Development of Smart Mobility Platform

⑤ Understanding the actual situation of logistics MaaS and developing a strategy to build it

Proposals for improving regulations, systems, and business practices that streamline long distance transport by trucks and development of software for converting logistics information into digital

<Summary Report>

March 2026

Hino Motors, Ltd.

HINO

General Overview

Theme (a): Proposals for improving regulations, systems, and business practices that streamline long distance transport by trucks

Theme (b): development of software for converting logistics information into digital

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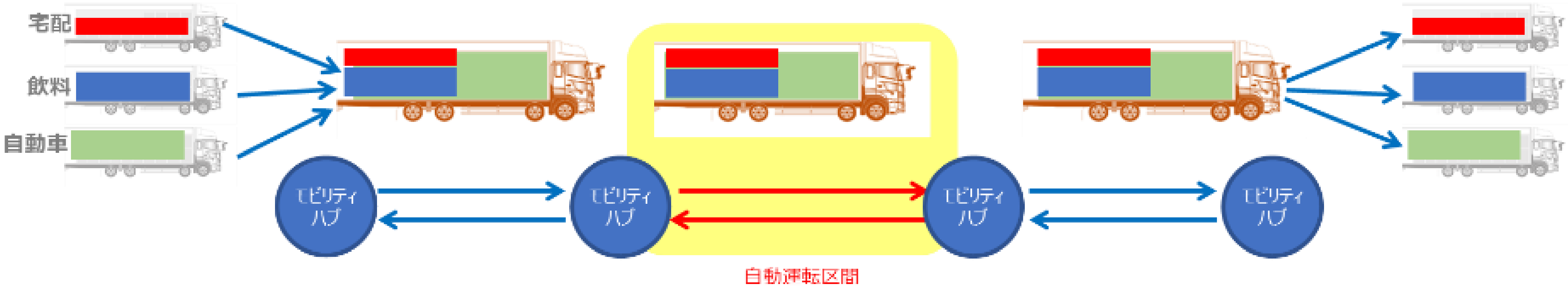
Overview

SIP's Vision: Achieve efficiency and productivity gains through joint transport, and enhance the sustainability of logistics



Elements necessary to realize the desired future state

Logistics Information Digitalization

Automated cargo allocation and loading system

Optimal Operational Planning

Front-to-Back System Integration (TMS/WMS)

Digital National Highway
Logistics MaaS Project - **Ministry of Economy, Trade and Industry**

Aggregation/Relay Hubs Cargo Handling

Vehicle (Asset) Sharing

Carpooling and Car Sharing

Challenges in Implementing Logistics Information Standard Guidelines (Theme (b))

One of the major challenges facing the Japanese logistics industry is the current situation where approximately half of shippers have not yet digitized their cargo and packaging information.

To digitize this cargo configuration information, based on dialogue with various industries to date, we believe that systematizing the "invisible loading know-how"—which has been dependent on individual skilled workers at logistics sites—is an effective solution, and we will develop digital conversion software. Furthermore, we will implement this software into society through measures such as making it open-source (OSS) to achieve labor savings and efficiency improvements in logistics.

Challenges in Joint Transportation Operations (Theme (a))

In the policy package formulated by the government for logistics innovation, challenges such as labor shortages and carbon neutrality have been identified regarding logistics, a critical social infrastructure. To make Japan's logistics sustainable, the pillars of the policy include improving logistics efficiency, reviewing commercial practices, and changing the behavior of shippers and consumers.

We will identify the challenges facing the logistics industry, simulate the effectiveness of regulatory and institutional improvements in addressing these challenges, and examine countermeasures for at least the two issues mentioned above, along with strategies for social implementation, while clarifying the relationship with Theme (b).

General Overview

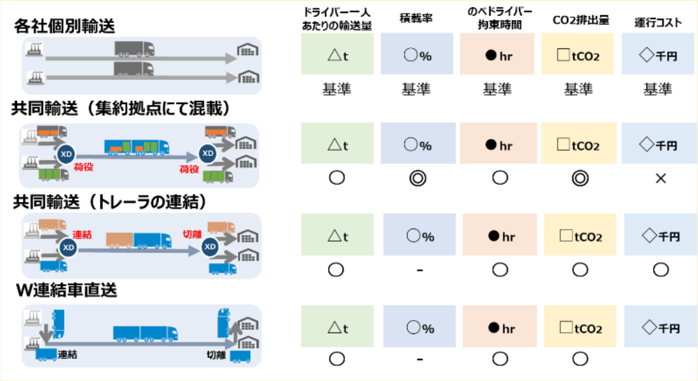
Theme (a): Proposals for improving regulations, systems, and business practices that streamline long distance transport by trucks

Theme (b): development of software for converting logistics information into digital

1. Overview

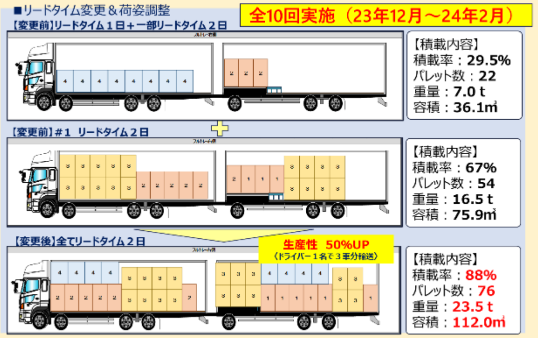
・**Using “joint** transport” utilizing **“double-articulated** trucks”—cited as a specific example of logistics efficiency in the **“Key Points of the Logistics Innovation Policy** Package”—as a case study,
we will conduct simulations using actual NLJ data to quantify **the efficiency effects** resulting from different transport methods
・Furthermore, quantify **the improvements in logistics efficiency** resulting from **changes in business practices** (extended transport lead times and standardization of cargo packaging) **through simulation**, identify key issues, and define the theme
(b) and clarify the relationship with the development of software for the digital conversion of cargo configuration information

[Simulations by Transport Mode]
・In joint transport using W-linked trucks, **simulations** for each transport mode **will be conducted using Logistics Japan**
・**Quantitatively demonstrate the effects**
・**Quantitatively demonstrate the benefits** and identify shippers (logistics operators)method



[Simulation for Further Efficiency Improvements]

1) Improving **transport efficiency**
improving transport efficiency
2) Improving transport efficiency
Improvement



Identifying Issues

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1. Development

Implementation Schedule/Progress

	2025									2026		
	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Formulation of Overall Plan ・Review of implementation details ・Review of simulation details ・Review of output concepts												
Conducting the simulation ・Simulation by mode of transport ・Simulations to further improve efficiency Effects of extending transport lead times Standardization of cargo packaging	Simulation by mode of transport Simulation			For Further Efficiency Simulation				Add Simulation				
Identification of Issues Clarification of the relationship with Theme b												
Overall Summary												

2. Details of the Simulation of Effects by Transport Mode

Overview of simulations of effects by transport mode

We will conduct simulations comparing existing transport methods using large trucks with joint transport utilizing double-trailer trucks, and summarize the advantages and other characteristics of each method.

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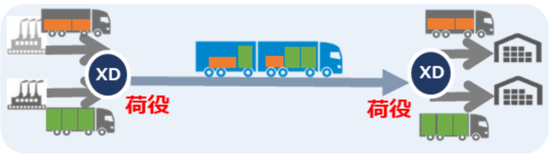

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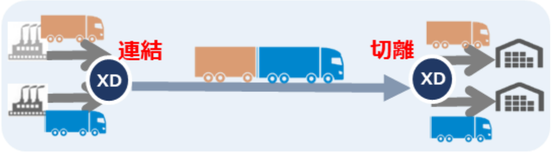
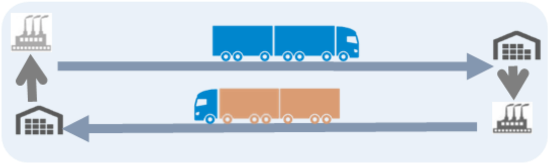


W連結車直送



◇Transportation Methods

1) Joint Transport (Consolidation at Hubs)

Main Route: Cargo is consolidated onto W-coupled trucks at consolidation hubs, and W-coupled trucks are used to transport cargo between consolidation hubs.Feeder Routes: Transport is carried out using large trucks between collection points and consolidation hubs, and between consolidation hubs and delivery locations.

2) Joint Transport (Trailer Coupling/Uncoupling)

Trunk Route: W-coupled trucks are coupled and uncoupled at coupling points. Transportation between coupling points is performed using W-coupled trucks.

Feeder Route: Transportation is carried out using a semi-tractor and trailer configuration from the pickup location to the coupling hub and from the uncoupling hub to the delivery location.

3) Direct Delivery by Double-Tractor-Trailer

Transportation is carried out using double-trailer trucks for the entire route from the pickup location to the delivery location.
For round-trip transport, the outbound and return legs may involve different shippers.

◇Input Information

Cargo Information: Weight/dimensions (width/length/height) per pallet, number of pallets, transport lead time
Vehicle Information: Payload capacity, permissible dimensions (width/length/height), schedule information (departure time/arrival time)
Location Information: Distances between pickup locations, delivery locations, consolidation hubs, and coupling hubs

◇Output Information

Indicators of **logistics efficiency**
Indicators of economic efficiency: Operating costs
Indicators of environmental performance: CO_2 emissions

2. Details of the simulation of effects by transport mode

Regarding the input data for the simulations in this project

We used actual data (135 trips) from operations conducted by NEXT Logistics Japan Co., Ltd. between April 21 and 24.

◇Transportation from Kansai to Kanto: 65 trips total (65 large trucks)
Breakdown: Beverages, frozen foods, confectionery, food products, machinery, beverage containers, recycled goods,etc.

◇Transportation from Kansai to Kanto: 70 trips total (equivalent to 70 large trucks)
Breakdown: Beverages, frozen foods, confectionery, food products, machinery, metals, recyclables, miscellaneous goods, etc.

Sample data used

モード	発送荷主	出荷元	届け先	出発日	経由XD	便数 週間	容積 ㎥	重量 kg	積載率 (容積)	積載率 (重量)	複合積載率
A	飲料	吹田物流センター	茨城物流センター	4/23	西→東	西宮４便	23.0	12,772.1	38.3%	94.6%	66.5%
A	飲料	明石工場	群馬配送センター	4/23	西→東	西宮３便	25.3	11,666.0	42.2%	86.4%	64.3%
A	食品	岡山県岡山市	埼玉県戸田市	4/23	西→東	西宮２便	35.1	3,552.0	58.5%	26.3%	42.4%
A	雑貨	堺市	横浜市	4/23	西→東	西宮４便	7.9	2,500.2	13.2%	18.5%	15.9%
A	飲料	静岡県	川崎倉庫	4/23	西→東	西宮１便	21.8	12,300.0	36.3%	91.1%	63.7%
A	パレット	兵庫県　東条	静岡県	4/23	西→東	西宮１便	44.6	6,656.0	74.3%	49.3%	61.8%
A	飲料容器	大阪工場	東京工場	4/23	西→東	西宮１便	45.2	3,240.0	75.3%	24.0%	49.7%
A	食品	関西工場	千葉県船橋市	4/23	西→東	西宮２便	36.8	3,360.0	61.4%	24.9%	43.1%
A	飲料	平和島ＤＣ（１５：００迄）	吹田物流センター	4/23	東→西	相模原３便	21.4	10,998.0	35.6%	81.5%	58.6%
A	飲料	備蓄群馬配送センター	明石工場	4/23	東→西	相模原１・２便	56.6	25,518.3	47.2%	94.5%	70.8%
A	食品	関東工場	広島	4/23	東→西	相模原１便	51.8	3,711.6	86.4%	27.5%	56.9%
A	食品	野田市	高砂市	4/23	東→西	相模原２便	20.6	4,824.0	34.4%	35.7%	35.0%
A	雑貨	横浜市	堺市	4/23	東→西	相模原２便	20.3	3,650.2	33.9%	27.0%	30.5%
A	機械	サービスパーツセンター厚木	サービスパーツセンター吹田	4/23	東→西	相模原３便	49.2	6,600.0	82.1%	48.9%	65.5%
A	飲料容器	松戸工場	大阪工場	4/23	東→西	相模原４便	85.3	5,200.0	71.1%	19.3%	45.2%
B	冷凍品	舞洲	厚木	4/23	西→東	西宮Ｃ２便	54.7	5,204.0	91.2%	38.5%	64.9%
B	リサイクル品	大阪市港区	南足柄市	4/23	西→東	西宮Ｃ２便	41.1	6,400.0	68.6%	47.4%	58.0%
B	製薬	神戸工場	北本工場	4/23	西→東	西ｘｘｘ便	38.7	4,800.0	64.5%	35.6%	50.0%

2. Details of simulations conducted to evaluate the effectiveness of each transport mode

Approach to Selecting Transport Modes

Select the shipping method based on the cargo volume on the previous page and the following guidelines

◇**Transportation Method**

1) Consolidated Shipping (Consolidated at a hub)

Unit of shipment: Palletized cargo is assumed
Shipment Volume: Acceptable even for shipments that do not fill a single large truck
Consolidation eligibility: Must be suitable for consolidation

2) Consolidated Transport (Trailer Coupling/Uncoupling)

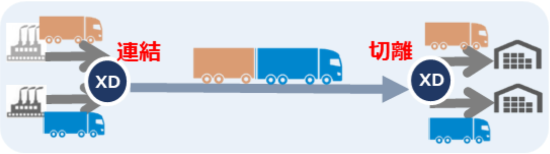
Shipment Unit: Non-palletized shipments are also accepted
Cargo Volume: Cargo that fills one large truck and achieves the required load factor
Consolidation: Acceptable even for cargo that cannot be consolidated
(Cargo requiring temperature control (refrigerated/frozen), industrial products, and cargo where odors may transfer to other items)

3) Direct Delivery via Double-Tractor-Trailer

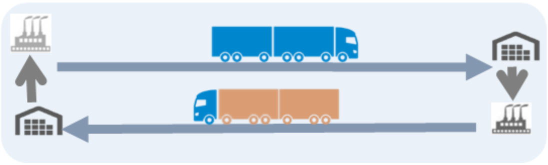
Shipment Unit: Non-palletized shipments are also acceptable
Cargo Volume: Cargo that fills two large trucks with sufficient load factor
Consolidation: Acceptable even for shipments that cannot be consolidated
(Cargo requiring temperature control (refrigerated/frozen), industrial products, and cargo where odors may transfer to other items)

共同輸送（集約拠点にて混載）

共同輸送（トレーラの連結）



W連結車直送



In addition to the above, the mode of transport is determined based on the relative locations of the facilities (pickup and delivery locations, transfer points, and coupling/consolidation points)

2. Details of the simulation of effects by transport mode

Regarding the simulation output data for this project

Using the input data listed on the previous page, we calculated the loading and allocation for the W-articulated truck using the automatic loading and allocation calculation software NeLOSS*1.
Based on the calculated route information, the following metrics were derived. An evaluation was conducted from the perspectives of efficiency, cost-effectiveness, and environmental impact.

◇Indicators Used for Evaluation

Indicators of logistics efficiency

Transport weight per trip [t/trip], transport volume [m^3/trip]
Total driver working hours [hr]
Load factor (weight) [%], load factor (volume) [%], composite load factor [%]
To indicate full utilization of both weight and volume, the average of weight and volume was set as the composite load factor.

Indicators of economic efficiency

Transportation cost [JPY/trip]
We established a calculation model based on NLJ’s business model to derive figures that more closely reflect actual business operations.

Environmental indicators

CO_2 Emissions [tCO_2]:
Calculated based on the fuel efficiency method outlined in the Guidelines for Calculating CO_2 Emissions in the Logistics Sector.
We selected a highly accurate fuel consumption calculation method using fuel consumption data from NEXT Logistics Japan.

*1: NeLOSS is an abbreviation for NEXT Logistics Japan’s NEXT Logistics Optimal Solution System.
By utilizing Inspired quantum technology, the system automatically generates the optimal solution in tens of seconds to a few minutes for the complex task of determining vehicle-load pairings—a process that previously relied on human “experience and intuition” and took several hours.
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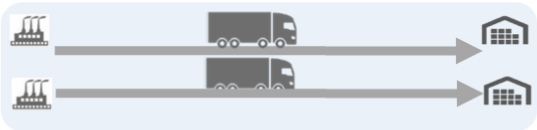
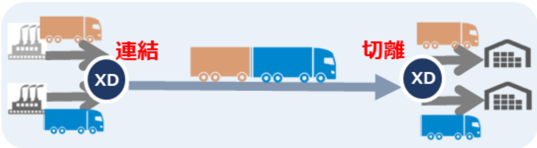
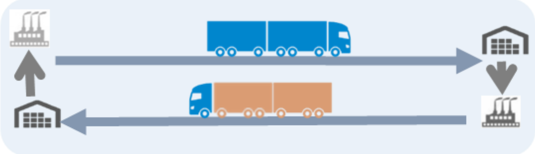
3. Simulation Results and Challenges for Each Transport Mode

Simulation Results

The simulation results showed that, for indicators of **logistics efficiency and** environmental performance, all modes of transport demonstrated **improvements in efficiency**.

On the other hand, regarding operating costs (which indicate economic efficiency), the calculations showed that (**A) consolidated hub consolidation and (B) trailer** coupling **resulted in a deterioration**, **while (C) direct delivery** was effective.

		Logistics Efficiency				Cost-effectiveness	Environmental Impact
	Number of flights	Total weight / Total Volume	weight per flight / Transport per flight	Total driver hours / Working Hours	Load factor Volume/Weight Combined	Operating	Reduction in CO2 emissions
各社個別輸送 	Flight 135	1,057 tons / 4,261 m³	7.8 t/trip / 31 m³/trip	1,020 hr / 7.6 hours/flight	55%/54% 55%	17,871,000 yen	0.038 tCO2
共同輸送（集約拠点にて混載） 	28 W-linked (equivalent to 53 flights)	411 t / 2,057 m³	14.7 t/trip +88% / 74 m³ per trip +139%	322 hours / 6.0 hours/flight -21%	63%/61% 62% +7%	Individual: 8,491,000 yen → Joint: 9,493,000 yen +12%	0.032 tCO2 -20%
共同輸送（トレーラの連結） 	15 W-Linked (equivalent to 25 trips)	197 t / 1,056 m³	13.1 t/trip +68% / 70 m³ /trip +125%	178 hr / 7.1 hours/flight -7%	58%/59% 59% +4%	Individual 4,028,000 yen → Joint: 4,252,000 yen +6%	0.035 tCO2 -10%
W連結車直送 	22 W-Linked (equivalent to 57 trips)	449 t / 1,148 m³	20.4 t/trip +160% / 52 m³ /trip +67%	151 hr / 2.6 hours/trip -65%	76%/44% 60% +5%	Individual 5,352,000 yen → Joint: 3,480,000 yen -35%	0.024 tCO2 -37%
	All 135 shipments were allocated as described above		67%–160% increase in efficiency	-7% to -65% efficiency	+5–7% improvement		10–37% reduction

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3. Simulation Results and Challenges for Each Mode of Transport

Challenges by Transport Mode

The results of the simulation and the challenges identified by NEXT Logistics Japan Co., Ltd. through actual operations are shown below.

Transportation Method	Challenges	Details	forwarder	Shipper
Consolidated Transport (Consolidation at a hub) 	Standardization of Order Information	[General Order Information] Order data varies by company. Since it is based on output from each company's proprietary production systems, etc., changes are difficult to implement. Some business practices involving fax communication still remain. **[Package Information]** **In many cases, the information required for consolidated shipping (pallet-level dimensions—length, width, and height—and pallet-level weight) is missing**. As a business practice, only the information necessary to arrange a single vehicle (e.g., one large truck = 18 pallets, weight under xx tons, etc.) is considered sufficient, so there is no need to manage this data.		○
	Schedule Control	When feeder routes experience delays—such as due to traffic congestion or waiting for cargo handling—resulting in late arrivals at consolidation hubs, this leads to waiting times before departure or the necessity to depart with cargo still pending, which impacts operating costs. **Extending lead times** and allowing for flexible acceptance of deliveries are effective solutions.	○	○
	Balance of Light and Heavy Cargo	From the perspective of fully utilizing cargo space, it is essential to balance the loading of light and heavy cargo. However, it is difficult to meet transportation conditions—such as delivery lead times (delivery dates)—while maintaining a balanced load of light and heavy cargo.	○	

3. Simulation Results and Challenges for Each Mode of Transport

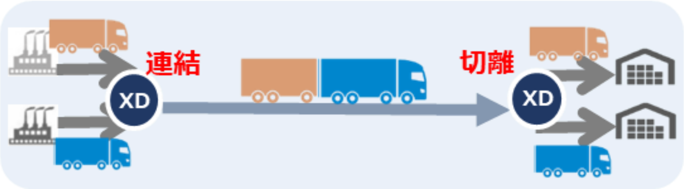
Transportation Method	Challenges	Details	forwarder	Shipper
Consolidated Transport (Consolidation at a hub) 	Balance Between Inbound and Outbound	It is common to increase or decrease the number of flights based on fluctuations in cargo volume; however, when conducting shuttle transport between XDs, the number of flights cannot be adjusted based on the requirements of just one direction (inbound or outbound). Maintaining a balanced ratio of inbound and outbound shipments leads to efficient transport.	○	
	Lead Time and Shipping Timing	The challenge lies in striking a balance between the constraints of pickup and delivery times and the need to efficiently match them with trunk routes. Extending lead times and allowing for flexible acceptance of shipments are effective strategies.	○	
	Costs Associated with Consolidated Shipping	・Feeder/Trunk Line Costs: What was previously transported directly from A to B is now split into three segments: A→XD, XD→XD, and XD→B. It is necessary to optimize the collection and delivery processes for the feeder segments (A→XD and XD→B). ・Handling Costs: Additional unloading and loading for mixed cargo will be required compared to the previous method, resulting in handling costs. From the above perspectives, increasing the load factor leads to greater economic efficiency.	○	○

3. Simulation Results and Challenges for Each Mode of Transport

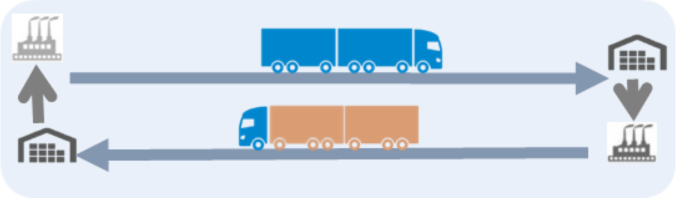
Challenges by Transport Mode

The results of the simulations and the challenges identified by NEXT Logistics Japan Co., Ltd. through actual operations are presented below.

Regarding joint transport (trailer coupling) and direct delivery by W-coupled vehicles, while efficient transport is possible if conditions are met, the scheme is limited to shippers

Transport Method	Challenges	Details	forwarder	Shipper
Joint Transport (Trailer Coupling)	Schedule Planning Location	When creating a schedule, it is necessary to set a standard of one round trip or one run per 24-hour period. This is because if the schedule does not fit within this timeframe, daily pickup and delivery times will vary, making it difficult for the pickup and delivery sides to coordinate. 24 hours – main route operating time (e.g., 10 hours × 2 for a round trip between Tokyo and Osaka) = branch route time (e.g., 4 hours). Facilities must be configured to accommodate pickups and deliveries within this timeframe.	○	○
	Vehicle Fixed Costs	As one solution to the challenges of schedule creation and location conditions mentioned above, it is possible to establish a schedule by utilizing multiple trailers for a single head tractor; however, this creates a trade-off where utilization rates decrease while fixed costs increase.	○	
	Costs Required for Coupling	・Feeder/Trunk Line Costs: What was previously transported from A to B is now split into three segments: A→XD, XD→XD, and XD→B. It is necessary to optimize the connections on the feeder segments (A→XD and XD→B). ・Connection Costs: Labor and facility costs associated with connecting mixed loads will be incurred, as they were previously. However, since the work involved in mixed loading requires less space and less time, costs can be kept lower compared to conventional mixed loading.	○	○

3. Simulation Results and Challenges for Each Mode of Transport

Transport Method	Challenges	Details	forwarder	Shipper
Direct Delivery via W-Connected Vehicles	Freight Volume	This requires regular transport of a stable volume of cargo.		○
	Maneuvering Double-Tractor Trucks at Pickup/Delivery Locations	・It is necessary to obtain the required permits for the route to the pickup/delivery locations, and the premises must allow for the maneuvering of double-trailer trucks. ・Since the GVW of a double-trailer truck cannot handle the same load capacity as two standard large trucks (13-ton capacity for a single large truck vs. 24-ton capacity for a double-trailer truck), special arrangements may be required for logistics and supply chain management when transporting heavy cargo.		○

5. Results and Challenges of the Simulation on Extended Transportation Lead Times and Standardization of Cargo Packaging

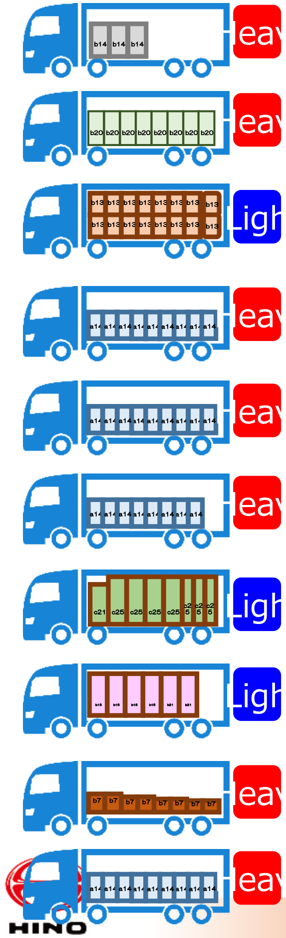
Results of the Simulation on Extended Transportation Lead Times

By selecting and loading cargo with high loading efficiency, **a 16% efficiency improvement** was achieved (0.8 truckloads out of 5) due to the front-loading effect

・Inconsistent cargo dimensions (varying heights) resulted in cases where mixed-weight stacking could not be achieved

・Cargo from a single shipper (per feeder service) was dispersed across up to three mainline vehicles

Branch Line Inbound



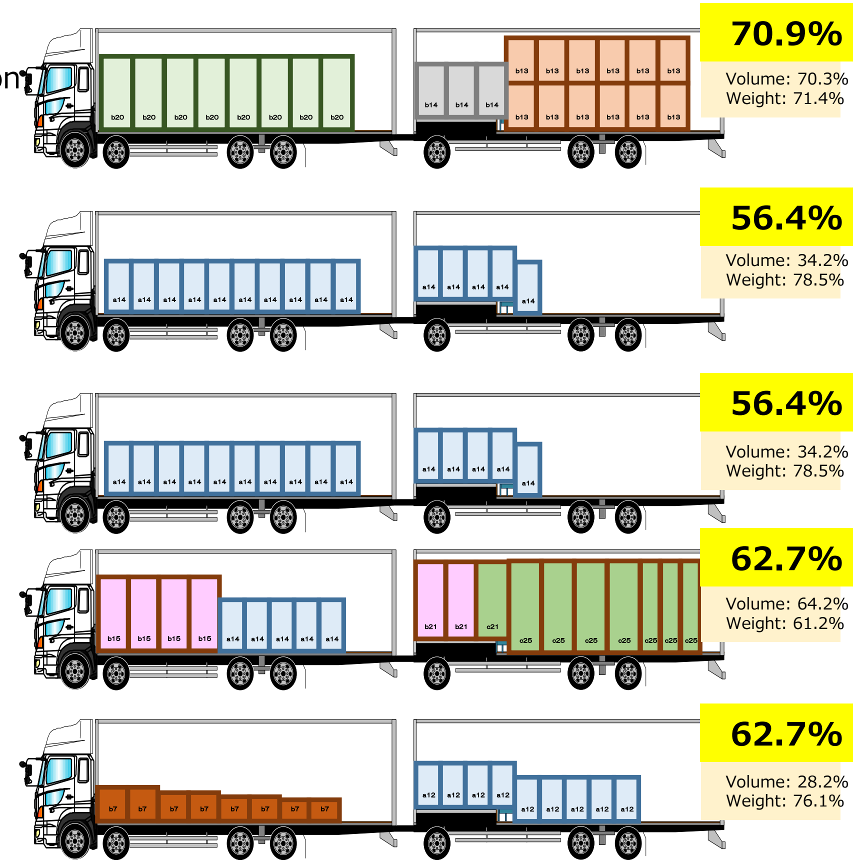
Packaging Information
Weight only

Packaging Information
Weight Only

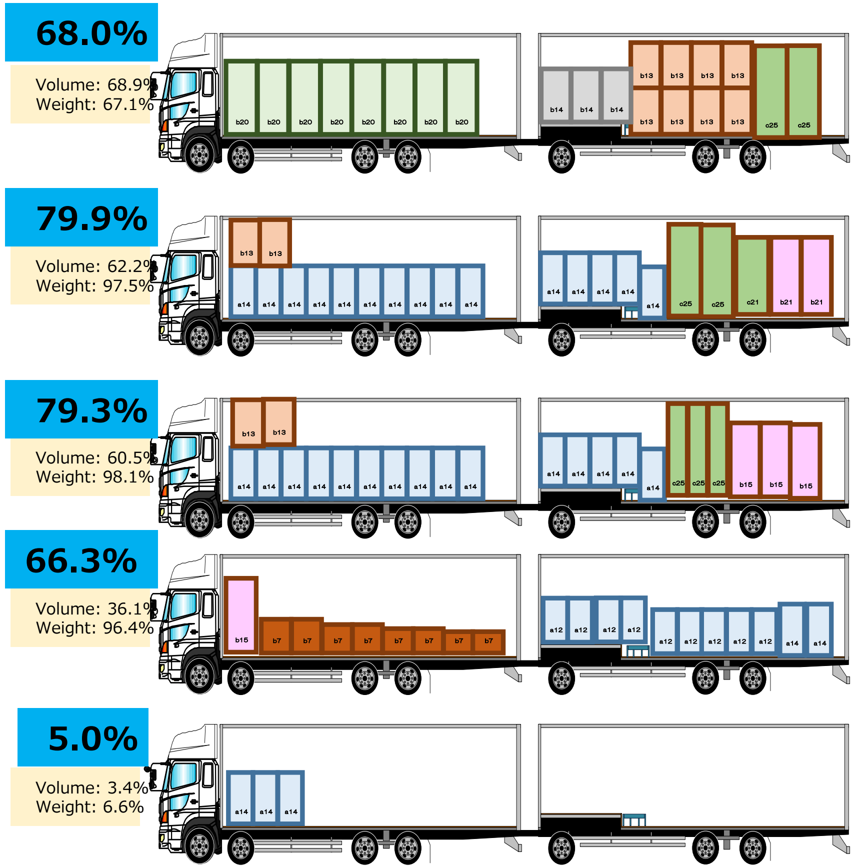
Pallet size
Multiple

Load height
Varies

Loading Performance



Simulation Results

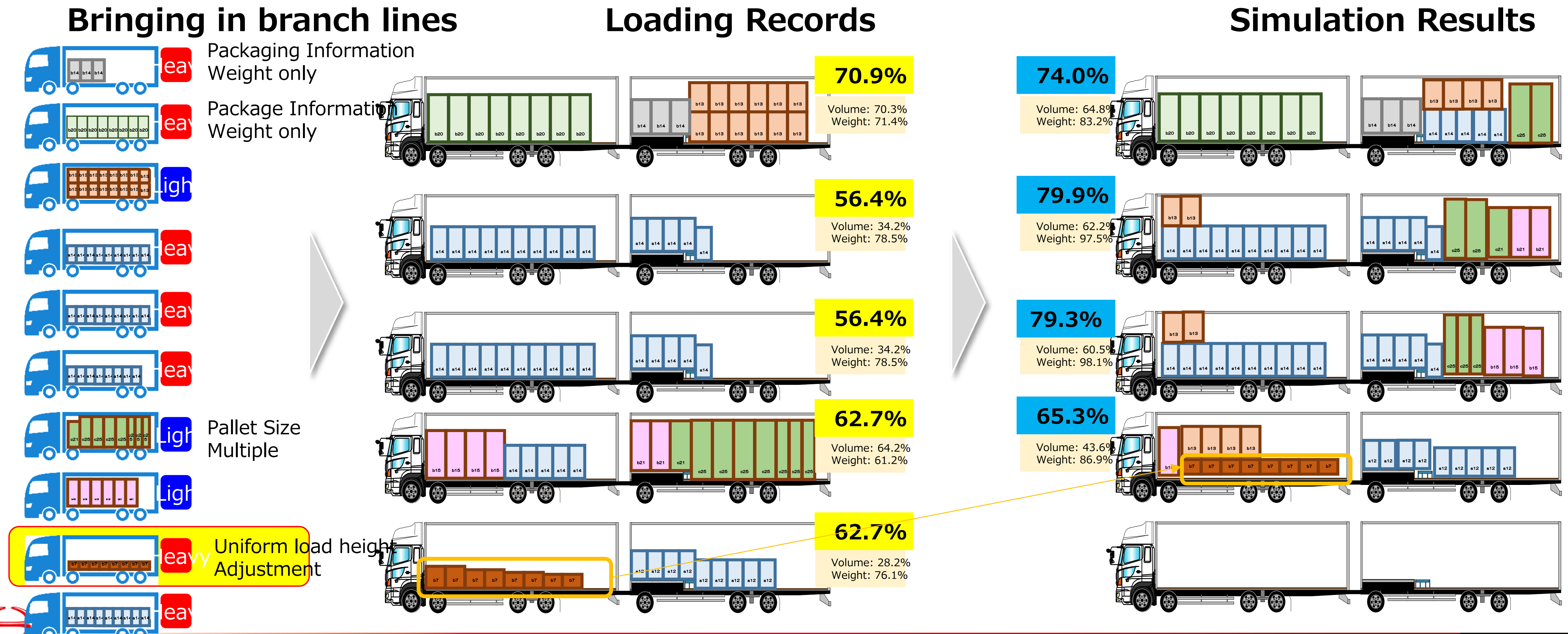


5. Results and Challenges of the Simulation on Extended Transportation Lead Times and Standardization of Packaging

Results of the Simulation on Standardization of Cargo Configurations

Extended transport lead times + standardizing irregularly sized cargo to a uniform height resulted in **a 22% efficiency improvement** (equivalent to 1.1 additional trucks out of 5) due to stacking efficiency

- Increased number of successful mixed-weight stacking operations
- Cargo per shipper (per feeder service) was distributed across up to 4 mainline vehicles



5. Results and Challenges of Simulations on Extended Lead Times and Standardization of Cargo Configurations

Summary of Effects and Challenges of Extended Lead Times and Standardization of Cargo Configuration

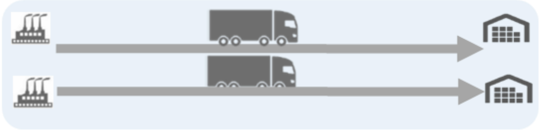
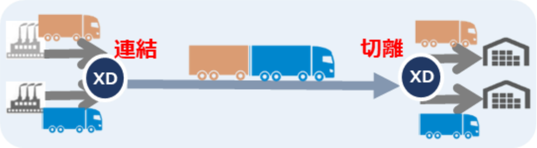
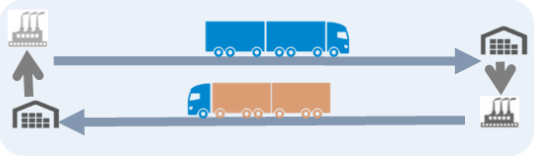
The effects, changes, and challenges are as follows:

Transport Lead Time Extension	**[Results] ·Approximately 16% improvement in transport efficiency** ***Efficiency improvements were limited due to the following two factors: (1) Cargo volume skewed toward heavy items, and (2) inconsistent heights of potential lower-deck cargo** **[Changes] ·Assignment of cargo from feeder routes to trunk routes was distributed across up to three routes ·Lead time for some cargo increased by 1 day** **[Challenges] 1. Increased workload for cargo management and operations before and after trunk line transport** ·Arrangements to distribute feeder shipments to three trunk routes, and operations to consolidate trunk route shipments into one feeder route ·Tracking management by shipment type **2. Unstable delivery lead times** ·Since transport timing varies based on trunk line loading calculations, the delivery/receiving window needs to be expanded ·Increased cargo backlog at the cross-dock facility requires sufficient temporary storage space
Standardization of cargo packaging	**[Results] ·Approximately 22% improvement in transportation efficiency (due to a combination of extended transportation lead times and other factors)** **[Changes] ·For heavy cargo with varying heights, heights were standardized ·Allocation of cargo from feeder routes to trunk routes was distributed across up to four routes** **[Challenges] 1. Establishing standard dimensions for cargo configurations based on consolidated transport** ·Size and weight standards that balance the efficiency of each transport mode, storage, and handling ·Packaging materials capable of withstanding stacked transport alongside other companies' cargo **2. Changes to specifications from existing packaging** ·The significant efficiency gap between specifications optimized for individual companies or individual products and standard specifications ·Costs and man-hours associated with specification changes **3. Improving the Efficiency of Mixed-Load Transportation** ·Optimal matching of vehicle constraints (vehicle height, maximum payload) with cargo size and weight → Cases where heavy cargo dominates and cargo space is not fully utilized are frequently observed

6. Simulation Summary

Summary of Simulation Results

Joint transportation improves logistics efficiency, and regarding the challenge of operating costs, extending lead times and standardizing cargo configurations were found to be effective quantified through simulations conducted under certain conditions in this study.

	Number of flights	Logistics Efficiency: Total Transport Volume	Logistics Efficiency: Transport weight per flight / Transport volume per shipment	Logistics Efficiency: Total Driver Working Hours	Logistics Efficiency: Load factor		Cost- Operating	CO2 emissions per ton of cargo
各社個別輸送 	135 trips	1,057 tons 4,261 m³	7.8 tons per trip 31 m³ per trip	1,020 hr 7.6 hours per trip	55%/54% 55%		17,871,000 yer	0.038 tCO2
共同輸送（集約拠点にて混載） 	28W-Linked (equivalent to 53 flights)	411 t 2,057 m³	14.7 t/trip +88% 74 m³ per trip +139%	322 hours 6.0 hours per trip -21%	63%/61% 62% +7%	Extended Lead Time resulting in 72%	Individual: 8,491,0 Joint: 9,493,000 +12%	0.032 tCO2 -20%
共同輸送（トレーラの連結） 	15W-Linked (equivalent to 25 trips)	197 t 1,056 m³	13.1 tons per trip +68% 70 m³ per trip +125%	178 hr 7.1 hours per trip -7%	58%/59% 59% +4%	Standardization of packaging resulted in 76% (+22%)	vidual 4,028,0 Joint: 4,252,000 +6%	0.035 tCO2 -10%
W連結車直送 	22W-Linked (equivalent to 57 trips)	449 t 1,148 m³	20.4 tons per trip +160% 52 m³ per trip +67%	151 hr 2.6 hours per flight -65%	76%/44% 60% +5%		Individual 5,352,0 Joint: 3,480,000 -35%	0.024 tCO2 -37%

7. Clarification of the Relationship with Development Theme (b) and Social Implementation

While this simulation focuses on joint transport using W-configuration trucks for trunk transport, there are various ways to improve the efficiency of transport operations. In Theme (b), we will develop digital conversion software capable of acquiring cargo configuration data—which serves as a prerequisite for logistics efficiency—and implement it in society by releasing it as open-source software (OSS).

Operations Planning Phase | Operation Phase

Operations

Order

・Formulation of operation plans

・Operation of feeder routes

・Unloading
・Preparation
・Loading

・Main route operation

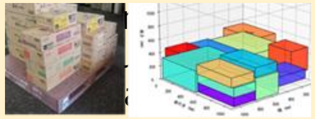
Scope of this theme
Scope of Simulation

・Unloading
・Preparation
・Loading

・Operation of Feeder Routes

Efficiency Improvement Methods Examples

・Utilization of Software for



Challenges
・Lack of cargo configuration data to improve efficiency

・Utilization of automated loading software
・Utilization of automated dispatching software

・Optimal Delivery Benefits: Labor savings Increased efficiency
・Utilization of berth reservation software Benefits: Minimization

・Automated cargo handling using automated machines (AGVs, AMRs, etc.)
Benefits: Labor savings

・Joint transportation using W-linked trucks
Benefits: Labor savings Efficiency

・Trunk transportation using autonomous trucks
Benefits: Labor savings

・Automated cargo handling using automated equipment (AGVs, AMRs, etc.)
Benefits: Labor savings

・Optimal Delivery Benefits: Labor savings Increased efficiency
・Utilization of berth reservation software Benefits: Minimization

Utilization of cargo configuration data

METI Logistics MaaS

SIP
Development of software for digitizing cargo configuration information (Hino Motors)

Logistics MaaS
Automatic cargo handling demonstration
(NEXT Logistics Japan)

Logistics MaaS
Japanese Truck Data Standard

Logistics MaaS
Automatic cargo handling demonstration
(NEXT Logistics Japan)

METI/Logistics MaaS: Guide to Joint Transportation

Cabinet Office/SIP Logistics Standard Guidelines

General Overview

Theme (a): Proposals for improving regulations, systems, and business practices that streamline long distance transport by trucks

Theme (b): development of software for converting logistics information into digital

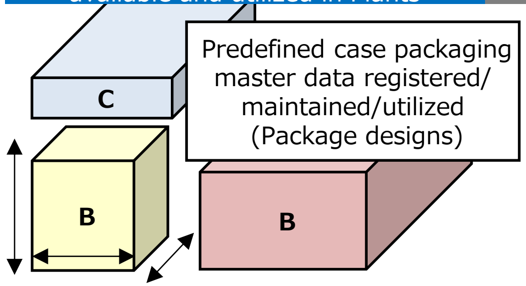
1. Background of the Development

Challenges of the current logistics industry
(inter-company logistics utilizing pallets for shipments)

*Packaging style: form of outer packaging serves as the basic unit for shipments and storage, having the following information therein: individual case dimensions, individual case weight, outer packaging dimensions and weight after palletized et.al

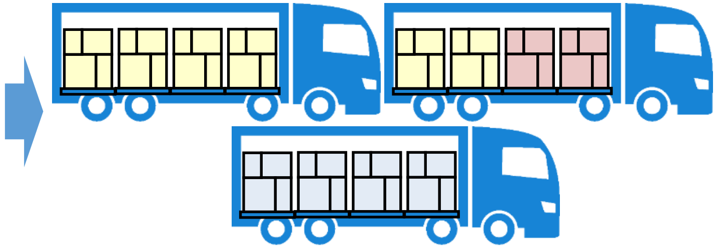
Packaging style* data registered, available and utilized in Plants

(1) Plant-to-distribution center (DC) logistics phase: No packaging style data provided by the manufacturers for use in logistics

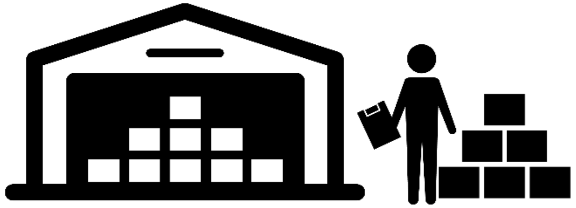


Manufacturer's internal processes

Shipments solely in the predefined cases



Shipments in the single or limited SKUs



Receiving and temporary storage in distribution centers

Manufacturer's production process uilizing packaging style data

Logistcs planning and execution based on estimated total cargo volume information such as total shipment M3 and weight to estimate the required number of trucks; No packaging style information is provided by manufacturers to trucking companies

Issue: the required number of trucks tend to be estimated with margin, not at optimal efficiency

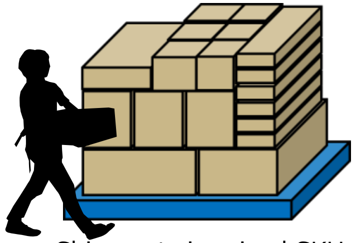
Storage planning and operations based on estimated total cargo M3 by visual estimate upon truck arrival to determine necessary storage location/space and operators

Issue: the required warehouse spaces and operators estimated with margin, not at optimal efficiency

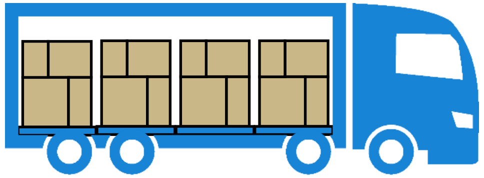
(2) DC-to-retailers (warehouses) logistics phase: No packaging style data available or utilized

From DC to warehouse logistics, shipments are made in mixed SKUs

Logistics planning



Shipments in mixed SKUs



shipments in mixed SKUs

Receiving and Inspection at retailers' warehouses

DC to retailers logistics planning based on estimated total cargo volumes
Estimates are usually made with wider margins than plant to DC logistics due to mixed SKU shipments

Issue: logistics planning is not optimized for maximum efficiency

On-site palletizing with no prior planning; ad-hoc operations by experienced operators

Issue: No work plans

Shipping in mixed SKUs on pallets and mixed packaging styles on cargo space

Issue: Loading orders and loaded locations on truck are difficult to track

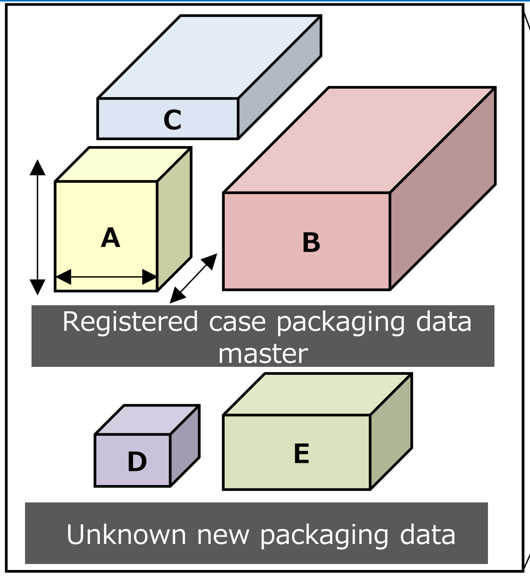
Inspecting all the cargos one by one upon receipt

Issue: Inspection takes time because items must be identified/located

Due to no packaging styles information sharing between manufactures and trucking and warehousing industries, the efficiency of overall logistics is impacted in all the phases, limiting improvement possibilities

2. Development Goals

Creating packaging styles information for unknown new cargos and providing complete packaging styles data to the total phases of the logistics operations

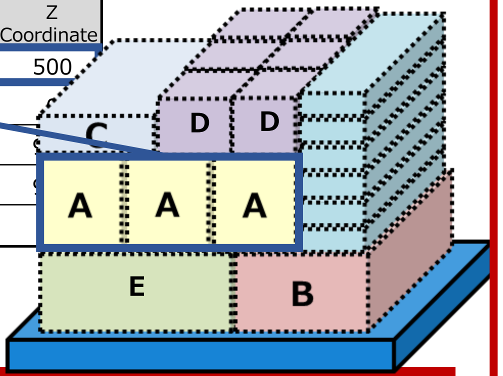


Information to be used in all the phases of logistics will be included in the first shipping details originating in the plants

This development

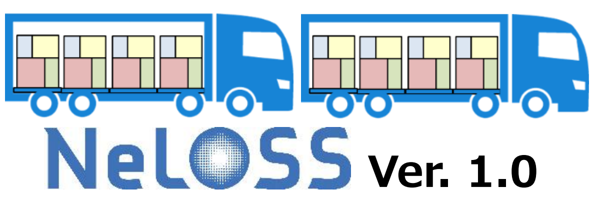
Perform packaging style configurations and create complete packaging style information for unknown new cargos and execute optimal palletizing plans

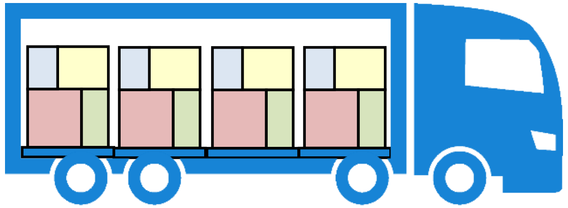
SKU	Quantity	Palletizing Information				
		Layer	Order	X Coordinate	Y-coordinate	Z Coordinate
A	9	2	3	0	0	500
B	1	1	2	700	0	[illegible]
C	1	3	5	0	0	[illegible]
D	6	1	6	300	0	[illegible]
E	3	3	1	0	0	[illegible]



Automatically generate palletizing plans optimized for mixed cargos of various SKUs

Complete packaging style information is available throughout the logistics operations in all the phases





Automatically calculates the optimal number **of trucks for optimal transport**

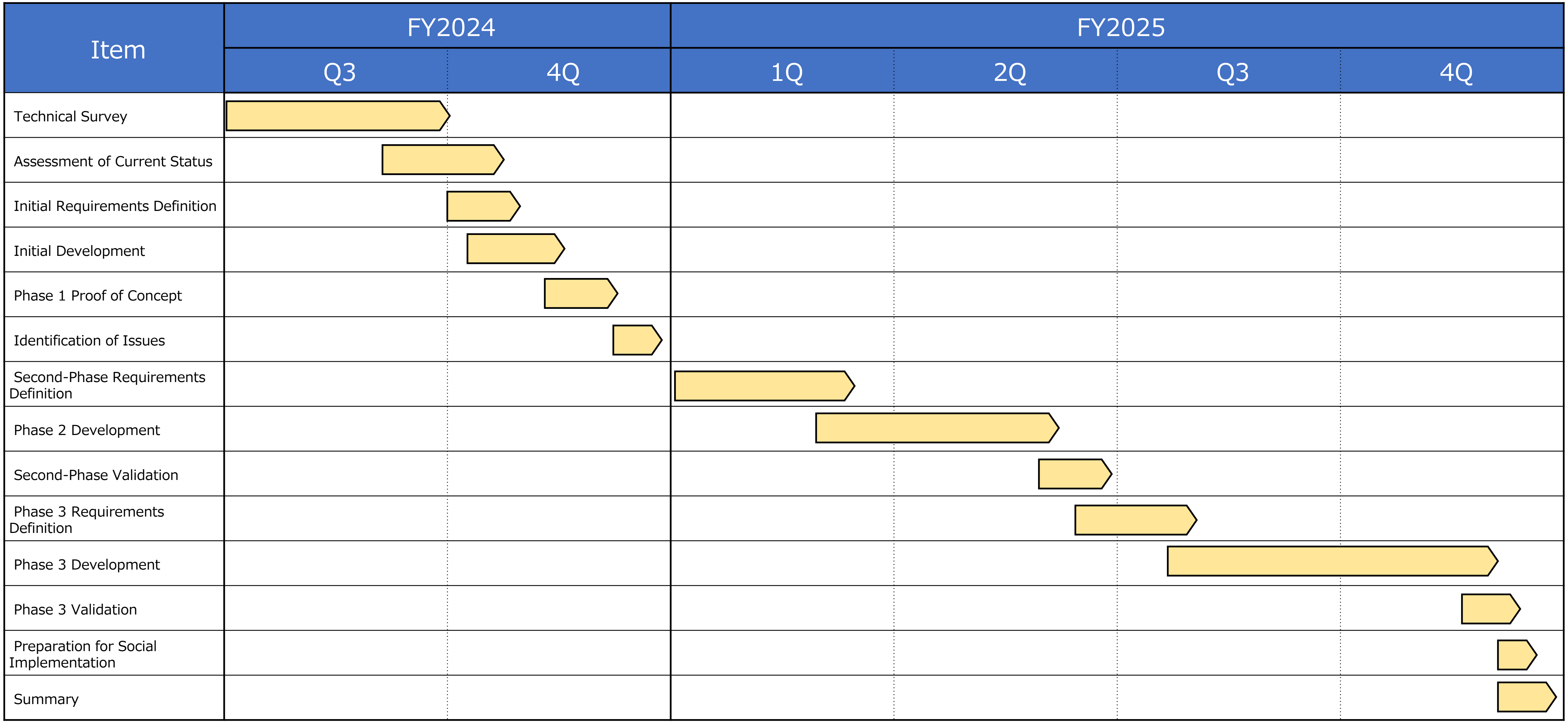
Optimize all the following logistics operations through to shipping

Make packaging style information available and assure traceability throughout the transpot

Develop a palletizing planning software that utilizes package style information and establish an environment where package style information data can be shared and utilized throughout the entire logistics processes

HINO

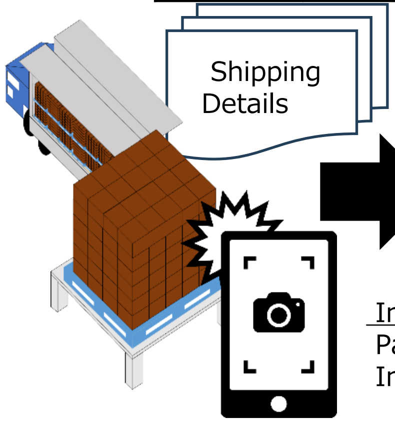
3. Schedule


Item
FY2024
FY2025
Q3
4Q
1Q
2Q
Q3
4Q
Technical Survey
Assessment of Current Status
Initial Requirements Definition
Initial Development
Phase 1 Proof of Concept
Identification of Issues
Second-Phase Requirements Definition
Phase 2 Development
Second-Phase Validation
Phase 3 Requirements Definition
Phase 3 Development
Phase 3 Validation
Preparation for Social Implementation
Summary

4. Software Configuration and Objectives

Shipping Details I/F (per case)

SKU	New Products	L [mm]	W [mm]	H [mm]	Weight [kg]	Quantity	Palletizing Master		Total Number of pallets	Configuration Number of pattern layers	Fractions Quantity
							Quantity per layer	Quantity per pallet			
A		250	200	180	1.8	150	25	125	②.2 1	1	0
B		280	240	210	2.3	90	20	60	1	1	10
C		300	370	240	2.7	15	12	48	0	1	3
D	○	① 320	400	280	4.5	8	②.1 10	40	0	0	8



Inbound Cargo Imaging

Input
Pallet Configuration Image

Dimension Estimation App

Output
Case Dimensions

①

Input
Case Dimensions

Palletizing Pattern Recognition App

Output
1. Palletizing Master
2. Consolidation, Fractional Box Quantities

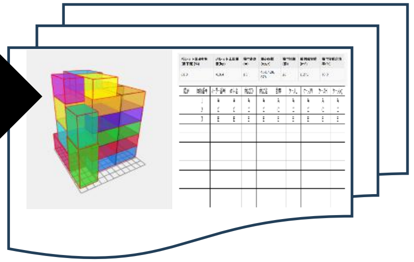
②

Input
Fractional Box Quantities

Palletizing Simulation App

Output
1. Mixed-load simulation
2. Consolidated Loading Combinations

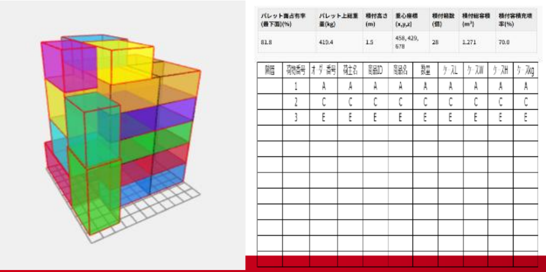
③



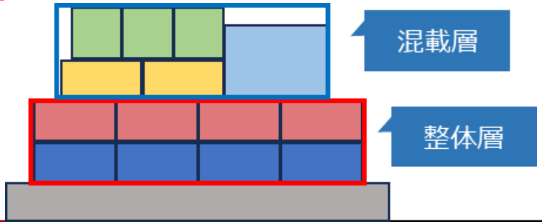
Palletizing Plan

-The interface appends data for consolidated handling by SKU to standard shipping details
-Output sheets of the Plan can also be configured to place both full loads and mixed loads on the same pallet

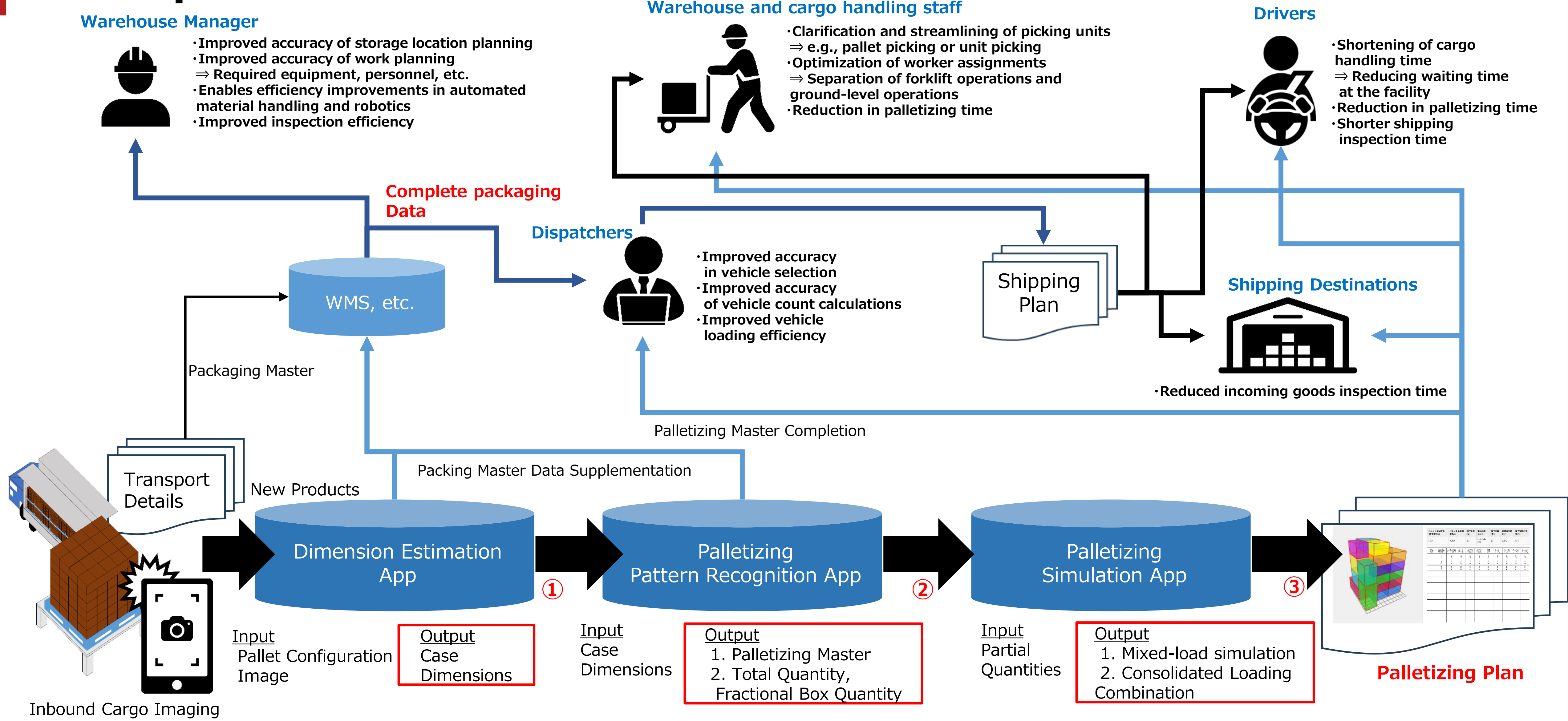
③.1



③.2

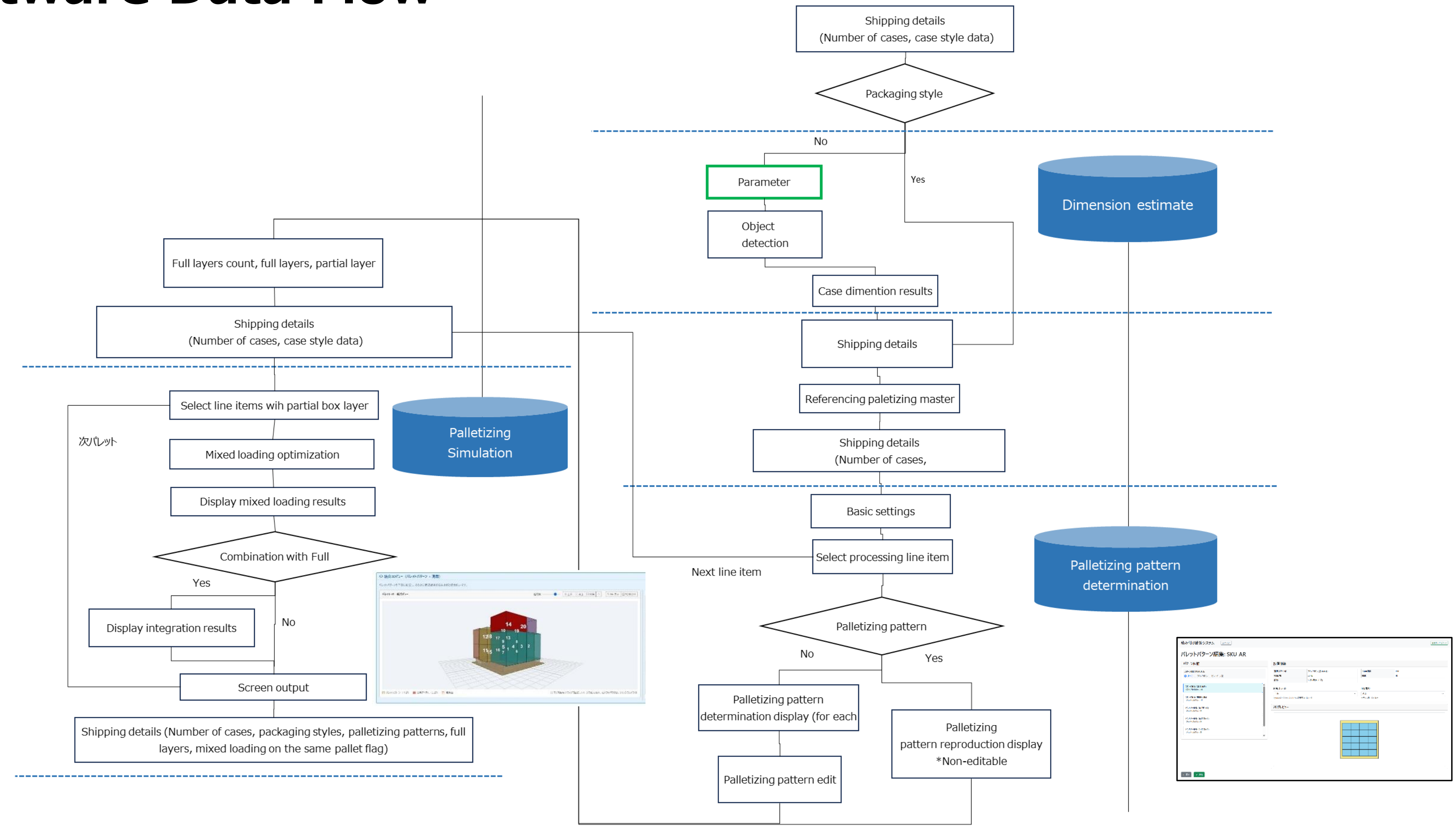


5. Expected Use Cases



Utilizes complete packaging data and system-generated palletizing plans to improve operational efficiency in each logistics process

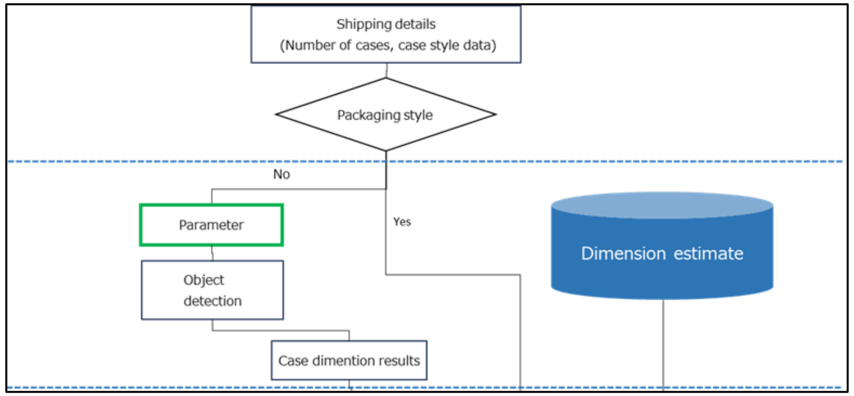
6. Software Data Flow

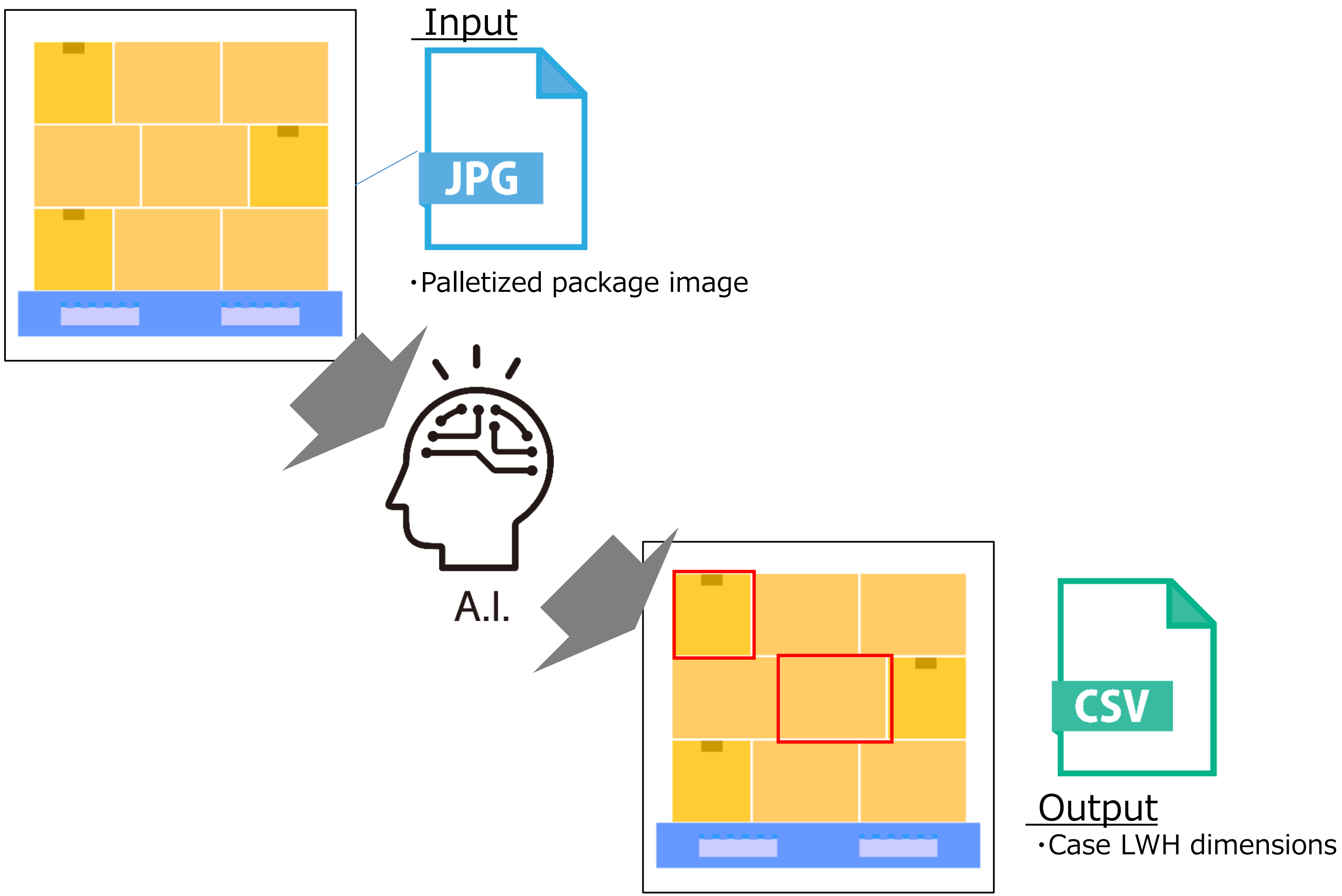


Define system transition flows and interfaces based on actual user procedures

7. Software Details: ① Package Dimension Estimation App

Data Flow

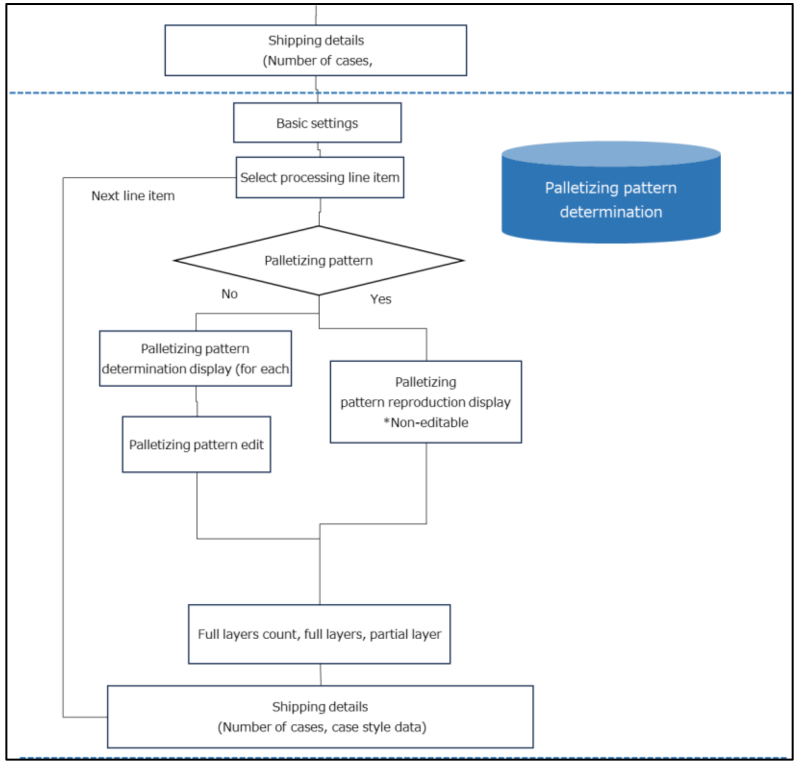


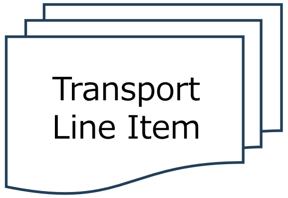


Estimates case dimensions from images of palletized cargo

7. Software Details: ②Palletizing Pattern Determination App

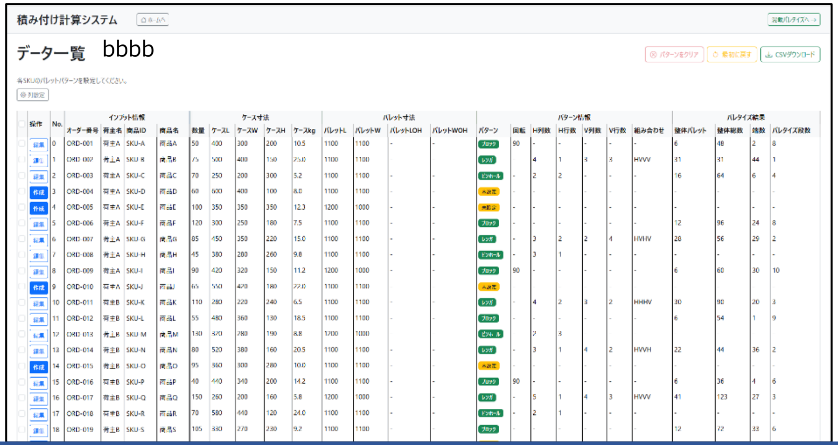
Data Flow



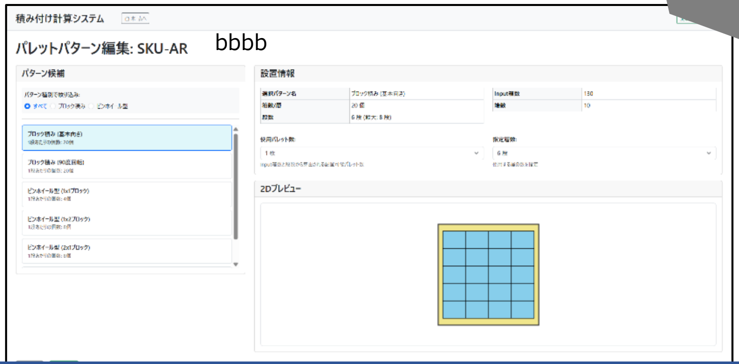


Input

・Product Name
・Quantity
・LWH Weight
・Applicable Pallet



Edit the single-load palletizing pattern for each detail



Edit patterns to match actual conditions

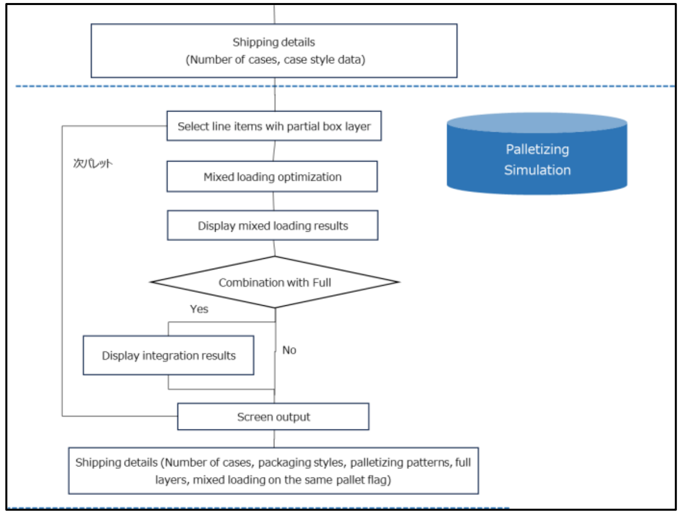
Output

・Palletizing Pattern
(Shape, number used, etc.)
・Total number of pallets
・Number of full layers
・Partial loads

Screen layout designed to facilitate editing of optimal patterns and actual patterns

7. Software Details ③ Palletizing Simulation App

Data Flow



Basic Settings (Maximum Package Dimensions)

- Pallet Size
- Package Height
- Package weight

Input

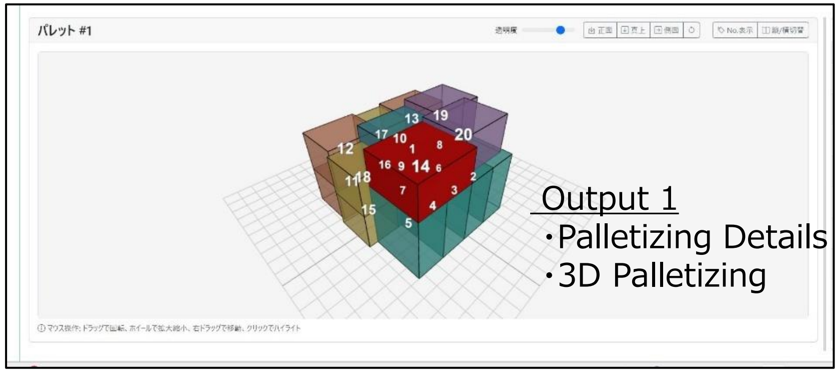
- Product Name
- Quantity (fractional)
- LWH Weight
- Do Not Turn Upside Down, etc.

Select Simulation Target

混載データ一覧　bbbb

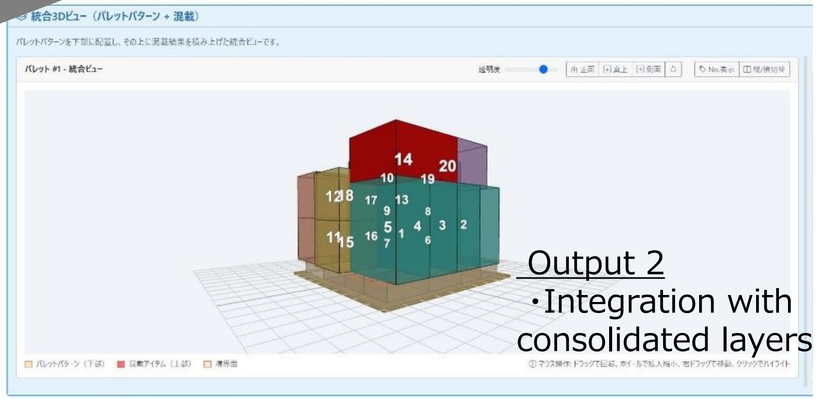
混載パレタイズに使用するSKUを選択してください。

No.	インプット情報					ケース寸法				混載パレ
	オーダー番号	荷主名	商品ID	商品名	数量	ケースL	ケースW	ケースH	ケースkg	
0	ORD-001	AL1111	A-001	A-001	4	410	220	500	5.70	
1	ORD-002	AL1111	A-002	A-002	5	340	410	230	9.33	
2	ORD-003	AL1111	A-003	A-003	3	325	400	300	10.47	
3	ORD-004	AL1111	A-004	A-004	4	320	255	290	6.80	
4	ORD-005	AL1111	A-005	A-005	2	340	400	280	10.80	
5	ORD-006	AL1111	A-006	A-006	1	410	440	250	2.85	
6	ORD-007	AL1111	A-007	A-007	1	330	400	300	10.48	
7	ORD-008	AL2222	A-008	A-008	2	350	680	260	18.05	
8	ORD-009	AL2222	A-009	A-009	23	410	440	250	4.46	
9	ORD-010	AL2222	A-010	A-010	3	325	450	250	4.37	
10	ORD-011	DR3333	A-011	A-011	4	282	192	87	0.70	
11	ORD-012	DR3333	A-012	A-012	30	200	285	98	1.00	
12	ORD-013	DR3333	A-013	A-013	5	211	315	107	2.10	
13	ORD-014	DR3333	A-014	A-014	1	185	405	160	6.00	
14	ORD-015	DR3333	A-015	A-015	1	293	210	157	2.05	
15	ORD-016	DR3333	A-016	A-016	2	493	204	156	6.00	
16	ORD-017	DR3333	A-017	A-017	2	284	144	167	1.60	
17	ORD-018	DR3333	A-018	A-018	3	192	286	100	1.20	



Output 1

- Palletizing Details
- 3D Palletizing



Output 2

- Integration with consolidated layers

・Includes rotation control for each box ・Can also create combination plans with single-unit SKU consolidation layers

8. Software Accuracy

① Package Dimension Estimation App

Accuracy Results

Box Detection Rate	Size estimation error [mm]
99.4%	**11.7**

Confirmed box detection rate and size estimation error are at a level that is robust enough for the filed use

② Robustness of Palletizing Pattern Determination App

Prioritizing operational feasibility in the field, the interface and screen layout are designed to accommodate the following practical palletizing concepts

Approach for Lightweight Shippers: Since the primary goal is to maximize volume utilization, patterns that allow for overhang beyond the pallet are adopted

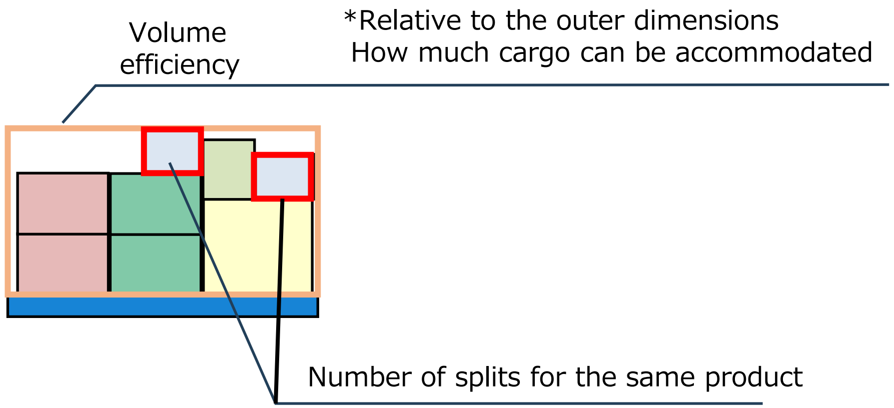
⇒ Added a "Pallet Overhang Allowance" field to the interface, and the system outputs pattern calculations for cases with overhang

Heavy-goods shippers’ approach: Since it is not possible to fully utilize the volume inside the truck, but rather the pattern that ensures the highest transport quality (Deliberately reducing the quantity per layer to select a stable pattern)

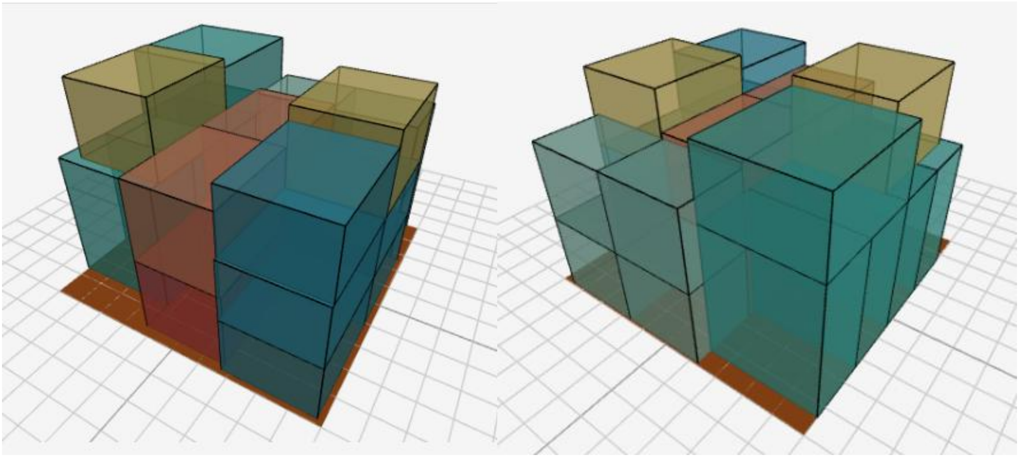
⇒Output calculations for quality-focused patterns such as brick stacking and pinhole stacking, even if they do not result in a quantity-maximizing layout

8. Software Accuracy: ③Palletizing Simulation Application

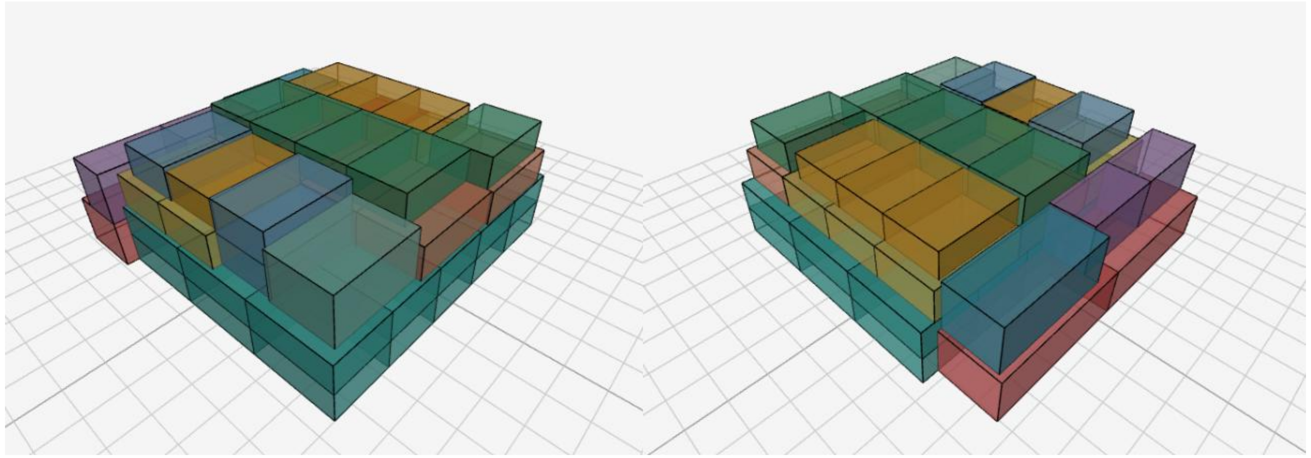
	Volume Efficiency	Separation Efficiency of This Product
Last Year's Logic	57.8%	30.8%/SKU
Current logic	**73.3%**	**6.0%/SKU**



Consolidation Optimization Case Study 1



Case Study 2: Mixed-Load Optimization



Volume efficiency and separation rates for identical items can be performed at a level comparable to capabilities of the experienced operators

9. Software Effect①(Impact on Logistics Efficiency and Work Time)

Impact on Logistics Efficiency

Before : Palletizing efficiency: 62% (Transportation of office supplies)

With the Software : Palletizing Efficiency: **73.3%**

⇒ Combined Loading Rate per Cargo Compartment: **Approx. +6% Improvement**

⇒ Number of delivery vehicles: **Approx. -13% Reduction**

Reduction in Palletizing Work Time

Assumptions

Number of boxes per pallet: 30 boxes

Number of pallets per truck: 16 pallets

Item	Work Motion	Positioning	Work Time/Box	Work Time/Pallet	Work Time/Unit
Before	7 seconds	3 seconds	10 seconds	5 minutes	80 minutes
After SystemUsage	7 seconds	0 seconds	7 seconds	3.5 minutes	56 minutes

Labor savings: -24 min./truck

9. Software Effect② (Improved Logistics Efficiency Through Standardized Cargo Configurations)

The system allows for loading planning by specifying the external dimensions of the cargo (L, W, H, kg)
⇒ Enables standardization of mixed-load palletized cargo, which tends to vary by operations

Deck rack transport

Replacing conventional mixed-load palletized transport
・If replaced with a palletizing planning system (while maintaining the conventional cargo configuration)
・If replaced with standard cargo specifications + a palletizing planning system + deck rack transport
Simulations of the effects of the two scenarios above were conducted

*1 Palletization volume efficiency for a certain office supplies transport operation

*2 Volume load factor

Dimensions [mm]

Vehicle Class	Cargo Space L	Cargo Area W	Cargo Area H
Large	9500	2400	2450

Details of the Implementation	Pallet L	Pallet W	Pallet H	Palletizing Volume Efficiency	Number of pallets	Volume [m³]	Number of units	Loading Rate
Before	1100	1100	1850	62.0%	16	22.2	798.3	100%
Palletizing Planning System	1100	1100	1,850	**73.3%**	16	26.3	943.7	**118%**
System +Standardization + Deck Rack	1100	1100	**1125**	**73.3%**	**32**	31.9	1,147.8	**144%**

Vehicle Class	Cargo Area L	Cargo Area W	Cargo Area H
Medium	6200	2400	2350

Implementation Details	Pallet L	Pallet W	Pallet H	Palletizing Volume Efficiency	Number of pallets	Volume [m³]	Number of units	Loading Rate
Before	1100	1100	1850	62.0%	10	13.9	498.9	100%
Palletizing Planning System	1100	1100	1,850	**73.3%**	10	16.4	589.8	**118%**
System + Standardization + Deck Rack	1100	1100	**1075**	**73.3%**	**18**	17.2	616.9	**124%**

When implementing a palletization plan to standardize cargo configurations for large trucks and using deck rack transport, a 44% increase in load capacity is expected

10. Social Implementation and Adoption

Social Implementation Status

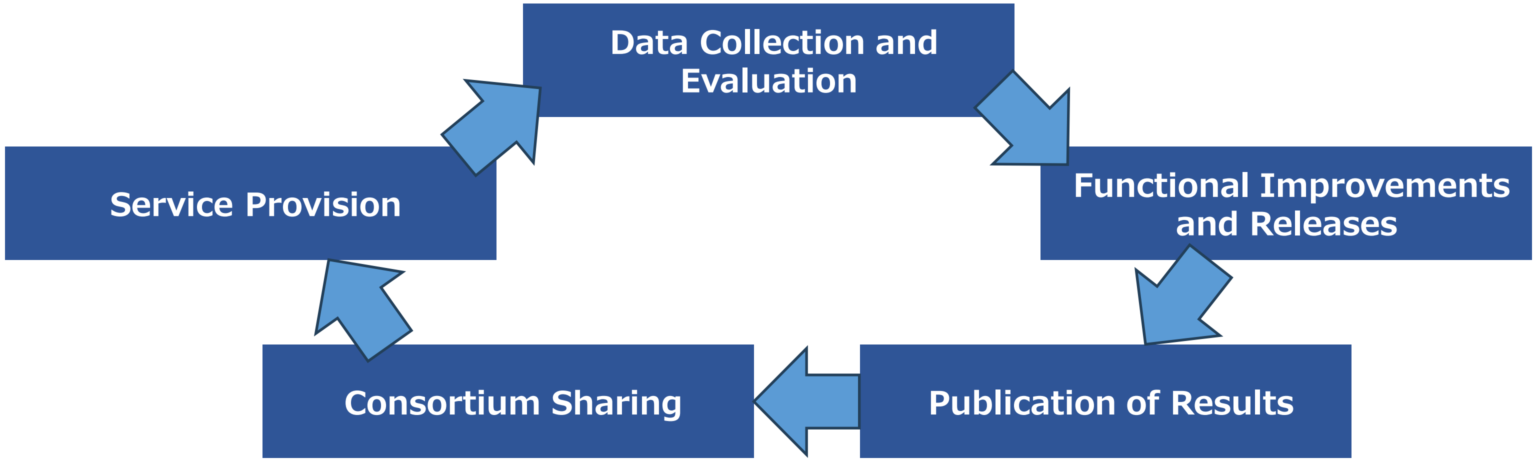
-We have established an open environment that allows companies that have inquired about using this software to start using the software free of charge

-We are currently preparing to establish a consortium focused on joint transportation on trunk routes. We plan to establish a subcommittee within the consortium to evaluate digital solutions, including this app.

-We have introduced the software to companies planning to join the consortium, and have received inquiries from multiple companies; we plan to begin pilot testing in April 2024 or later

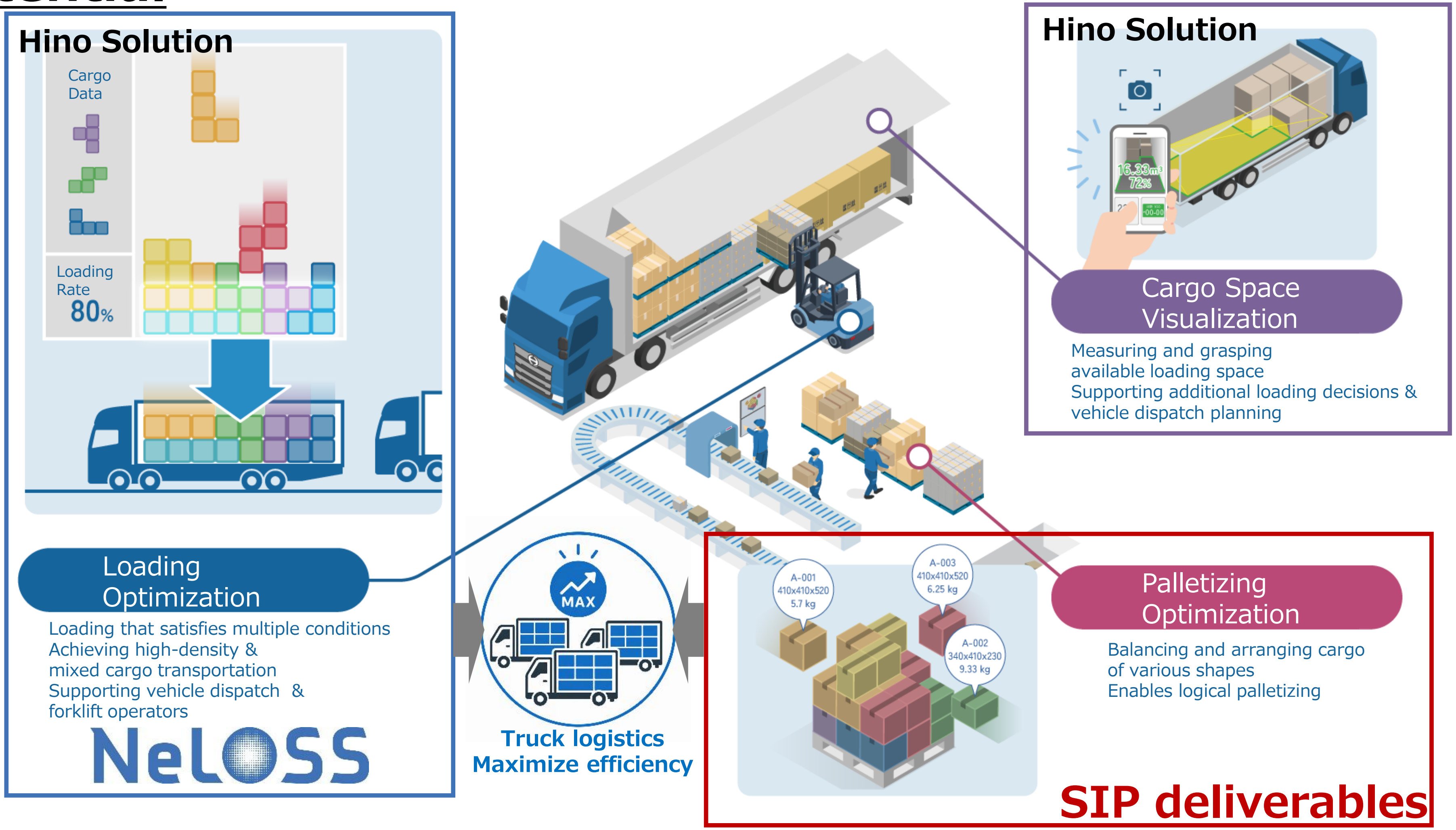
Rollout Phase Plan

・In addition to the above demonstrations, we plan to implement short-term feature improvements based on real data from companies using the open environment to implement short-term functional improvements and accelerate the transition to dissemination phase



10. Social Implementation and Adoption

Future potential



By linking palletizing planning software with NeLOSS, we aim **to maximize the efficiency of truck logistics** and promote **the digitization of the entire logistics process**, along with the visualization of cargo compartments.