A STUDY OF A NETWORK ANALYSIS MODEL FOR FREIGHT DEMAND

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Contents

1. Background and Objective of This Study

(1) Background of This Study

- Road planning focusing on the movement of people
- Road planning focusing on the quantitative evaluations

- Necessity of Investment of limited budget
- Necessity of Provision of easy-understanding effects

⇒ Qualitative evaluation is necessary

Effort in USA

From view of freight flow, improvement of road function are progressed.
(Freight Analysis Framework (FAF))

1. Background and Objective of This Study

(2) Objective of This Study

(1) To construct a method of analysis that evaluates the quality and function of road use from the perspective of freight flow

(2) To build a database that matches logistical data related to roads, ports and airports

- Construction of a Japanese version of Freight Analysis Framework (FAF)

Merits of FAF: evaluation of route apportionment and added value by types of products of freight

→ Contributes to the extraction of major routes and the preparation of improvement plans for logistical networks

2. Outline of the U.S. Freight Analysis Framework (FAF)

- FAF is an effort by the U.S. Federal Highway Administration (FHWA) to estimate future transportation demand related to logistics.

- It integrates the various types of government and private sector databases, prepares a comprehensive database of freight flow using trucks, railroads, shipping and aviation and conducts future estimations of freight OD.

- It distributes future estimation figures for freight OD over a network, prepares a “Freight Flow Map” that exhibits this through GIS and conducts network evaluations.

2. Outline of the U.S. Freight Analysis Framework (FAF)

Figure: Truck freight flows (1998, truck traffic volume/day)

Figure: Truck freight flows (2020, truck traffic volume/day)

Figure: Rail freight flows (1998, ton)

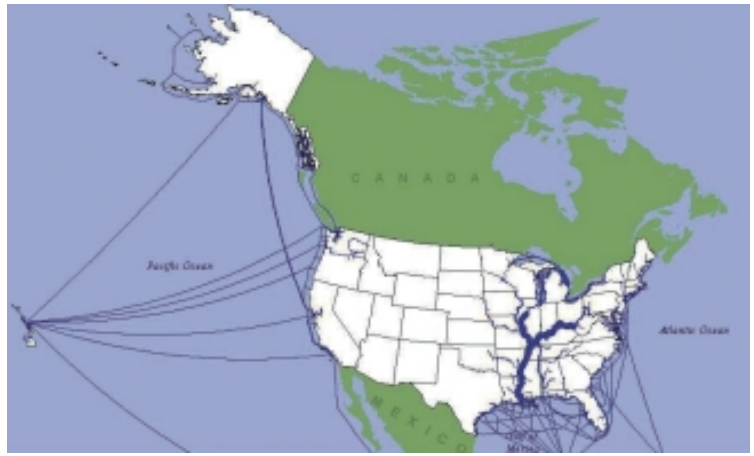


Figure: marine freight flows (1998, ton)

Graphic representation of national tonnage and traffic volume indices by mode of transportation and year

3. Preparation of Road Network Data Used in This Study

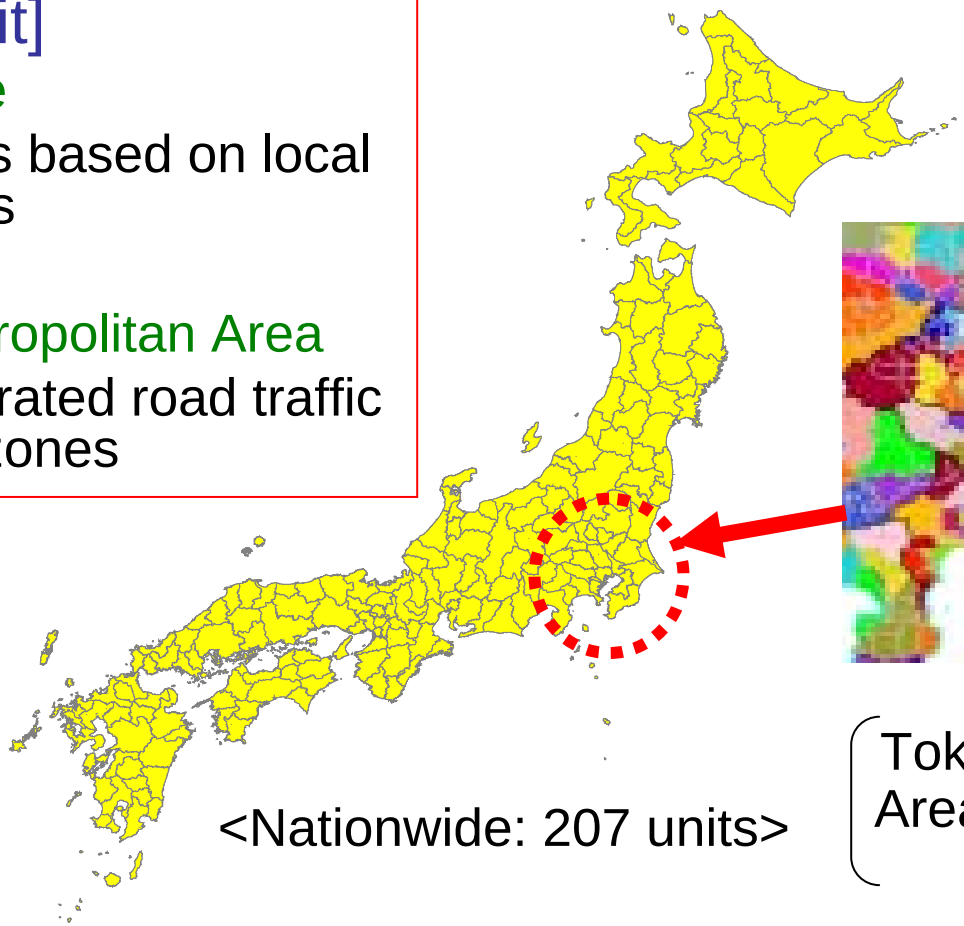
[Zone unit]

Nationwide

207 units based on local life spheres

Tokyo Metropolitan Area

Concentrated road traffic census B zones



<Nationwide: 207 units>

Tokyo Metropolitan Area: concentrated B zones

3. Preparation of Road Network Data Used in This Study

[Network]

From the network of road traffic census B zones:

Nationwide

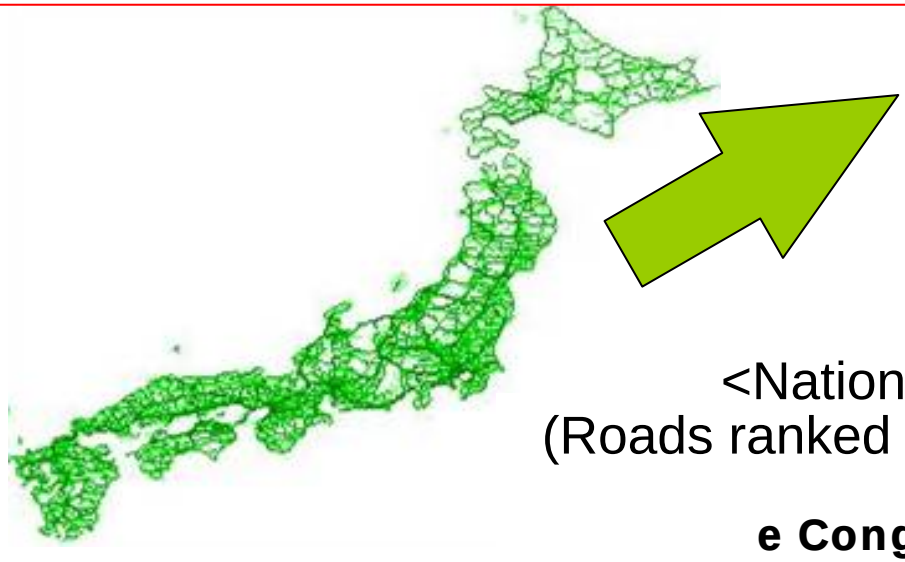
Extract roads ranked main local roads and higher

Tokyo Metropolitan Area

Targets all links, including municipal roads

Road Type	No. of Links
National expressways	22,351
National highways	141,224
Main local roads (prefectural roads)	130,058
Main local roads (city roads in specified cities)	6,069
Others (roads in Tokyo metropolitan area)	113,598
Total	413,300

Number of targeted links by type of road



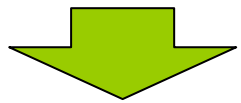
<Nationwide Road Network>
(Roads ranked main local roads and higher)

4. Preparation of OD Data on Freight

[1. Preparation of OD Data on International Marine Containers]

- Collect import/export container freight data (freight ton figures by month) for the Tokyo port and Yokohama port, by 9 product types of freight, by freight points of provenance and destination and by whether imported or exported

  (Source: “Land Export and Import Freight Survey,” 2003)



4. Preparation of OD Data on Freight

[2. Conversion from Freight Ton to Metric Ton]

Conversion to metric ton : convert to metric ton by multiplying the freight ton data by the converter*

*: A converter is prepared for each product type and whether imported or exported, using the formula below

"Seventh Logistics Census" Annual Survey Data (1999 figures : Metric ton unit)

Annual Report on Port and Harbor Statistics (1999 figures : Freight ton unit)

4. Preparation of OD Data on Freight

[3. Converting from Metric Ton to Number of Vehicles and Price]

Conversion to trailers: (22.15 tons/shipment)

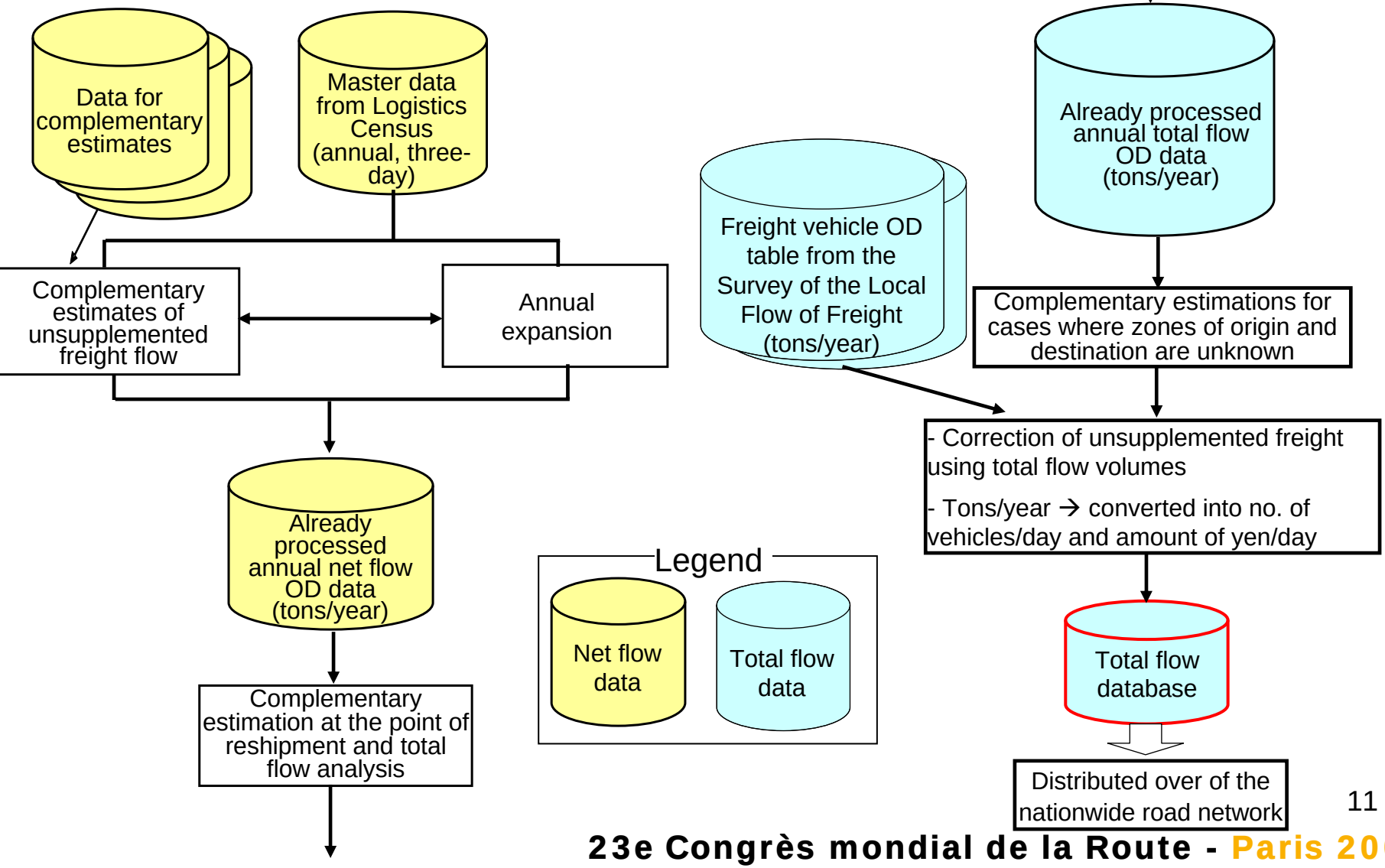
Conversion to price: Price per 1 freight ton

Table: Price Per 1 Freight Ton by Product and Import/Export (\10,000/ton)

Items	Exports	Imports
Agriculture/fisheries	17.9	24.6
Forestry products	19.8	6.5
Mining products	11.5	5.8
Metal/machinery industry	44.6	30.7
Chemical industry	20.3	19.6
Light industry goods	20.7	19.3
Miscellaneous industry	19.8	16.8
Special products	16.7	8.0
Total	33.1	19.4

4. Preparation of OD Data on Freight

Integration of Databases on Road and Port and Harbor Data



5. Route Distribution Model for International Marine Container Freight

-Apply an all-or-nothing distribution method that has no capacity limitations.

-Apply the large freight vehicle travel route selection model*, which is constructed based on survey data from the “Travel Routes for Large Freight Vehicles Survey” of the Tokyo Metropolitan Region Freight Survey.

$$GC = (\text{cost [yen]} + 80 \times \text{time [min.]}) \times 0.79^{\text{specified weight link dummy}}$$

GC : perceived generalized cost in each kink

Cost: gasoline + toll charge

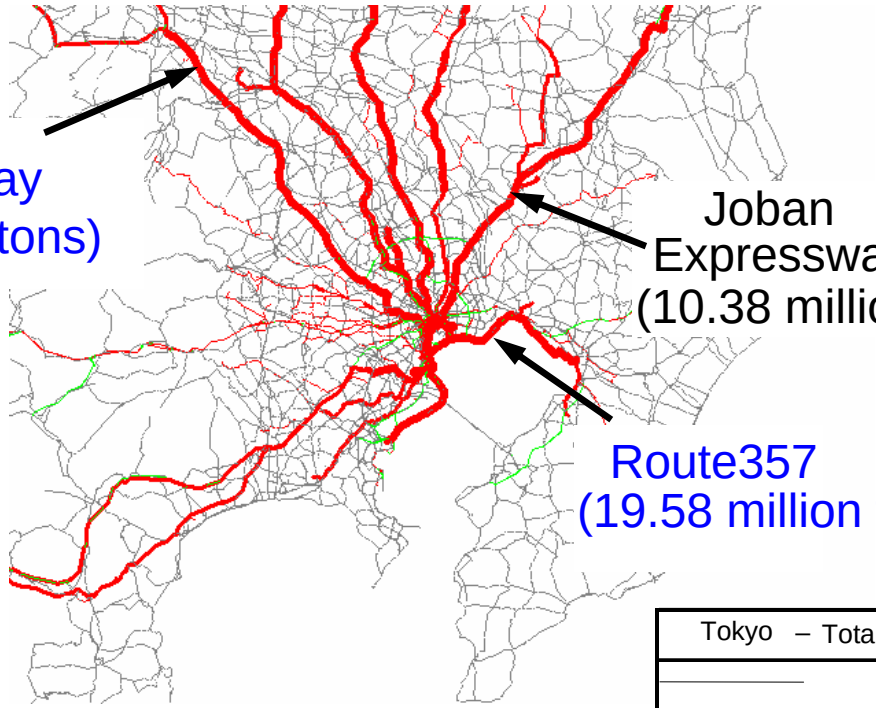
Time: time required by each link. Calculated using the BPR function

Specified weight link dummy : 1 if the link is a road with specified weight

* Source: Tokyo Metropolitan Region Transport Planning Council: “Desired Comprehensive Urban Transport System for the Tokyo Metropolitan Region from the Viewpoint of Logistics”; May 2006.

6. Qualitative Evaluation of Roads Stemming from International Logistics

Roads Used in International Freight Flow in Tokyo port (Estimate)



Transportation volume (total of exports and imports)

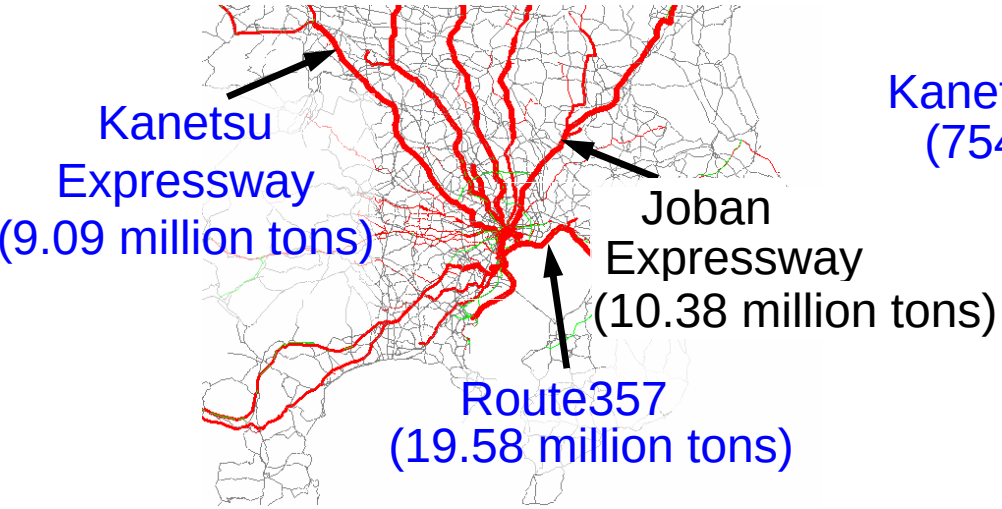
Traffic Flow

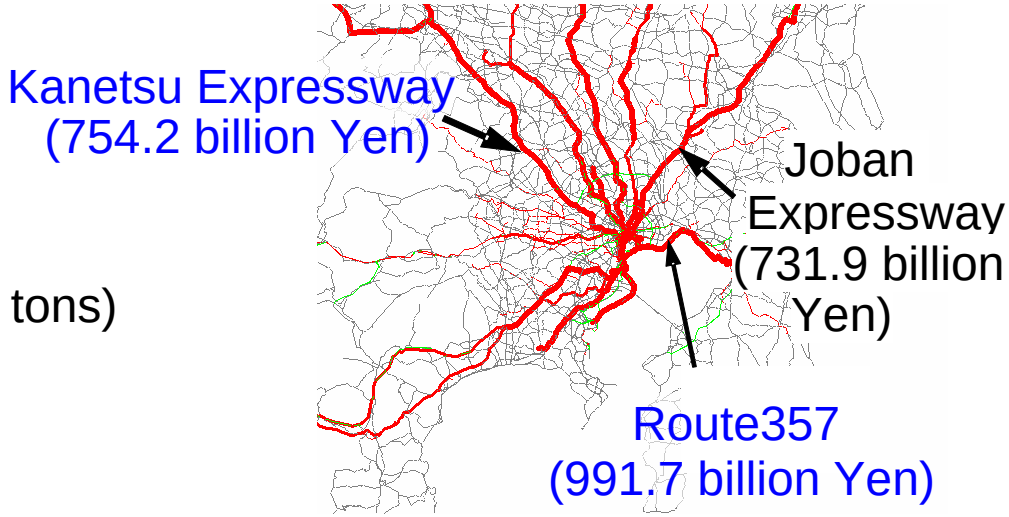
(Traditional viewpoint)

Tokyo – Total of exports and imports – Weight	
0	(ton/year)
0 ~ 100,000	(ton/year)
100,000 ~ 400,000	(ton/year)
400,000 ~	(ton/year)
National expressways and national highways	

6. Qualitative Evaluation of Roads Stemming from International Logistics

Roads Used in International Freight Flow in Tokyo port (Estimate)





Tokyo – Total of exports and imports	– Weight
0	(ton/year)
0 ~ 100,000	(ton/year)
100,000 ~ 400,000	(ton/year)
400,000 ~	(ton/year)
National expressways and national highways	

Transportation volume
(total of exports and imports)

Traffic Flow
(Traditional viewpoint)

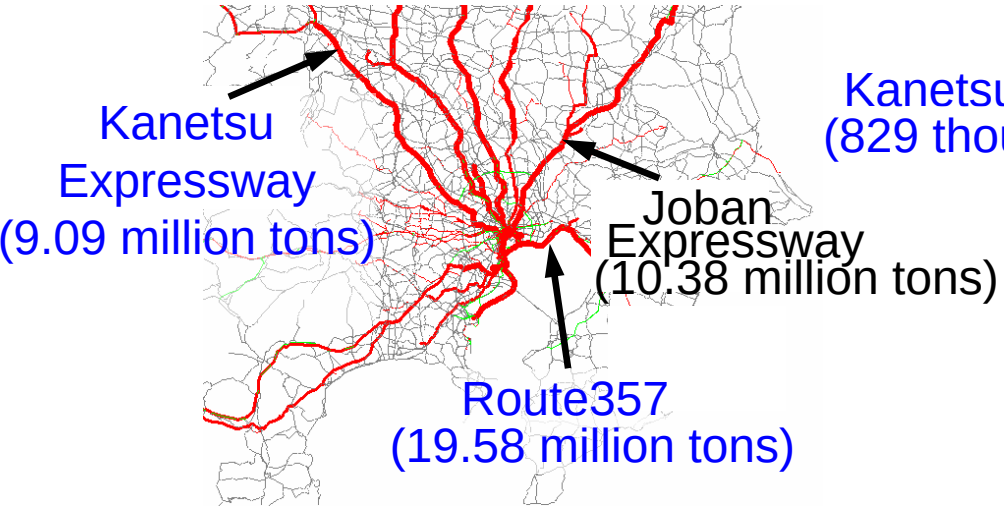
Tokyo – Total of exports and imports	– Price
0	(hundred million Yen/year)
0~1,000	(hundred million Yen/year)
1,000~2,000	(hundred million Yen/year)
2,000~	(hundred million Yen/year)
National expressways and national highways	

Prices (total of exports and imports)

Value Flow
(New viewpoint)

6. Qualitative Evaluation of Roads Stemming from International Logistics

Roads Used in International Freight Flow in Tokyo port (Estimate)



Tokyo – Total of exports and imports – Weight	
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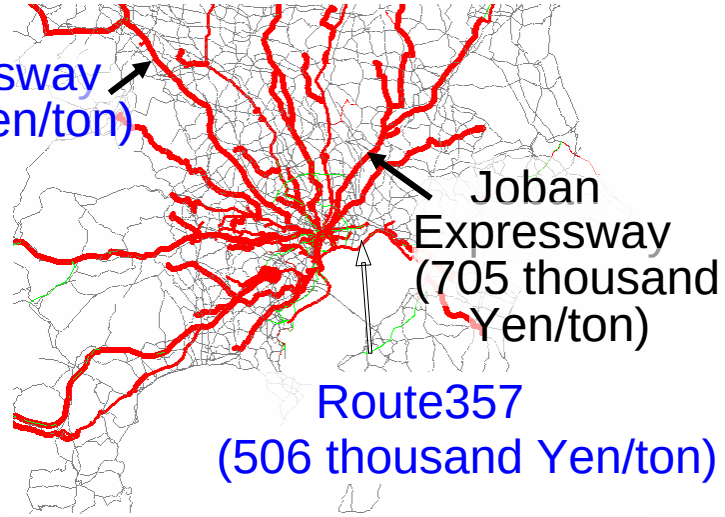
National expressways and national highways	

Transportation volume

(total of exports and imports)

Traffic Flow

(Traditional viewpoint)



Explanatory note	
	0 (10 thousand Yen/ton)
0 ~	40 (10thousand Yen/ton)
40 ~	80 (10thousand Yen/ton)
80 ~	120 (10 thousand Yen/ton)
120	(10 thousand Yen/ton)
National expressways and National highways	

Prices per ton

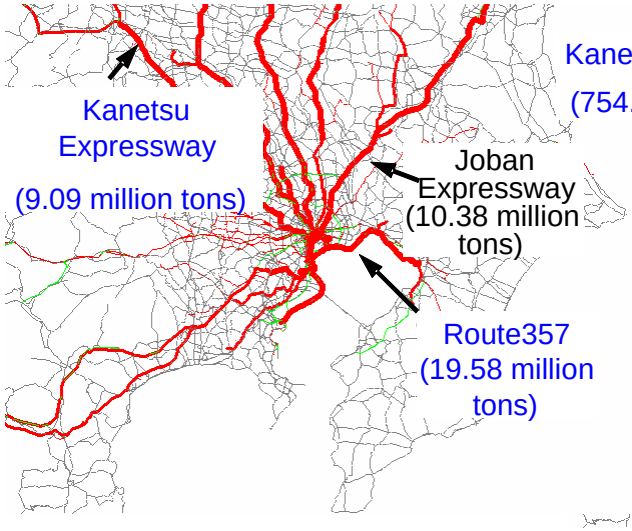
(total of exports and imports)

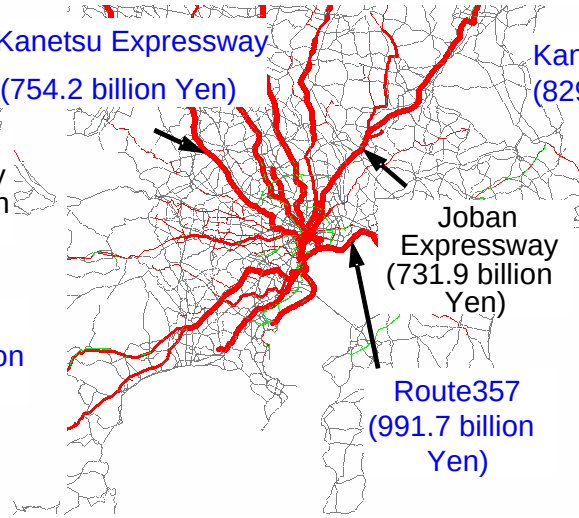
Value Flow

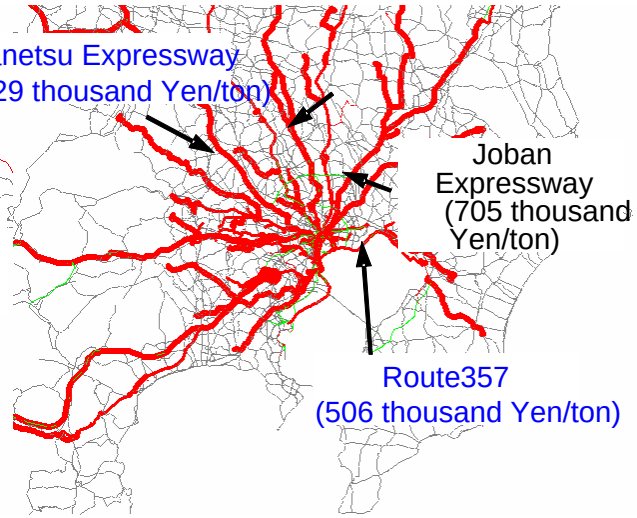
(New viewpoint)

6. Qualitative Evaluation of Roads Stemming from International Logistics

Roads Used in International Freight Flow in Tokyo port (Estimate)







Tokyo – Total of exports and imports – Weight	
	0 (ton/year)
0 ~	100,000 (ton/year)
100,000 ~	400,000 (ton/year)
400,000 ~	(ton/year)
National expressways and national highways	

Tokyo – Total of exports and imports – Price	
	0 (hundred million Yen/year)
0~1,000	(hundred million Yen/year)
1,000~2,000	(hundred million Yen/year)
2,000~	(hundred million Yen/year)
National expressways and national highways	

Explanatory note		
		0 (10 thousand Yen/ton)
0	~	40 (10thousand Yen/ton)
40	~	80 (10thousand Yen/ton)
80	~	120 (10 thousand Yen/ton)
120		(10 thousand Yen/ton)
National expressways and National highways		

Transportation volume (total of exports and imports)

Traffic Flow
(Traditional viewpoint)

Prices (total of exports and imports)

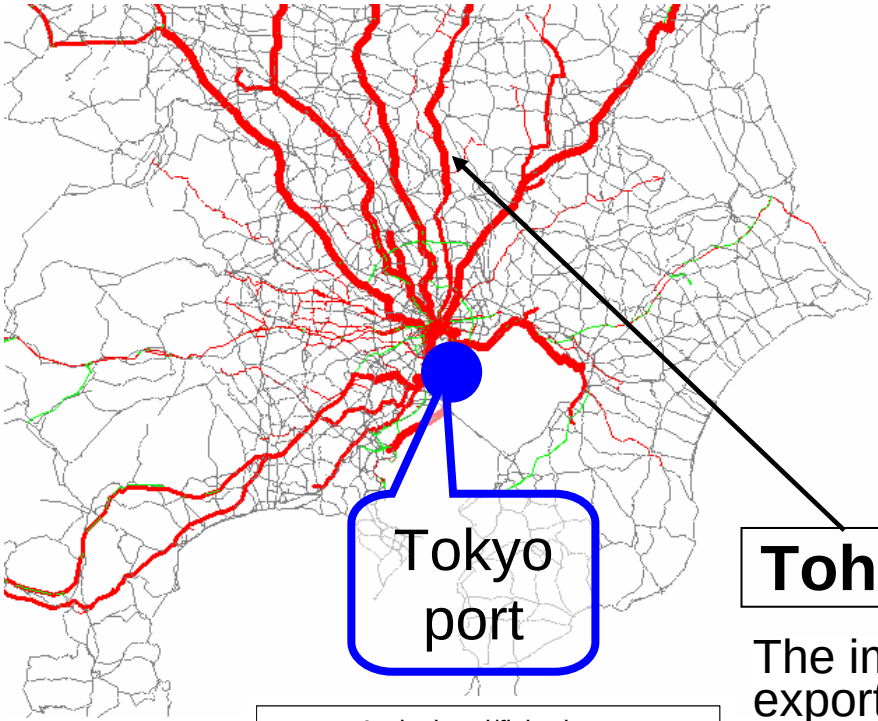
Value Flow
(New viewpoint)

Prices per ton (total of exports and imports)

Roads Used for International Logistics in Tokyo Port

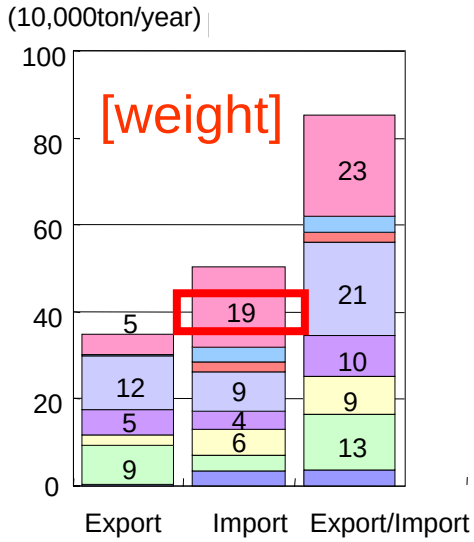
(Estimate)

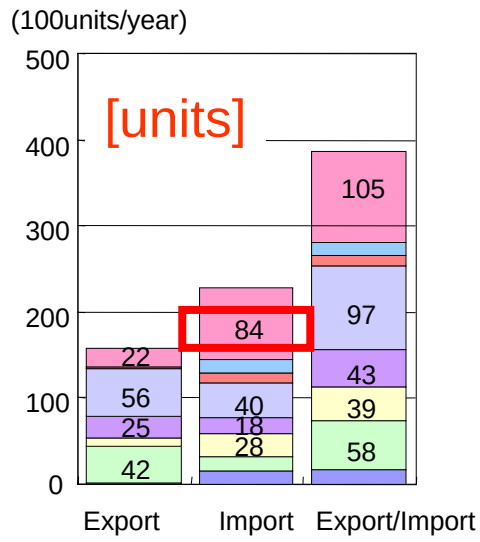
(By Product Type, Import/Export Tonnage, Number of Vehicles and Price)



Ton for export/ import

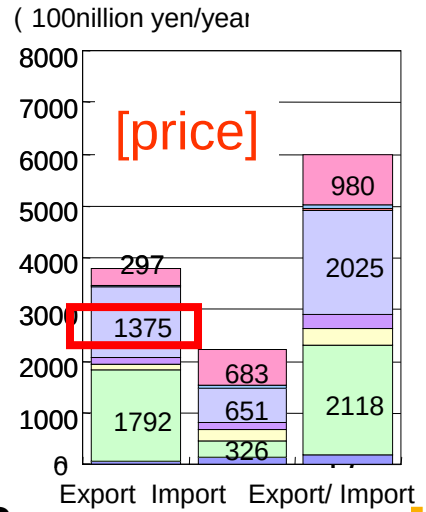
- Agricultural/fisheries
- Forestry products
- Mining products
- Metal /machinery industry
- Chemical industry
- Light industry products
- Miscellaneous industry
- Special products





Tohoku Expressway

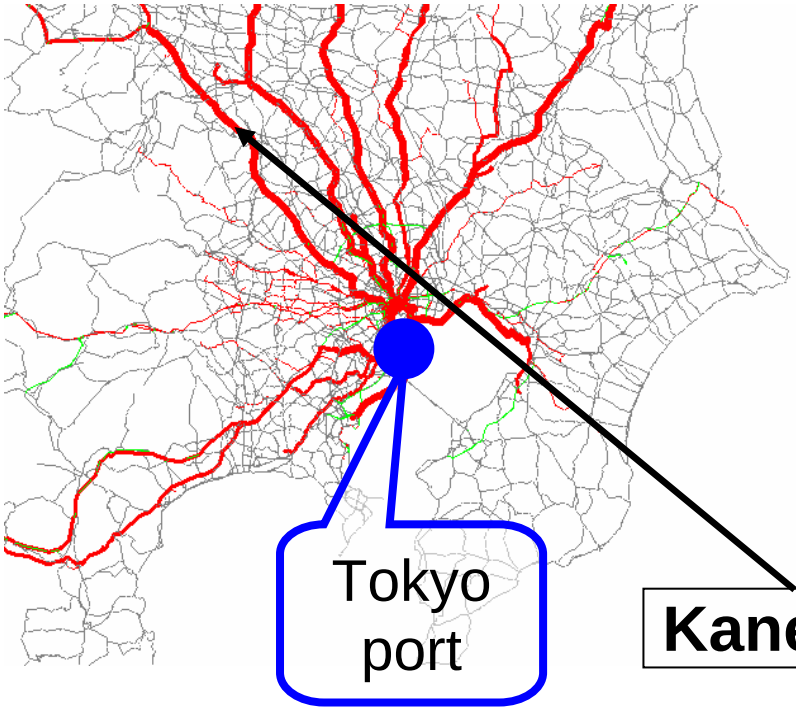
The import exceeds the export in terms of weight and the number of cargoes, whereas the latter exceeds the former in terms of price. Major goods are metal and machine products, and miscellaneous industrial products.

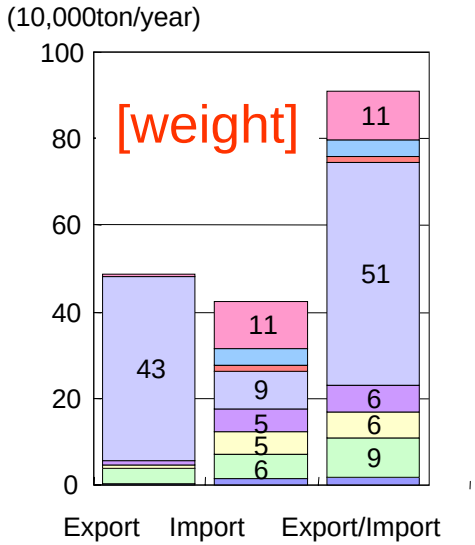


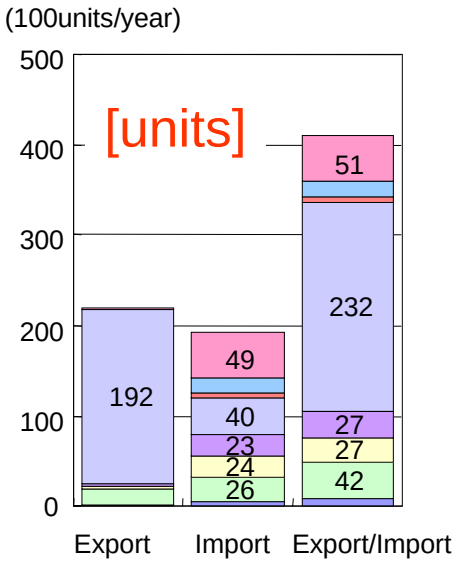
Roads Used for International Logistics in Tokyo Port

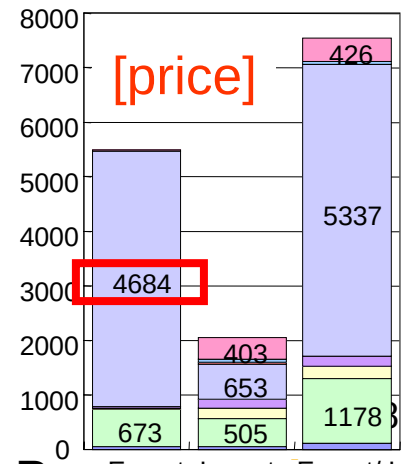
(Estimate)

(By Product Type, Import/Export Tonnage, Number of Vehicles and Price)









Ton for export/ import

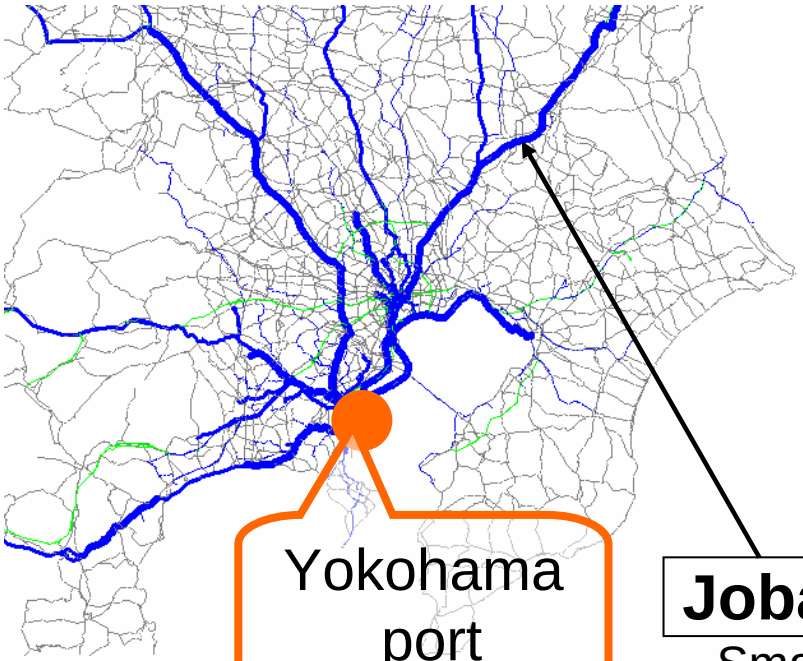
- Agricultural/fisheries
- Forestry products
- Mining products
- Metal /machinery industry
- Chemical industry
- Light industry products
- Miscellaneous industry
- Special products

The export exceeds the import in all indices.
There is a large volume of exports of metal and machine products

Roads Used for International Logistics in Yokohama Port

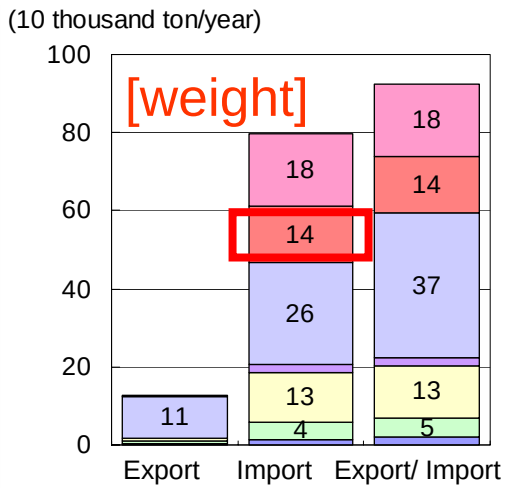
(Estimate)

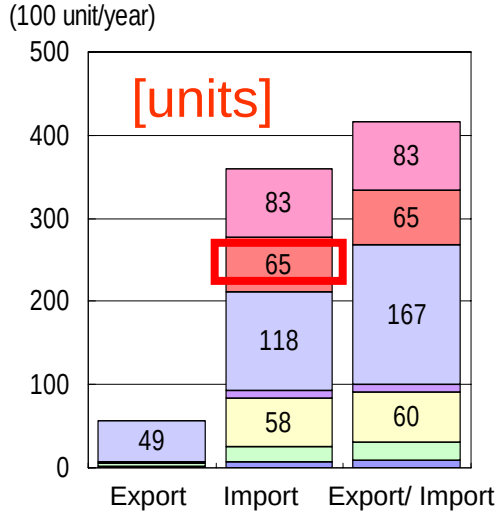
(By Product Type, Import/Export Tonnage, Number of Vehicles and Price)



Ton for export/import

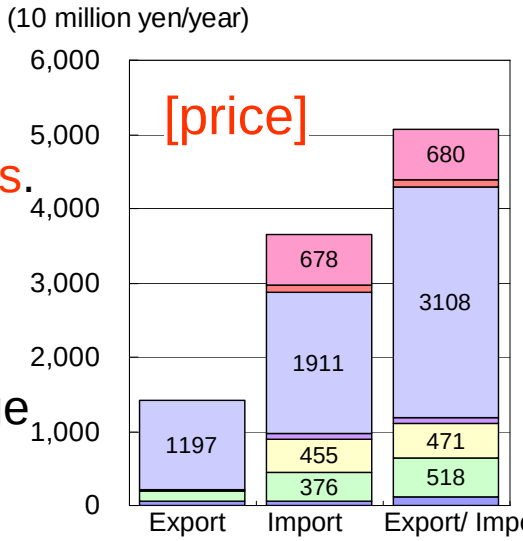
- Agricultural/fisheries
- Forestry products
- Mining products
- Metal / machinery industry
- Chemical industry
- Light industry products
- Miscellaneous industry
- Special products





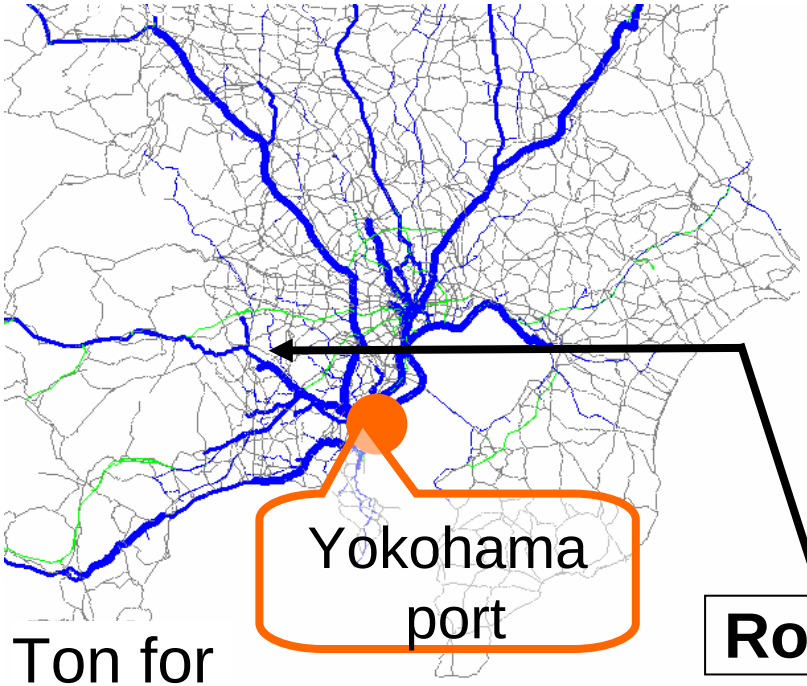
Joban Expressway

Small volume of exports, and large volume of imports. As for imports in terms of weight and the number of cargoes, mineral products account for a relatively large proportion.



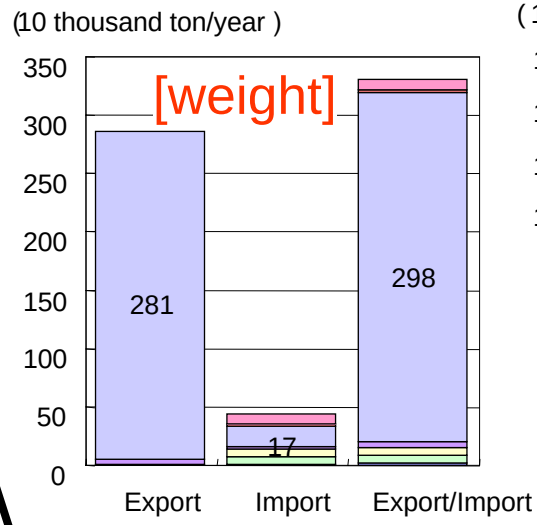
Roads Used for International Logistics in Yokohama Port

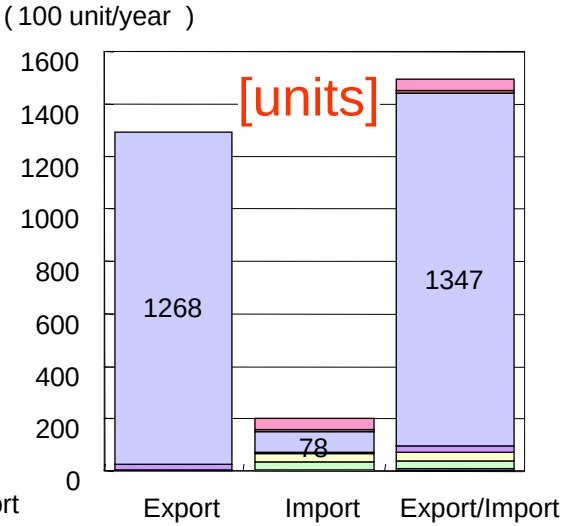
(By Product Type, Import/Export Tonnage, Number of Vehicles and Price) (Estimate)



Ton for export/import

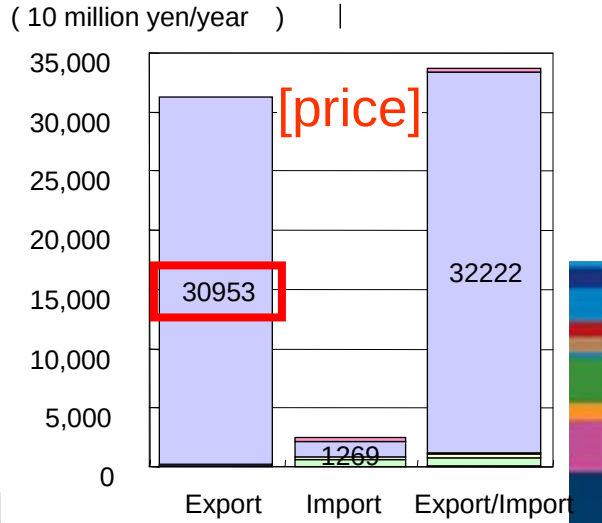
- Agricultural/fisheries
- Forestry products
- Mining products
- Metal / machinery
- Chemical industry
- Light industry products
- Miscellaneous
- Special products





Route 16

The export exceeds the import in all indices. There is a large volume of exports of metal and machine products.

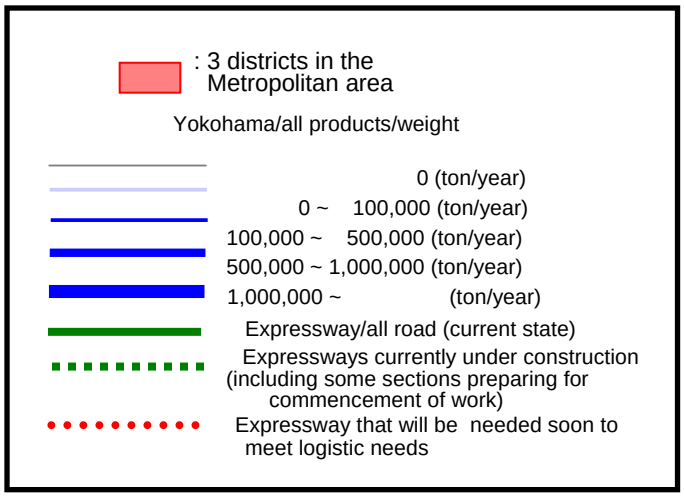


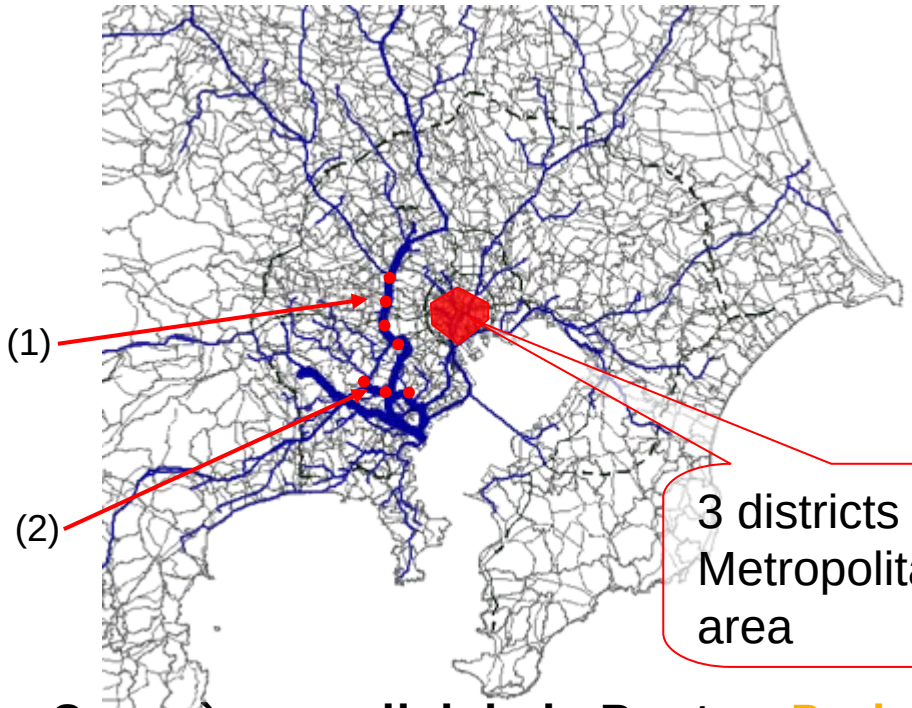
7. Case of an Evaluation of Road Measures

– Improvement Effect of the Missing Link

Estimate by focusing on the effects of building
(1) Tokyo ring roads
(2) Yokohama ring highway north
on the inward and outward international freight flow in the Yokohama port

Targeted road network: approximately 410,000 links nationwide (all roads ranked main local road or higher + α)

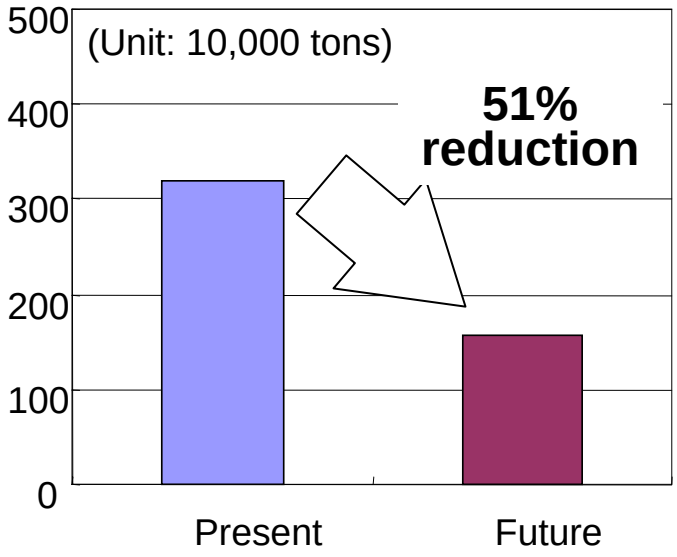




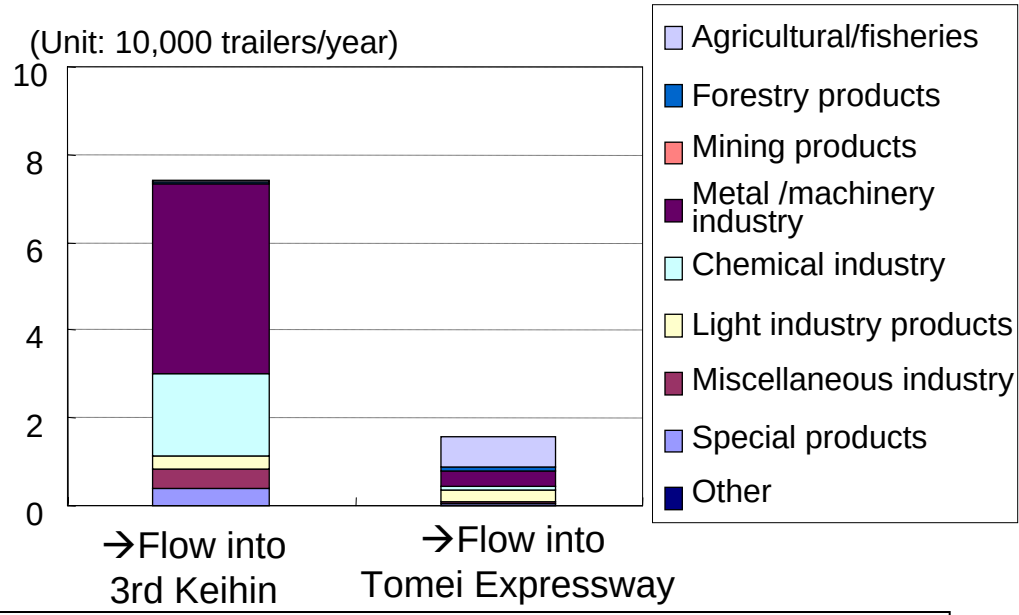
7. Case of an Evaluation of Road Measures

– Improvement Effect of the Missing Link

Freight flow into 3 districts in the Metropolitan area (Chiyoda Ward, Chuo Ward and Minato Ward)



Product characteristics of port-related freight using the Yokohama ring highway north



Conventional evaluation (volume) + focus on product characteristics of freight

Information: The possibility of evaluating measures that focus on added value by type of product of freight was demonstrated

8. Future Issues

[Expansion of Analysis Targets]

(1) Evaluate freight flow at the national level

For example, region of production → ascertain main roads used in the flow of freight in the region of consumption

(2) Evaluation of toll road charge measures

[Improvement of estimation method]

(1) Improvement of the route distribution model (confirmation and improvement of the possibility of re-creating the present conditions)

(2) Examination of the factors that determine route selection (such as taking into consideration characteristics based on import/export and type of product)

End

Thank you for listening