **University research institutions** | **Students and individuals**

<Reference> "The Council for promoting the Smart Mobility Challenge Project"

- **The Council for promoting the Smart mobility Challenge project is a virtual council** established in 2019 by METI and MLIT. **Approximately 390 organizations** (as of the end of April 2024), including businesses and municipalities, are members, **facilitating information sharing from the government or among members, regional and business matching, and sharing of results.**

Outline of the Council

- AIST commissioned by METI serves as the secretariat, establishes a dedicated website, and operates a council.
- There is no annual membership fee or registration fee. As of the end of April 2024, approximately 390 organizations participated.

The Council for promoting the Smart mobility Challenge project website

Specific activities of the council

- The following three activities were carried out:

① **Disseminating information**
Reports and guidebooks on the results of demonstration projects and leading examples from various regions are published, along with regular email newsletters.

② **Symposiums and events**
Symposiums and events are held in various locations to facilitate collaboration and matching between local governments and businesses, as well as to promote the horizontal expansion of leading examples. Additionally, several times a year, experience tours to regions with leading examples are conducted, offering test rides and opportunities for exchange of opinions.

③ **Policy Trends**
Reports on research and development and demonstration projects related to automated driving and MaaS from METI and MLIT are published.

Results briefing held in February 2024
(Hibiya Midtown)

Experience tours held in January 2024
(Shiojiri, Nagano)