The second phase of SIP- Automated Driving for Universal Services／Field Tests and evaluation for improving logistics efficiency based on architecture utilizing vehicle information such as probes

2021 results report (overall interim report) Summary

NX Logistics Research Institute and Consulting, Inc.

May 31, 2022

Overview of the Field Tests survey project

In anticipation of the practical application of self-driving technology in truck logistics in the future, we conducted research and examination on further field tests utilizing vehicle and probe information and organized issues for implementation in some use cases, with the aim of utilizing vehicle and probe information to improve the operational efficiency and safety of truck logistics.

【Overview of the field test survey】

Understanding the status of cargo waiting time and sharing among related parties	⇒Providing information for measures to reduce cargo waiting time
Confirmation of daily inspection items using vehicle data	⇒Drivers' work time efficiency and work standardization
Measurement of load weight / tire data for legal compliance and safety assurance	⇒Ensuring compliance Pursuit of safe driving

- ◆ Examination of materials that are likely to be useful for truck transportation business of vehicle and probe information
- ◆ Architectural design and construction of other measures and examination of the possibility of providing information to the portal site
- ◆ Issues for implementation of vehicle and probe information for logistics efficiency and examination of future promotion entity

Background and problem awareness of this project

- As the problem of a shortage of truck drivers becomes more serious, it is feared that truck logistics will not be able to adequately meet the demand for freight transportation in the future, which will adversely affect the Japanese economy. As one of the effective solutions to this problem, it is expected that the introduction of services using self-driving technology will be put into practical use.
- On the other hand, prior to the implementation of self-driving in truck logistics operations, it is necessary to consider how to deal with issues related to truck logistics operations and issues when implementing self-driving, and how to improve the environment.
  - There are many inefficiencies in the truck logistics business, and even if self-driving is implemented without dealing with these business inefficiencies, it will not solve the fundamental problem of the truck logistics business.
  - From the perspective of "labor saving" expected in the practical application of self-driving in truck logistics, not only automation of the driving process, but also labor saving such as inspection work before departure and loading / unloading work is expected.
  - Regarding the practical application of self-driving in truck logistics, there are business operators that are concerned about safety, and it is necessary to ensure safety further.
- It is possible that the utilization of vehicle and probe information will contribute effectively to dealing with these issues and supporting the promotion of countermeasures. For this reason, it is necessary to further promote the examination of measures utilizing vehicle and probe information in truck logistics operations.

Based on the above problem awareness, this survey targets several use cases and aims to demonstrate utilizing vehicle and probe information for the realization and practical application of measures to solve or mitigate these problems in the future.

Current status of the project

- The three field test surveys described on the previous page are all at the stage of acquiring the necessary data.
- Due to the time required to arrange the installation schedule of data measurement equipment, etc. on trucks of each trucking company that cooperates with data acquisition, the start of data acquisition was slightly delayed from the initial schedule, but the plan for the field test and acquiring data itself are progressing steadily.
- From the end of April, it will be the stage to proceed mainly with analysis of acquired data and organization of issues. However, it is recognized that the initially-planned period was not enough to consider and tackle these issues deeply.

Current status and future plan of the project

(1) Understanding the status of waiting time for cargo and sharing among related parties ①

<Overview>

The trucking company and the shipper company share the cargo waiting time grasped and analyzed from the data acquired from the actual vehicle of the trucking company, and both parties share the recognition of the status of the cargo waiting time, as well as utilize it for analysis of factors that cause waiting time and examination of improvement measures.

- The operation history data is acquired from the actual truck of the trucking company, the waiting time of each vehicle is analyzed and grasped, and the operating vehicle having a long waiting time will be identified.
- The data to be acquired consists of data acquired from in-vehicle devices such as digital tachograph and data from trucking companies such as vehicle allocation / dynamic management information.
- Since this project is premised on receiving cooperation from the to provide operation data from the digital tachograph, the target trucking company, trucking company which would be able to have a cooperative relationship with the shipper company, will be selected for the purpose of the verification survey.
- The results of the cargo waiting time analysis will be shared between the trucking company and the shipper company, and the factors that cause the cargo waiting time and the examination of improvement measures will be promoted. This will lead to the field test that the analysis and examination by sharing the operation history data will contribute to the planning of measures for reducing the waiting time for cargo.

Current status and future plan of the project

(1) Understanding the status of waiting time for cargo and sharing among related parties ②

＜Efforts up to FY2021＞

- In addition to trucking company with a reputation for improving transportation operations in collaboration with the shipper company, we also discussed how to proceed this project with their shipper companies, after explaining the purpose of this project and obtaining the consent of cooperation.
- Through this discussion, it was decided that the vehicles subject to data acquisition would be 12 trucks of the trucking company, and operation data would be acquired by the trucking company's in-vehicle terminal equipment and dynamic management system.
- The data acquisition period was about 6 weeks from the high season at the end of March, the low season in early April, the normal season in mid-April to the high season before consecutive holidays in late April. Regarding the data for these 6 weeks, we decided to receive the data aggregated on the system operated by the trucking company.

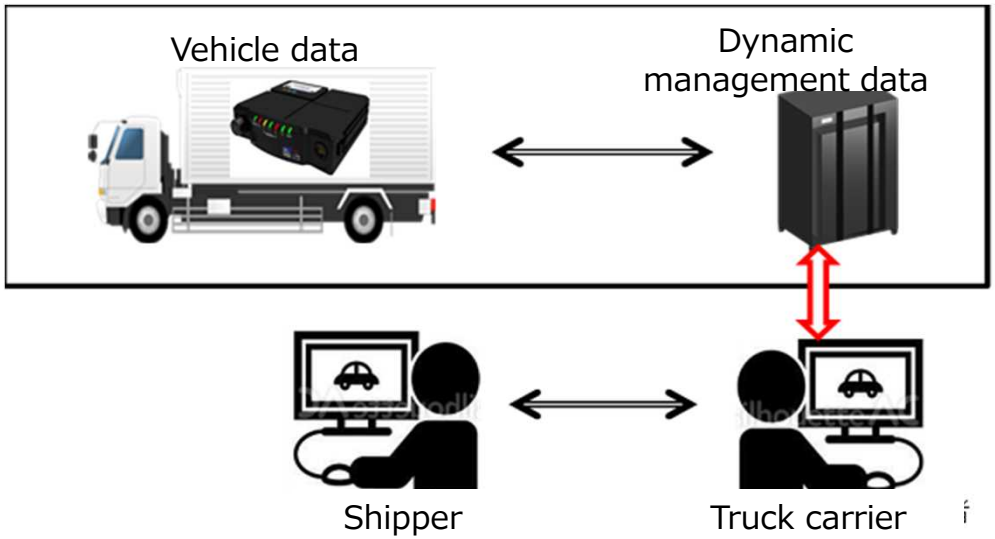
Current status and future plan of the project

(1) Understanding the status of waiting time for cargo and sharing among related parties ③

<Future efforts>

- The data provided after the holidays in May will be processed and tabulated by focusing on vehicles, operation routes, departure and arrival points, etc.
- We plan to feed back the data that clarifies the occurrence of waiting time for cargo from the aggregated results to the trucking company and share it with the shipper company.
- Based on the above feedback data, both the shipper company and the trucking company share the awareness of the problem of improving the working conditions of the carrier, set up a meeting for consideration, and then review and improve the contents of the truck operation business.

【Image of vehicle and dynamics management data collection / sharing】



Current status and future plan of the project

(2) Confirmation of daily inspection items using vehicle data ①

<Overview>

Utilizing vehicles owned by truck manufacturers, event data that contributes to daily inspection item confirmation is collected from vehicle and probe information, etc., and the status of trucks related to daily inspection items is confirmed remotely.

- At the Japan Automobile Manufacturers Association, "data items provided for vehicle and probe data" and "API production rules used by users to acquire data from the backend of heavy-duty truck manufacturers" are standardized and it is developing a mechanism to acquire and use common data items from truck companies using the same API, for the same service menu of the same. (see the next page).
- Based on this, when assuming the use of the API, we will consider how to collect event data that contributes to daily inspection item confirmation from vehicle and probe data, etc.
- With the cooperation of the truck manufacturer, in April 2022, we will be able to receive the data that contributes to the confirmation of daily inspection items among the vehicle and probe data of the truck manufacturer's test truck. Using this data, we aim to visually confirm the maintenance status of daily inspection items numerically on the display.

Current status and future plan of the project

(2) Confirmation of daily inspection items using vehicle data ②

<Efforts up to FY2021>

- This is the period during which discussions were held with the truck manufacturer and the vehicle and probe data analysis subcontractor as a preparatory stage for the field test project.
- Through this discussion, after examining the existence of vehicle and probe data that corresponds to each item of daily inspection, the truck manufacturer will consider whether it can extract it or not. After confirming whether or not the vehicle signal can be obtained from the vehicle model used in this field test project, the data to be finally provided is defined as follows.

① Parking brake signal
② Engine speed signal
③ Accelerator pedal opening signal
④ Wind washer switch signal
⑤ Wiper switch signal
⑥ Air tank pressure signal
⑦ Cooling water amount decrease signal
⑧ Lights signal (Vehicle side lights, headlights, tail lights, number lights, indicator, emergency flashing indicator lights, back lights)

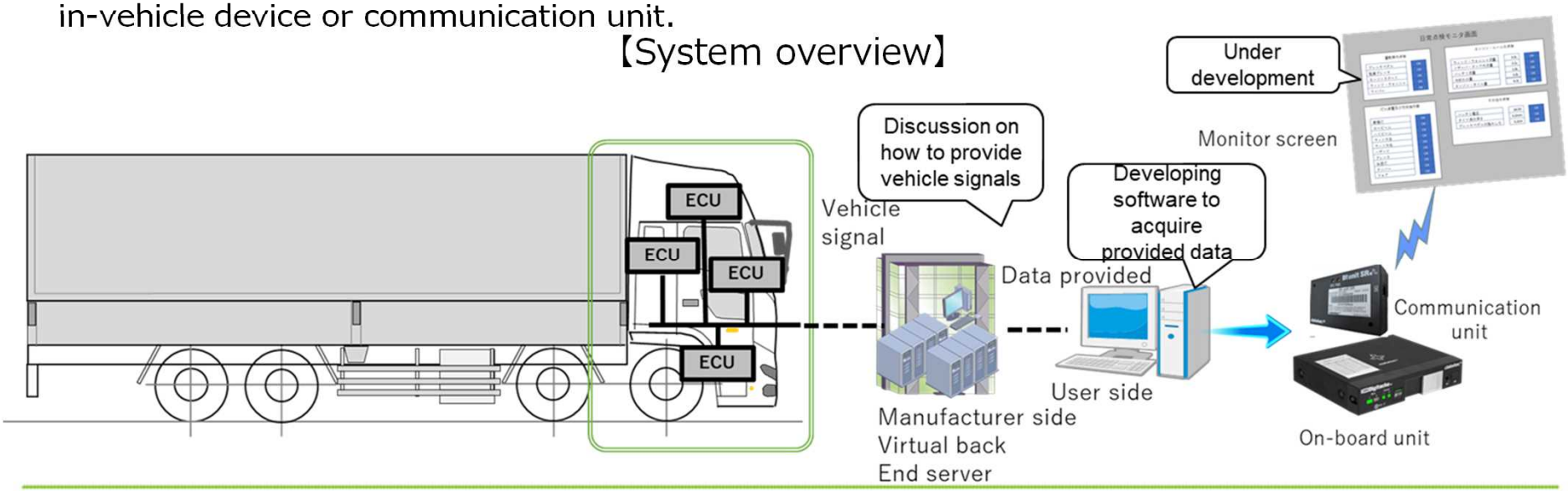
Current status and future plan of the project

(2) Confirmation of daily inspection items using vehicle data ③

<Recent activities>

- Based on the data defined as shown on the previous page, a vehicle data acquisition field test related to daily inspection items was conducted.
  - ✓ Date: April 14, 2022
  - ✓ Place: Truck manufacturer's experimental building
  - ✓ Vehicle: Heavy-duty truck (gross vehicle weight 25 tons class)
  - ✓ Details: ・A test driver conducts daily inspections in the driver's seat (operations related to inspection items)
    ・Truck manufacturer receives vehicle signal
- Currently, the truck manufacturer who cooperated with the experiment is selecting signals that contribute to daily inspections and creating data to be provided to us. At the same time, we are developing a system for reading the provided data and displaying it on the monitor screen via the in-vehicle device or communication unit.

【System overview】



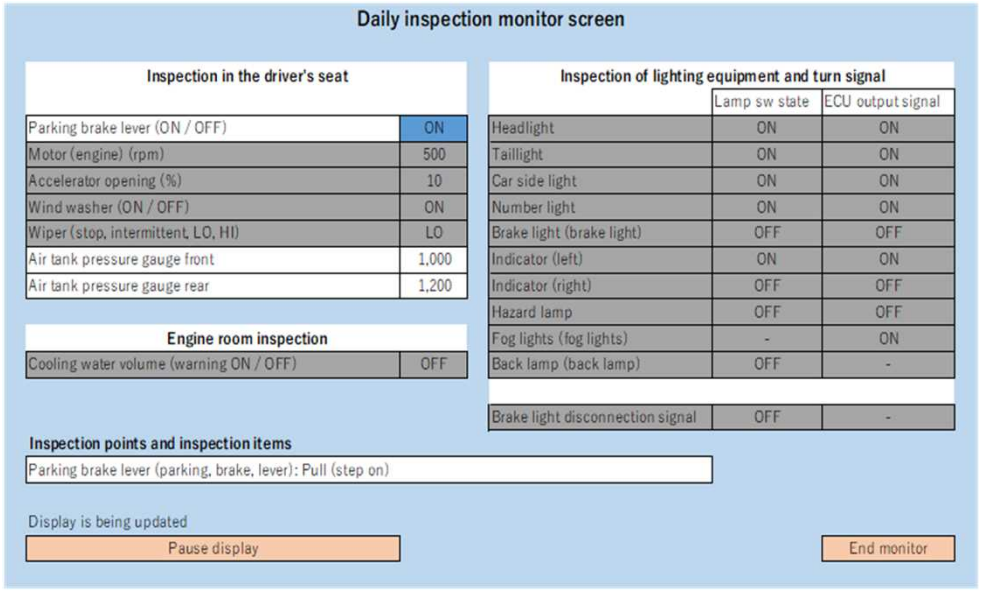
Current status and future plan of the project

(2) Confirmation of daily inspection items using vehicle data ④

＜ Future efforts ＞

- By using the provided truck vehicle signal data to display on the monitor screen whether or not the vehicle maintenance status related to the daily inspection items is appropriate, we verify the possibility of using the truck vehicle signal data to confirm the related daily inspection.

【Monitor screen image for daily inspection result confirmation】
(Example: display of "Parking brake lever : Pull (step on)



The flow of daily inspection monitor

(1) Open "Inspection points / inspection items" from the pull-down menu and select the inspection item to be performed.
- Put a gray translucent mask on items that are not related to the inspection item so that the items related to the inspection item can be easily seen.
- Numerical value and ON OFF are updated even if masked.

(2) Click the "Pause display" button to stop updating the display. Press again to resume updating

(3) The background color of the displayed item is blue when the signal is ON. When OFF, the background color is white.

Points to keep in mind for daily inspection monitors

- ✓ This monitor is for confirming the vehicle signal, and does not judge the pass / fail of daily inspection items from the result of the signal.
- ✓ Signals related to daily inspections other than the field test are not displayed on the screen.

Current status and future plan of the project

(3) Measurement of load weight / tire data for legal compliance and safety assurance ①

<Overview>

An axis load sensor that grasps the load weight and a sensor that contributes to grasping the tire condition such as TPMS are attached to the actual operation heavy-duty truck of the trucking company, and the load weight at the time of business operation and whether or not the data regarding the tire condition can be grasped would be confirmed. Regarding the load weight data, it will be confirmed whether or not the data can be transmitted so that the sales office can share and check.

Load weight	➢ Load weight meters will be installed on each of the four heavy trucks of the four cooperating trucking companies, and the load weight will be measured during actual loading and unloading operations. ➢ At the same time, the usefulness will be verified by repeatedly conducting a field test in which the load weight data is grasped by the driver's seat or the terminal of the sales office using the communication function provided in the load weight meter.
Tire date	➢ TPMS-equipped tires are installed on four heavy trucks equipped with the above-mentioned axis load weight sensor for load weight measurement, and data on tire pressure is grasped and feasibility is examined through analysis of data acquired and accumulated from TPMS. In addition, some of the four vehicles will be equipped with sensors that have functions that contribute to grasping conditions such as road surface conditions and tire wear, and the possibility of utilizing the data acquired and accumulated from them will be examined.

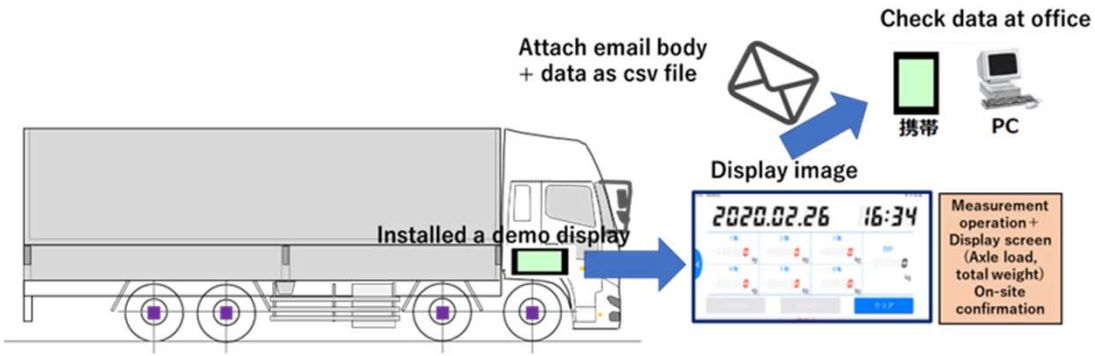
Current status and future plan of the project

(3) Measurement of load weight / tire data for legal compliance and safety assurance②

<Efforts up to FY2021>

- We explained the purpose of this project to four trucking companies and obtained consent for cooperation in weight measurement and tire data measurement.
- Regarding load weight measurement, we have been developing tablet terminals for truck drivers to perform measurement operations and check measured values, and devices and mechanisms that allow operation managers to check the weight. From the beginning of March 2022, a loading weight scale and a tablet for operation and measurement value confirmation will be installed on each of the trucks of the four companies, for a total of four vehicles. Data measurement and communication to the office have started.
- Regarding tire data, we installed TPMS-equipped tires in late March for four vehicles equipped with load weight meters from four cooperating trucking companies, acquired air pressure data, and started accumulating them on the servers of cooperating tire manufacturers. Sensors that have functions that contribute to grasping conditions such as road surface conditions and tire wear are currently being adjusted.

【Load weight measurement / communication system overview】



【Load weight measurement / tablet screen (left) and email text example (right)】

Item	Contents
To	Set address
Subject	"Vehicle number" measurement result
Text	The following measurements were made. [Vehicle number] ○○○○○○ [Measurement start] yyyy year mm month dd day hh hour dd minute [End of measurement] yyyy year mm month dd day hh hour dd minute [Address] ○○ Prefecture ○○ City ○○ Town ○ Chome ○○ [Loading weight] Total: ○,○○○ kg 1 axis: ○○○ kg 2 axis: ○○○ kg 3 axis: ○○○ kg 4 axis: ○○○ kg [Total weight] Total: ○,○○○ kg 1 axis: ○○○ kg 2 axis: ○○○ kg 3 axis: ○○○ kg 4 axis: ○○○ kg

Current status and future plan of the project

(3) Measurement of load weight / tire data for legal compliance and safety assurance ③

<Future efforts>

- The data on loading and unloading during operation and the tire pressure data are being acquired and accumulated steadily, and the collection is scheduled to be completed by the middle of May. The data contents will be analyzed thereafter. On the other hand, regarding the installation of sensors that have functions that contribute to grasping the conditions such as road surface conditions and tire wear, we will consider handling after confirming whether or not they can be linked with truck vehicle signals necessary for data acquisition.

- The evaluation of the usefulness and feasibility of the load weight and air pressure measurement data during operation in the field test will be confirmed by hearing with the trucking companies at the end of the measurement period.

  * Hearing items proposal

  (1) Evaluation in terms of usability and operation, and points for improvement that are considered necessary

  (2) When the improvement points in (1) above are resolved, in what situations can the data be used?

  (3) What do you think about sharing data with shippers, trucking companies, public situations, etc.

【Example of data analysis of accumulated load weight based on CSV data】

Loading weight and gross vehicle weight at the time of loading and unloading

Each axle load at the time of loading and unloading

Composition of committee organization

In the above field test, a committee should be formed based on the fact that the participation and opinion hearing of the trucking company who will be the recipient of the service and the provider of vehicle and probe information and telematics data are indispensable. Despite it is a remote meeting, it is decided to set up a discussion to meet with each business operator to hear their opinions and proceed with the project.

【Study Group on Logistics Improvement Measures by Utilizing Vehicle and Probe Information】

Purpose	➢ Communicating the overall picture of this field test project to each company that cooperates ➢ Hearing opinions on issues and countermeasures for the use of vehicle and probe information for truck operations, as well as for improving the logistics efficiency of vehicle and probe information. ➢ Advice and support for planning and promoting various field tests
Period	➢ From February 2022 (scheduled to be held 4 times) ➢ The first study group was held on February 25, 2022.
Participating parties	➢ 4 trucking companies, truck manufacturing companies, information equipment development and service providers, tire manufacturing companies (Observer: Related administrative agencies (Cabinet Office, Ministry of Economy, Trade and Industry, Ministry of Land, Infrastructure, Transport and Tourism), NEDO)
Cooperation request	➢ Presenting opinions and advice on the subjects that we would like to expect about the possibility of using vehicle and probe information for trucking operations, as well as constraints, issues and countermeasures for realization ➢ Support for implementation of various field tests, provision of data, and presentation of impressions and opinions after implementation

NIPPON EXPRESS | 株式会社ＮＸ総合研究所

NX Logistics Research Institute and Consulting, Inc.

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