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AN EXPERIMENTAL COOPERATIVE PARCEL PICK-UP SYSTEM USING THE INTERNET IN THE CENTRAL BUSINESS DISTRICT IN TOKYO

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ABSTRACT

Inefficiency in urban freight transport is partly resulted from a number of uncontrolled trucks of different carriers entering the business districts, in order to quickly respond the shippers' pick-up requests. To improve this situation, a co-operative pick-up system by the internet was experimented in Tokyo downtown area, in an effort of public-private partnership involving stakeholders concerned. In the experiment, we tried to standardize the data and messages and proposed an internet system to match transportation demand (cargoes) and supply (trucks) automatically, expecting more convenient ordering for the shippers, less frequent pick-ups for the carriers, and less congestion for the society. It was found that a small number of shippers used the system since the participating shippers were doubtful of its convenience, while the system did not cause any technical problems. The economic analysis, however, suggests that we could introduce favourable conditions to increase the participation of shippers and utilisation of the system.

INTRODUCTION

In Japan, commercial transactions through the internet between individuals and companies, and among companies, have intensified since cheap high-capacity communication began to be available. These transactions have directly impacted the form of distribution by increasing the frequency of small-lot deliveries from upstream business to downstream business (or from producer to final consumer, in the extreme case). As a result, the number of cases of parcel delivery companies responsible for moving the goods has been increasing.

Although parcel delivery companies are efficient in practising full-load transport of large trucks between cities, the delivery and pick-up of cargo within the city is relatively inefficient, thus causing traffic congestion. In particular, a number of small trucks park on the roadside during delivery in the commercial business districts because several building establishments do not have an underground parking space wherein delivery trucks can load and unload their goods, or because the amount of shipment may be so small that parking off the road is a troublesome thing to do. The picking-up of parcels is also inefficient. In the central business district where a large amount of door-to-door transport is generated, there are cases when small trucks used for picking-up goods wait on the roadside so that they can immediately respond to unexpected requests from shippers.

To improve the above situation, the Ministry of Land, Infrastructure and Transport conducted an experiment in Otemachi, Tokyo in 2002. In this experiment, transport requests by shippers are made easily through the use of internet (shipper's merit), and an appropriate logistics service provider collects the bundled transport demand for each building, thus increasing transport efficiency (carrier’s merit) and reducing roadside parking and truck traffic in terms of vehicle-kilometres resulting in less congestion and environmental burdens (social merit). The consolidation of pick-up activities, which is one of the challenges in the experiment, is more difficult than that of delivery activities. Consequently there have been few successful co-operative pick-up practices while consolidated delivery systems are working in several cities including Fukuoka (Nemoto, 1997), Monaco (Taniguchi and Nemoto, 2001) and Nurnberg (Planung Transport Verkehr AG, 2002).

Another challenge was the establishment of a planning committee to design and implement the experiment, involving shippers and logistics service providers in the Otemachi district, as a public-private partnership (PPP). PPP has been introduced to ensure stakeholder participation in freight transport planning, for example in the UK cities (Department for Transport, 2003). In our view, an experiment would be an effective step for successful PPP by sharing common understanding on the impacts of freight transport policies and by eliminating stakeholders’ unfounded concerns.

The objective of this paper is to clarify the following: a) the principles of the experiment based on the review of E-logistics, b) the detailed system design carried out by the planning committee for its implementation, and c) the results of the experiment and favourable conditions to promote co-operative parcel pick-up system using the internet. The paper will then try to present conclusions.

E-LOGISTICS AND EXPERIMENTAL DESIGN

The E-logistics model

The mechanism that matches the shipper’s demand and the logistics service provider’s supply through the internet has been in existence and is termed as “E-logistics”. In this section, the existing structure of E-logistics was first examined to understand important concerns that shippers and logistics service providers might have (Figure 1).

Type A is the bulletin board type wherein shippers and carriers (or logistics service providers) freely input cargo information and empty truck information. After checking the bulletin board, interested shippers and carriers negotiate separately by telephone the various terms of the contract, including freight charges. This type of scheme allows some website administrators to charge commissions from the shippers and carriers while others profit from other means. The former involves charging of a fixed commission after both parties have agreed on the service contract, for example 5% for freight liquidation and insurance. The latter enables websites to earn income through banner advertising and from utilising the site for manpower staffing and selling of office equipment.

Type B is the auction type wherein empty truck information registered by the carriers is offered by bidding to several shippers. The highest bidder will then get the contract for the logistics service offered. This type of scheme is difficult to implement in practice because it needs to involve a certain number of potential buyers requiring the same conditions to join the auction before automatic matching is attained. Stated conditions not only include the trip origin and destination but also the time for the transport service and the type of vehicle.

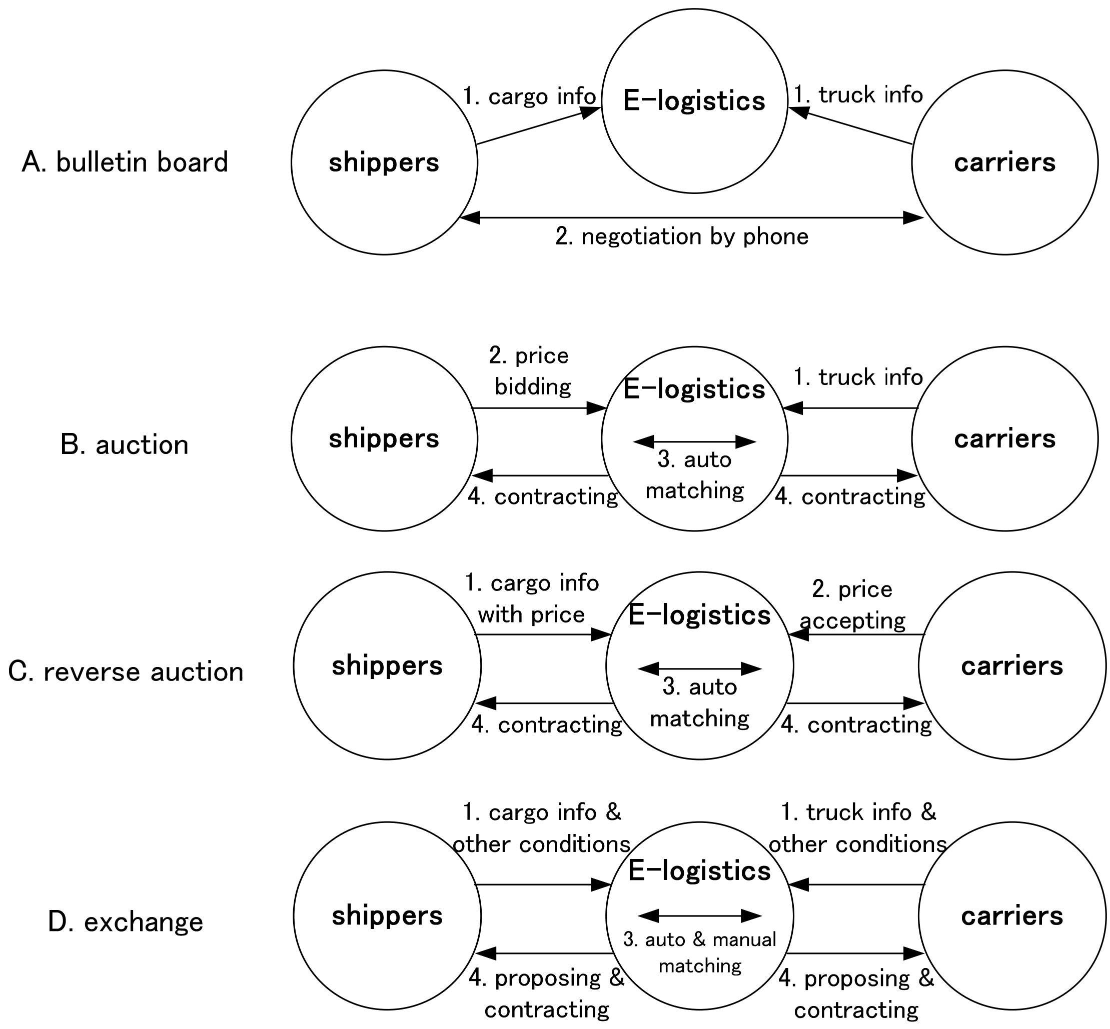

Figure 1 Business models for E-logistics
(Krishnamurthy, 2003 and Daiwa Research, 2001)

Type C is the reverse-auction type wherein the cargo information and the desired price for the service are registered by the shippers. The contract is then awarded to the carrier who first accepted the price and signifies their intention to perform the service. This concept is more difficult to implement in practice than Type B because it requires a certain number of potential sellers out of relatively small number of willing shippers in a depressed economy at present.

Type D is the exchange type wherein sellers and buyers, who simultaneously share information and conditions, search for their appropriate partners. Automatic matching is first utilised to reduce the number of candidates who satisfy the basic conditions. Then these conditions are subsequently adjusted manually. A good example, which can be regarded as successful, is the site by NTE Inc. (formerly the National Transportation Exchange), a non-asset third party logistics provider. The company is responsible for the determination of freight charges and other payment matters.

As indicated by Hayashi (2002) that even in the US, the slowdown in the progress of IT caused the recent economic recession and therefore IT’s serviceability is being reassessed in the field of logistics. Even the excitement brought about by the logistics e-market place (E-logistics), such as trade exchange using the internet and truck and cargo matching systems, also experienced decline and are likewise being reassessed.

Truck and cargo matching system by telephone and by internet

From the point of view of business, there are only a few successful E-logistics websites in Japan. Some are successful in getting a number of contracts, however, including those who only use the internet to arrange payment of freight charges and facilitate documents for insurance. The case is, in fact, an example of Type A where actual matching is performed by telephone.

Misui (2002) pointed out that there were almost 50 entities that employed the internet truck and cargo matching system from its inception by Japan Digicom, Inc. at the end of 1996. These entities not only include logistics service providers but also other companies, such as shippers, information system companies, trading companies and business ventures. Later, however, several companies, including the Japan Digicom, Inc., announced withdrawal from business or shutdown of their truck and cargo matching systems.

In order to identify the reasons why E-logistics is quite unpopular in Japan, Japan’s transport industry, in general, and the truck and cargo matching system, in particular, will be investigated.

First it must be recognised that majority of the logistics service providers are also the shipper or the client (in over 70% of freight contracts). This means that there exist two or three hierarchical structures in Japan, the so-called principal contractor, the subcontractor and the sub-subcontractor. From the viewpoint of the shipper, they experience difficulty in requesting service from a logistics service provider in the area where the cargo is to be delivered. It could be convenient if they collectively commission all cargo to a credible logistics service provider associated with them. This concept is the so-called “one-stop services” for shippers or “third party logistics” for logistics companies who subcontract the services.

The relationship between the principal contractor and the subcontractor is, in a sense, economically justifiable. Subcontractors could be set-up even if the freight charges are somewhat cheap, as long as a fixed amount of cargo is maintained without a large degree of marketing. Even if the principal contractors get the brokerage fee without doing the actual transportation, they bear the burden of risk of being the guarantor not only for the operating expenses but also for the quality of work of the subcontractor. The relationship between the principal contractor and the subcontractor is maintained by keeping this delicate balance. The truck and cargo matching system using the telephone in Japan thus evolved to become a mechanism facilitating mutual requests of transport services among logistics service providers.

It was assumed that the internet truck and cargo matching system would replace the conventional system of using the telephone. With the internet, the principal contractor seemed to have more chances to meet cheaper subcontractors, while the subcontractor seemed to have more chances to meet principal contractors who are willing to pay higher freight charges.

Unfortunately, however, the internet matching systems have not become popular because they lack a mechanism to mitigate against the risks involved, which relied mainly on conventional human relationships in the past. The principal contractor is afraid of failure in the deliver service when the cargo is entrusted to an unknown logistics service provider with cheap freight charges. The subcontractor is afraid of failure with respect to receiving the right amount of payment contracted for freight charges. It is difficult to reduce the risks involved in truck and cargo matching systems.

Risks must be mitigated against as much as possible. If these risks were reduced systematically, the internet system would become attractive. To cite an example, a risk assessment system could be developed, as similar efforts are being made with increasing security concerns. Another practical way several websites adopt is a membership system that only allows participants who could fulfil predetermined qualifications.

Direct shipper participation in matching

We have another assumption that the internet matching system involving the shippers directly is more effective, which is not common yet in Japan. If shippers can directly join the bidding process, the more desirable solution could be obtained by increasing the flexibility of finding an appropriate shipper-carrier combination making efficient configuration of transport, consolidation (de-consolidation) and storage. Though it is convenient for the shippers to request service from the same carrier regardless of the cargo's destination, the logistics chain might be sub-optimised because of the constraints concerning transport, consolidation and storage they or their affiliated subcontractors have.

Risk management is more important for the shipper-participating in an internet matching system than the inter-carrier matching system, because shippers (carriers) have not conducted business with many carriers (shippers) and they do not know each other well.

One way to reduce risk is to identify the client as credible shippers in a particular district, and at the same time to carefully choose credible carriers that have been doing business there, thus creating a virtual business community. Though the limited membership in a particular area can become a preventing factor for the efficient implementation given the limited extent of matching, this disadvantage might be outweighed by the advantage of direct shipper participation. In the experiment, a virtual business community is intended to be formed.

It is notable that the experimental system has a weak point because the target of matching is not freight transport characterised as ‘inter-urban Full Truck Load (FTL)’ which is common in the existing market, but ‘urban Less-than-Truck Load (LTL)’. When matching trucks and cargo with inter-urban FTL, it is easier to get a better business opportunity for carriers. Depending on the transport demand, carriers may offer lower freight rates to prevent their trucks from going returning without any backhaul. The internet system enables them to check their partners in a short period of time. However, when matching truck and cargo in urban LTL, they have less incentive to offer lower/higher freight rates manually in real time, even though in the long term they are making every effort to raise the volume of parcels in order to enjoy a higher economy of scale in the production of urban LTL transport. In order to make feasible E-logistics for urban LTL services, transaction costs should be reduced dramatically, for example, by automatic bidding, matching, contracting and dispatching.

Principles of the experiment

The experiment was conducted in front of the JR Tokyo station in Otemachi, a commercial business district where rents are very high and only companies of good standing are occupants. Ninety-nine buildings are erected within the 110-hectare area. A major real estate firm has control of the majority of the buildings inside the district. The tenant companies, as members of the District Redevelopment Project Council for Otemachi, Marunochi, and Yurakucho (www.lares.dti.ne.jp/~tcc/index.html), developed a joint project for the area. The shippers in this area have good credibility.

Carriers doing parcel delivery business in the same district were invited to collaborate on the experiment. Carriers that agreed to co-operate were registered. The matching process, through the internet, was planned with the objective of seeking the most optimal combination of providing cheap services from the viewpoint of the shipper, allowing efficient pick-up from the viewpoint of the carrier, and reducing environmental externalities for the society.

DETAILED DESIGN OF THE COOPERATIVE PARCEL PICK-UP SYSTEM

The detailed system design was entrusted to a planning committee composed of representatives from the shippers, carriers and governmental officials, chaired by Professor Nemoto of Hitotsubashi University. Several problems identified during the process of discussions caused the first draft of the plan to undergo considerable revisions (Table 1).

Table 1 Original plan and implemented system

	Original plan	Implemented system
Matching	Automatic matching by price, truck location and other conditions	Transmitting pick-up requests to fixed pre-contracted carriers
Bundling	Bundling of different carriers’ orders	Bundling the same carriers’ orders with less frequent pick-up
Invoice	Standardised invoice	Individual invoice attached additionally
Communication	Internet	Internet, EDI and fax

One of the major problems identified was the issue of automatic matching. As mentioned earlier, the objective of the matching process through the internet was to seek the most desirable combination of providing cheap services, allowing efficient pick-up, and reducing environmental externalities. Then the inclusion of freight charges as a factor in the matching process was proposed. This, however, received strong opposition from the carriers because the plan may lead to increased competition in the form of price cutting, which forced the committee to revise the original plan.

Although the common household is charged a flat rate for the parcel delivery service, the freight rate of business shipment is negotiated according to the number of transactions in a month and other requirements. Evidently the shippers have the advantage of using the website in finding carriers that offer cheaper freight rates. However, the carriers already doing business in the area insisted that the use of the website does not warrant better business performance (e.g. winning new shippers). As a result, it was decided that the setting of freight charges between shippers and carriers would not be dependent on the experimental system.

Even if each shipper requests different carriers for the pick-up service, it is possible that a particular carrier could perform the actual collection work jointly in a particular area. Unfortunately, however, the carriers opposed the method of joint collection. They stressed that the collection must be from the same carrier because the collection provides a good opportunity for their sales drivers to find additional business opportunities. As a compromise, it was resolved that pick-up efforts shall be made by the same carriers and shall follow a system in which for one day, a total of three pick-up times (11:30, 14:30 and 18:00) be designated, not a system in which carriers enjoy the freedom to collect any time they wish.

There was also the issue of standardising the invoice forms. The standardised invoice was not enough to reflect the differentiated services of the carriers so that separate invoices of some carriers had to be attached to the standardised invoice forms. Examples of differentiated services offered by the carriers include a service that enable shippers to validate the computerised signature of the accepting person and a record of guarantee of up to 300,000 yen, amongst other features.

Furthermore, although a standard system for internet communication was preferred, it was decided that ordinary EDI and FAX were also to be used because of the large investment involved and short duration of the experiment.

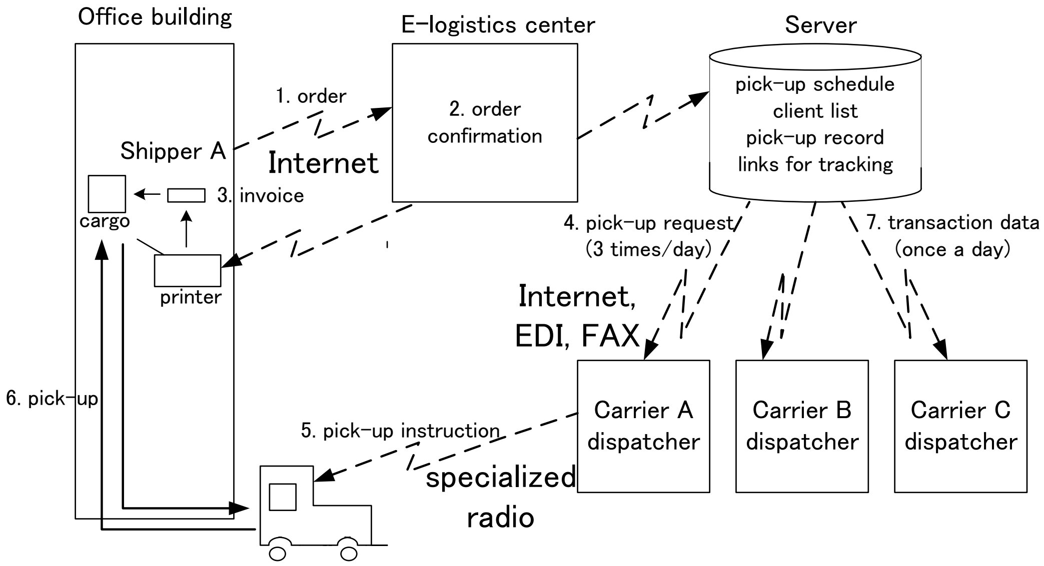

Figure 2 Implemented co-operative parcel pick-up system

RESULTS OF THE EXPERIMENT AND ITS EVALUATION

Implementation of the experiment

The experiment was conducted on weekdays from 28 January to 15 March 2002. The system was installed for 70 shippers (from 14 buildings) who signified their intention to participate in the experiment. This number consists of 0.2% of all the companies that perform business in the district. The participating carriers include the top five in the parcel delivery business, Sagawa Express, Seino Transportation, Nippon Express, Fukuyama Transporting, and Yamato Transport.

However, the number of shippers that used the experimental system to request pick-ups was very small. Only 12 shippers out of 70 used the system. In addition, the total number of parcels did not exceed 256 pieces, or 8 pieces per day on the average. Thus, the collection efforts of carriers three times a day did not result to an efficient pick-up system.

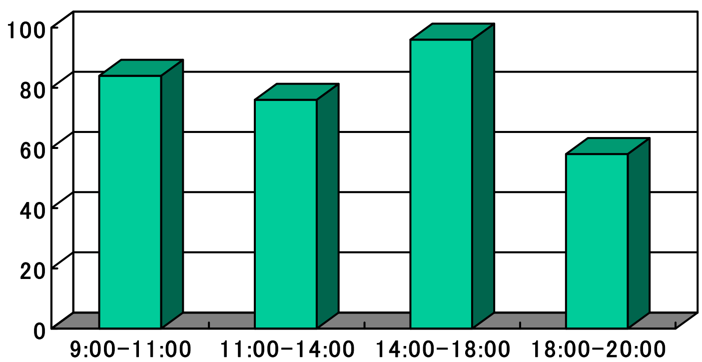

Figure 3 Number of collected parcels by time period

Evaluation

Questionnaire surveys were administered to the participating shippers and interviews were conducted for the carriers after the experiment.

The internet system was basically well operated by the shippers and they indicated that they did not encounter any technical problems. At the same time, however, there was a lot of negative replies to the question, "Is the system more convenient or not?" The reply "It got complicated", received a higher percentage than "It became convenient" (Table 2). It was believed that the use of the internet offers little benefits in cases when the amount of parcels per request is small.

Table 2 Evaluation from shippers: Convenience of the pick-up system

It became convenient	3 (15%)
No change	4 (20%)
It got complicated	6 (30%)
I do not know	7 (35%)
Total	20 (100%)

It can be said that integrating the pick-up process to three times a day resulted in a reduction in the service quality. In the present practice of pick-up by telephone request, a quick response can be expected usually. Even if the carrier cannot respond at once, the client is informed of the pick-up time by an operator orally, thereby having a sense of security, which suggests the importance of adding a call centre function for improving the internet system in the future.

Another inconvenience indicated by the 84% of shippers was the inability to designate the time window of the delivery to the consignee. This service is commonly provided without additional charge by major parcel delivery companies. The co-operative system could provide this service when it can further access the management system of the participating companies in order to judge the possibility of the time window requested. In this way, use of the internet system is thought to have few economic benefits, and thus have little impact on increasing the amount of parcels being handled.

Although some problems were experienced by the carriers, including, the list of pick-up addresses of shipments did not fit the present system for scheduling vehicles, the standard invoice used was not enough to cover the various services offered by some of the carriers; there was no complaint about the reliability and operability of the system itself. Technically, a mechanism can be developed to add the original services of each carrier in the standardised system.

In this experiment, the amount of handled parcels for pick-up was very small, and there were no significant curtailment effects such as the reduction of pick-up vehicles. However, there was an indication from the carriers that benefits can be obtained if the range of geographical coverage and the number of shippers was increased. Furthermore, they have also pointed out that this will be effective if one staff can stay in the building and be in-charge of the collection system at all times, playing a complementary role to the internet system.

Pick-up by telephone has been the current practice. However, because of the inefficient collection of cargo, in which carriers sometimes go back and forth to the same building to collect cargo again after just a few minutes, they seem to share awareness that there is certainly a need to improve the present pick-up system.

Co-operative pick-up system with externalities internalised

The internet matching system proved to be technically feasible but economically unattractive. This experiment, however, was conducted given the existing institutional and regulatory arrangement, which can be relaxed when examining the economic nature of the system theoretically. We would like investigate the hypothesis that the internet matching system would bring economic benefits to the shippers, the carriers and the society under different arrangements, and to demonstrate it in another experiment in the future.

For this purpose, an economic model was developed (Figure 4), where social costs are introduced. In order for all stakeholders to obtain economic benefits to some extent, one of the necessary conditions that the co-operative parcel pick-up system must fulfil is to reduce the total social costs. Here the social costs include the order costs of shippers, pick-up costs of carriers and traffic congestion costs. Also we assumed that pick-up costs are passed on to shippers by way of freight charges, and that freight charges and order costs comprise the cost for shippers.

Despite the fact that the current collection activity causes traffic congestion, carriers have not been burdened with the traffic congestion cost, which others have come to bear, and shippers are not even held responsible for this problem. Certainly, the carriers alone should not be blamed. Among the causes of congestion is the lack of off-street parking spaces for the loading and un-loading of goods. Carriers have no alternative but to park on the street, whereas the police cannot strictly enforce the control measures. At any rate, there is no point or logic in comparing the cost of specific stakeholders with and without the co-operative pick-up system if we ignore the existence of external diseconomies.

On the contrary, if external diseconomies are to be internalised, it is possible to make a correct comparison of the impact of introducing the co-operative pick-up system. Here, a way of internalising external diseconomies is, for example, to strictly restrain on-street parking and to permit trucks to park off-street with parking fees. Fortunately, the government of Tokyo has compelled new buildings (more than 2,000 square meters) to provide off-street parking spaces for loading goods since October 2002. Taking into account of the advancement of automatic vehicle identification technology as well, the environment for controlling illegal parking has gradually been improved.

Traffic congestion cost will decrease and the cost of carriers will increase if vehicles are forced to use the off-street parking spaces with parking fees. Carriers will then be obligated to increase the amount of cargo to be picked-up per stop. It is under these conditions that co-operative pick-up system will have a significant impact.

Social costs can be reduced as external diseconomies are internalised. Although carriers have to pay new parking fees, which can be the cause of increased prices for services, it is eventually expected that parking fees can be saved and prices are reduced since the introduction of a co-operative pick-up system with capability to consider truck location will result to efficient vehicle load usage. Even though there is no assurance that prices will

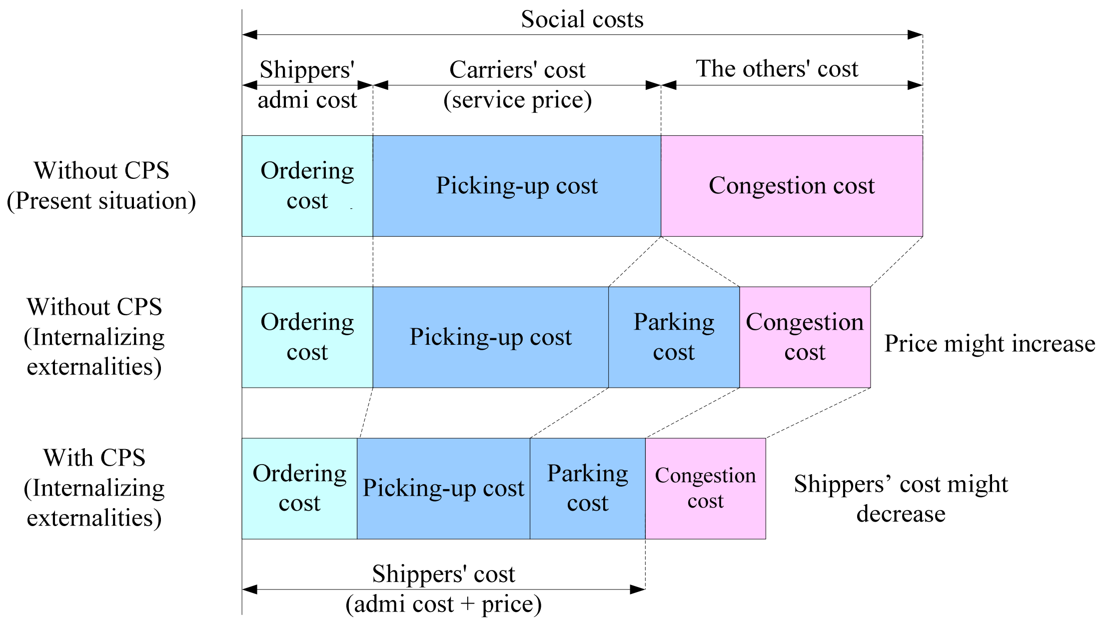

Figure 4 Social costs of pick-up with/without Co-operative Pick-up System (CPS)

decrease, it is possible to reduce the costs for shippers, composed of ordering cost and service price. The co-operative system will not become popular if these conditions are not realised.

Other favourable conditions

Two additional conditions deserve examination. The first condition is the impact of the introduction of co-operative pick-up systems inside the building. These systems have been introduced in some buildings in Otemachi such as in Mitsui Trading and Shin-Otemachi buildings to reinforce security by performing joint receiving and delivery inside the buildings. If this becomes successful and common, the shippers would be ready to accept the area-wide co-operative system as the extension of in-building systems.

The second condition relates to the co-ordination of co-operative pick-up with delivery. As clarified by our surveys, some of pick-ups are requested in the morning, when deliveries are usually carried out. Good collaboration between pick-up and delivery will result in even more efficiency. Although the problem is much more complicated, there is a need to investigate this co-ordination.

By combining these conditions, it can be shown that "reduction in social costs", "reduction in carrier costs", and "reduction in shipper costs" are highly probable impacts of the implementation of a co-operative parcel pick-up system using the internet.

Although it was discussed that it is necessary to reduce the cost of shippers to encourage and stimulate demand, it is also crucial that the carriers should have benefits. The perceived benefits are less for the carriers. In our view, the carriers would be compensated with increased amount of freight cargo through the reduction of freight charges. This is because profits would increase in proportion to the amount of freight cargo supposing reasonable profit per parcel.

CONCLUSIONS

An experiment on co-operative parcel pick-up system was conducted as an effort of PPP in freight transport planning. It did not caused any technical problems while auto-matching was not fully implemented. Only a small number of shippers used the system since the participating shippers were doubtful of its convenience, and there were no reduction in the freight charges. The carriers, on the other hand, indicated that the system could be of use if the amount of freight cargo for pick-up increased in future.

These results do not imply that the co-operative parcel pick-up system in the urban area should be viewed negatively. It was found that the limited conditions during the experiment resulted in the low utilisation of the system, and thus, it is necessary to examine favourable conditions to increase the participation of companies and utilisation of the system.

The economic model of social costs of co-operative parcel pick-up system suggests that reducing the total social costs would be achievable, and that all stakeholders including the shippers, the carriers and society could obtain economic benefits to some extent with the introduction of co-operative parcel pick-up system if the external diseconomies were internalised by enforcing off-street parking, for example. If we could increase our common understanding of the economic nature of the system in a future PPP attempt, all the stakeholders would be willing to join the internet co-operative system.

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