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New co-operative system using electric vans for urban freight transport

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Abstract

This paper presents a new concept of co-operative use of electric vans for urban freight transport. The main idea of the system is that an organisation provides some electric vans at various public parking places to be used cooperatively by many companies. Tests have been conducted in the central area of Osaka City using 28 electric vans equipped with advanced information systems with the participation of 79 voluntary companies. The test system has been well operated without any serious trouble. About 24% of users returned the electric vans at the different parking place from the starting parking place after delivering goods to customers and changed to public transport. This behaviour can contribute to reduce truck traffic in urban areas for better environment. The willingness to pay of most users was found to be too low as compared with the required costs for the system. Some subsidies or any strategic policy may be necessary from the public sector to promote the system.

1 Introduction

Urban freight problems have become important issues for the sustainable

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economic development, the better quality of life and the higher level of environment in urban areas. Some researchers (e.g. Ruske[5], Kohler[3], Taniguchi and van der Heijden[8]) have proposed the idea of "city logistics" to achieve these objectives. Taniguchi *et al.*[7] defined city logistics as "the process for totally optimising the logistics and transport activities by private companies in urban areas considering the traffic environment, the traffic congestion and the energy savings within the framework of market economy." Some city logistics initiatives have been proposed and several cities have implemented some of them: (a) advanced information systems, (b) co-operative freight transport systems, (c) public logistics terminals, (d) load factor controls and (e) underground freight transport systems.

The idea of co-operative freight transport systems has been proposed and implemented in some cities. (e.g. Nemoto[4], Duin[1], Taniguchi *et al.*[6]) However, the conventional co-operation of freight transport is not an easy task, since freight carriers are very competitive and the monopoly of a single freight carrier in a district is not welcomed. Then, this paper proposes a new idea of co-operative use of electric vans for urban freight transport. The proposed systems assume that competitive carriers can take time-sharing of the environmental friendly vehicles. Some experiments on electric vehicles have been conducted in several cities in Europe (ELCIDIS).[2] But the co-operative use of vehicles is not included in ELCIDIS.

Another essential point of the urban freight transport is the difficulty of the intermodal transport systems. Road freight transport is the major mode in the urban freight transport. Railways and boats in rivers or canals are very limited for carrying goods in urban areas. It is hard to convert from road to railway or boat for urban freight transport. To overcome the difficulty, this paper presents the new possibility of converting the truck traffic without loads to subway or bus by drivers after delivering goods to customers. The details will be given below.

2 Overview of systems

2.1 Objectives of systems

This paper focuses on the new concept of co-operative use of electric vans for urban freight transport. The system is proposed and actually tested in the central area of Osaka City, Japan. The objectives of the system proposed here are:

a) Alleviate traffic congestion by reducing freight traffic
b) Provide environment friendly logistics systems
c) Reduce the costs for freight carriers.

Therefore the system aims to achieve multiple objectives. If the system works well, it will be beneficial to all the stakeholders of city logistics including

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shippers, freight carriers, residents and administrators.

2.2 Concept of systems

The main concept of the system is that an organisation provides some electric vans (EV) at various public parking places to be used cooperatively by many companies. These user companies should register in advance for using electric vans. Figure 1 illustrates the typical usage of this system for delivering goods to some customers. A user can book for using an electric van through Internet in advance. He/she may walk or go by bicycle to the parking place where the electric van is prepared. He/she starts the commercial trip by the electric van to pickup some goods at the company. Then he/she visits some customers to deliver commodities and returns the electric van at the nearest parking place to the last customer. Then he/she takes subway or bus to come back to the office. The last trip from the parking place to the office by electric van without load is replaced by the subway or bus. This conversion to public transport from truck can reduce freight traffic without carrying goods. Electric van itself is better for environment than normal gasoline or diesel pickup/delivery trucks.

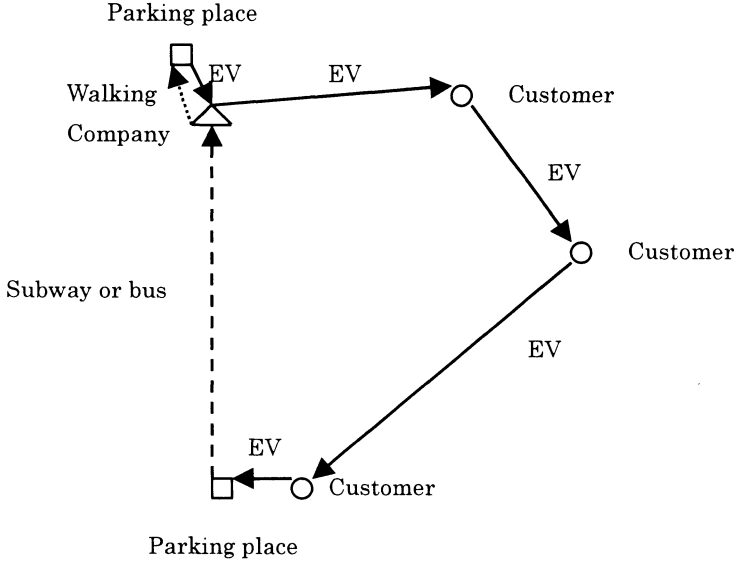

Figure 1: Typical trip of delivering goods to customers by electric van and subway or bus

In addition the electric vans are equipped with advanced information systems, including the car navigation with GPS (Global Positioning Systems), VICS (Vehicle Information Communication Systems), PHS (Personal Handy-phone Systems). These advanced information systems allow drivers to choose optimal route for visiting customers. They also enable the control centre and the company to identify the present location of each vehicle.

3 Tests in Osaka City

3.1 Test systems in Osaka City

Osaka City is located in the west of Japan. The population of the city is about 2.6 millions. Passenger cars and commercial vehicles heavily congest the central area of Osaka City.

The Institute of Urban Traffic Research with two private companies has conducted tests using electric vans in the central area of Osaka City. They prepared 28 electric vans for 79 voluntary companies and public corporations that belong to various business areas; including trade (27%), service (14%), manufacturing (14%), retail (14%), advertisement planning (8%), printing (4%), construction (4%), public corporation (4%), transport (3%) and others (8%). These companies can book for using the electric vans through Internet in advance. The electric vans are kept in 8 parking places with the full charge of electricity in the central Osaka to be picked up. The users can return electric vans to any of these 8 parking places after using for business. They can park at 16 parking places during the trip that include these 8 parking places. The test in Osaka City started on 13th December 1999 and will last until March 2001. During the test period, users can use electric vans without paying any charge.

Figure 2 shows an electric van used in the systems. The electric vans used in the test can carry goods up to 200 kg. It can run about 100 km on 10-15 modes with the full charge of electricity that normally requires 7 hours for recharging. However, in the congested urban area the maximum running distance is limited to 40 – 50 km.

The electric van is equipped with data communication system using PHS. This system allows the control centre to control the electric vans including: (1) Booking and renting vehicles, (2) Operation and route guidance and (3) Management of the balance of electricity. Once a user booked for using the electric van, the central computer transmits the information of the user and visiting places to the vehicle in advance. Then the user can open the door of the vehicle using IC card (Figure 3) and the car navigation system in vehicle can show the driver the optimal route to visit customers. The location of the vehicle is always identified by GPS and transmitted to the central computer at the interval of 5 minutes. The central computer checks the balance of electricity in each vehicle and gives a warning to the driver in case of shortage of electricity.

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Figure 2: Electric van used in the systems

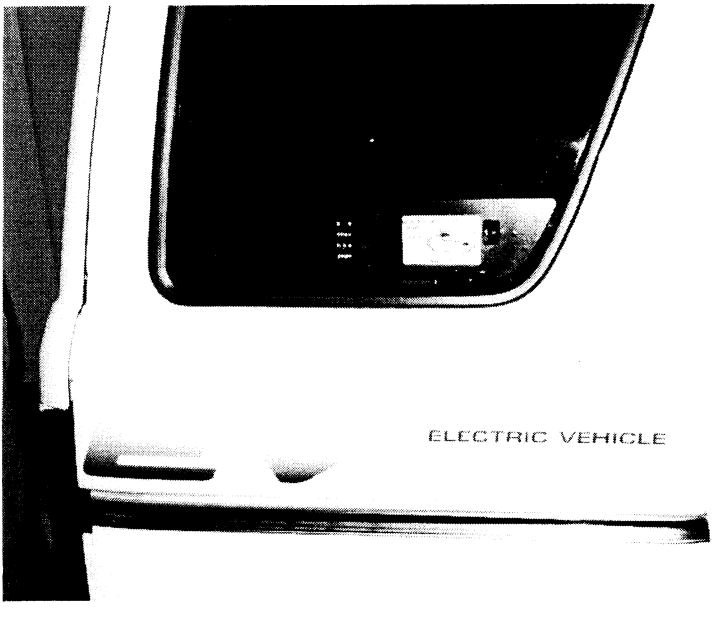

Figure 3: IC card reader for identifying the user

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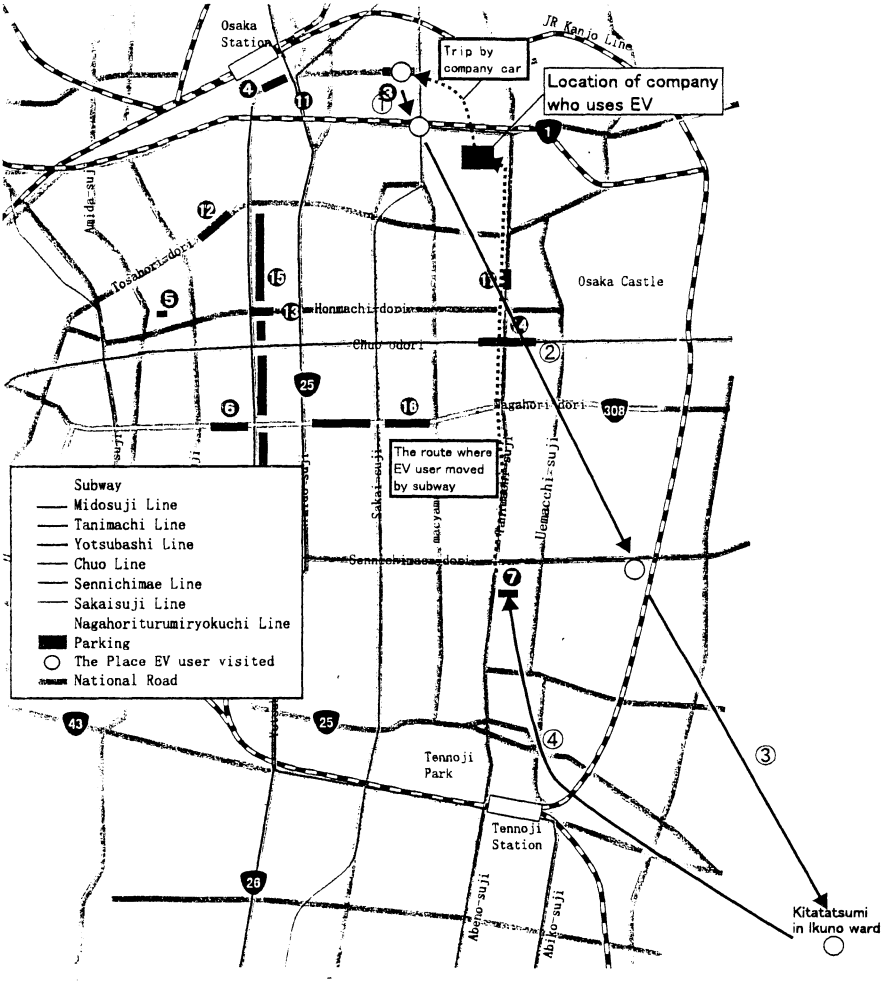

Figure 4: Typical trip by electric van (printing company)

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3.2 Performance of systems

The tests in Osaka City have been conducted successfully without any serious trouble. Figure 4 shows a typical trip using the electric van by a printing company. In this case the user of a printing company picked up the electric van at the parking place No.3. He/she used a company car from the company to the parking place. Presumably he/she needed it for carrying goods. Otherwise he/she had to come back to load the electric van at the company after picking it up at the parking place. Then he/she delivered small paper products to three customers. After visiting the last customer, the user returned the electric van to the parking place No.7 and came back to the company by subway. The last trip from the parking place No.7 to the company was replaced to subway from the truck without load. The user can reduce the travel time by using subway if the route was heavily congested.

Two types of questionnaires were performed for users; (Q1) Daily questionnaire by fax and (Q2) another questionnaire by mail. The total of 379 users (92% of all 413 users) replied to Q1 and 75 companies (95% of all 79 companies) replied to Q2. Results of Q1 showed that 24% (91/ 379) of all the users returned the electric van to the different parking place from the starting parking place. Then 75% of them used subway and 1% of them used bus and 16% of them walked to come back to the company. These changes from vacant truck to public transport contributed to reduce the truck traffic at daytime. The major purposes of trips were delivery/collection of goods (40.9%), meeting (16.6%) and sales (14.0%). The main items of carrying goods were books and magazines (26.6%), paper and paper products (24.9%), computer and relating devices (17.5%), electric products (5.3%). The weight of these goods was very small; 66.4% of all items were less than 20 kg and 12.5% were 20-40 kg.

Table 1 shows the means to access and egress the parking place. This table indicates that about half of users walk to the parking place to pick up an electric van and walk to company after returning the electric van. About 38% of users used subway for the return trip to the company after returning the electric van. This behaviour of drivers fit the objectives of the tests.

Table 1. Means to access and egress the parking place

	trip from company to starting parking place		trip from parking place EV was returned to company	
	frequency	percentage	frequency	percentage
walking	196	52.7	191	51.1
subway	79	21.2	141	37.7
bicycle	25	6.7	24	6.4
bus	0	0	3	0.8
others	72	19.4	15	4
total	372	100	374	100

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Results of Q2 showed that the business for which the electric van was used in the test has been carried out; by the company's own vehicles (53.8%) and by rental vehicles (23.1%). Regarding the characteristics of the electric vans, about 73% of users recognised that the electric vans have better or same capability of conventional vehicles. Some users hope to use it for longer distance than 50 km that is normally allowed at the moment in urban areas. On the overall convenience of returning the electric van to different parking place, the system was; convenient (34.6%), not convenient (19.2%) and neutral (46.2%). Some users require denser allocation of parking places for returning the electric van, in particular in the suburb of the city.

One of the important merits for the users is reducing the travel times. Results of Q1 and Q2 for frequent users (over 4 times) showed on the reduction of travel times by returning the electric van at the different parking place and changing to public transport; reduced (33.3% (4/12)), same (8.3% (1/12)) and unable to answer (58.4% (7/12)). The benefit of reducing the travel times was limited to about 33% of the frequent users. But the reduction of travel times can be an incentive to promote using public transport. It is interesting that about 31% of the users said that they enjoyed the reduction of travel times using car navigation systems.

No charge has been imposed for using electric vans during the tests, but charging is required for the future business. Table 2 shows the willingness to pay of the users to use the test system. About half of the users hope to pay 300-600 yen/hour. It is estimated that 300-600 yen/hour is too low as compared with the costs for operating the electric van system. Many of the users hope to use this system at lower cost than the conventional system. However, a kind of subsidies from public sector is required to provide this system at lower cost than the existing system.

Table 2. Willingness to pay for the electric van

price (yen/hour)	frequency	percent
– 300	5	9.3
300 – 600	27	50.0
600 – 900	6	11.1
900 – 1200	11	20.4
1200 – 1500	0	0.0
1500 –	5	9.3
	54	100.0

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4 Conclusions

This paper presents a new concept of co-operative use of electric vans for urban freight transport. The main idea of the system is that an organisation provides some electric vans at various public parking places to be used cooperatively by many companies. Tests have been conducted to evaluate the new co-operative system of electric vans in the central area of Osaka City. Following findings were derived from the tests.

(1) The co-operative system of electric vans has been well operated and used by many of 79 voluntary companies without any serious trouble. Companies as well as residents welcomed the electric vans equipped with advanced information systems.
(2) About 24% of all users returned the electric van at the different parking place from the starting parking place and changed to subway or bus or walking to come back to the company. This behaviour of the driver can contribute to alleviate congestion and improve the environment by reducing the truck traffic. Some users obtained the benefit of reducing the travel time by changing to public transport.
(3) The questionnaire indicated that the willingness to pay for the system is too low as compared with the required costs, if the system is actually provided in the market. Some subsidies may be necessary from the public sector to promote the system.

There are various needs for further investigations on the following points for realising this system as urban transport mode.

(1) Some strategic studies are required to promote this system. For example, a regulation for other vehicles than electric vans in the central area of a city will make this system more attractive to freight carriers.
(2) The allocation of parking places plays an important role in the system. Therefore modelling the behaviour of electric vans is required to identify the optimal allocation of parking places.
(3) The co-operation in pickup/delivery of goods in a common vehicle between multiple companies can be realised using this system. The further studies are needed to promote companies toward this direction.

Acknowledgments

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