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PROCEEDINGS

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Dedicated Conference on ADVANCED LOGISTICS AND COMMUNICATIONS IN ROAD FREIGHT TRANSPORT

Aachen, Germany 13th – 17th September 1993

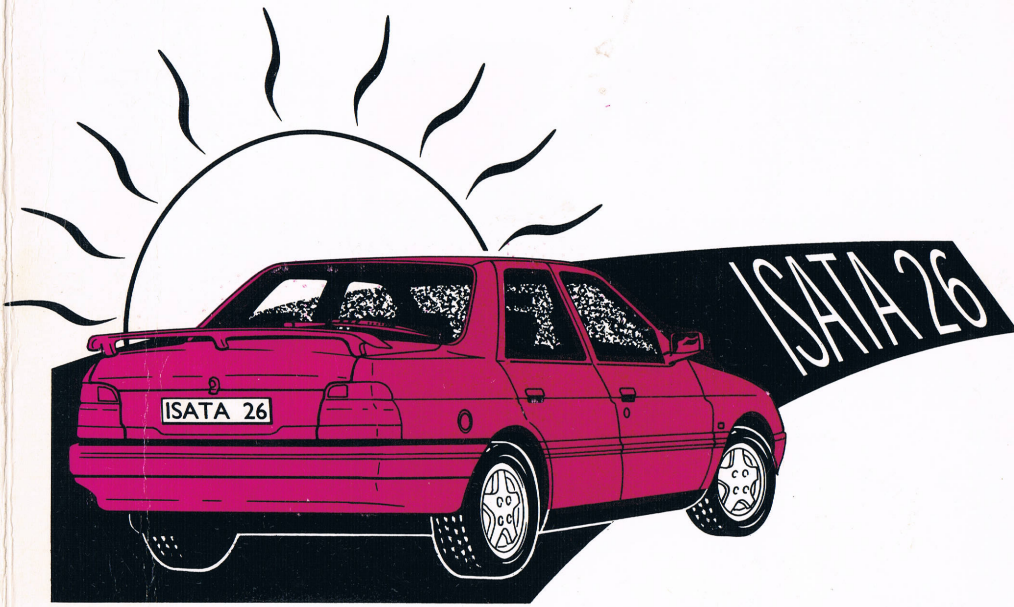

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Table 2 The Advantages and Disadvantages of a Consolidation System

Advantages	(1) It is possible to transport with a collection of goods between a goods distribution in the suburbs and downtown areas (2) It is possible to consolidate goods of collection / delivery in downtown areas (3) It is possible to reduce truck movement for reasons of (1) and (2) (4) It is easy to crack down on illegal parking on road (5) It is easy to introduce low-emission trucks (6) It is possible to reduce the exhaust of CO_2 for reasons of (3) and (5)
Disadvantages	(1) It is difficult for businesses to take part in goods distribution (2) Each company is not involved in the services of goods distribution from their business (3) There are obligation of the building and of the collection / delivery

(1) Within the public parking lot

The construction of a multistory public parking lot has been advanced. It is important to construct a part of the buildings for truck usage. If the parking space and height for trucks is secured, this parking lot will be able to accommodate trucks which are now parking on the road and to subdivide truck collection and delivery. This is a function of the truck depots in the downtown area.

On the other hand, with the instrumentation of the software, the satellite parking system can be utilized. This system is to call up trucks from the satellite parking around the downtown areas when there is no parking in front of the buildings. It is reported that this system is successful in the area of wholesalers of clothes in New York.

(2) Within the big building

When the big building is constructed, the substation is located under ground. The truck depot should be located under ground, too. If this truck depot is used instead of the depot around the building, the volume of truck parking on road will be decreased.

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THE IMPACT ANALYSIS OF CENTRALIZED STORAGE AND ADVANCED FLEET MANAGEMENT SYSTEM ON ROAD FREIGHT TRAFFIC VOLUME

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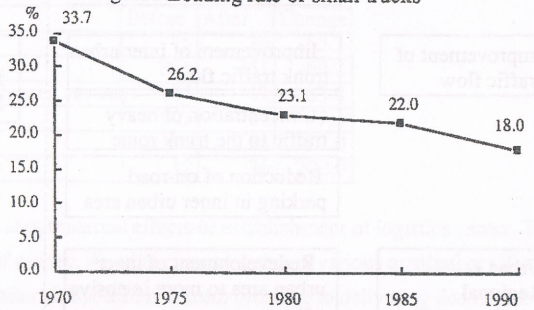
1 INTRODUCTION

Fig.1 Loading rate of small trucks



Source : Ministry of Transport
Note: Loading rate means Actual ton-km/ton-km capacity incl. empty vehicles

Recently, the road traffic condition in inner urban area is becoming worse due to high-frequent and small-shipment transport in response to the requirement of exhibit of most items of goods and zero-idle space in retailers in matured consumer society. For example, the loading rate of small trucks decrease from 33 % in 1970 to 18 % in 1990. This means that the traffic volume in 1990 need twice as many in 1970 for the transport of same cargo.

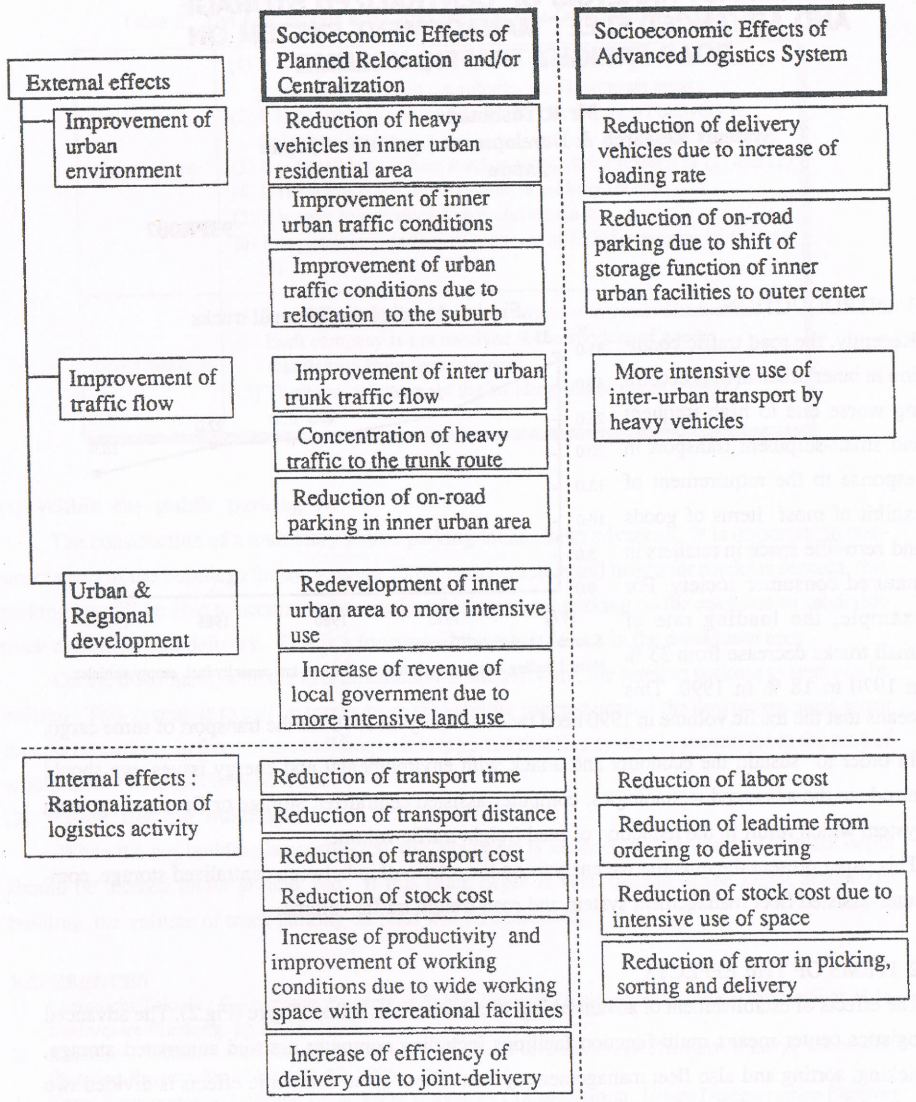
In order to sustain the economy and attack with environmental and energy issues, we should introduce the advanced technologies, computer-assisted centralized storage or fleet management system which result in the reduction of road freight traffic volume.

This paper present the quantitative analysis on the relationship between centralized storage, computer-assisted fleet management system and road freight traffic volume.

2 ITEMS OF THE EFFECTS

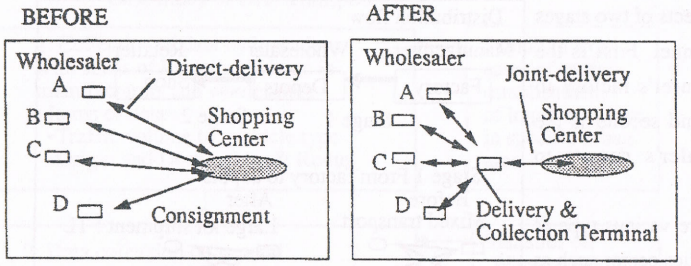
The effects of establishment of advanced logistics center is as follow figure (Fig.2). The advanced logistics center means multi-function facilities including computer assisted automated storage, picking, sorting and also fleet management system. These socio economic effects is divided two types that is external and internal from the view point of individual firm. And these effects consists of two different causes. One is the effect of relocation or centralization of logistics center that result in direct reduction of traffic volume in inner urban congested area due to shift to suburban area. The other is the effect of use of advanced logistics system and actual effects is mixed type of these effects.

Fig.2 Socioeconomic Effects of Logistics Center



Within these effects, the joint delivery system is traditional one unrelated to recent advanced system. Though its effects on traffic volume is most drastic one (See Fig.3), the number of success cases of joint delivery is rare due to various barriers such as competitive elements between wholesalers. It needs specific conditions between shippers or conditions about location and density of consignees, delivery frequency and final time of collection of goods etc.

Fig.3 Example of Joint-Delivery to Shopping Center



Model calculation of effects of joint delivery

	Before	After	Change
No. of trucks (vehicles)	75	26	-65.3
Total vehicle km per day	816	251	-69.2
Vehicle km in joint delivery area per day	105	17	-83.8
Total no. of stops per day	502	14	-97.2
Total stop hours per day	100	83	-17.0
Ave. stop minutes per stop	12	36	200.0

We can see so many examples about internal effects of establishment of logistics center. Table 1 shows typical effects in terms of money. Another examples shows various qualitative effects. For examples, in the case of big retailer A, the leadtime from ordering to delivering decrease from 69 hours to 45 hours and miss-delivery rates decrease from 0.2% to 0.005%. In the case of maker B, storage volume decrease to one third and labor cost decrease to one fifth. In the case of foods wholesaler C, delivery vehicles decrease from 22 to 15. In general, we can see that the effects of digital picking system decrease miss-picking rate from 0.3% of manual picking to 0.01% and its handling time decrease to one third or one fourth.

These internal effects means the reduction of storage volume, man-hour and delivery vehicle that is micro effects. In order to use technologies of advanced logistics as tools of achievements of sustainable economy, we have to know the socioeconomic consequences of advanced logistics system. Following paper present case study of external effects.

Table 1 Example of internal effects of logistics center Unit : mil. yen

	Before 1986	After 1987	Change	Remarks
Total cost	5,500	4,950	-550	
Delivery cost	1,000	1,130	130	Delivery distance increases Delivery frequency becomes high Efficiency of heavy vehicles increases by use of container
Labor cost	62	39	-23	Use of automated picking machine Reduction of staffs of logistics division
Storage cost	900	700	-200	Reduction of storage space
Other cost	3,600	3,120	-480	
Storage volume	0.5month	0.3month		

Source : Nikkei Ryutyu Shinbun (Newspaper)

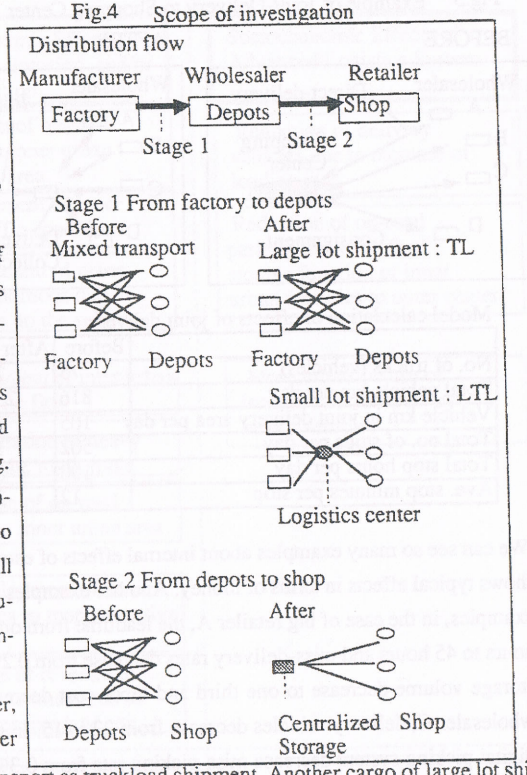
3 SCOPE OF INVESTIGATION

We investigate the effects of two stages from distribution channel. First is the stage from manufacturer's factory to wholesaler's depots and second is the stage from wholesaler's depots to retailer's shop.

In first stage, there are various type of establishment of logistics center such as relocation of present depots due to variation of demand patterns or new establishment in response to small shipments due to demand fluctuations. We choiced later type. Its conceptual figure is as Fig. 4. Before establishment of logistics center, maker transport his goods to wholesaler's depots no relation to small or large shipment. Therefore, distribution function by factories has been confused by increase of small shipment.

After establishment of logistics center, this center function as specific center handling small shipment cargo and transport as truckload shipment. Another cargo of large lot shipment transport same as before that is direct delivery to wholesalers by heavy vehicles.

Fig.4 Scope of investigation

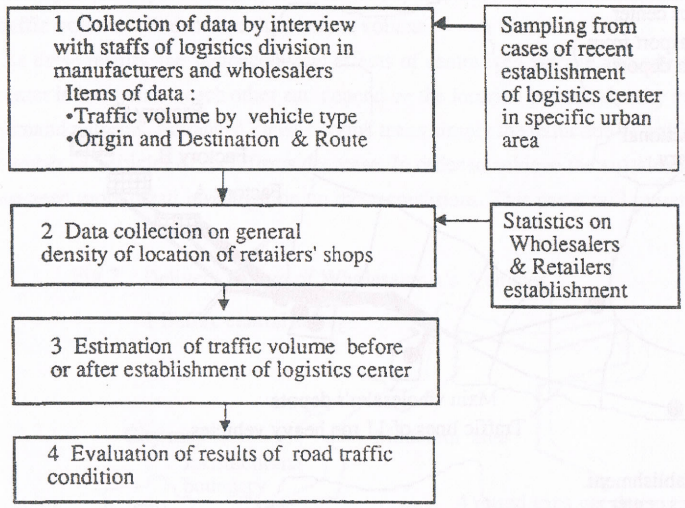


In second stage, there are few examples of establishment of new advanced logistics center because most of wholesaler are small or medium one and its capital power is poor. Instead of new center, they centralize present inner urban depots to suburban new depots. But its function is traditional manual type and not computer assisted one. However, they can reduce delivery vehicles by rationalization of storage management or ordering system. We take this case as sample of case study.

4 THE WAY OF ESTIMATION

We have investigated related firms by the way of interview with logistics managers and got the information about cargo route and origin and destination by type of vehicle. And we estimate the traffic volume under before or after conditions that other things equal. We can estimate almost exact figure about first stage. But in the case of second stage, we cannot take all information about individual retailer's shop. Therefore, we simulated both present condition and after-centralization condition by setting up location of retailer's shop and delivery patterns based on general statistics about wholesalers and retailer in same kinds of group (Fig.5).

Fig.5 Investigation Flow of Effect of Logistics Center on Road Traffic Volume
Case Study of Beer Transport



5 RESULTS AND EVALUATION

5-1 CASE OF MANUFACTURER'S LOGISTICS CENTER

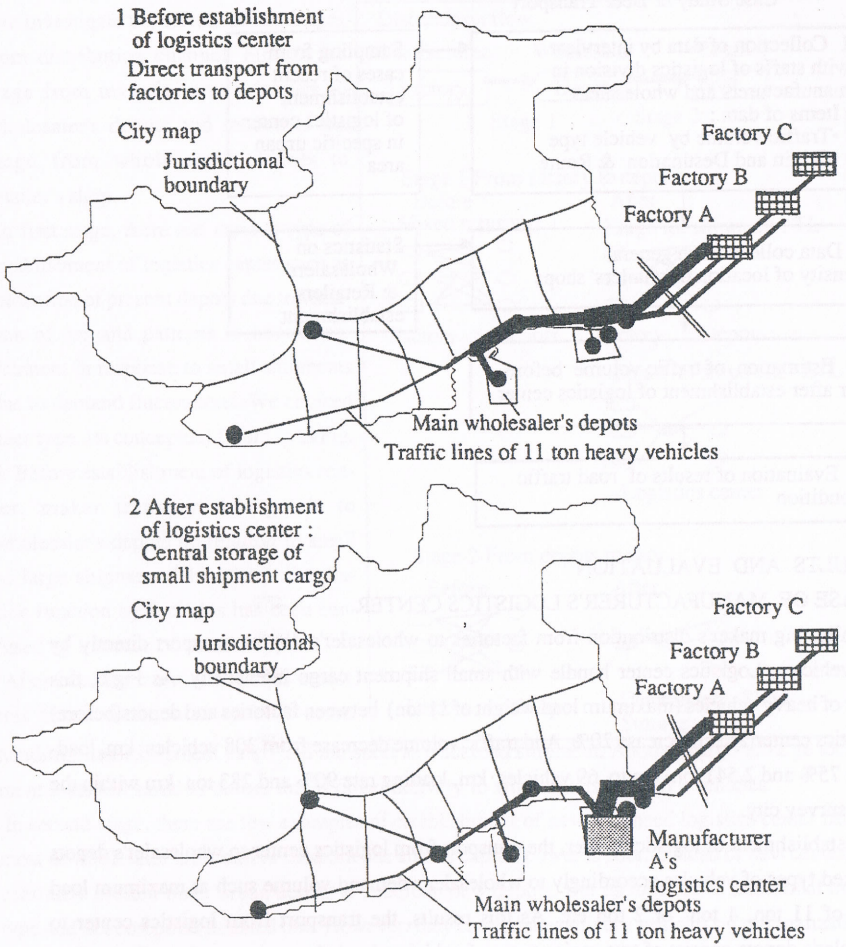
Generally, big maker's distribution from factories to wholesaler's depots transport directly by heavy vehicles. Logistics center handle with small shipment cargo intensively. As Fig.6, this number of heavy vehicles (maximum load weight of 11 ton) between factories and depots(before) or logistics center(after) decrease 20%. And traffic volume decrease from 308 vehicles · km, loading rate 75% and 2,541 ton · km to 69 vehicles · km, loading rate 90% and 283 ton · km within the area of survey city.

After establishment of logistics center, the transport from logistics center to wholesaler's depots use mixed types of vehicles accordingly to wholesaler's demand volume such as maximum load weight of 11 ton, 4 ton or 2 ton etc. As this results, the transport from logistics center to wholesaler's depots consist of two major types of vehicles that is heavy one and small one. The traffic volume of 11 ton vehicles is 138 vehicle · km and the traffic volume of small vehicles is 276 vehicle · km.

If we sum up the traffic volume of heavy vehicles both the transport from factories to logistics center and the transport from logistics center to wholesaler's depots, the volume of heavy vehicles become 207 vehicle · km and total volume of all types of vehicles become 483 vehicle · km.

The traffic volume of heavy vehicles decrease 32.8% from 308 vehicle · km to 207 vehicle · km. But the total volume of vehicles including small vehicles increase 56.8% from 308 vehicle · km to 483 vehicle · km. Instead of traffic volume, if we can evaluate by the term of the volume of emission of CO or NOx exhaust, these figure means same conditions as before in terms of CO exhaust level and the improvement in terms of NOx exhaust level.

Fig.6 Traffic Volume of Vehicles from Factories to Depots



5-2 CASE OF WHOLESALER'S DEPOTS

This case is centralization of wholesaler's depots in inner urban area to suburban center (Fig.7). In this case, wholesaler A has a plan which the number of delivery vehicles decrease 15% from 26 vehicles to 22 vehicles. The present delivery pattern is that 26 delivery vehicles of type of 2 ton transport 4 times per day from 3 depots. And according to his plan, future pattern is that 22 vehicles transport 4 times per day from 1 centralized depot. Based on this figure, we estimated the traffic volume. As this results, the traffic volume of delivery vehicle increase 1% from 2,418 vehicle·km to 2,453 vehicle·km because delivery distance increase due to shift to suburban area where is far from retailer's shop located in inner urban area.

This figure means that it is necessary for the improvement of urban traffic conditions to increase loading efficiency more highly. In this case, by the reduction of 1 vehicle to inner urban area, total traffic volume will decrease than before volume.

As these results, the socioeconomic effects of centralized storage and advancement of logistics center is interrelated each other and depend on the location pattern, density of retailer's shops and demand patterns. Advanced logistics don't mean simply the reduction of traffic volume even if the number of vehicles of each firms decrease. In order to achieve the sustainable regional logistics, we need more detail investigation on these conditions. This paper will present its first step.

Fig.7 Delivery Pattern of Wholesaler A's Vehicles