STRATIFIED DIESEL VEHICLE SURVEY FOR BANGKOK

FINAL REPORT

Covering Vehicle Types 1-9

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1. INTRODUCTION

1.1 BACKGROUND

The Stratified Diesel Vehicle Survey program, conducted in Bangkok, commenced on January 26, 2004 and the final report was submitted on August 13, 2004. The survey was conducted in two parts. The following table presents an overall description of each part.

Table 1.1 Principal Characteristics of Parts 1 and 2 Surveys

Part	Vehicle Types	Vehicle Description	Sample Stipulated in TOR	Actual Sample	Survey Type
1 Jan 26 – Mar 17	1	Passenger Car	200	4	Interview of individual vehicle owners
	2	Pickup	200	416	
	3	Private Van	200	101	
	4	Van or Rot Tu	200	294	
		Sub Total	**800**	**815**	
2 Mar 22 – Jul 16	5	Fixed Route Bus	30	28	Interview of selected organizations or company
	6	Private Bus	5	4	
	7	Non Fixed Route Bus	10	9	
	8	Non Fixed Route Truck	30	19	
	9	Private Truck	30	24	
		Sub Total	**105**(1)	**84**	

(1) A range of 70-150 was stipulated.

Part 1 interviews were conducted primarily at Department of Land Transport main offices at Chatuchak where a ready availability of interviewees was assured. In Part 1, prior to the main survey of 815 vehicle owners a Pilot survey was conducted on January 26 and 27 during which 137 persons were interviewed. On the basis of the information obtained the interview form was modified and the main survey commenced on Monday February 9, when 104 interviews were completed. It was decided however to modify the interview form still further and to disregard all previous 241 interviews (ie 137 + 104). The main survey commenced again on Wednesday February 11 and concluded on Friday February 20, 2004. Over the next 3 weeks the database was prepared and the first Progress Report was submitted on March 17.

It was realized that the survey of vehicle types 5 to 9 could not be carried out at DLT offices, as was the case for vehicle types 1-4. The reason was that vehicle types 5-9 infrequently came to the DLT offices. Rather they were mostly inspected at their

home base. The other important consideration was the ownership pattern of vehicle types 5-9. These vehicles were owned as fleets. As a consequence it was decided that the interview technique had to be changed in Part 2. Thus whereas in Part 1 it was regarded as satisfactory to interview owners of individual vehicles the requirement in Part 2 was now to interview organizations or companies who owned a fleet of vehicle and to obtain information about the vehicle fleet. This necessitated a change of interview staff and a change of interview form. The interview forms are shown in Appendix A.

1.2 SURVEY OUTPUTS

The principal output of the survey has been the preparation of separate database for Parts 1 and 2. To the extent possible, additional effort has been allocated to improving the reliability of data obtained by telephone call back. The two databases for Parts 1 and 2 cannot conveniently be presented in hard copy. They have been or will be provided in electronic form. To ensure that latest version of both databases is used a date of August 13 has been adopted in Version Date box.

2. PART 1 : SURVEY OF VEHICLE TYPES 1-4

On June 18 a brief report on database contents reconciliation was presented. The main opportunity for checking data reliability was to use odometer reading and vehicle age to obtain average annual travel and to compare this statistic with current estimate of travel in a stated period (usually a week). This check was carried out by a telephone call back.

2.1 TELEPHONE CALL BACK SURVEY

The main concern about the survey results was the considerable difference between historical travel obtained from vehicle odometer and what interviewees stated as their average travel distance in a prescribed period (usually a week). The following table was presented in the Progress Report on March 17, 2004.

Table 2.1 Average Distance Traveled Per Year by Vehicle Type : From Stated Travel Per Period (Kilometres)

Vehicle Type	Stated Travel	From Table 2.3
1 Passenger Car	30,050	25,800
2 Pickup	35,650	26,750
3 Private Van	51,850	37,450
4a Van, Rot Tu	94,650	41,350
4b Song Taew	51,540	25,150
Total	**-**	**33,200**

The significant difference between two sources is evident. We agreed to make a telephone call back to 100 interviewees to ascertain reliability of the data.

In actual fact we were only able to contact 40 out of the 100 that were nominated. Of the 40 persons contacted the odometer reading was confirmed in 37 cases. The 3 values changed were as follows:

Old	Revised Odometer
1,310,000	131,060
37,000	370,000
11,058	112,000

In each case the mistake is a 10 fold one. The call back did indicate that as a rule the odometer data is correct (ie 37 out of 40). The distance traveled per week (the selected period) was incorrect for 14 out of 40. The distance was invariably

overstated. For the 14 who overstated, the level of overstatement was 31%, a considerable revision on the earlier estimate. If applied to the whole sample the overstatement is estimated to be 11%. On this basis Table 2.1 would be amended as follows:

Table 2.2 Average Distance Traveled Per Year by Vehicle Type : From Stated Travel Per Period (Kilometres)

Vehicle Type	Originally Stated Travel	Revised Stated Travel	Derived from Odometer
1 Passenger Car	30,050	27,000	25,800
2 Pickup	35,650	32,000	26,750
3 Private Van	51,850	46,700	37,450
4a Van, Rot Tu	94,650	85,000	41,350
4b Song Taew	51,540	46,000	25,150

The reconciliation is better but still very poor for Type 4a and 4b. What we did find out was that of 40 calls, in 27 cases there had been a change of ownership. There is a likelihood therefore that there have been two patterns of vehicle use in many of the vehicles and this may partly account for poor reconciliation. It does appear therefore that odometer readings are the most reliable statistic we obtained because the reconciliation between stated fuel expenditure and distance traveled is not consistent.

Our observations of Type 4a vehicle indicate that they are idle for a large part of the day. These vehicles congregate and park in significant numbers in particular locations in Bangkok. An example is shown later in the report. The most likely travel estimate we would make for these vehicles is only two round trips (one is morning plus one in evening) of about 60-70 km for each round trip for 6 days a week and 50 weeks per year. The annual travel distance would thus be:

$$2 \times 65 \times 6 \times 50 = 39{,}000 \text{ km}$$

The average obtained from revised odometer reading (see Table 2.2) is 41,350 which agrees quite well with our estimate. Our conclusion is that for reasons we cannot explain the owners of both types 4a and 4b considerably overstated their travel. A priori we would have expected this group of people to have above average ability in estimating weekly travel.

Out telephone call back confirmed odometer in 37 out of 40 cases. All 3 odometer errors occurred as a result of a mistake by interviewer in recording a value 10 times too high or 10 times too low. In our view the odometer results are reliable and the results we obtained should thus be applicable to each vehicle type.

If we however assume that the annual travel distance of type 4a vehicles is 85,000 km (see Table 2.2) the average daily travel would be 285 km. For trips from outer

to inner Bangkok an average travel speed above 25-30 kph seems unlikely. On this basis these vehicle would be driven over 10 hours per day primarily between the hours of 5.30 am and 7.30 pm, that is in a period of 14 hours. A rest period of 4 hours does not match the idle time we have noted, although we have not carried out any survey to measure idle time. As mentioned above we cannot explain the discrepancy although we do conclude the odometer estimate is more likely to be closer to actual travel than the estimate based on stated travel.

In percentage terms the discrepancy between revised stated travel and statistic derived from odometer is also considerable for vehicle type 4b (Song Taew). We would expect these vehicles to travel more slowly because they stop frequently, although their hours of operation are notionally longer. Nonetheless the odometer derived annual travel distance of 25,150 km seems low. However as noted earlier the odometer statistic appears the more reliable and from this statistic it would appear that the operation of song taews is not similar to fixed route buses, which operate up and down a specific route for up to 14 hours a day. The conclusion derived from the song taew odometer statistic is that these vehicles only operate for about 6 hours a day. If this is so, then operation of song taews is similar to vehicle types 4a (Van and Rot Tu), which primarily serve the journey to and from work.

Any reconciliation of information in the database as regards a comparison of stated fuel expenditure reconciled with odometer reading does not seem warranted. The conclusion we formed during coding was that in a number of instances the answer given seemed like a guess and in other instances we suspected a reasonable answer was given based on '2 Baht per km', which is approximately equivalent to 8 km per litre (or conventionally 12.5 l/100 km).

Our other general observation was that in a number of questions the interviewee was requested to provide an average description of a parameter extending over the ownership period of the vehicle. It is questionable if the answers provided coincide with what has actually occurred.

2.2 COMMENT ON SAMPLE FRAME FOR VEHICLE TYPES 1-4

Table 1.1 shows that the overall requirement of 800 interviews specified for main survey was exceeded although passenger car sample and private van sample size was not achieved. In the original formulation of the sample frame the official statistics indicated a significant population of private passenger cars with diesel engines. The incidence we measured of 4 in 815 or about 0.5% of light vehicle population seems much closer to the truth. Diesel passenger cars are not popular in Thailand and the population may be dwindling because new car sales appear to be even less popular. Accordingly it was agreed that the sample could be distributed among vehicle types 2, 3 and 4. On this basis the sample of 101 vehicles obtained for Private Vans (type 3) is less than stipulated, although this sample is nonetheless of significant size. The explanation for the lower than stipulated sample is that private vans are not frequently encountered and it would have taken a good deal more survey time to have reached the stipulated sample. Furthermore as the following photograph shows we observed vans, that are notionally private, being used for commercial use. Thus a fraction of private vans (type 3) are functionally type 4 (Van or Rot Tu). This observation indicates that any analysis to distinguish

operating characteristics among vehicle types may be flawed. This observation applies also and in particular to pickups. They are ubiquitous in Thailand, very versatile, and may perform the following transport tasks:

- for passenger hire and reward
- for freight hire and reward
- private passenger transport (ie passenger car)
- company use for freight and employee transport.

The engine size of pickups (type 2) is similar to types 3 and 4 and pickup use straddles the transport tasks provided by types 3 and 4, although it must be noted that types 3 and 4 usually offer air conditioned passenger comfort whereas pickups do not. Historically the vehicle number plate type has aimed to categorize vehicle use but vehicle number plate type is not always a true indicator of vehicle function. An example is shown later in the report.

3. PART 2 : SURVEY OF VEHICLE TYPES 5-9

As mentioned in Chapter 1 the survey of vehicle types 5-9 differed considerably from Part 1, where we interviewed vehicle owners who were visiting DLT offices to renew vehicle registration or for purpose of notifying a change of ownership. In Part 2 the approach was changed to interview a company or organization who operated vehicle types 5, 6 7, 8 or 9. These operations were usually a fleet of vehicles although a vehicle fleet comprising just one vehicle was possible. For the Part 2 survey it was necessary to engage interviews who had some understanding of vehicle fleet operations and maintenance procedures and who could conduct an interview with a senior company representative.

3.1 DESCRIPTION OF VEHICLE TYPES 5-9

The following table sets out some general details about vehicle types surveyed in Part 2 of the project.

Table 3.1 Characteristics of Vehicle Types 5-9

Vehicle Type	Operation	Short Description	Transport Task
5	Bus	Fixed Route Bus	Fixed route bus operating in Bangkok(1). These vehicles were classified further as Type A, B, C, D, E, F.
6	Bus	Private Bus	Bus owned by company to carry company employees or perform other tasks on company's own account.
7	Bus	Non Fixed Route Bus	Bus used for hire and reward. These are primarily charter buses and may operate anywhere.
8	Truck	Non Fixed Route Truck	This is a somewhat misleading formal description. These trucks are owned by a company and operate for hire and reward. The vehicles may operate anywhere in Thailand.
9	Truck	Private Truck	Truck owned by company for company's own account. Not used for hire and reward.

(1) Bangkok and environs, defined as Bangkok Metropolitan Region (BMR).

3.2 SAMPLE SELECTION OF VEHICLE TYPES 5-9

The following table shows the sample frame specified in the TOR and that actually achieved.

Table 3.2 Sample Frame for Part 2 Survey

Sample	Type					Total
	5	6	7	8	9	
Specified in TOR	30	5	10	30	30	105(1)
Actual	28	4	9	19	24	84

(1) TOR stipulated a minimum requirement of 70 completed interviews.

The sample was selected from organizations within BMR. This sub region comprises the following provinces:

- BMA Bangkok Metropolitan Area
- Nonthaburi
- Pathum Thani
- Nakhon Pathom
- Samutsakhon
- Samut Prakan

The relationship of BMR within Thailand is shown in the following figure.

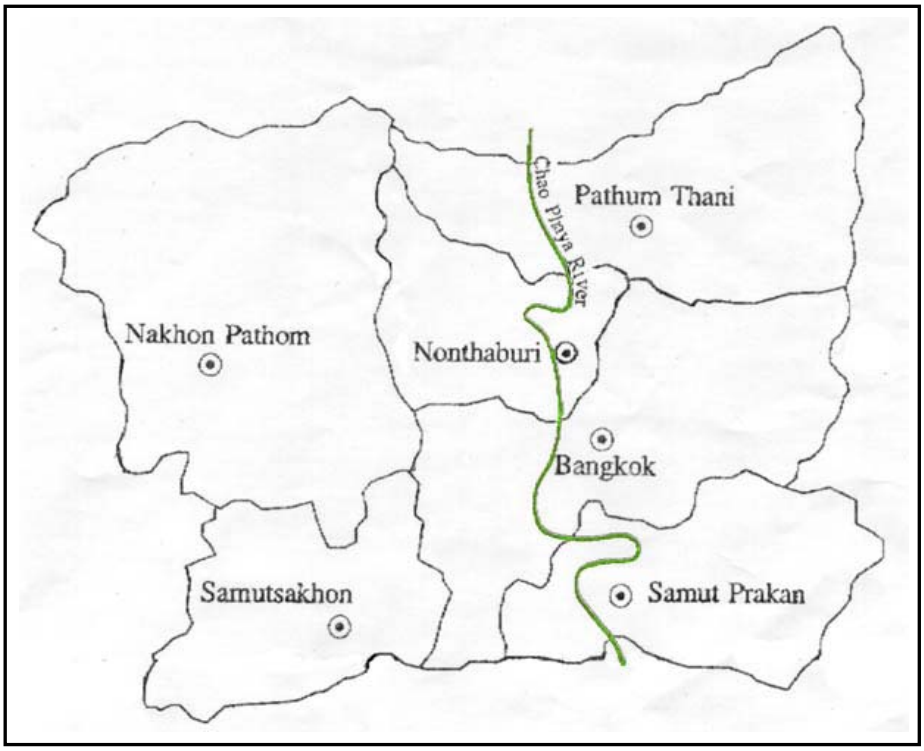


Figure 3.1 Provinces Comprising the BMR

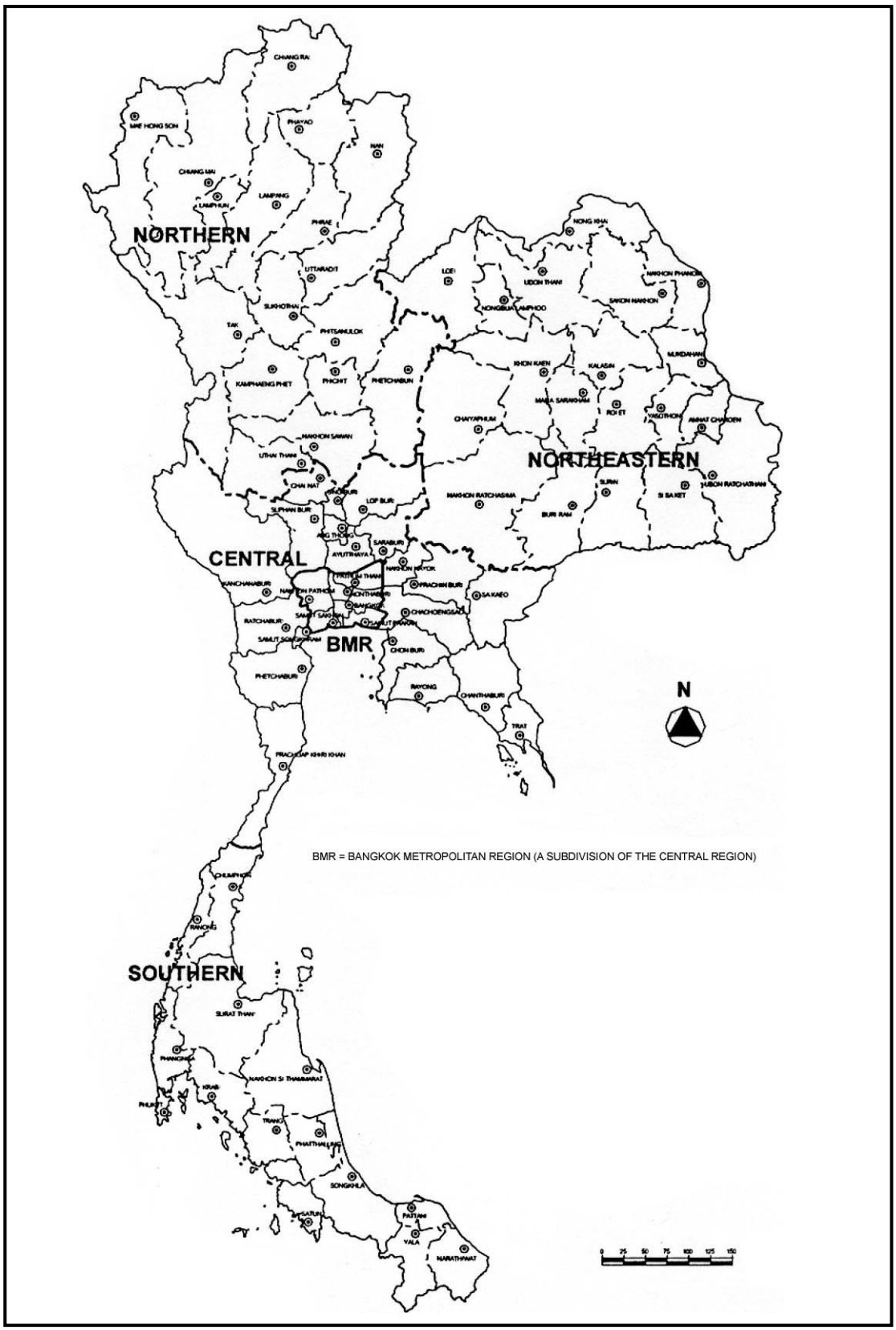


Figure 3.2 Regions of Thailand

The BMR is a division of the central region. The point of showing Figure 3.1 is to show that only type 5 vehicles operate exclusively within the BMR and furthermore their operations are confined to the central portion of the BMR mostly within the BMA. All other vehicle types may and do operate throughout Thailand. The sample we selected within the BMR was concentrated towards the centre of the BMR. We were told that many organizations are located beyond the BMR but a significant proportion of the transport tasks they perform cross the BMR. Land cost is a significant factor affecting location of transport companies although obviously transport costs is also a significant determinant of company location.

One objective of the survey was to determine the amount of travel performed within the BMR. We therefore asked a question about percentage travel in Bangkok for vehicle types 6, 7, 8 and 9. It is not possible for us to conclude if the information we obtained is reliable.

The sample selection process took far longer than originally estimated. This resulted in a considerably protracted survey program duration and the allocation of significant resources to the sample selection process. We encountered much reluctance to agree to an interview, frequent changes to initially agreed interview date and time, a requirement that we first send a copy of interview form and numerous other requests. Our eventual success was achieved by a slow process of finding vehicle associations, speaking to the president, arranging to attend association meetings and then soliciting cooperation. Even when this point was reached companies still refused to be interviewed. We did agree to allow a limited number of companies to complete the interview form themselves. However in all cases the forms were very unsatisfactorily completed and had to be discarded. The 84 completed interviews thus represent complete interviews and therefore the number does not include discarded interviews.

Our aim was to achieve a representative sample covering all vehicle types in accordance with sample number specified for each type. That criterion was generally satisfied. However we suspect that organizations with small vehicle fleets may be under represented, although we cannot be sure. The factor that offsets any concern about the sample structure is the conformity being increasingly applied to all aspects of vehicle operation. In other words, companies with only a few vehicles usually have to provide their services by subcontracting to a larger operational entity and this brings about progressive uniformity in practices that mirror the practices performed by larger companies. In addition, the influence of associations and the perceived need to belong probably reinforces more uniformity.

The following table presents vehicle fleet information for the selected sample.

Table 3.3 Vehicle Fleet of Selected Sample

Vehicle Type	Short Description	No. of Interviews	Total Vehicle Fleet	Average Fleet Size
5	Fixed Route Bus	28	5358	191
6	Private Bus	4	145	36
7	Non Fixed Route Bus	9	468	52
Sub Total		**41**	**5971**	**146**
8	Non Fixed Route Truck	19	2406	127
9	Private Truck	24	185	77
Sub Total		**43**	**4257**	**99**
Total		**84**	**10228**	**122**

The following table provides more detail on the distribution of vehicle fleet size.

Table 3.4 Fleet Size Distribution by Vehicle Type

(number of organizations and %)

Vehicle Type	Short Description	No. of Interviews	Fleet Size			
			< 10	10 – 50	51 – 100	>100
5	Fixed Route Bus	28	5	9	5	9(1)
6	Private Bus	4	2	1	1	-
7	Non Fixed Route Bus	9	3	3	2	1
8	Non Fixed Route Truck	19	-	10	2	7
9	Private Truck	24	1	12	6	5

(1) 3 companies with more than 900 vehicles in fleet

Table 3.4 does not provide a breakdown of the size of vehicle. In the case of buses most were heavy and only a small portion of sample were medium. For presentation purposes the buses have been categorized as AC or non AC. For trucks the distribution among light, medium and heavy was much more spread. The following tables set out these details.

Table 3.5 Bus Fleet Distribution by Category

Vehicle Type	Bus Category	Fleet Size			
		< 10	10 – 50	51 – 100	> 100
5	AC	1	6	1	7(1)
	Non AC	3	13	3	4(2)
6	AC	1		1	
	Non AC	2	2		
7	AC	1	3	2	1(3)
	Non AC	4			

(1) All fleets 300 or more
(2) 3 fleets 380 or more
(3) 238 buses

Table 3.6 Truck Fleet Distribution by Truck Size

Vehicle Type	Truck Category	Fleet Size			
		< 10	10 – 50	51 – 100	> 100
8	Light	5	3	-	1(1)
	Medium	4	6	1	1(2)
	Heavy	2	6	-	4
9	Light	5	3	2	-
	Medium	4	7	3	2
	Heavy	3	4	-	-

(1) 300 light trucks
(2) 666 medium trucks

It should be noted that whereas the information in Table 3.4 refers to total fleet of the company and frequency distribution by fleet size bands, the information in Tables 3.5 and 3.6 refers to the fleet size according to bus category (AC and non AC) or size of truck (light, medium or heavy). It is clear from this information that a company may operate both categories of bus or up to 3 sizes of vehicles. This information is presented in database in Excel spreadsheet format.

3.3 DISCUSSION OF INFORMATION OBTAINED

Of all the questions, the responses to only a few can be examined for reliability and consistency. One of these questions concerned oil and fuel consumption. The question on fuel consumption was asked as frequency of refueling and kms traveled between refueling. We do not place a very high reliability on the answers provided because in hindsight we were asking interviewees to estimate an average for two parameters : frequency per week and amount of fuel added. As a supplementary question we did ask total fuel and oil use per month for the total fleet and we regard this as more reliable information. The oil consumption was also asked as average

number of barrels (200 l) of oil used per month. In spite of our attempts to obtain good information our interviewers reported what appeared to be a reluctance to reveal information. Oil and fuel consumption are two items that should be precisely known. We now know that the single best indicator of engine condition is oil consumption and this was frequently stated as the indicator for major engine reconditioning. The information that we obtained and shown in spreadsheets in the database show very large variations. The other complicating factor is that we believe that some operators use old sump oil, that has been allowed to settle or has been simply filtered, for top up requirements. This practice appears to be more prevalent with fixed route buses. The following table summarizes fuel and oil consumption per month by vehicle type.

Table 3.7 Summary of Fuel and Oil Consumption by Vehicle Type

Vehicle Type	Short Description	Total Fleet in Sample	Fleet consumption		Per Vehicle	
			Fuel Cons. per Month (l)	Oil Cons. per Month (l)	Average Fuel Cons. per Month	Average Oil Cons. per Month
5	Fixed Route Bus	5,358	9,254,000	176,700	1,730	33.0
6	Private Bus	145	35,900	2,600	250	17.9
7	Non Fixed Route Bus	468	836,500	11,800	1,790	25.2
8	Non Fixed Route Truck	2,406	2,311,000	18,700	960	7.8
9	Private Truck	1,851	1,670,000	16,000	902	8.6
Totals		**10,228**	**14,108,000**	**225,800**	**1,380**	**22.1**

The information in the above table is not related to travel distance in the month but it suggests private buses are not used to any appreciable extent. The more interesting observation is the relationship between fuel consumption and oil consumption and this is compared in following table.

Table 3.8 Summary Relationship between Fuel and Oil Consumption

Vehicle Type	Short Description	Ratio of Fuel to Oil Consumption from Table 3.7
5	Fixed Route Bus	52
6	Private Bus	14
7	Non Fixed Route Bus	71
8	Non Fixed Route Truck	123
9	Private Truck	105

Although the comparison may be considered somewhat dubious it shows that buses have a much higher proportionate use of oil than trucks. The ratio for private buses

is particularly low but it is likely that their small use and oil changing based on time rather than distance traveled accounts for the low ratio. The ratio for fixed route buses seems about right and a higher ratio for non fixed route buses although lower than trucks also seems reasonable. Truck statistics also appear reasonable in that private trucks are likely to have smaller use than non fixed route trucks and oil change period depends more on time than distance traveled.

Obviously the above analysis would be enhanced by relating data with distance traveled in a month. However for this report this analysis has not been carried out.

3.4 CASE STUDY 1

The first case study concerns non fixed route trucks (type 8). Because of the truck ban in Bangkok which has been in operation since the 1980's the movement of freight has had to adjust to these restrictions. There is very little information available on freight movements in Bangkok and the following discussion is by no means comprehensive.

Above a stipulated truck size of 1,600 kg tare weight truck activity in a defined region of Bangkok is banned in the following hours:

- 4 and 6 wheel : 06.00–09.00 and 16.00–20.00 hours
- 10 wheel and greater : 06.00–10.00 and 16.00–20.00 hours.

Concrete delivery trucks are not affected by the ban. In addition these restrictions only apply to truck movements. Trucks may park legally on roads. Movement on certain major routes are not affected and trucks may use these roads throughout the day. In general the influence of the truck ban extends out to the Bangkok Outer Ring Road (ORR).

Some years ago, although precise timing is not known, freight terminals were established on the western side of Bangkok in the Putthamonthon area. The Department of Land Transport established a truck terminal in accordance with the recommendations of a Japanese funded study. The objective of the truck terminal was to be the location of freight consolidation from smaller to larger vehicles and the reverse process outside the perimeter of the truck ban region. For reasons that are not altogether clear the private sector established their own cluster of smaller truck terminals in the same area but 5-7 km closer to Bangkok. Figure 3.3 shows the relationship of these terminals to Bangkok. The next Figure 3.4 presents diagrammatically the flow of freight between Bangkok and the rest of Thailand. With few exceptions small trucks and pickups, not affected by the truck ban, deliver freight throughout the day from origins in Bangkok to the freight terminals. The freight is then loaded on to larger trucks. Putthamonthon serves all regions of Thailand. In addition the freight flow through these terminals is in one direction only. There is no back flow. The back flow represents about 10% of the main flow in tonnage terms and comprises mainly agricultural products to be consumed in Bangkok. The back flow delivery locations are not in Putthamonthon and we did not obtain any details about this movement.

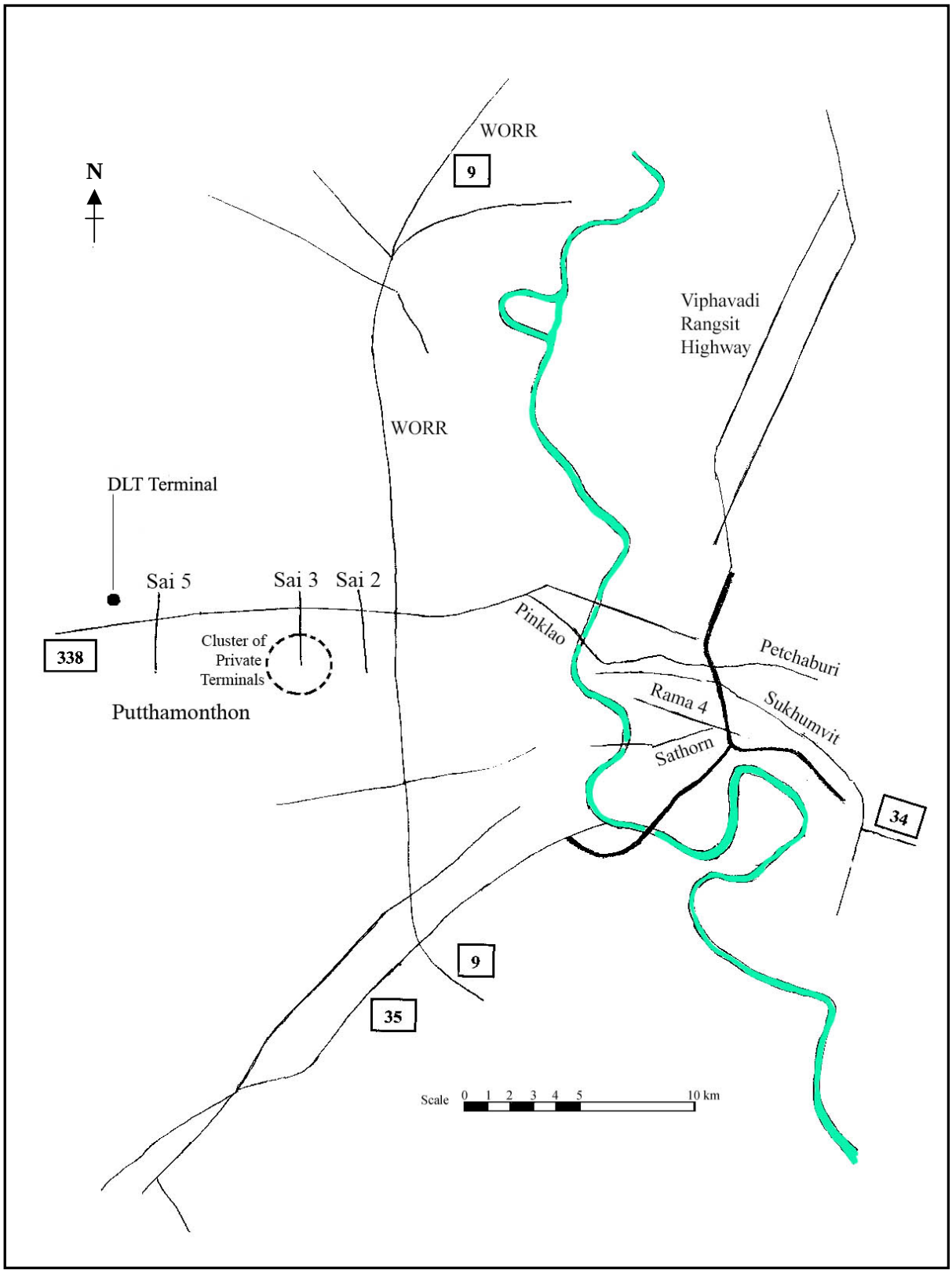


Figure 3.3 Map Showing Relationship of Putthamonthon to Bangkok

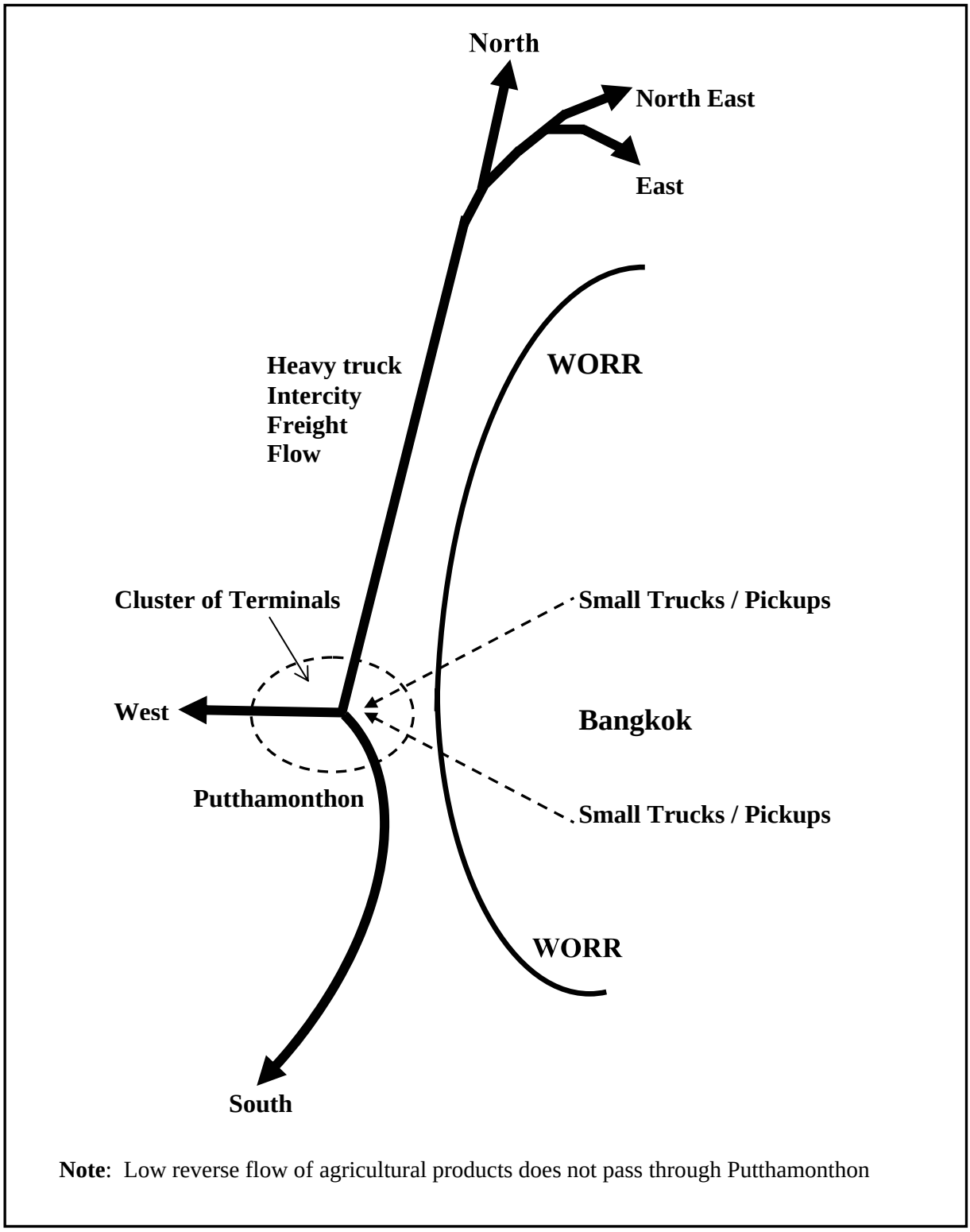
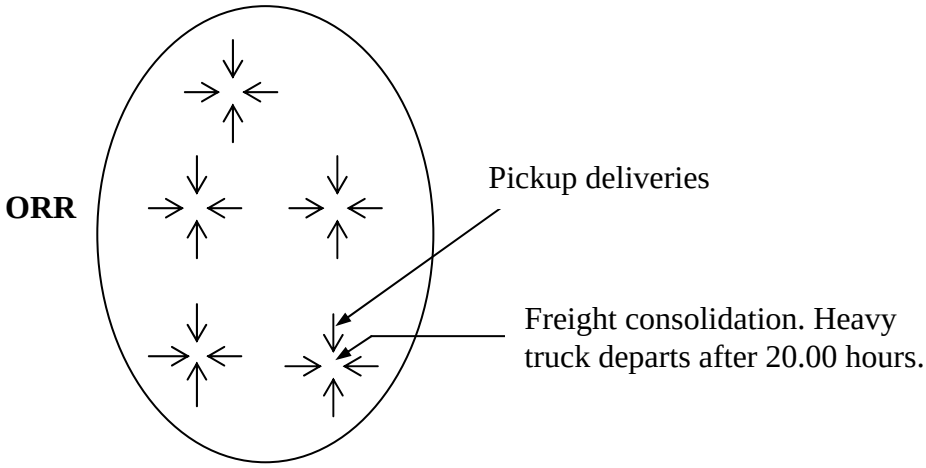


Figure 3.4 Diagrammatic Freight Flow Through Truck Terminals for Intercity Movement from Bangkok

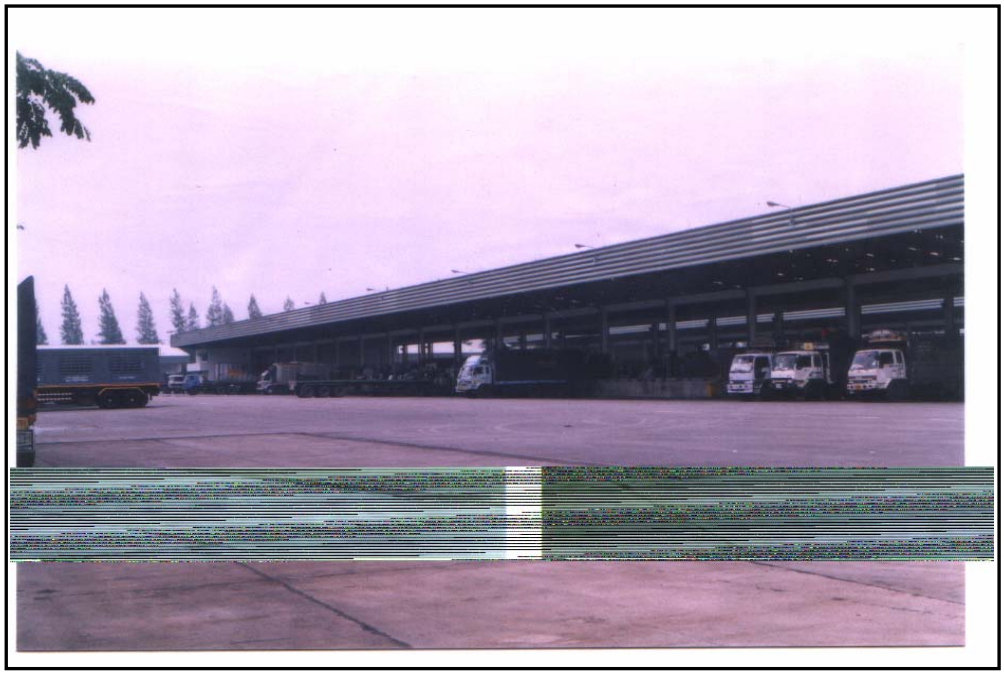
The above description is only a partial description of the total outward intercity freight flow by truck, although we think it is by far the dominant portion. At various locations in Bangkok individual trucks are loaded during the day and leave Bangkok in the evening after the truck ban ceases. This represents the other portion of the intercity freight flow and the following diagram represents this process.



The following photographs depict freight activity we observed in Putthamonthon.

Private Sector terminal traffic chaos

Private Sector terminal. Note preponderance of pickups



DLT terminal little activity

The sample of truck companies we interviewed were located primarily within the ORR perimeter but we have been advised that many transport companies are located outside ORR. Beyond the ORR heavy vehicle truck activity appears to be much higher than within the boundary formed by ORR as would be expected.

The above discussion applies only to non bulk freight. We have not included here any discussion of principal bulk freight movements comprising mainly building material such as sand, gravel and cement. The flow of this freight is almost exclusively into Bangkok to serve the building construction industry. If this flow is taken into account it is considerably greater than the outflow. However it is likely a high proportion of this material is converted to concrete, which is then delivered to building sites. It is also likely that concrete production occurs mainly on the outskirts of Bangkok and as noted earlier the delivery of concrete to building sites is not affected by the truck ban. With the recovery of Thailand's economy the building and construction industry has also recovered significantly since 2003.

3.5 CAST STUDY 2

In the survey of type 5 buses, that is fixed route buses we observed the following main differences between BMTA owned (or leased) buses and buses owned by the private sector. The main differences are as follows.

Table 3.9 Major Differences between BMTA Owned and Privately Owned Type 5 – Fixed Route Buses

Item	BMTA Owned	Privately Owned
Profitability	Operate at a loss	Operate at a profit
Bus Replacement	Buy new after 12 years	Rebuild using old chassis
Daily Budget for Bus Maintenance	Approx. 1,500 Baht	200 – 600 Baht
Engine Technology	Up to Euro II	Pre Euro standards

It is not possible to draw definite conclusions from Table 3.9 but the other factor not included in Table 3.9 is fare structure. All non AC buses operate on a fixed fare of 3.5, 4.0 and 5.0 Baht. The fare of 3.5 Baht applies to private sector green minibuses. The fare of 4.0 Baht applies to BMTA red and cream buses and 5.0 Baht applies to Private sector white and blue buses. The AC buses have a graduated fare commencing at 8.0 Baht for all buses except Euro II which start at 10.0 Baht (down from 12.0 Baht until February 2004). We have not calculated average fare structure for BMTA owned and private sector buses but we think BMTA enjoys on average a significantly higher fare structure. In addition, BMTA has increased Euro II bus fleet offset by a decline in other AC bus fleet and also non AC fleet. We believe the private sector is restricted in ability to change its fleet composition. As a consequence an increase in income for the private sector does not seem likely. Although we do not have any accurate statistics of fixed route bus patronage we think it is declining. One estimate puts the decline at 2% per year. This is based on incomplete data on total bus fleet time series information and limited bus occupancy surveys. In spite of the uncertainties in these estimates we do know BMTA owned bus fleet is declining and composition is shifting towards later technology AC buses. This discussion provides the platform for our conclusion that, while the fare and bus fleet composition restrictions persist, the private sector will continue to rebuild buses using the existing truck chassis, which appears to have a life of up to 50 years.

The stamped identification number on the chassis provides the basis for rebuilding and continuing the registration process of the bus. All other mechanical components can be either purchased second hand or repaired. These components include engine, gearbox, steering, back axle, front axle, brakes and cooling system. The body, seats and glass are then added, often by the private bus owner or specialist body builder. This process avoids capital borrowing and funding is provided out of operating profits. In approximate terms a bus can be manufactured in this way for about 30% of new manufacturer price. As an example, a second hand engine in good condition can be purchased for as low as 120,000 Baht (US$ 3,000). We were told that under present regulations there is no requirement for engine technology of second hand engines to satisfy new vehicle requirements. It would appear therefore that engine technology of a high proportion of private sector owned buses lags considerably behind the latest available engine technology. It is tempting to conclude that the fare structure is responsible for this situation but it also seems that the reluctance to borrow capital in order to purchase new buses is also a major determinant. In other words there is no incentive to determine if fuel savings and other possible operational savings achievable from new technology would outweigh the additional capital cost.

We cannot speculate what will happen in the future but it seems likely that the technology gap between BMTA and private sector will slowly widen. Furthermore because the private sector have demonstrated they can operate buses profitably any willingness to increase fares substantially seems unlikely. The obvious answer of calculating by what amount fares would have to increase in order to satisfy new engine technology regulations may take considerable time to negotiate.

Remanufacture of a bus from a truck chassis

Two months later bus body is well advanced

3.6 CASE STUDY 3

As discussed earlier we have concluded the odometer statistics we obtained appear reliable. In respect of vehicle types 4a (Van, Rot Tu) and 4b (Song Taew) the odometer reading is considerably less than stated travel. We are unable to explain why this group of owners should over state their travel.

By way of justification of our conclusion the following photographs were taken at 11.00 hours on a weekday in central Bangkok between Silom and Surawong Roads. The first photograph shows the large accumulation of 4a type vehicles and suggest that their travel is mainly associated with the journey to and from work. We think it very unlikely these vehicles could perform two round trips in each peak period and as a result the annual travel distance of 41,350 km based on odometer seems reasonable rather than stated annual travel of 85,000 km. By similar logic we have made the same conclusion about type 4b vehicles.

The second photograph shows the number plates of some vehicles and the yellow plate of a type 4a can be seen together with a non yellow plate of a type 3 private van. The non yellow plate is in fact blue lettering and numbers on a white background. The registration category of this plate is for a vehicle, with capacity for 7 or more persons, used for private purposes. However the type 3 vehicle would seem to be performing the same duties as a type 4 vehicle. The photograph shows that vehicle function cannot be confidently determined for certain types of number plate.

Accumulation of type 4a Vans, Rot Tu's at 11.00 hours on a weekday

Mixed type of number plates in parked type 4 vehicles