"Strategic Innovation Promotion (SIP) Program for Automated Driving Systems"

Feasibility study aimed at the multipurpose use of dynamic maps for use in studies and investigations of the approaches to use in resolving issues affecting the realization of automated driving systems

Report (Overview)

March 28, 2018

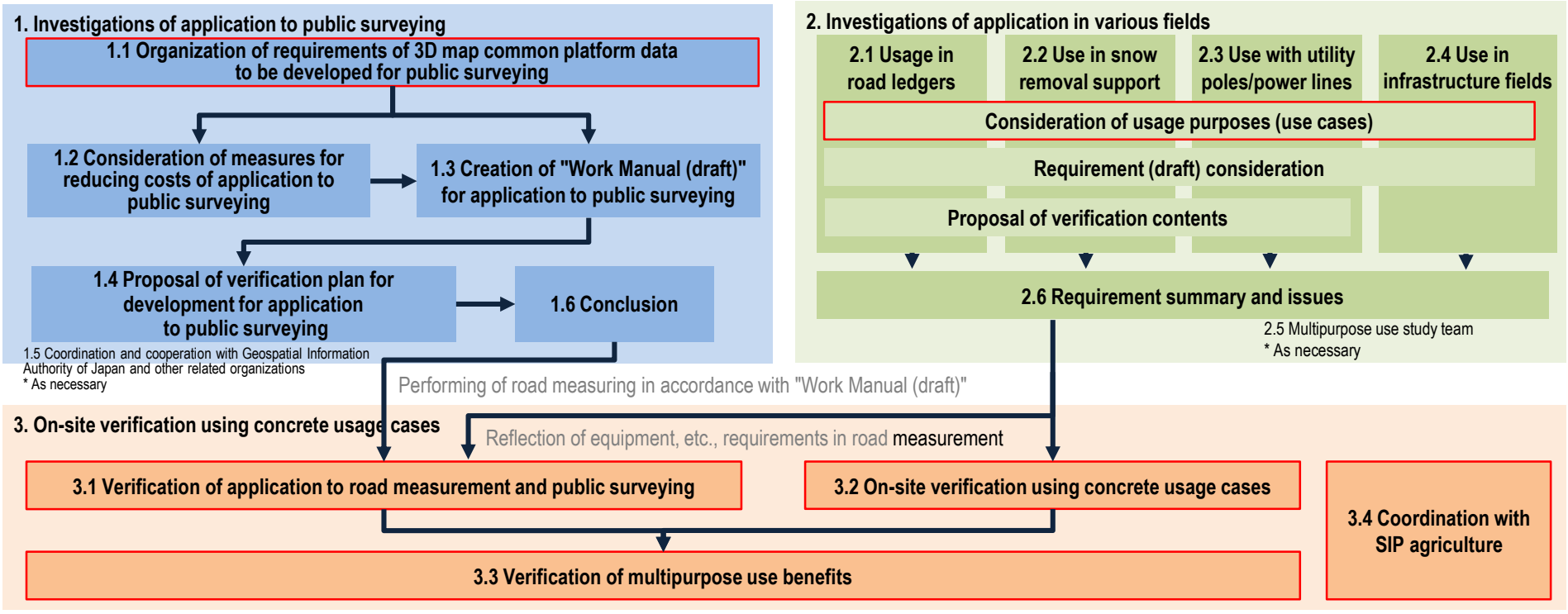
Dynamic Map Common Platform Study Consortium

Contents

Investigation process of this study and items reported for this overview

- In Chapters 1 and 2 of this operation the requirements for the application of 3D map common platform data, etc., for automated driving to public surveying and the requirements for its use in various fields (multipurpose use) were considered. In Chapter 3 actual data was used in verification, requirements were reviewed and revised, and result verification, etc., were performed. This overview therefore primarily reports the results of the investigations in Chapter 3.

  * In creating an "Operation Manual (draft)" aimed at application to public surveying, for this operation the "Operation Manual (draft)" was organized and named the "Work Manual (draft)" based on meetings with the Geospatial Information Authority of Japan.



* Items outlined in red in the diagram are reported in this report (overview)

1. Investigations of application to public surveying
Organization of requirements of 3D map common platform data to be developed for public surveying

- Data preparation specifications, etc., for dynamic maps for automated driving were compared with public surveying (work regulation standards), and issues which would present challenges to applying 3D map common platform data, etc. to public surveying, as well as measures for handling those issues (requirements) were organized.
- Issues which were stipulated in the work regulation standards of the "Work Manual (draft)" for application to public surveying but were not stipulated and were changed in the data preparation specifications, etc., for dynamic maps for automated driving were defined.
- The Dynamic Map Platform Company, Ltd., the agent responsible for the preparation of dynamic maps, served as the surveying planning organization of this operation, and performed surveying.

Issues which would present challenges to applying 3D map common platform data, etc. to public surveying		Handling measures (requirements)
System-related	The following two issues exist with relation to the application of measurement results by private companies to public surveying ✓ Approach of using dynamic maps to correct existing public survey results through the "use of measurement results by private companies (notification pursuant to Survey Act Article 46 Paragraph 1)" ✓ Approach of having dynamic map preparation agent perform measurements as a surveying planning organization (falling under Survey Act Article 5 Item 1)	**Consider taking approach of having dynamic map preparation agent perform measurements as a surveying planning organization** so that measurement results by private companies can be used even if new. (Survey Act Article 5 Item 2) * The recognition of 3D map common platform data, etc., as public surveying results will objectively demonstrate that it possesses a level of accuracy equivalent to the work regulation standards as well as promoting its use in public fields.
Accuracy-related	Data preparation specifications, etc., for dynamic maps for automated driving do not specify the creation of Ground Control Points (GCPs) stipulated in the work regulation standards, nor do they specify the accuracy, etc., of GCPs.	**Stipulate GCP installation locations and GCP accuracy, etc., in the "Work Manual (draft)" for application to public surveying.**
	Data preparation specifications, etc., for dynamic maps for automated driving do not specify the evaluation and inspection of absolute positions of data for numerical plotting (3D map common platform data) or numerical plotting data (dynamic maps) stipulated in the work regulation standards.	**Stipulate 3D map common platform data, etc., absolute position evaluation and inspection in the "Work Manual (draft)" for application to public surveying.**
Plotting method	Data preparation specifications, etc., for dynamic maps for automated driving do not specify the features stipulated in the work regulation standards. The plotting method of the data preparation specifications, etc., for dynamic maps differs from that of the work regulation standards.	**Stipulate the features and plotting method indicated in the work regulation standards in the "Work Manual (draft)" for application to public surveying. When the agent responsible for the preparation of dynamic maps conducts public surveying, add the features and plotting method needed for automated driving to the manual.**

2. Investigations of application in various fields
Consideration of usage purposes (use cases) [(1) Usage situations and conceptual image]

- Conventional methods were examined on an individual usage situation basis, and potential uses of 3D map common platform data, etc., with conventional methods were organized.

Field	Usage situation	Conceptual image of usage of 3D map common platform data, etc.
Road ledger preparation and updating	**Road ledger preparation (new)**	• For roads for which road ledgers have yet to be prepared, it would be used when newly preparing road ledgers.
	Road ledger preparation (updating)	• For sections of road requiring road ledger updates due to road widening, zone changes, etc., the features, etc., requiring updating would be identified and used when updating road ledger attached diagrams.
Snow removal support	**Operational support for snow removal**	• It would be used to display road conditions (images) of roads before snow accumulation. This would be displayed on tablet devices, etc., based on the position of the snowplow. • It would be used to display warnings regarding the positions of road structures for which care is required when removing snow. These would be displayed on tablet devices, etc., based on the position of the snowplow.
	Provision of snow disposal information	• It would be used to display warning information regarding areas where snow disposal is prohibited. This information would be displayed on tablet devices, etc., based on the position of the snowplow.
	Driving assistance for snowplows	• It would be used to provide automated driving support for snowplows.
Daily utility pole/power line inspection, maintenance, and management	**Maintenance and management operations by telecommunications companies**	• When performing relocation work for telecommunication infrastructure equipment, etc.,, it would be used together with telecommunications ledgers to determine the need for on-site attended work. • When laying new lines, it would be used together with facility management information customer home, distribution pole, and lead-in pole confirmation and route design (basic design) • In utility pole property management operations, it would be used to confirm locations where utility poles could be erected. • On construction on-site attendance operations, it would be used together with telecommunications ledgers to confirm the presence of existing facilities and general burial positions, assisting with initial determination of the need for on-site attendance. • When repairing faults, it would be used to assess in advance the positions of failed equipment and road conditions in the surrounding area.
	Maintenance and management operations by power companies	• It would be used in theoretical confirmation of power distribution work and in the creation of construction-related materials. • It would be used in external visual confirmation during facility inspection operations and used to share problem points.

※**Bold and underlined** usage situation areas are those for which verification has been performed using road measurement data.

2. Investigations of application in various fields

Consideration of range of uses (use cases) [(2) 3D map common platform data, etc. usage methods]

- The use of 3D map common platform data, etc. and dynamic maps, as well as usage methods, were considered for individual fields.
- All data will be used for road ledgers and snow removal support. 3D map common platform data will primarily be used for utility poles/power lines.

		Road ledgers (Road ledger preparation and updating)	Snow removal support	Utility poles/power lines (Daily utility pole/power line inspection, maintenance, and management)
3D map common platform data	Point group data (laser)	○ Of the features prepared in road ledgers, features which are not included in vector data, or which are defined in the preparation specifications, etc.*, as extended features (utility poles, road lights, etc.) would be plotted based on this data	○ Of the features prepared for snow removal support, features which are not included in vector data, or which are defined in the preparation specifications, etc.*, as extended features (parking lots, etc.) would have their location information acquired based on this data	○ Local site confirmation before performing work: Use to identify positions of power lines and distribution poles ○ Use in operations during facility inspection, etc., using new technologies: Use as software input data
	Image data (camera)	○ As above	○ This data would be confirmed for reference purposes when confirming features before snow accumulated	○ Local site confirmation before performing work: Use to confirm utility poles and manholes, diagnose degradation, and for attached photos for road occupancy applications X Use in operations during facility inspection, etc., using new technologies: Not needed, as only point group data is used
Dynamic map	Vector data (plotting data)	○ Of the features prepared in road ledgers, features defined in the preparation specifications, etc.*, as essential features, and which are defined identically (road shoulders, etc.), or which can be used by offsetting (traffic signals, road signs, etc.) would use dynamic maps	△ Of the features, etc., provided for operational support and warning information, features defined in the design specifications, etc.*, as essential features, and which are defined identically, or which can be used by offsetting would use dynamic maps * There were no corresponding features in this study	△ Local site confirmation before performing work: Can be used to confirm presence of management features, but there are few situations in which this confirmation would be necessary X Use in operations during facility inspection, etc., using new technologies: Not needed, as only point group data is used

○: Data use mandatory, △: Data can be used conditionally, X: Low possibility of data use

* Data preparation specifications for dynamic maps for automated driving

3.1 Verification of application to road measurement and public surveying

Verification of application to public surveying [(1) Verification results]

- Road measurement data was used to perform verification of whether the data, when applied to public surveying, provided the level of accuracy, etc., required for public surveying, and of methods for reducing costs through the use of new technologies and improvements to work efficiency.
- The verification found that the method was capable of ensuring sufficient accuracy for the improvement of GCP placement and substitution of local GCPs by existing resources.

Verification contents	Verification pattern	Specific methods and results	Verification results
Improvement of GCP placement efficiency	Road network (area) accuracy management	• The number of GCPs is stipulated by Article 111 of the work regulation standards, but the number of GCPs can be reduced by managing road network (area) accuracy. The procedure consists of the following three steps. (1) Only inspect framework routes: Perform inspection using the GCPs indicated in the work regulation standards only for road network framework routes. (2) Framework route adjustment: In addition to (1), use GCPs to perform framework route adjustment (3) Compositing of other routes: In addition to (2), perform compositing of other routes and inspection of central sections of each of these other routes • When following the work regulation standards, GCPs must be placed at two or more locations, such as the start and end points of each route, but the above method can be used to reduce the number of GCPs that must be established.	Feasible (The investigation showed that if steps (1) through (3) were performed the level of accuracy for the entire route corresponding to the two verified points would be sufficient (for some routes (1) and (2) alone would be enough to provide sufficient accuracy))
Use of existing resources when placing GCPs	a) Use existing aerial photography results	• Use existing resources (aerial photography, MMS measurement data, road ledger attached diagrams, satellite photography, base map information) to determine coordinates of clearly identifiable features and topographical change points, etc., and use them as GCPs. • When following the work regulation standards, GCPs must be measured on-site, but the above method eliminates the need for on-site measurement. *Those GCPs are used only for inspection when trying to "Improvement of GCP placement efficiency".	Feasible (when using map information level 500 aerial photography results)
	b) Use existing MMS measurement data		Feasible (when using map information level 500 MMS measurement data)
	c) Use road ledger attached diagrams		Not feasible (the investigation found that when map information level 1000 road ledger attached diagrams are used, the accuracy of the GCPs does not meet map information level 500 creation requirements)
	d) Use satellite photography		Not feasible (the resolution of general satellite photographs is on the meter level and cannot be used, so verification was not performed)
	e) Use base map information		Not feasible (as a rule map information level 2500-equivalent urban plan diagrams are required; the required level of accuracy is not met, so verification was not performed)
Use new technologies	a) Use quasi-zenith satellites	• Compared to conventional GNSS positioning, quasi-zenith satellites can be used to improve FIX rate.	Feasible (Increase in stable high-accuracy positioning section, expansion of working time, etc., especially improvement effect in urban areas was obtained)
	b) Use high density point group data	• Using a high density laser scanner improves automatic plotting detection rates, etc.	- (this is still in the research and development stage, and it was determined that further verification is required)

3.1 Verification of application to road measurement and public surveying
Verification of application to public surveying [(2) Work Manual (draft) creation]

- Based on the verification results shown on the previous page, the work regulation standards were used to create a work (draft) (3D map common platform data and dynamic map public measurement application manual (draft)) limited to methods and equipment specifically tailored to dynamic map preparation. The differences from the work regulation standards are indicated in the table below.
- Changes to the work regulation standards were made to GCP placement, mobile acquisition, and data processing.

<table>
<tr><th colspan="3">Location</th><th>Work regulation standards</th><th>Work Manual (draft)</th></tr>
<tr><td rowspan="2">GCP placement</td><td colspan="2">GCP placement</td><td>[Article 111]
• At least two GCPs must be placed, depending on the route length and state of the travel section, and as a rule they must be placed in the order indicated below.
1) In locations which have difficulty receiving signals from GNSS satellites
2) In places where movement directions change, such as curves and left and right turns
3) At the start and end points of acquired sections</td><td>• Area design is used to stipulate a method for reducing the number of GCPs indicated in the work regulation standards.
(Framework routes are inspected and compositing is performed for other routes, reducing the number of GCPs while ensuring accuracy.)</td></tr>
<tr><td colspan="2">Local GCP substitution</td><td>[Article 113]
• GCP placement is performed through on-site measurement.</td><td>• A method is stipulated of theoretically designing GCPs based on existing resources (aerial photographs, MMS measurement data).</td></tr>
<tr><td rowspan="3">Mobile acquisition and data processing</td><td rowspan="2">Mobile acquisition</td><td>Device and system details</td><td>[Article 115]
• Specific devices are not indicated, but laser measurement device density, etc., is stipulated.
(Regulation example)
✓ When performing numerical plotting using laser point groups alone, there must be 400 or more points per square meter.
✓ When using laser point groups to perform numerical plotting and distance determination for features with three-dimensional structures through composite display, there must be 50 or more points per square meter.
✓ When using laser point groups to perform numerical plotting for features with two-dimensional structures through composite display, there must be 25 or more points per square meter.</td><td>• In this time, stipulates the use of a device and system that uses the Mitsubishi Electric "MMS-K320."
<table>
<tr><th>Equipment/system name</th><th>Quantity</th><th>Notes</th></tr>
<tr><td>Single frequency GPS receiver</td><td></td><td></td></tr>
<tr><td>Dual frequency GPS receiver</td><td></td><td>Receives FKP correction data for post-processing from the correction information center</td></tr>
<tr><td>IMU</td><td></td><td></td></tr>
<tr><td>Odometer</td><td></td><td></td></tr>
<tr><td>Laser scanner</td><td></td><td>Class 1, 905nm wavelength
Max. 27,100 points/second, 180 degrees (maximum resolution 0.1667°)</td></tr>
<tr><td>Digital camera</td><td></td><td>2,400 x 2,000 pix, 3.5μm pixel size, focal distance 5.2 mm, time and distance-triggered shutter</td></tr>
<tr><td>Control PC</td><td></td><td></td></tr>
<tr><td>Camera log PC</td><td></td><td>One computer</td></tr>
<tr><td>Post-processing software</td><td></td><td></td></tr>
</table></td></tr>
<tr><td rowspan="2">Data processing</td><td>Inspection of results of vehicle own position and posture data analysis results</td><td rowspan="2">[Article 126]
• The following methods are stipulated as adjustment result inspection methods.
✓ Standard deviations, mean values, and maximum values of optimal travel route analysis solutions
✓ Differences in standard deviations of optimal travel route analysis solutions before and after adjustment
✓ Differences in data for use in numerical plotting and GCPs before and after adjustment</td><td>• Perform travel route discontinuity inspection (fix error inspection) (When fix errors are found, reprocessing is performed after changing the satellites used for analysis, etc.)</td></tr>
<tr><td>Inspection of vehicle own position and posture accuracy</td><td>• After performing fix error inspection, vehicle own position and posture accuracy is evaluated. Evaluation is performed after analysis based on forecast deviation values.</td></tr>
</table>

3.2 On-site verification using concrete usage cases
Results of verification for individual uses

Road ledger preparation and updating

- 3D map common platform data accuracy and imaging scope confirmation, and comparison of dynamic maps against existing road ledger attached diagrams, found that the data could be used to substitute for MMS measurement used by local government agencies to prepare road ledger attached diagrams, and could be used to substitute for some of the work involved in road topography data updating.
- When updating road topography data, it is possible to use shape data such as road shoulders (essential features), etc., defined in dynamic map data preparation specifications, etc., and traffic signals (extended features) by performing offsetting.

Snow removal support

- The investigation verified that warning site data displayed in the snow removal support app researched and developed by the Construction Research Center of Gifu Prefecture could be prepared based on 3D map common platform data.
- The features for which warnings would be issued are not required items in dynamic maps, so for this investigation target features were identified in 3D map common platform data, and registration image data, etc., was created and used as input data for the snow removal support app.

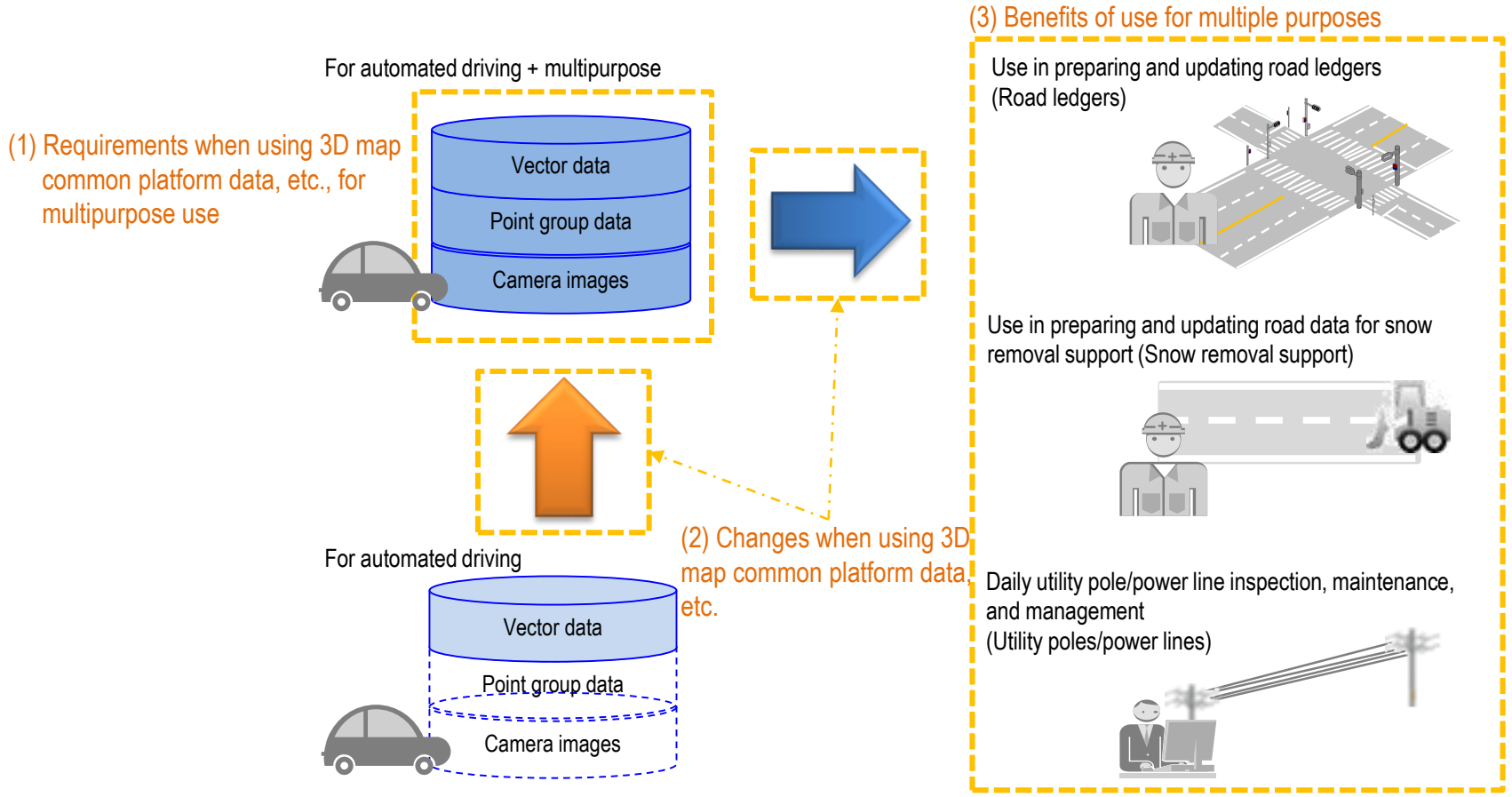
<Conceptual image of snow removal caution data (curb)

Daily utility pole/power line inspection, maintenance, and management

- Data acquired through this operation was shown and explained to workers, envisioning use in performing site confirmation before starting work, and effectiveness confirmation was conducted. Through this confirmation those to whom the data was shown and explained indicated that the data would make it possible to assess conditions without going on-site, and that it could be used to make detailed measurements, etc.
- The use of data as input data for new technologies applied in operations such as facility inspection, etc., was verified using data with varying point group densities. This verification found that for this technical application, the usage scope of the measuring devices used to prepare data for automated driving would be limited.

3.3 Verification of multipurpose use benefits
Method for investigation of result verification

- "(1) Requirements when using 3D map common platform data, etc., for multipurpose use," "(2) Changes when using 3D map common platform data, etc.," and "(3) Benefits of use for multiple purposes" were considered with regard to the multipurpose use of 3D map common platform data, etc., for automated driving.



3.3 Verification of multipurpose use benefits
(1) Requirements when using 3D map common platform data, etc., for multipurpose use

- Road measurement data was used to perform verification and organize the requirements for using 3D map common platform data, etc., for various purposes (road ledger preparation and updating, snow removal support, utility pole/power line daily inspection, maintenance, and management).
- There were equipment (laser), acquisition scope (lateral and vertical), and plotting additions (outlined in red) for requirements for 3D map common platform data, etc. for automated driving that did not satisfy the multipurpose use requirements.

	Requirements for 3D map common platform data, etc. for automated driving (preparation method)	Road ledgers	Snow removal support	Utility poles/power lines
Equipment requirements Laser	● 50 points/m^2 —* * Use values stipulated in Article 136 of the work regulation standards, based on the accuracy envisioned as the preparation target of the Automated Driving System Map Data Specification Proposal's procurement specification (SIP-adus Cabinet Office (2018) Study of Prototyping and Evaluation Aimed at the Creation of Dynamic Maps procurement specifications) dynamic maps.	25 points/m^2 or more	25 points/m^2 or more	up to 1,800 points/m^2
Camera	● 5 million pixels* * Use the number of pixels of photographic images listed as information which can generally be acquired by MMS as indicated in Chapter 3 (Plotting procedures and points of note) of the Map Data Creation Guidelines.	5 million pixels	5 million pixels	5 million pixels
Acquisition scope requirements Lateral	● The degree to which road shoulders are included * * Set taking into account areas defined by features in the Automated Driving System Map Data Specification Proposal.	To public-private boundary	To edge of carriageway	Beyond public-private boundary
Vertical	● Degree of inclusion of road signs, traffic signals, etc. * * Set taking into account features in the Automated Driving System Map Data Specification Proposal with high acquisition positions.	None	None	Capable of acquiring entire utility poles Roughly 20m
Plotting requirements Increase/decrease in plotted features in comparison to Automated Driving System Map Data Specification Proposal essential features	● Road shoulders, carriageway lines, rail crossings, road markings, traffic signals, road signs, carriageway links, intersection areas	Increase Guardrails, road lights, utility poles, etc.	Increase Guardrails, curbs, manholes, etc.	Increase Utility poles, power lines, etc.
Freshness requirements	● Once per month * * Use the period of time believed necessary for the sharing of static information with users as indicated in the materials used by the Cabinet Office to report on the status of automated driving system research and development measures at the 4th Industrial Revolution (Society5.0) Innovation meeting (in December 2016).	Once per year	Once per year (before snowfall)	As necessary – within 3 years

3.3 Verification of multipurpose use benefits
(2) Changes when using 3D map common platform data, etc.

- In order to satisfy the requirements in (1), the changes from data preparation specifications, etc., for dynamic maps for automated driving are organized below.
- Using the data for multiple purposes will require, for data preparation, work process changes in order to comply with work regulation standards and, for data provision, the addition of provided files.

		Changes from data preparation specifications, etc., for dynamic maps aimed at automated driving		Impact on data quality and cost
		Contents	Reason for change	
Data preparation	Road measuring	Work process changes: ① Addition of accuracy management (absolute position evaluation) indicated in work regulation standards ② Improvement of GCP placement efficiency, use of existing resources, and use of new technologies	① For public uses such as road ledger attached diagrams, etc., data must be applied to public surveying ② Reduces costs compared to work performed as indicated in work regulation standards	☐ Accuracy of data is objectively guaranteed for public surveying ✓ Performing work as indicated in work regulation standards would increase preparation costs for general roads for automated driving by 16% (the increase could be reduced to 6% if cost reduction measures being considered separately are used)
	Road measuring	Changes to survey devices and survey methods, etc. ① Use of high-density (500,000 to 1,000,000 points/second) long-range laser equipment ② Changes to imaging intervals, direction, and scope (complete perimeter imaging)	① Data acquired by high-density, long-range laser equipment is necessary when using point group data in management of utility poles and power lines to extract power lines ② Accurate assessment of entire work sites	☐ High-density point group data has the potential for increasing the accuracy of dynamic map automatic plotting (technical verification has not yet been performed) ✓ Laser device changes and measurement method changes will increase cost of measurement equipment ✓ Point group data volume will increase, raising management costs
	Plotting	None	—	—
Data provision		Addition of provided files: Add 3D map common platform data (point group data, image data) in addition to dynamic map	3D map common platform data will supplement features, etc., lacking in dynamic maps when using data for various purposes	✓ Need to create a system for providing large volumes of 3D map common platform data in addition to dynamic maps

Legend : Items required for multipurpose use : Items required to promote multipurpose use

3.3 Verification of multipurpose use benefits
(3) Benefits of use for multiple purposes

- The benefits of using 3D map common platform data, etc., with the changes indicated in (2) for various purposes (road ledger preparation and updating, snow removal support, utility pole/power line daily inspection, maintenance, and management) were organized as indicated below, based on the results of the verification.
- There is potential for work volume and cost reductions and accuracy improvements when using data instead of manual on-site measurement and confirmation. When MMS, etc., measurement methods are already in use, MMS measurement work could be eliminated, only reducing costs.

Benefit		Road ledgers	Snow removal support	Utility poles/power lines	
				Local site confirmation before performing work	Application of new technologies to facility inspection
Benefits of data use (Stock effects)	Improved accuracy through use of data	● No change in accuracy in comparison to current method	● Currently, dangerous areas are determined based on the experience of personnel, but the use of data would make it possible to identify dangerous areas using quantitative conditions	● Improved dimension, etc., accuracy in comparison to results of local site confirmation before performing work	● No change in accuracy in comparison to current method
	Reduced work volume and cost through use of data	● About 15% cost reduction for new preparation and partial improvement	● Reduction in volume of work involved in dangerous area position measurement and data creation	● Local site confirmation before performing work eliminated in some cases	● Local measurement work to determine power line separation distances, etc., eliminated in some cases
Other benefits (Flow effects)	Promotion of 3D data creation	● Accelerating computerization by local government agencies	● None	● None	● None
	Benefits of 3D data sharing	● None	● None	● None	● Data prepared by telecommunications companies can be shared
	Other business	● Increased update frequency	● None	● None	● Increased safety when measuring power line separation distances, etc.

Legend : Areas in which using 3D map common platform data, etc. produces benefits

3.3 Verification of multipurpose use benefits
Summary

I Use of 3D map common platform data, etc. for automated driving without major changes for various purposes

Data preparation	● For data preparation, make work process changes in order to comply with work regulation standards and, for data provision, add provided files.
Multipurpose use	● Data could be used in the preparation or updating of road ledgers, and in the preparation and updating of road data for snow removal support. ● Data could be used in utility pole/power line daily inspection, maintenance, and management for site confirmation before starting work.
Impact on automated driving	☐ Road ledger preparation costs would be reduced (by approximately 20%), data could be used to provide snow removal support and for work site confirmation for utility poles/power lines, and preparation costs would be shared. ✓ Preparation costs would cost roughly 6% compared to the preparation of data for automated driving.

II Changes to 3D map common platform data, etc., for automated driving to meet all multipurpose use requirements

Data preparation	● (In addition to I) Change preparation method to perform measurement using high-density (500,000 to 1,000,000 points/second) long-range laser equipment.
Multipurpose use	● (In addition to I) Envisioned expansion of application scope to utility pole/power line daily inspection, maintenance, and management operations, and of use as input data for new technologies applied to operations such as facility inspection.
Impact on automated driving	☐ (In addition to I) Use data in utility pole/power line daily inspection, maintenance, and management operations, sharing preparation costs. Point group data acquired by telecommunications companies, etc., would also be sharable. ✓ (In addition to I) Preparation costs would be expected to decrease due to data sharing, but data management costs would rise due to changes to measuring equipment and increases in data volume.

3.4 Coordination with SIP agriculture

- SIP agriculture was coordinated with to perform measurement of roughly 10km of inbound and outbound lanes of ordinary road at the Kitamura Flood-Control Basin (Iwamizawa City, Hokkaido) based on the data for dynamic maps for automated driving, but based on discussions with members of SIP agriculture, preparation specifications, etc., for dynamic maps aimed at automated driving.
- As a general rule, preparation was carried out in accordance with data preparation specific attributes were added (pavement type: paved road, dirt road, footpath) and virtual lane edge lines and center lines were created.

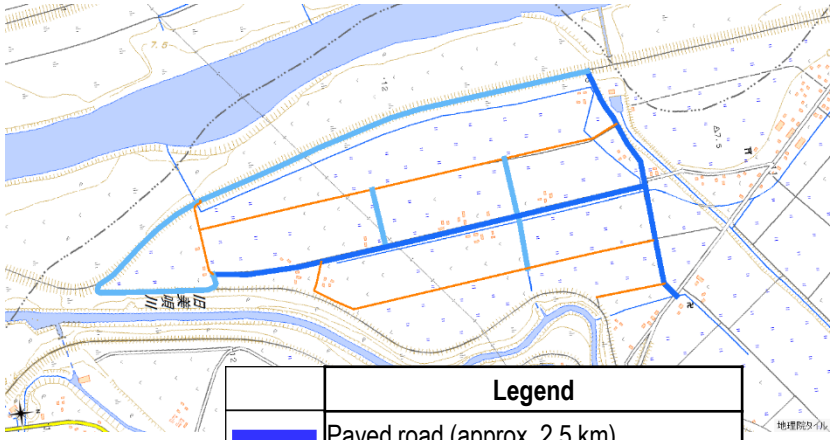


Figure Measurement scope

Figure Pavement types (paved roads, dirt roads, footpaths)

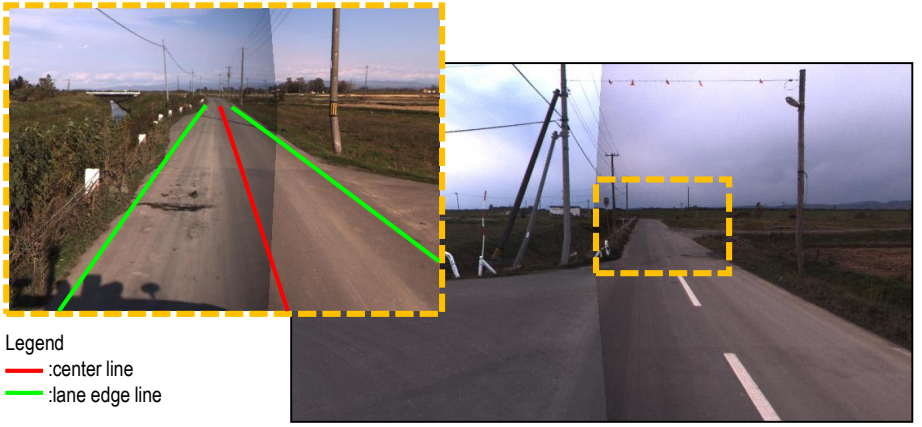


Figure Examples of creation of virtual lane edge lines and center lines

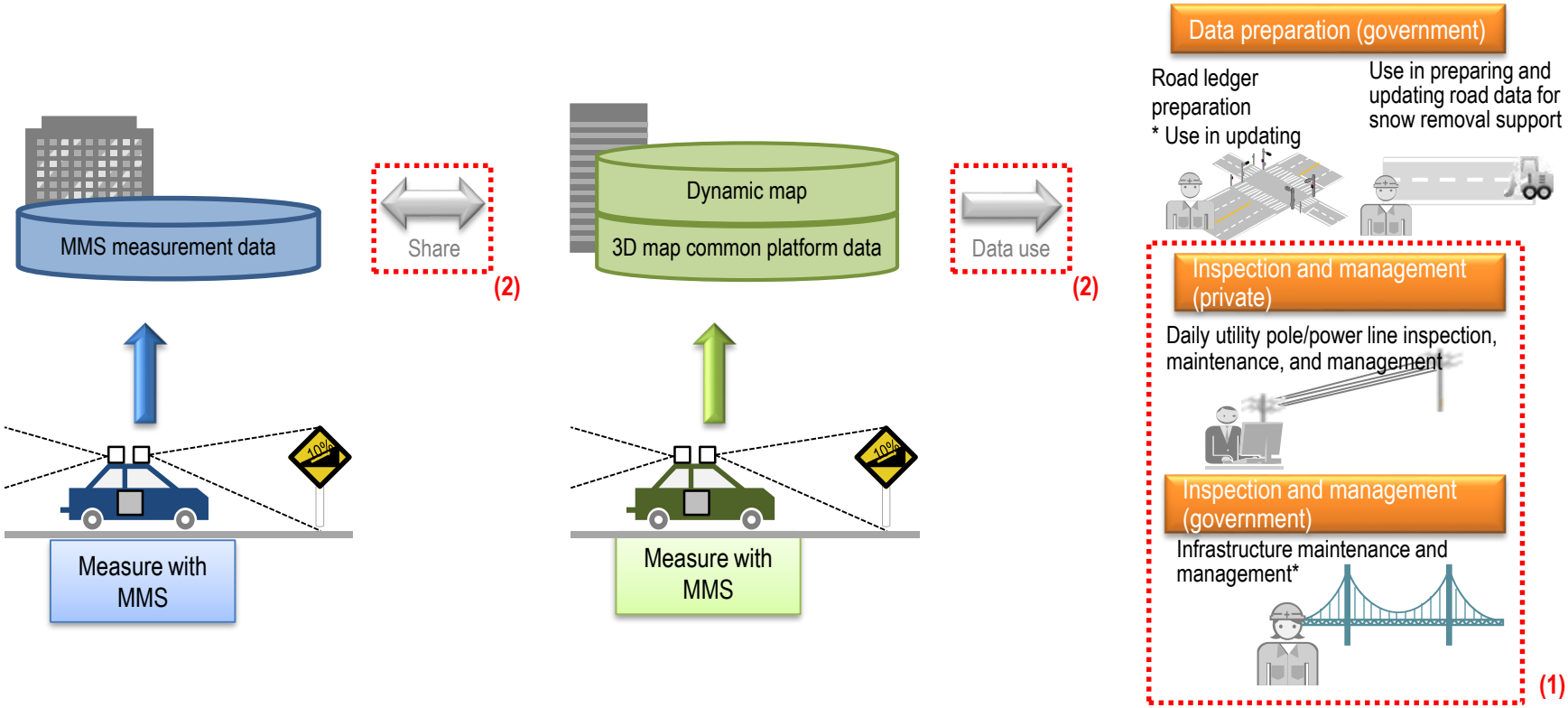
4. Future issues and prospects
The results for the year 2017

- The "Investigations of application to public surveying" have completed the creation of a system for applying 3D map common platform data, etc. to public surveying, and it will be possible to apply this data in the future.
- The "Investigations of application in various fields" and "Coordination with SIP agriculture" conducted actual field prototyping and verification in limited fields and scopes. Verification will need to be extended to cover more fields and greater scopes, and consideration will have to be given to systems for actually providing data.

Implemented this year	This year's results and future prospects
Investigations of application to public surveying	● Created Work Manual (draft) for use in public surveying based on measurements of prefectural roads and local roads in Gifu Prefecture ➢ Created Work Manual (draft) that can be used together with the method indicated by the work rules based on data preparation specifications, etc., for dynamic maps aimed at automated driving (manual which can be used for applications as indicated in Article 17 of the work regulation standards). In the future, if the application is made based on this manual under the premise of receiving designation under Article 5, item 2 of the law, it is expected to be accepted as a public survey. (However, if a person other than this consortium becomes a survey work organization, an accuracy verification report is necessary)
Investigations of application in various fields	● Verified potential for use of data in road ledger preparation and updating, snow removal support, and utility pole/power line daily inspection, maintenance, and management based on results of measurement conducted in Gifu Prefecture ● Considered requirements for dynamic maps when using them for infrastructure maintenance and management (theoretical study found no changes from the data for automated driving) ➢ Found that there were purposes for which data could be used without major changes the data preparation specifications, etc., for dynamic maps aimed at automated driving, etc. ➢ Need to flesh out system for providing data for use, and to flesh out business model
Coordination with SIP agriculture	● Created dynamic map in conjunction with SIP agriculture with scope of roads between farm fields in Kitamura Flood-Control Basin ➢ SIP agriculture plans to merge this with farm field data in 2018 and conduct an experiment

4. Future issues and prospects
Issues to be addressed in future

- The following issues should be given consideration in order to practically implement 3D map common platform data, etc.
  - (1) Verification of use of 3D map common platform data, etc., in inspection and management fields
    - ➢ Verify using MMS measurement data, prototype system, etc.
  - (2) Consider methods for sharing 3D map common platform data, etc.
    - ➢ Assess current conditions, consider distribution specifications, and build distribution platform.



* This year's theoretical study found that use in inspections would be difficult due to measurement scope and accuracy considerations, but there is potential for use in slope and retaining wall studies, roadside tree studies, etc.