

# AN INVESTIGATION INTO THE FREIGHT PICK-UP DELIVERY ACTIVITIES IN CITY CENTER OF JAKARTA

**Nahry, R. JachrizalSumabrata**

*Dept of Civil Engineering, Faculty of Engineering, Universitas Indonesia, Kampus UI Depok 16424*

*Email : [nahry@eng.ui.ac.id](mailto:nahry@eng.ui.ac.id), [rjs@eng.ui.ac.id](mailto:rjs@eng.ui.ac.id)*

## **Introduction**

As experienced by many big cities in the world, currently Jakarta has the same crucial problem in its road transport. The number of road users (i.e. passenger cars, public vehicles and freight cars) are increased steadily, while the growth of road transport infrastructure could not anticipate the negative impact of this situation. Goods vehicles and passenger vehicles, as well as pedestrians compete for space and priority. City center deteriorates at the most due to its lack of space. For the response, most of local authorities give more priority to people movements rather than freight ones. Consequently, almost all the rules regarding the freight vehicle activities are punitive instruments. Those cars are restrained in space or time to access city centers. There are no sufficient supportive instruments to facilitate their flows and pick-up delivery operations. Previous research works show that there seems to be very little understanding at the local authority to the existence of freight transport in urban areas. Despite the relevance of freight movements in the support of economic life in urban areas, it is often found that urban freight operations play a secondary role in city planning priorities (Lindholm, 2010; Munuzuri et al, 2005). Indeed, freight vehicles should be treated like other road users because even they contribute to the negative impacts to the city, they are the major contributors in economic and social development of the city.

As the concerns of contemporary transportation planning is to move as many as possible people and goods instead of cars, local authorities should essentially give more priority to public vehicles and freight cars rather than passenger cars. For that reason, local authorities should recognize the local characteristics of the people movements as well freight movements in order to balance the attention to both road users. Knowing local characteristics become important to avoid inappropriate policies in solving the problems. The overall policies or instruments which are applied in wide-ranging of objects or areas without taking into account the specific behavior of the local area may cause vain or even adverse impacts which actually could be avoided.

The common problems of freight movement in general are occurred when they travel the route (en route) and at the end points of their trips at which they must park their car, make loading unloading and also goods delivery (Ogden, 1992). This study is aimed to investigate the current operations of freight transport in one important end point of freight movement in Jakarta, that is Jatinegara Wholesale Shopping Center (JWSC). Results of the investigation will illustrate the characteristics of parking and pick-up delivery operation and lead to the raise of the important issues which have to be considered by local authority to improve the existing condition.

This study will identify the characteristics of pick-up delivery process through field survey, and measures are proposed to maximize the utilization of parking space. Interview to the stake holders will be carried out to confirm the field survey and the proposed measures.

## **Survey on Parking and Pick-up Delivery Operation**

Jatinegara is one of the famous shopping centers in center of Jakarta. It is a wholesale shopping center so as the traffic flow surrounding the area is dominated by freight vehicles all the day. In addition, its location is on the major arterial road in which Bus Rapid Transit system is operated, though it is not in the exclusive lane due to the lack of space. Hence, it has made the BRT has to compete with freight vehicles and other road users for having space, while on-street parking takes place illegally due to limited space of parking building in this area.

The freight movements in city centers essentially includes activities related to parking, loading unloading, goods conveyance and inside building delivery (Shimizu et al, 2008). Investigation which

will be carried out is in accordance to those activities (Figure 1). Since loading/unloading is highly related to parking operation, we emphasize our investigation to the parking issues at this site.

In order to identify and analyze the characteristics of freight movement in JWSC, we conducted parking volume counting, patrol survey, loading and unloading survey, as well as questionnaire survey amongst shop keepers and porters who are engaged in pick-up and delivery services. In addition, physical inventory of the parking facilities was also carried out to represent the supply side of the parking facility.

## Analysis of the Existing Condition

### Parking Vehicle Characteristics

JWSC has one parking building. Currently, due to the over capacity of the existing building, people park their cars illegally on the street. Figure 2a shows the situation at the entrance of JWSC, at which the street traders occupy almost half of the access road to the parking building. They also inhabit the sidewalks, so pedestrians must walk at the roadside, together with the cars. Figure 2b shows the situation of illegal on-street parking which are dominated by public transports and loading/unloading trucks. Figure 2c illustrates the porter who conveys the goods to the shops on the car corridor due to the absence of pedestrian sidewalk within parking building.

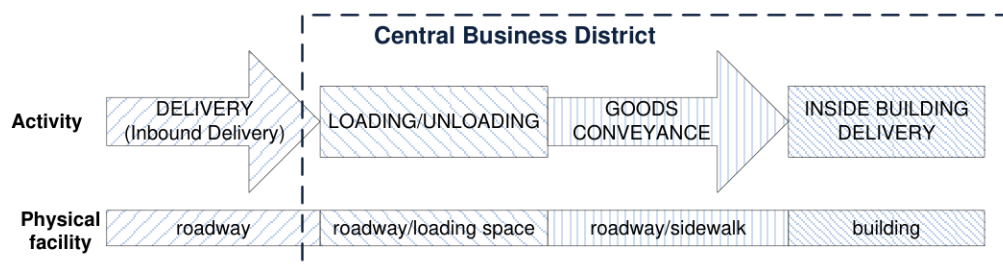


Figure 1 The activities related to freight movement in city center



Figure 2a The entrance of Jatinegara Shopping Center



Figure 2b Illegal on-street parking



Figure 2c Goods conveyance

Identification to the parking characteristics is carried out through the traffic counting and patrol survey. We classified the vehicles into freight cars (trucks), passenger cars and motor cycles. The composition of total volume of vehicles parked are 21.06% for freight cars (FC), 26.90% for Passenger Cars (PC) and 51.18% for motorcycles. The number of motorcycles is spectacularly almost double the PC or FC. This fact indeed becomes common phenomenon in Jakarta, in which motorcycles dominate the road traffic. However, since in JWSC motorcycles have their own parking spaces so they do not compete for space with other types of vehicles, in this research we just take into account the existence of FCs and PCs. Figure 3 ~ Figure 6 illustrate the basic characteristics of parking usage, those are parking inflow, parking outflow, parking accumulation and parking volume for the three types of vehicles during period of survey.

Based on *t-test* for significance level  $\alpha=0.5$  it is found that the trends of the inflow and outflow of both PC and FC are similar. With such trends of movement, it is quite difficult to utilize the parking spaces as shared facilities, i.e. to take advantage from different peak/off-peak characteristics of volume in order to utilize the space more efficiently. However, from the observation, one important issue comes up, that is the existence of PCs which are functioned as freight vehicles (for simplicity, we name this type of car as PC+). PC+ could not be identified from volume counting. Traffic counting, which is

conducted at the entrance gate of parking building, could not distinguish if the PC bring common people (as buyer) or it bring also goods for commercial purposes. The vehicle type of PC+ usually is Multi Purpose Vehicles (MPV) and they have no licence for bringing commercial goods. We notice their existence as they do loading unloading in a quite big volume and also they occupy the parking spaces for quite long time. Our presumption regarding the existence of PC+ is strengthened by the result of patrol survey (Table 1).

From table 1 it can be seen that the parking duration of FC and PC are almost similar, i.e. 4.87 hours and 4.17 hours, respectively. Whereas intuitively we believe that their characteristics supposed to be not similar. From that point, we try to scrutinize the result of patrol survey by separating the PCs whose parking duration is more than 5 hours and add them to FC (namely Modified FC).

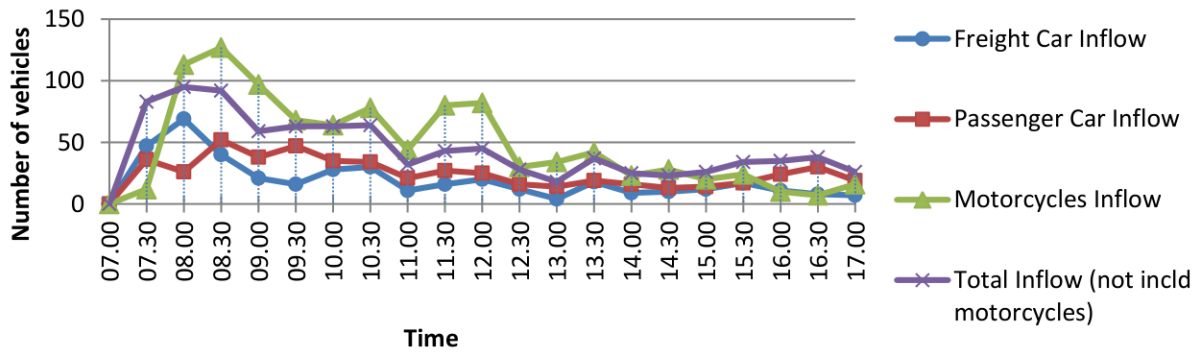


Figure 3 Parking Inflow

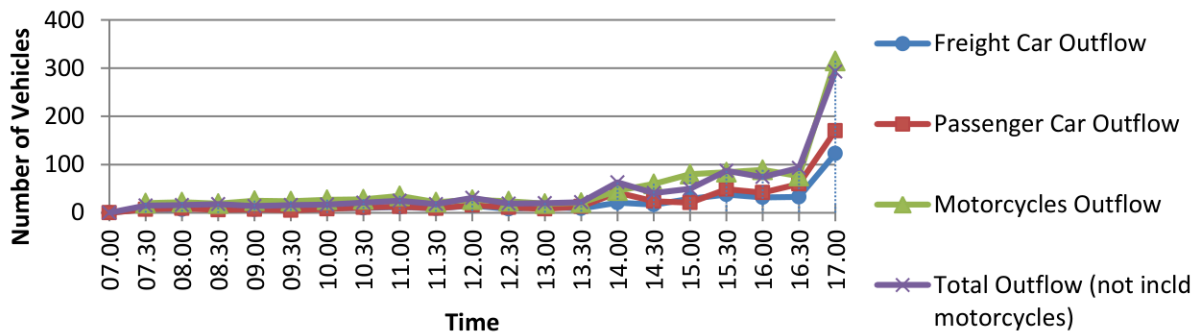


Figure 4 Parking Outflow

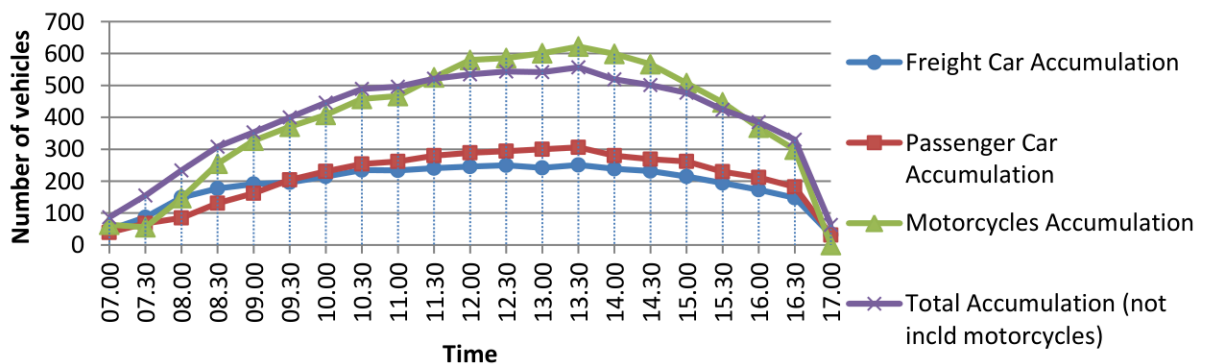


Figure 5 Parking Accumulation

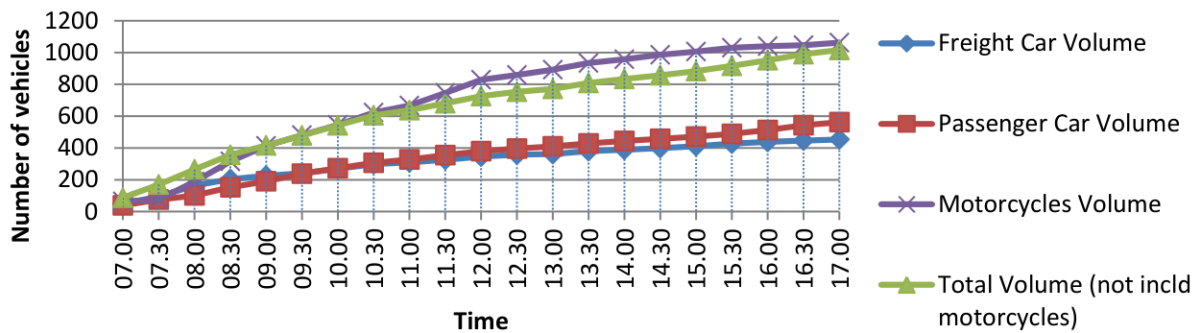


Figure 6 Parking Volume

Types of car	Total car parked hours	Total car	Duration (hour)
Total car	2,944	665	4.43
FC	1,188	244	4.87
PC	1,756	421	4.17
Modified FC (i.e. FC plus PC+) *)	2,085	330	6.32
Modified PC (i.e. PC minus PC+) *)	859	335	2.56

\*)

\*) If PC which functioned as FC is considered as FC

It is found that the parking duration of modified FC becomes 6.32 hours, while duration of modified PC becomes 2.56 hours. We ensure that the latter numbers represent the real characteristics of both freight and passenger movements, regardless the type of the vehicles they use. Since the numbers of PC+ is quite big (around 26% of Modified FC or 12.93% of total car), it is required to take into account explicitly the existence of PC+ as freight car in the analysis (even though it is illegal). It is realized that the difficulty will take place when the traffic counting surveyor has to distinguish the PC and PC+ while their appearances are almost similar. It can be solved by applying video camera-based traffic counting survey which enable the surveyor to observe the plate numbers (and it is then cross-checked with patrol survey) and the appearance of the car in longer time.

The other important issue is the existence of cars which are functioned as warehouse (i.e. mobile warehouse). Most of them belong to the shop owner, but some belong to suppliers. Such vehicles stay for long time and the drivers or porters make loading unloading repeatedly to serve the shops. It is occurred since their warehouses are full or even they do not have any warehouse inside the building. This activity is suspected as another cause of high parking duration.

Furthermore, the other important issue concerns with the Parking Index (PI). The parking building provide 160 parking space units, excluded the areas for motorcycles. They are used for both PC and FC, and no specified areas for each of them. Figure 7 illustrates the Parking Index during time period of survey. PI at almost all the day are greater than 1. It denotes that the 160 parking space units are fully occupied all the day. Even at the midday it reaches the maximum point 3.48. It can be occurred since the cars occupy almost all the available areas (not only the parking areas), including the car corridor.

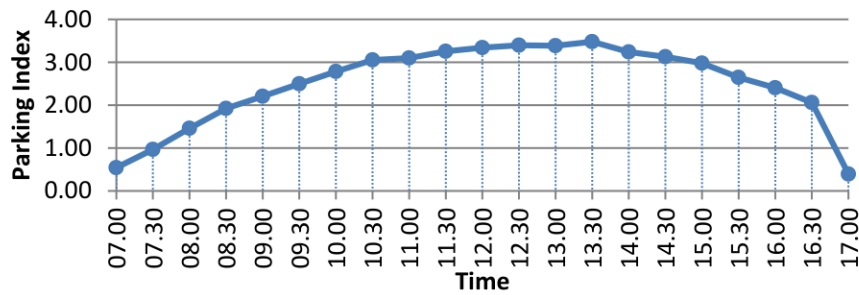


Figure 7 Parking Index

*Loading Unloading and Delivery Characteristics*

A survey related to loading unloading activities were conducted to 59 samples of freight cars. It reveal that majority (57.63%) spent 30 minutes for loading unloading process, while 22.03% take 60 minutes and 15.25% need 15 minutes. The remain (5.08%) need longer time, i.e. up to 90 minutes. The time required for loading unloading includes the time for conveying the goods to/from the shops. The more the shops to visit, the longer the time required for the whole process of loading unloading.

Interview to shopkeepers and porters were also carried out to identify some aspects related to goods delivery and order management. Interview was addressed to 41 shopkeepers for the representation of shop owners and 52 porters for the representation of goods suppliers. It is found that almost all the shops take their own carand 75.6% of them have right for monthly paid parking space. 41.46% of shop owners park their car whole the day, while only 30.77% of suppliers do the same thing. Regarding the mobile warehouse, it is found that 17.3% of shop owners make use of their car to keep their goods along with their warehouse, even though 90.24% of the shop owners have their own warehouse inside the building. In association to the order management, 43.9% of the shops have their own suppliers who deliver the goods periodically and most of shops engage with 1-3 suppliers. The 56.1% of the shops are goods producers so they do not deal with suppliers frequently. The delivery frequency of the suppliers is 1-3 times a week (44.4%), but 55.6% of the suppliers deliver the goods daily.

**The Improvement of the System**

From the above explanation, we have identified some important issues which are related to the off-street parking and pick-up delivery activity in JWSC. We identify that the very highPI is the most crucial issue in this area. Moreover, the existence of passenger cars which are functioned as freight cars and also the use of car as warehouse (mobile warehouse) are the other important issues which have made the parking conditionworse. As the PI is characterized by total car inflow and total car outflow and also the total parking space units provided, in order to reduce the PI we focus to two points, those are increasing the number of parking area units and reducing the parking accumulation. Based on the notion that we need to give more priority to freight movements rather than to people movement (due to the fact that in Jatinegara people movement has been served by the BRT), we divide the parking area into two groups, those are the areas for PC and the areas for FC, and accordingly we have two PIs, those are  $PI_{FC}$  and  $PI_{PC}$ . The area provided to each group embodies the total parking space units which can be used by each group. Our proposed measure to reduce the PIs dynamic in nature as PI at certain time may be changed as the inflow cars or outflow cars changed. Accordingly, in our proposed measures the parking area units of PC or FC at time  $t$  could be increased or decreased at time  $t+1$  depend on the  $PI$  at time  $t$ . Moreover, the measures to reduce the parking accumulation could be carried out by controlling both car inflow and outflow based on the level of PIs. The following mathematical programming will explain the idea of reducing the PI.

$$Min Z(\alpha; \beta) = \alpha (PI_{FC})_t + \beta (PI_{PC})_t \quad \forall t \in T$$

subject to :  $(R_{FC})_t + (R_{PC})_t = 1$

$$(PI_{FC})_t \leq PI_{FCmax}$$

$$(PI_{PC})_t \leq PI_{PCmax}$$

where  $(PI_{FC})_t = \frac{(ACC_{FC})_t}{(R_{FC})_t \cdot Cap}$

$$(PI_{PC})_t = \frac{(ACC_{FC})_t}{R_{PC} \cdot Cap}$$

$$(ACC_{FC})_t = (ACC_{FC})_{t-1} + (Fin_{FC})_t - (Fout_{FC})_t$$

$$(ACC_{PC})_t = (ACC_{PC})_{t-1} + (Fin_{PC})_t - (Fout_{PC})_t$$

$(PI_{FC})_t, (PI_{PC})_t$  : Parking Index of freight car and passenger car, respectively, during time  $t$   
 $(ACC_{FC})_t, (ACC_{PC})_t$  : Accumulation of freight car and passenger car, respectively, during time  $t$

Decision variables :  $(R_{FC})_t$  and  $(R_{PC})_t$   
 where :  $(R_{FC})_t, (R_{PC})_t$  : Proportion of area of freight car parking space and passenger car parking space, respectively, during time  $t$

Input Variables :

$\alpha$  : Weight of Freight Car

$\beta$  : Weight of Passenger Car

$Cap$  : Total number of parking space unit

$PI_{FCmax}, PI_{PCmax}$  : Maximum allowable Parking Index of freight car and passenger car, respectively

$(Fin_{FC})_t, (Fin_{PC})_t$  : Freight car inflow and passenger car inflow, respectively, during time  $t$

$(Fout_{FC})_t, (Fout_{PC})_t$  : Freight car outflow and passenger car outflow, respectively, during time  $t$

We divide operation time of parking building ( $T$ ) into some time interval. The proposed model is aimed to minimize the total Plof PC and FC during time  $t$ , while the proportion of area for both types of cars becomes its decision variables. The coefficient  $\alpha$  and  $\beta$  are used to make weighting of both types of cars. When the authority intend to give more priority to freight cars, it is able to use any number for  $\alpha$  and  $\beta$  provided that  $\alpha$  is greater than  $\beta$ . The bigger the difference between both coefficients, the bigger the difference of priority given to both types of cars. The objective function is constrained by the total number of parking space unit, and also the maximum allowable PI. The case of Jatinegara shows us that PI as 3 may be occurred, but the parking authority indeed has right to limit it in order to give satisfaction to the customers.

Figure 7 shows an example of the optimization of  $Z$ -value in order to find the best ratio of area of FC parking space to PC parking space with two sets of  $\alpha$  and  $\beta$  values, those are  $Z(1;1)$  and  $Z(7;3)$ . In figure 7 we can see that as the ratio area of PC to FC increased, PI of freight cars would be increased due the smaller area provided for them. The  $Z$ -value helps us to find the best ratio to provide parking area for both types of cars. It can also be seen from two  $Z(\alpha;\beta)$  curves that the bigger the  $\alpha$ , the more satisfied the freight cars. When we use  $Z(1;1)$ , we found that ratio area 1.00 is the absis of the point at which the  $Z$  value is minimum. At that point,  $PI_{FC}$  and  $PI_{PC}$  are 2.68 and 3.23, respectively. Whereas, when we use  $Z(7;3)$ , we found that the minimum point is at the absis 0.67 and the associated  $PI_{FC}$  and  $PI_{PC}$  are 2.23 and 4.03, respectively. The value of  $\alpha$  and  $\beta$  values are determined by the policy maker, and it depends on its policy concerning with the freight and passenger movement.

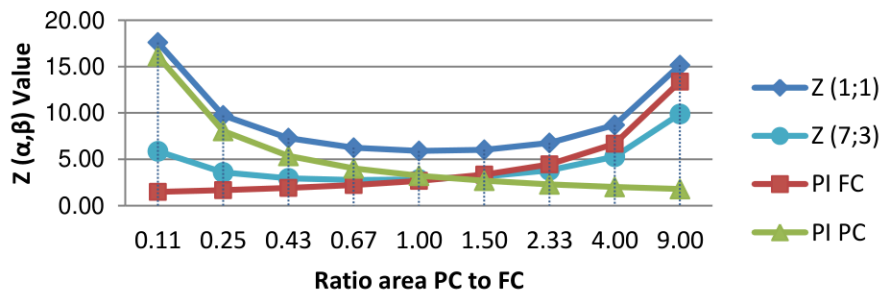


Figure 7 An illustrative example of the optimization curve of Parking Index

From such explanation it can be seen that this mathematical programming is used to optimize the proportion of the parking space of freight cars and passenger cars during time  $t$ . It is realized that the area of parking space indeed has to be defined prior to the flow comes in. For that reason, we use the optimum area proportion of time  $t$  to manage the parking area of time  $(t+1)$ . Due to the limited total parking area and the unlimited car inflow, some conditions may prevail and violate the constraints.

The huge inflow, for FC or/and PC, may cause maximum allowable PI is violated. In this case, it is required to restrain the inflow (by utilizing parking lot next to this area or on-street parking) or to increase the parking space unit for one of the two types of car. The following straightforward algorithm (Figure 8) shows the steps which may be applied to comply with the constraints. The proposed technique to control performance of parking serviceability may be implemented through the use of parking guidance and information systems display configurations (Thompson et al, 2001). This information system could be utilized to simulate dynamically the real time situation of parking system.

Regarding the existence of PC+ and its relation to the effort of reducing the PI, it is essential to forbid PC+ so as the proposed measures could assign the parking space efficiently and PI could be minimized. It is realized that the unreliable input data produced by the illegal PC+ may cause the underutilized or overutilized parking space. The other effort which has to be taken into account in order to reduce the PI is the restriction of mobile warehouses and also limiting the duration time of loading unloading activity. These efforts are expected to increase the car outflow, hence the parking accumulation will be decreased. Lastly, the improvement of the access road and also pedestrian facilities should be included into the parking improvement so as the access road capacity could be fully utilized. It is expected that the searching time will be reduced, and the parking turn over will become higher.

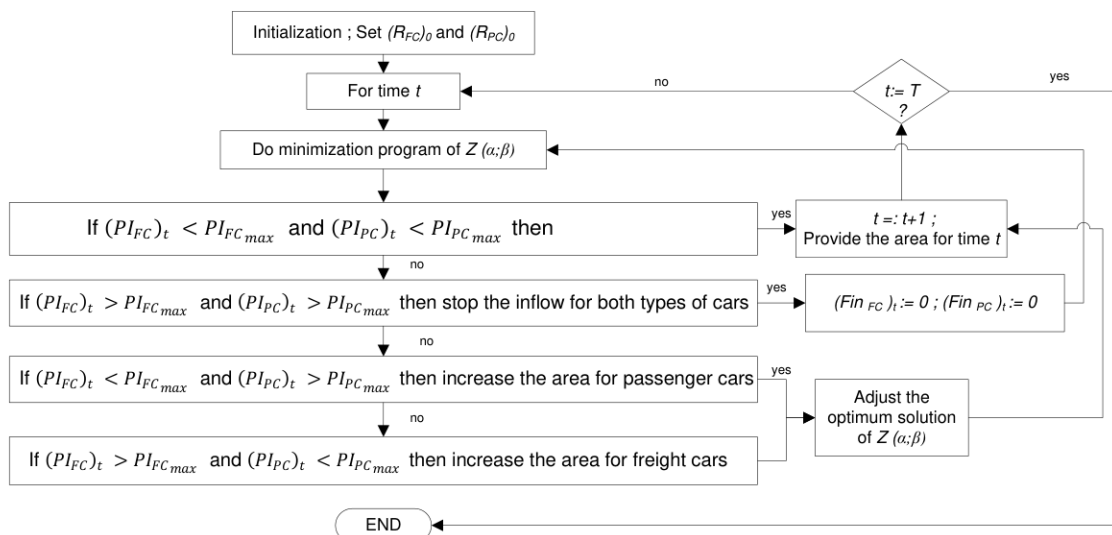


Figure 8 The algorithm of Parking Index Improvement

**Conclusion**

The freight pick up delivery activities in city center of Jakarta, which is represented by Jatinegara shopping center, is highly dominated by parking problems. Lack of parking space, the existence of illegal passenger cars which are functioned as freight cars and also the existence of cars which are functioned as warehouses contribute to the severe parking service. The insufficient access road and pedestrian facilities have also made it worse. This condition is not appropriate to be occurred at a prominent shopping center such as JWSC. Some measures are proposed in order to improve current condition. They are aimed to give more priority to freight cars for using parking spaces rather than to passenger cars, in respect to the fact that in Jatinegara people movement has been served by the BRT. Local authority should identify seriously the local characteristics of parking usage and parking supply, as well as pick-up delivery process, and also conduct the holistic study prior to apply the punitive instruments to freight movements. It is to avoid the unnecessary adverse impact to them and also to the city. The methodology of this study, as well as the proposed measures could be applied to other locations in city center, and local authority is expected to consider them in their city transportation planning. Lastly, law enforcement takes the major role in its implementation.

**References**

Lindholm, M (2010), "A sustainable perspective on urban freight transport : Factors affecting local authorities in the planning procedures", *Procedia Social and Behavioral Science*, 2 , 6205 – 6216.

Munuzuri, J., Larraneta, J, Onieva, L and Cortes, P. (2005).,“Solutions applicable by local administrations for urban logistics improvement ”, *Cities*, Vol 22, No.1, 15-28.

Ogden, K.W. (1992), *Urban Goods Movement*, Ashgate Publishing Company.

Shimizu, M., Hyodo, T., Takebayashi, H., Kuse, H., and Hagini, Y. (2008), “Studying distribution in Tokyo Metropolitan Region using local freight survey”, in *Innovations in city logistics*, edited by Eiichi Taniguchi and Russel G. Thompson, Nova Publisher.

Thompson , R.G., Takada, K. and Kobayakawa, S. (2001), “Optimisation of parking guidance and information systems display configurations”, *Transportation Research Part C*, 9 , 69-85.