ANALYSIS OF THE CHARACTERISTICS AND DIRECTIONS OF LOADING IN THE CENTRAL COMMERCIAL AREA IN PUSAN CITY

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Abstract: This study firstly, aims to analyze the current situation and characteristics of the loading zone that creates various transportation problems in the central business district (CBD) area in Pusan. Secondly, devising the counter plan for loading zone problem in Pusan is the other aim. The outcomes of the analysis are: 1) Individual loading and unloading is the major way of transport; 2) Small truck is the major transportation mode; 3) Relationship between loading/unloading spaces and illegal parking spaces were identified by the simulation result of queuing model for estimating loading zone spaces. Meanwhile, in order to avoid disordering loading/unloading activities, secured loading/unloading zone is necessary, and off-street loading/unloading zone as well as integrated loading/unloading zone should be in operation.

1. INTRODUCTION

Logistics cost is increasing annually due to the increase of the traffic congestion cost. This is a part of reasons for weakening the competitiveness of the nation in the international market. Hence, in the national level, master-plan for improving the logistics and distribution system was established in 1994. However, no plan is yet to be established at the end point of the transport, i.e., logistics in the city. Frequent loading/unloading's are occurring in the central business district (CBD). It creates more congestion in the CBD, and it bothers walkways in the CBD.

Although the space for loading/unloading for truck should be secured in the parking law, study related to loading/unloading in the CBD is rare in Korea. More detailed study for

suggesting refined regulation is necessary. Therefore, this study focuses on identifying the characteristics of the loading/unloading zone in the CBD of Pusan. Additionally, estimation of loading/unloading spaces for the study area was conduced.

2. DATA COLLECTION

Field observation and on-site survey were conducted in order to identify both current situation of loading/unloading and its characteristics of Kukjae Market place in Pusan where the traffic congestion is a critical issue. The purpose of the field observation was to identify loading/unloading time and spacing. For this, 85 meters of road at western part, and 285 meters of southern part of Kukjae Market place were investigated. Total lengths of the western and southern parts are 380 meters, and 285 meters. They allow 4 lanes and both directions, and two lanes one direction, respectively.

For the field observation and on-site survey, 12 volunteers were participated. In 8 hours of field observation, 144 and 99 vehicle were observed for western and southern parts.



Figure 1. Field Observation and Survey Area

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On the other hand, survey which focused on identifying frequency of loading/unloading, and level of effort for cooperative delivery was conducted. Sample was extracted from the stores located at western and southern part of the Kukjae Market place. In total 211 stores were surveyed, and 103 data were collected. Table 1 reveals summary of the survey, and Figure 1 illustrates study area.

Division	Field observation	On-site survey
Time	1997. 11. 7 (Fri)09:0017:001997. 11. 21 (Fri)09:0017:00	1998. 6. 1. 1988.6. 6
Object	85meter of road of western part 285meter of road of southern part	Stores of the field observation
Contents	Loading volume and time Loading spacing Dwelling time	The general facts about the stores The facts of loading/unloading Establishment or not of loading/unloading

Table 1. Summary of Data Collection

3. CHARACTERISTICS OF LOADING AND UNLOADING

It was identified that average loading/unloading times for a store was 3.55 times a day. Loading/unloading frequencies for home decoration, daily goods, cosmetics, drug, grocery were high, whereas men and women's clothe, fancy goods, jewelry, and glasses were low. These results were revealed in Figure 2.



Figure 2. Average Frequency of Loading and Unloading

Origination of unloading goods was identified. 34% of goods were originated from Pusan. Major original loading places were factory, and whole sale stores. The percentages of these two places were 53.4 and 22.3%, respectively. Types of transport of goods are mutual, individual, and mixed transport. Table 3 illustrates types of loading/unloading. Individual unloading occupies 45.1%, and mutual unloading occupies 26%. Also, the truck mainly transported loaded goods.

Division	Origination			Originating Places			
	Pusan	Vicinity of Pusan	Other Areas	Factories	Whole Sale Stores	Head Shop	Others
The Number of Stores	32	57	5	55	23	20	5
Rates(%)	34.0	60.6	5.3	53.4	22.3	19.4	4.9

Table 2. Origination and Originating Places of Unloaded Goods

Division Unloading types		The Number of Stores	Rates (%)	Division Loading types	The Number of Stores	Rates(%)
Mutual Transport	Transporting Companies	27	26.47			
	Stores + Transporting Companies		16.67	By Buyer	23	24.2
Mutual	Truck Transporting Companies	4	3.92			
Transport	Stores + Transporting Companies Truck	8	7.84	Delivery By	21	22.1
	Total	29	28.43	Bike, Bicycle	21	22.1
	Stores	38	37.25			
Individual	Truck	2	1.96	Loading By		
Transport	Stores Truck	6	5.88	Truck,	51	53.7
Transport	Total	46	45.10	Transporting Companies		
	Total	102	100.00	Total	95	100.0

Table 3. Loading and Unloading Types

Meanwhile, Figure 3 illustrates the share of unloaded goods by transported by transport companies. Electric goods and Clothing occupies high percentages - 72%, and 60%, and home decoration, daily goods, cosmetics, drug, and groceries are following. These results revealed that the home decoration, etc. are not easy to transport by the transporting companies.

Analysis of the Characteristics and Directions of Loading in the Central Commercial Area in Pusan City



Figure 3. Rates of Unloaded Goods from the Transporting Companies

4. CHARACTERISTICS OF UNLOADING VEHICLE

4.1 Volume of Unloading Vehicle

For 8 hours' of field observation, 144 vehicles were counted as unloading vehicles at the southern part of the study area, and 99 vehicles were counted at the western part. In Figure 4, hourly unloading volume for 100 meter section of road at the study area is illustrated. At two locations, it was revealed that 10 A.M to noon are the peak period for unloading vehicle volume. Whereas 3 to 4 P.M shows the lowest volume for unloading. Peak and average volume for western and southern parts of the study area are 22, 14.36 vehicles per hour per 100 meter at western part, and 13, 6.32 vehicles per hour per 100 meter at southern parts.

Figure 4 shows that small truck, passenger vehicle, and van at the western part are 43.4%, 31.3%, 25.3%, respectively. At the southern part, small truck, passenger vehicle, and van are 63.2%, 9.0%, 27.8%, respectively. Therefore it can be concluded that small truck is the major mode of transportation for unloading.



Figure 4. Hourly Unloading Volume

4.2 Unloading Distance

Unloading distance, i.e., unloading zone to store, after parking is shown in Table 4. Average unloading distance for western and southern parts are 16, 10 meter, respectively. Since southern part of the road allows one directional movement, unloading distance is comparatively short. Unloading distance for the mode of transportation is identified at the western part as passenger vehicle (18.61 meter), and van (9.72 meter), whereas van (10 meter), and small truck (9.58 meter) at the southern part.

Figure 5 illustrates distribution of unloading distance. Less than 5 meter's of unloading distance occupies about 50% of totaled unloaded distance. It implies that half of the unloaded vehicle parks in front of stores. Another result revealed that about 80% of unloaded vehicle at the western part have 20 meter's of unloading distance. Also, in the rare case, there is more than 50 meter's of unloading distance.

Table 4.	Average	Unloading	g Distance
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D	Western Part				Eastern Part			
Division	Total	Passenger Vehicle	Van	Small Truck	Total	Passenge r Vehicle	Van	Small Truck
Average Distance(m)	15.98	18.61	9.72	17.73	10.20	11.67	11.00	9.58

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Figure 5. Average Unloading Distance

4.3 Time Duration for Unloading

Since unloading distance for western part is longer than that of the southern part, obviously average time duration for unloading at western and southern part are longer (12.7 and 10.9 minutes). This result is shown in Table 5.

	Western Part				Eastern Part			
Division	Total	Passenger Vehicle	Van	Small Truck	Total	Passenger Vehicle	Van	Small Truck
Average Time Duration (min)	12.74	10.48	12.52	14.63	10.93	12.69	10.78	10.72

Table 5. Average Time Duration for Unloading Vehicle

Distribution of average time duration for unloading vehicle is illustrated in Figure 6. In the result, less than 10 minutes of average time duration for loading/unloading occupies more than 60 percent. However, long term parking, i.e., more than an hour of parking, also exists in the rare case.



Figure 6. Dwelling Time for Unloading

5. COUNTER-PLAN FOR UNLOADING VEHICLE

5.1 Parameter for Unloading Space Estimation

Simulation was conducted for estimating the optimal unloading space. In order to analyze loading, queuing theory was adopted. Five-minute was adopted for marginal time for legal and illegal parking, i.e., more than five minutes of parking were considered as illegal. Simulation aims to minimize the percentage of illegal parking. Qui-square test and exponential distribution were adopted. First-In-First-Out (FIFO) mechanism was applied for the service in the queuing system. Table 6 summarizes parameters that were applied to the simulation, and detail description is as follows.

1) Volume

Average volume at the western side of the study area was calibrated as 14.4 vehicles per 100 meter per hour. Therefore, volume for 8 hours and entire section of the study area (western side) can be calculated as:

14.4 vehicle/100 meter/hr x entire length of the section (380 M)/unit length (100 M) x field observation duration (8 hr) = 437 vehicle.

According to the same calibration, volume at the southern section of the study area is 144 vehicle.

2) Average Arriving Interval

Average arrival interval can be calculated as observation time divided by total volume. Hence the results are 1.1 minutes per vehicle at western side and 3.3 minutes per vehicle at southern side.

3) Unloading Time

According to the field observation, average unloading time for a vehicle was 7.45 minutes for western side and 7.73 minutes for southern side. In here, more than 30 minutes of unloading time was extracted due to the reason that it requires other treatment. Hence, the results in Table 6 are less than those results in Table 5.

Division	Western Part	Eastern Part
Length of Study Area	380m	285m
Volume	437vehicles	144vehicles
Average Arriving Interval	1.1min/vehicle	3.3min/vehicle
Unloading Time	7.45min	7.73min

Table 6. Parameters for the Simulation

5.2 Simulation Results and Counter-plan

Basic assumption that was applied to the simulation was that unloading vehicle volume correlated to the length of study area. The result is summarized at Figure 7. In the 50 meter's of road section, 3, and 2 unloading vehicle spaces are required for western and southern section when illegal parking – more than 5 minutes of dwelling time - rate was assumed as less than 5 percent. Also, unloading vehicle spaces for 10 percent of illegal parking are included in the Figure 7.



Figure 7. Results of Unloading Vehicle Spaces

In the total length of western and southern side of study area, 12 and 6 unloading spaces were required for western and southern side when 0 percent of illegal parking rate was assumed. 10 and 4 spaces are needed when 5 percent of illegal parking.



Figure 8. Rates of Illegal Parking

Considering the reality, securing the unloading spaces at the study area is not feasible. It is essential that devising the alternative counter-plan is necessary. In fact, the study area is designated as no parking zones. Hence, strong enforcement of illegal parking is required.

Considering the unloading spaces, location of unloading spaces is the most important factor. Since average unloading distance was identified as 16 meters, illegal parking will increase when the location of unloading space is inappropriate. Unloading space should not hinder the sidewalk as well as main stream of traffic.

6. CONCLUSION

This study can be concluded as follows:

First, average loading/unloading times per day for the stores at the CBD in Pusan was 3.55 time/day, and individual transporting was the major way of transportation. Second, small truck was the major mode of transporting goods. And, people prefers short unloading distance, and it was identified as 16 meter at the congested area and 10 meter for the normal area. Average dwelling time for parking was 7 to 8 minutes. Third, unloading spaces based both on the length of road and illegal parking rates were estimated.

Afterwards, on-street parking lot in the CBD can be utilized as loading/unloading spaces. When parking lot is not available, short-term plan for avoiding illegal parking should be devised. Designation of loading/unloading space is required, and loading/unloading space should not conflict with stream of traffic as well as pedestrian. Since distribution of goods in the CBD area remains as critical transportation issues in the city, both short and long-term plan for relieving this issue should be continued to research.

Also, in advance, decision-makers should decide their policy directions on adopting either on-street parking or off-street parking in considering loading/unloading-parking issue. Especially, devising the loading/unlading zone is essential for establishing the on-street parking policy. It is principal rule that the loading/unloading zone should reside in the off-street. However, in considering the efficient use of roadway, it is permissive that loading/unloading zone can be devised on the on-street.

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