

ANALYSIS OF GOODS MOVEMENT BEHAVIOR OF TRUCK COMPANIES IN BANGKOK, THAILAND

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Abstract: Truck terminals in Bangkok were constructed to alleviate the problems occurred by the use of trucks, such as traffic congestion. However, very little cargo volume is handled at these truck terminals. In order to make policies for promoting the use of truck terminals, it is necessary to understand the behavior of truck companies. This study aimed to obtain insight into goods movement characteristics of truck companies both using truck terminal and not using it, and their opinion toward truck terminal. Binary logit model was also developed to see the impact of demand of truck terminal due to the change in truck terminal fee policy. It was found that truck terminal fee was not an influential factor for selecting to use it, but other aspects such as accessibility or convenience for using were the more important factors that should be emphasized when making policies to promote the use of truck terminal.

Key Words: truck terminal, freight distribution center, goods movement characteristics, logit model

1. INTRODUCTION

In Thailand, the dominant mode of land freight transport is road transport by trucks having just under 90 per cent of total land freight transport both in term of tonnage carried and tonne-kilometers. Three public truck terminals in Bangkok were constructed with the intention to alleviate problems occurred by the use of trucks such as traffic congestion, air and noise pollution and vibration, road accidents, and damage to infrastructure. However, the cargo volume handled at these truck terminals is extremely less than that expected in the demand forecasting. The truck companies still prefer doing goods transferring business at their own private location called "freight distribution center (FDC)" rather than truck terminals. Some efforts were made by the government to encourage truck transportation companies to use more of truck terminals and it came out as some policies. Such a policy is the truck regulation policy, which gradually increases the level of restriction from not allowing trucks to enter or park in the CBD area to finally the area inside the outer ring road, with the expectation that truck terminals will become the essential hub of transferring goods between big and small trucks. Unfortunately, the utilization of truck terminals is still very low. In order to make policies to increase the utilization of truck terminals, great understanding of transshipment behavior of truck companies and their attitude toward truck terminals and their current freight distribution center is vital.

This study aims to obtain insight into the daily characteristics of goods transferring activities of truck companies in Bangkok Metropolitan Region (BMR) and also the attitude of truck companies toward truck terminal and freight distribution center. Data collection was done by conducting questionnaire surveys with the representative of truck companies both using truck terminal and freight distribution center. Face to face interview was also made with the manager of one company using truck terminal for further information regarding advantages and disadvantages of using truck terminal. The study area is Puthamonthon truck terminal located in the western part of BMR and the nearby FDC. The characteristics of truck companies and their activities and their attitude toward truck terminal and freight distribution center were presented in the tabular form and charts. Binary logit model was also developed as a tool to find the impact of the demand of truck terminal and freight distribution center due to the change in truck terminal fee policy and to see how each attribute or characteristic of these two facilities influences the preference of truck companies in selecting them.

2. DATA COLLECTION

The data collection was done by distributing questionnaire to the truck transportation companies both using truck terminal and freight distribution center. The data collection sites were selected so as to satisfy the following requirements:

- There should be a certain number of truck transportation companies locate and operate their goods transferring business at the truck terminal, so that the data collected can be analyzed reasonably and correctly.
- The truck terminal and freight distribution center should locate not far from each other so that there will be not much effect or difference of location preference.

After considering these two requirements, Puthamonthon Truck Terminal and FDC along Puthamonthon road no. 2 and 3 were selected to be study area.

2.1 Puthamonthon Truck Terminal

This truck terminal is one of three public truck terminals in Bangkok Metropolitan Area (BMA). It is located at the west side of BMA on Puthamonthon road no.5 and consists of eight 4,700 square meters platforms, four 1,000 square meters warehouses, a 5-storey administration building, a 3-storey accommodation building with food center, parking area provided for 1,392 trucks, and a fuel station. This pattern is similar to the other two truck terminals located at north and east side of BMA.

At the time of this study, there were ten companies operate their business at Puthamonthon truck terminal. This number of companies may be looked very few but the amount or weight of goods that were handled at this truck terminal is the highest among three truck terminals, that's why this truck terminal was selected.

There are some difficulties of collecting data from small companies, since the companies' representatives are only employees and they have no idea about some questions that asked in the questionnaire. The owners or managers of the companies were not at this truck terminal, they work at their head offices in the provinces.

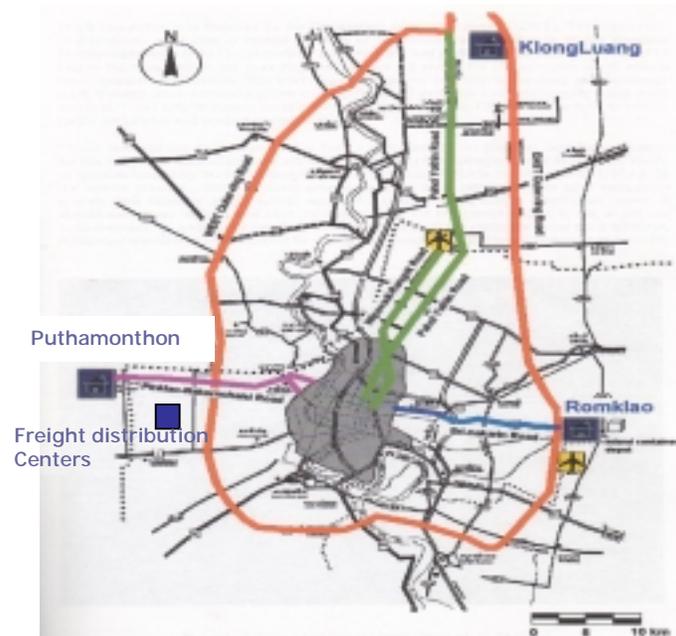


Figure 1. Location Map of Truck Terminals and FDC

2.2 FDC Along Puthamonthon Road No. 2 and 3

FDC is the place where the truck transportation companies locate and operate their business together. There are 4 major FDC along Puthamonthon road no.2, and one along no.3. At first most of buildings in FDC were built for residential purpose, however truck companies bought or rented these buildings and make them to be their FDC. These FDC are approximately 10 minutes by driving from Puthamonthon truck terminal so that the effect of location on the preference of truck terminal and FDC is not significant.

The inbound freight traffic to Bangkok will pass truck terminal before freight distribution center, while the outbound freight traffic will pass through FDC first.

In this study, the interviewers went to these truck companies and interviewed the representatives of the companies with the questions in the questionnaire. Sometimes they had to leave the questionnaires at the companies and came to pick them up later.

3. SURVEY RESULTS

3.1 Characteristics of Truck Companies Using Truck Terminal

Because of there is only ten companies locate at truck terminal, the data collected is not suitable to be shown in graph or tabular form. The detail about the characteristics of truck companies was obtained by interviewing a director of one truck company at truck terminal.

There are only ten truck companies operating their business at truck terminal. Five companies are big size companies that rent one or two platforms. The rest 5 companies are small size companies that rent some part of a platform. So, some platforms are occupied by more than one company. Questionnaires were distributed to all the ten companies but some of them refused to answer the questionnaire because of they did not want to reveal their companies' information. So, the total number of respondents is 6, 3 of them are big truck companies and the other are small companies.

Various types of goods were handled at truck terminal. About 70% of them are consumer products or manufactured goods, while agricultural products and construction materials posed some small proportions. But, however, nearly all of the goods handled at truck terminal were package type of goods, which are suitable to the characteristics of truck terminal.

The big companies that locate at truck terminal have quite similar characteristics. They own more than one hundred trucks, which the biggest company has 270 trucks. They have more than fifty employees including labors, drivers, accountants, clerks, managers, and other offices who work in the office. The biggest company in this truck terminal has as much as 130 employees. These companies transport goods more than one thousand tons per month. They distributed goods to the destination in the provinces. Some of them have destinations in every regions of the country while some companies distributed goods to only one region. The distance of transportation varies from about 100 km to as far as 800 km. Some of them transport goods to destinations all over the country. While small companies have extremely different characteristics, they own less than ten trucks, have small number of employees, transport goods with only one or two trucks per day, and their destinations are only one or two provinces.

The director of a truck company revealed that all the big truck companies own more than 100 trucks, some of them have more than 250 trucks, then it is not suitable for them to locate at FDC, which are quite small. Truck terminal is suitable for them in many aspects, including the convenience in parking trucks, convenience in loading and unloading goods, and area of warehouse compared with their amount of goods. These companies prefer truck terminal than freight distribution center because they can operate their business immediately after agreeing the least contract and they do not consider building their own freight distribution center because that will be a huge investment compared to truck terminal fee.

There is an accommodation building for employees or workers provided at truck terminal. But it is located quite far the platforms and warehouses and the truck companies have to pay a rental cost for the accommodation units also.

About safety for storing goods, most of big companies normally hire the security guards to look after their goods and sometimes they made removable fence for keeping their goods on the platform safe at nighttime.

From the viewpoint of big truck companies, they feel satisfy with their situations at truck terminal because of the convenience in many aspects as mentioned above and they also can afford for the lack of facilities of truck terminal without any problems. But, for the small companies it is difficult for them to operate their business conveniently at truck terminal because they cannot afford for some facilities such as security guards. So it is not a worth investment for them.

As for small companies, most of them have the head office in the provinces and their places at truck terminal were just only the branch offices or temporary distribution centers for their goods, which are not as important as the head offices in the provinces. The reason why they still use truck terminal is that they don't have to buy a building at FDC to be their goods distribution center, which could be a huge investment. Rather, they prefer to rent the area of platform in truck terminal to be their temporary goods distribution center, which is a lot cheaper in short term.

3.2 Characteristics of Truck Companies using FDC

FDC are the place where the truck companies locate together and operate their goods transferring business. Most of the trucking companies at these FDC have the branch offices in the provinces to store goods before distribute these goods to the final destinations.

About 70% of truck companies located at these FDC before the opening of truck terminal, while the rest 30% came to these FDC after it. Also, nearly 90% of all companies at FDC aware or know about truck terminal and some of them have gone there to survey and look around. However they still doing their goods transferring business at FDC not truck terminal.

Slightly more than 40% of trucking companies transport goods only from Bangkok to the destination in the provinces and the other 60% transport goods both from Bangkok to the provinces and from the provinces to the destinations in Bangkok. No trucking company at FDC transports goods only from the provinces to Bangkok.

Normally trucking companies forward goods to the destinations within one day after their clients bring their goods to them. Only about 10% of trucking companies at FDC forward goods within 3 or 4 days. These companies are small companies, which have a small number of clients and small amount of goods to be transported. They usually wait until their truck is full with goods. However, the duration of storing goods at FDC is also influenced by the time of year and the economic condition of the country. For example, if the economic condition is goods the amount of goods will be very much then the duration of storing goods will be shorter.

Manufactured goods is the most handled goods at FDC since the survey results show that more than 60% of the companies have manufactured goods as the most transported goods as shown in Figure 2. This type of goods is suitable for the characteristics of truck terminal and FDC to handle it because most of them are packaged type of goods.

Even though FDC are located at the west side of BMA and are suitable for the companies that have to transport goods to western and southern regions, but, surprisingly, most of them have the destination in other regions as shown in Figure. 3.

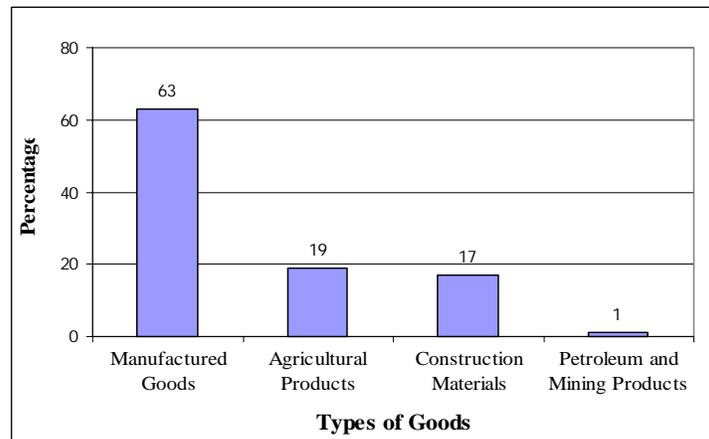


Figure 2. Types of Goods Handled at FDC

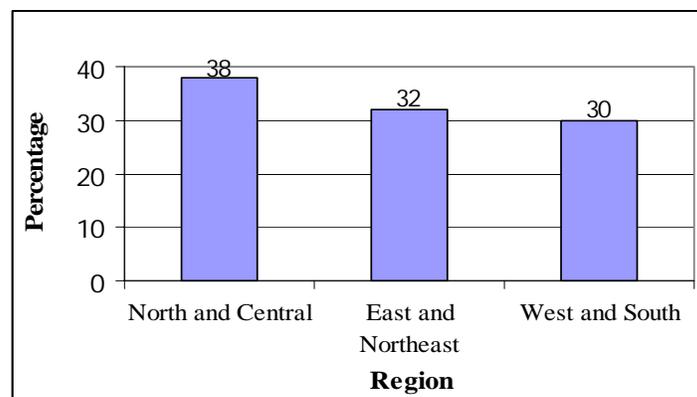


Figure 3. Destination of Goods from FDC

From Figure 3, it can be seen that these FDC are the hub of freight-truck transportation of the country since the goods from FDC are distributed to every region over the country. This makes convenience to the clients because they can distribute their goods to every part of the country by only coming to this place. This reason attracts the producers of goods to use FDC for distributing their goods rather than truck terminal and, in the same time, it makes the truck companies prefer to locate at FDC than truck terminal.

But there is one disadvantage of being the hub of freight-truck transportation. Traffic congestion and air pollution problems occur from the extremely high amount of trucks and their emissions. The residents who live around the FDC area always complain about these problems and they want the FDC to be relocated at other places. Truck companies that have their destinations in northern, northeastern, eastern, and central regions are about 70% of all truck companies locate at FDC. By considering their destinations, this FDC is not suitable for them because they will waste more time and fuel for traveling to this FDC. If they move away from this FDC, the traffic congestion and air pollution problems could be decreased dramatically.

Most of goods from FDC are transported by 10-wheeled trucks. This is because the capacity of 10-wheeled truck is approximately 4 times higher than 6-wheeled so truck companies can transport more goods in the same number of trip then they can save their expense from fuel cost according to the less number of trip. The survey results showed that the share of 10-wheeled trucks is as high as 75% of all trucks used to transport goods from FDC and they carry about 93% of goods by weight and nearly 94% by ton-km base. These results are also shown in Figure 4.

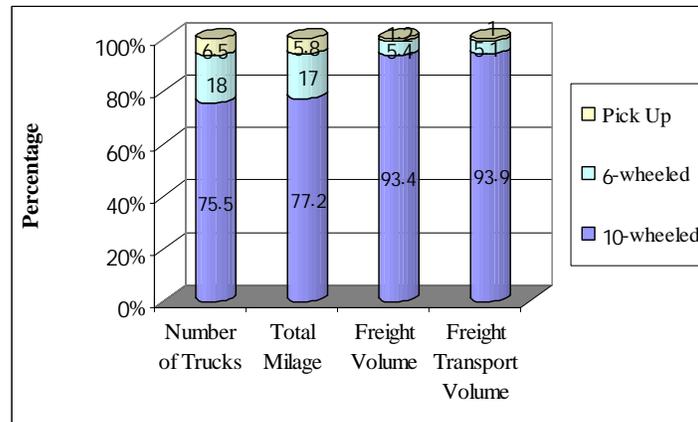


Figure 4. Goods and Truck Movement from FDC

3.3 Reasons that Truck Companies Do Not Use Truck Terminal

The major reasons that truck companies do not use truck terminal are shown in Figure 5. Most of the companies said that truck terminal is far from their current FDC, so if they move to truck terminal they may loss some of their clients who don't want to take their goods there because they can hire other companies at FDC instead. But, however, some companies commented that they would move to truck terminal if all the companies at FDC also move there because it will not make any advantages or disadvantages among the companies.

There are other reasons that several companies revealed. They have bought the land and building to be their FDC, which is a big investment, so if they move to truck terminal they have to invest such a big money again and also they don't know what to do with the current FDC. Some of them said that they feel secure with their own FDC rather than rent the platform at truck terminal, which does not guarantee their situation especially at the end of lease contract.

Some companies are not convinced in the management ability of the organization that manage truck terminal. They don't like to be under restriction or rules, which will be faced in truck terminal. They can do their business without any restrictions at their current FDC.

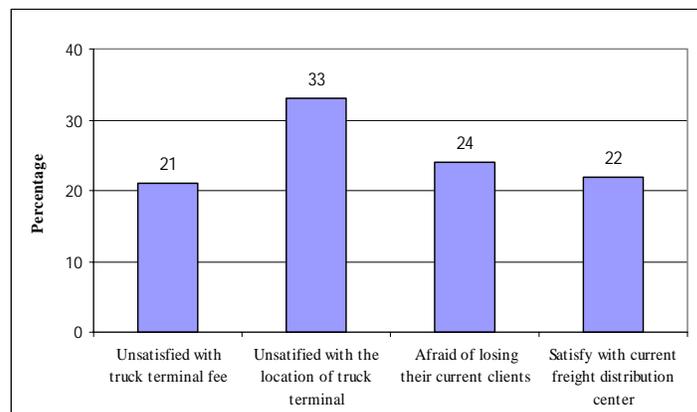


Figure 5. Reasons that Truck Companies Don't Use Truck Terminal

There are some physical characteristics of truck terminal that truck companies feel not suitable. The platform of truck terminal is open space and there is no fence or barrier separates the area on the platform, so they afraid that goods can be lost or mixed between adjacent companies.



Figure 6. Physical Characteristic of Truck terminal



Figure 7. Physical Characteristic of FDC

3.4 Comparison between of Truck Terminal and FDC

The questionnaire asked truck companies to compare the satisfaction about their current FDC and truck terminal. Purpose of this question is to know which characteristics of truck terminal that truck companies feel unsatisfied and then lead to the improvement of truck terminal. There were 6 aspects of truck terminal and FDC asked for comparing: (1) satisfaction in land rental cost, (2) accessibility, (3) convenience in parking trucks, (4) convenience in loading and unloading goods, (5) safety for storing goods, and (6) area of warehouse compared with amount of goods. The comparison results are shown in Figure 8.

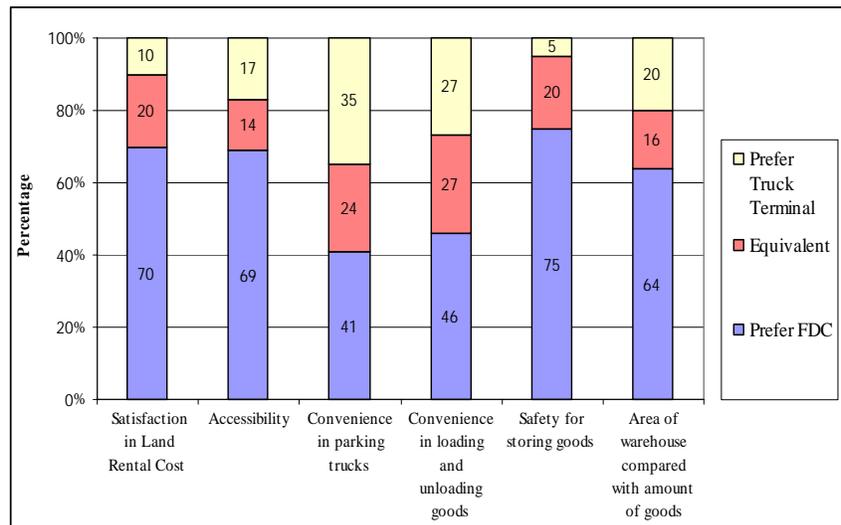


Figure 8. Comparison Between Truck Terminal and FDC

From Figure 8, the conclusion can be drawn as follow:

- About 70% of truck companies prefer to pay the land rental cost at FDC than truck terminal but they also feel that the rental cost at truck terminal, which is 40 Baht per square meter per month, is not too expensive.
- For accessibility, nearly 70% of the companies prefer FDC because they think that truck terminal is too far from them and they don't like some rules or restrictions of truck terminal.
- About convenience in parking trucks, 41% of the companies prefer freight distribution centers while 35% prefer truck terminal. Companies that prefer truck terminal think that there is a large area for parking their trucks at truck terminal, as shown in Figure

9., while at their freight distribution centers, there is no large space for parking their trucks conveniently since most of companies' freight distribution centers locate very closely so they always park their truck on the roadside in front of their office that sometimes obstruct other vehicles on the road and cause the traffic congestion as shown in Figure 10. In contrary, the companies that prefer freight distribution centers feel that truck terminal is very restrictive. There are many rules or restrictions regarding parking the trucks at truck terminal and they will be fined if they violate these rules.

- For convenience in loading and unloading goods, about 27% of the companies prefer truck terminal because the platform of truck terminal is designed for convenience in loading and unloading goods to and from trucks since the floor has been raised up to be at the same level of the floor of carriage unit of the trucks. So, they can load or unload goods between trucks and platform directly.
- Most of the companies prefer freight distribution centers for safety in storing goods than truck terminal. As mentioned in earlier, there is no fence separates the area of each company on the platform and employees are not allowed to stay on the platform at night, so no one can look after the goods. They afraid that the goods may be lost or broke if they keep them at truck terminal. Although, there are warehouses provided for keeping goods at truck terminal, the truck companies still not convinced in the security of the goods because their employees are not allowed to stay in the warehouse as well.
- For area of warehouse compare with amount of goods, about 64% of the companies prefer freight distribution centers. Most of companies feel satisfy with their situation at freight distribution centers and they always transport goods to destinations at the same they that their clients bring to them, so there is not much goods left at their freight distribution centers. Therefore, the large warehouse is not necessary for them. But, the companies that prefer truck terminal think that the warehouses at their freight distribution centers are too small, while truck terminal has large warehouses to store goods, which satisfied with their demand.



Figure 9. Area for Parking Trucks at Truck Terminal



Figure 10. Traffic Congestion at FDC

4. DEVELOPMENT OF LOGIT MODEL

Binary logit model was developed as a tool to find the impact on the demand of truck terminal and FDC due to the change in truck terminal fee policy and it can also show how each attribute of these two facilities influences the preference of truck companies in selecting them. The structure of variables in this binary choice model is shown in Table 1.

Table 1. Structure of Variables in Binary Logit Model

	Alternative Specific Constant	Generic Variables (Attribute Related)	Alternative Specific Socioeconomic Variables
	β_1	β_2	β_3
Freight Distribution Center	1	Land rental cost of freight distribution center in transferring goods	Number of trucks used
Truck Terminal	0	Truck terminal fee	0
Alternative Specific Socioeconomic Variables			
	β_4	β_5	
Freight Distribution Center	Number of clients	Number of employees	
Truck Terminal	0	0	

4.1 Coefficients Estimation

There are several approaches to find the value of parameters but the Maximum Likelihood and Least Square Methods are commonly used. For logit-based model, the Maximum Likelihood Method is used. In this study, HieLoW (Hierarchical Logit for Windows) software was used as a tool to estimate the value of coefficients. The results of coefficients estimation of the binary logit model are shown in Table 2, and the distributions of each variable are shown in Figure 11. Even though the t statistics of some variables are rather low and the null hypothesis that coefficients are equal to zero cannot be rejected at 0.1 level of significance, but the selected model specification is the one that consistent with the theory and performs best according to “goodness-of-fit” measures and statistical significance tests.

Table 2. Estimation Results of Binary Logit Model

Variable Number	Variable Name	Estimated Coefficient	Standard Error	t statistic
1	Freight distribution center (FDC) constant	4.033	1.035	3.895
2	Land rental cost	-0.0021	0.0096	-0.217
3	Number of trucks (specific to FDC)	-0.0228	0.0155	-1.473
4	Number of clients (specific to FDC)	-0.0022	0.0058	-0.388
5	Number of employees (specific to FDC)	-0.0175	0.0183	-0.961

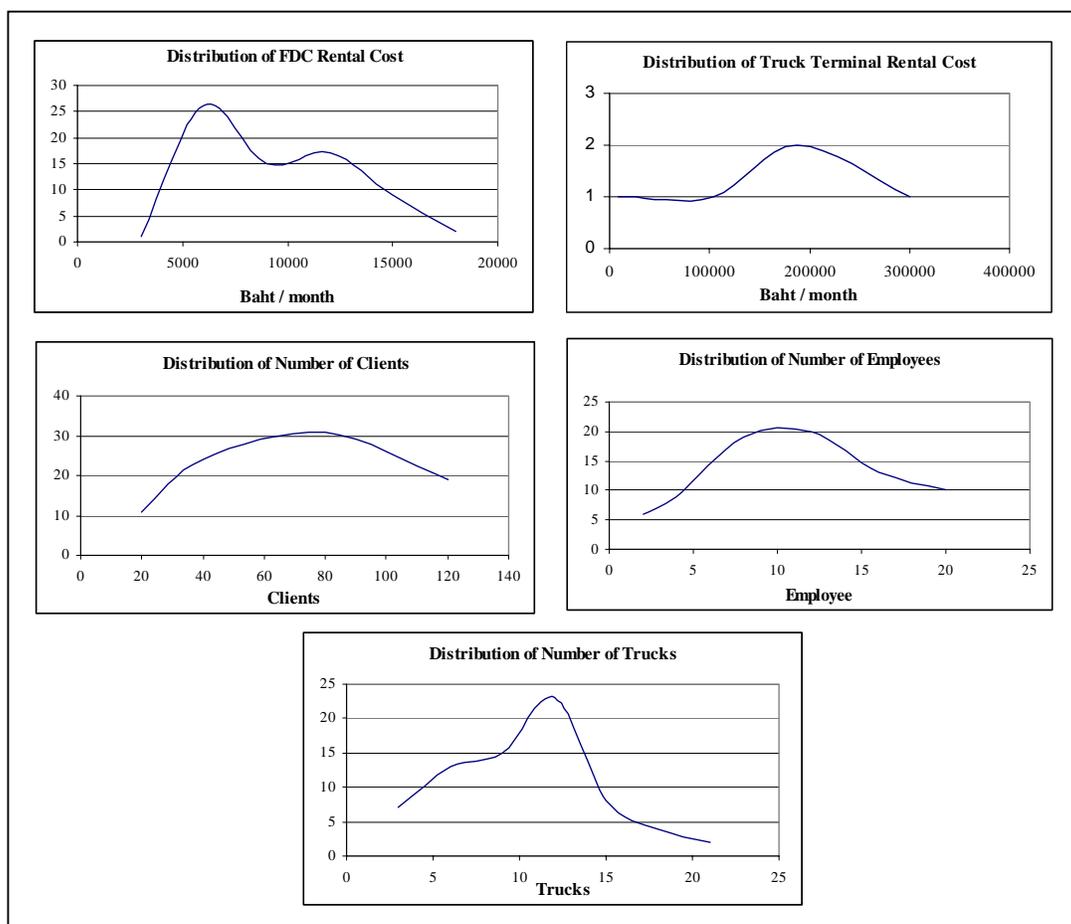


Figure 11. Distributions of Each Variable

From Figure 11, it can be seen clearly that each variable is not quite normally distributed, which results from too small sample size. It is noticed that the area rental cost of truck terminal that the companies have to pay is very high comparing to the rental cost of FDC. This is because the respondent companies at truck terminal are very big companies and they rent more than one platform for handling and transferring their goods, so the operation area is very large compared to the area of FDC so the rental cost has to be high automatically.

When conducting the data collection, the interviewers tried to distribute the questionnaires to the companies as much as possible. But about two third of the companies refused to answer. Some of them were busy at the time of interview while the others did not want to reveal their companies' information. To total number of questionnaires responded and effective is 97 which 6 of them were from truck companies using truck terminal. The results from questionnaires are shown in graphs above which seem reasonable and acceptable, but for developing logit model, this sample size is considered as too small. This causes most of the estimated coefficients not significant, but, at least, the signs of all coefficients are reasonable.

4.2 Impact of Demand Due to the Change in Truck Terminal Fee Policy

Truck terminal fee is an attribute included in the utility function of truck terminal. The change in truck terminal fee policy will affect the utility function of truck terminal and may lead to the change of preference of truck companies for choosing truck terminal or FDC as

their location to operate goods transportation businesses. Therefore, the change in truck terminal fee can be an effective way to promote the use of truck terminal.

Intuitively, it is known that if truck terminal fee is decreased the probability that truck companies choosing truck terminal will increase, as the fee or cost is concerned as disutility of truck terminal. Therefore, the assumption of the impact of the demand of truck terminal due to the change in truck terminal fee policy is set as if truck terminal fee is decreased, there will be some companies that shift their location from FDC to truck terminal.

The current truck terminal fee is set at 40 Baht/square meter/month. In this study, there are 3 policies of truck terminal fee, which are 30 Baht/square meter/month, 20 Baht/square meter/month, and 10 Baht/square meter/month, proposed for analyzing the impacts on demand of truck terminal. The analyzing results are shown in Figure 12.

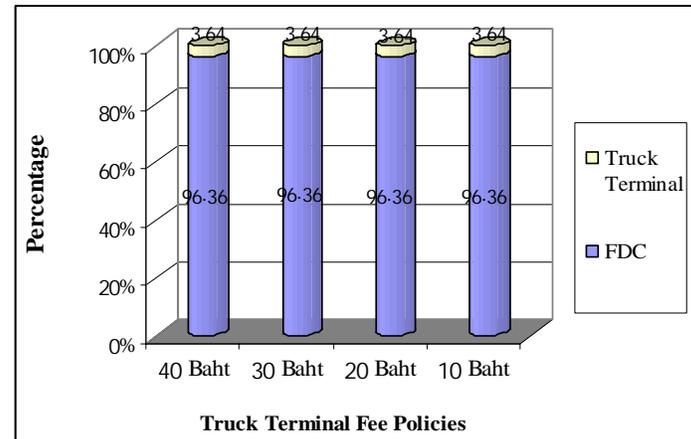


Figure 12. The Percentage Share Between Truck Terminal and FDC at Each Truck Terminal Fee Policy

The results of impact analysis show that the demand of truck terminal is not changed and there is no shift of the companies between FDC and truck terminal. This means that whatever the truck terminal fee is, most of truck companies still prefer to use FDC.

Consider the utility functions of FDC and truck terminal, it can be seen that the absolute value of coefficient of truck terminal fee or land rental cost is very small (0.0021) compare with the freight distribution center constant (4.033). This implies that truck terminal fee or land rental cost of freight distribution center has very small influence on the determination of truck companies to select to use any facilities.

From the estimated coefficients of the model shown in Table 2., utility function of FDC is likely to have positive value since it consists of an alternative specific constant which is high positive value comparing with the value of coefficients of the other four variables, which are small negative values. While the utility of truck terminal is always negative since it consists of an only attribute, which is truck terminal fee, and its coefficient is negative value. The truck companies will select truck terminal if their utility of truck terminal is higher than the utility of FDC, that's why the big companies with a lot of trucks, have lots of clients, and have a large number of employees prefer to use truck terminal since their utility of FDC will be negative and less than the utility of truck terminal. This result is according to the suggestion of the director of one big company using truck terminal that big companies are more suitable of using truck terminal than small companies as mentioned earlier.

There are other reasons that truck companies prefer to use FDC than truck terminal. Such the reasons are the satisfaction of the location of FDC, safety for storing goods, the lack of confidence in management ability of the organization that manage the truck terminal, too strict rules regarding the use of truck terminal, etc. All of these reasons cannot be included in the utility function of FDC since they are not the quantitative variables. So, the value of the FDC constant in the utility function of FDC is rather high to cover these non-quantitative variables.

5. CONCLUSIONS

Bangkok is considered as a hub of road-freight transportation of the country since excessive amount of goods are always distributed from Bangkok to all regions in the country. Freight distribution centers and truck terminals have a major role as a place of transferring goods from big trucks to small trucks, and vice versa, and make the goods movement system more efficiently and systematically. Major findings from the analysis of behavior of truck companies both using truck terminal and FDC are:

- Most of the goods transferred from FDC is manufactured goods. This is because it consists of packaged types of cargo, which are suitable to the characteristics of FDC.
- 10-wheeled trucks are the most used vehicles for transporting goods from FDC. 6-wheeled trucks and pick up trucks come as the second and third, respectively.
- The most important reasons that truck companies don't use truck terminal are unsatisfied with the location of truck terminal, afraid of losing their current clients, and satisfy with current freight distribution center, respectively. Other reasons that were mentioned are most of companies buy the building and land to be their own property and they don't want to waste these money by moving to truck terminal, they don't confident in the management ability of the organization that manage truck terminal, and they don't satisfy with the strict regulations and some characteristics of truck terminal, which is not suitable for the operation. Most of companies feel that the truck terminal fee is not the important reason.
- Currently, big companies that own a lot of trucks, have a large number of clients and employees, and transfer a huge amount of goods are considered to be suitable of using the truck terminal because of the large area of truck terminal and they can afford for the extra facilities that is not provided at truck terminal, such as fence or cage to protect their goods or security guards. On the contrary, small companies are not suitable for using truck terminal since they cannot afford for these things.
- It has been said by the truck companies that if they move to truck terminal from their current freight distribution centers, they would like all other companies to move together with them because this will make no advantages or disadvantages in their businesses. However, the size of truck terminal is too small to support all the truck companies if they have to move there. Therefore, it is desirable to expand the area or to construct new truck terminal(s) in the nearby location of the existing one. Not only that, but it will be very useful to expand the area of north and east truck terminal or construct new truck terminals around that area as well because there are many companies that have the destinations of transferring goods in the north, northeast, and east region locate at freight distribution centers in the western area of Bangkok. If there are truck terminals available for them to use, it will be more attractive to them for considering moving from their current location. This will help them save more time and fuel which lead to the reduction of the cost of transportation as well.
- Truck terminal fee is not an influential factor for the selection of truck terminal. The influential factors are the non-quantifiable variables such as safety for storing goods, accessibility, the strict rules regarding the use of truck terminal, accommodation for the workers, and the satisfaction with the location of truck terminal.

Further analyses are necessary to improve the model structure by adding more appropriate variables into the model. More data should be collected for improving the value of statistical test that is not so high in this study.

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