PART C

COLLECTION AND TRANSPORT IN K-WEST WARD, BOMBAY

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C-1 INTRODUCTION

Most of the solid waste from K-West Ward is collected by two types of vehicles: - compactor trucks owned by MCGB and open trucks (without tipping gear) which are operated by contractors, and which are rented to MCGB with a driver. Tractors and trailers are also used for collecting waste from the beach, and there are some MCGB open tipper trucks.

The compactor trucks are constructed entirely in India, and are of the rear loading type, with hydraulically operated packer and ejector plates. They are also equipped with hydraulic lifting gear to lift and empty specially designed trolley bins. Each driver of a compactor truck is accompanied by a cleaner, who generally operates the loading and compacting systems. Three of the vehicles deployed in each shift in K-West Ward are MCGB compactor trucks.

The contractor's trucks are generally old. Their bodies are mostly of wooden construction, with a small section between the cab and the waste-containing part, presumably for the crew to travel in. The height of the trucks is such that they must be loaded by passing the waste up to one or two men standing in the back of the truck.

For the first shift the vehicles are due at the motor loader chowkies at 6.30 am. Beats (routes) are assigned by the Junior Overseer (JO). Normally in each shift one vehicle makes only one trip from the ward to the dumping ground. The morning shift is from 6.30 am to 1.30 pm and evening shift is from 2.00 pm to 9.00 pm, (up to supervisor level, seven days a week; a rotation system allows the labourers one day off in seven). One vehicle also operates a night shift from 10 pm to 6.00 am for collecting refuse from certain markets. For attending to emergency calls three vehicles with crew are available at the central control room in 'B' Ward under a JO during the night shift. The refuse of K-West Ward is unloaded at the Chincholi disposal site (at Malad) which has no lighting facilities.

The loading team that is collected from the motor loader chowki comprises six motor loaders and one mukadam for each vehicle. If any of the motor loaders are absent, men are appointed as stand-in motor-loaders from among a reserve of casual labourers, on a daily wage basis.

This part of the report is concerned with vehicle operations. Data on operations were collected by following different trucks, observing the operations and noting the times taken and the quantities of waste handled. From this information the costs of collection of refuse by different means are estimated, and suggestions are made regarding possible improvements that should be examined further. Data were also collected from the vehicle workshops, to gain an understanding of the problems relating to keeping the vehicles in good condition.

C-2 STUDIES OF VEHICLE OPERATIONS

C-2.1 WORK STUDY MEASUREMENTS

Work study aims to identify the most efficient ways of performing a task and improve on them. Observation and measurement are the two main components of work study - observation suggests ways of improving methods, and measurement of times, distances, quantities and expenditures enables the calculation of costs so that the most economical method can be chosen. Comparison of costs is only meaningful if the costs are on a unit basis, such as costs per cubic metre or per tonne of refuse, because different methods generally relate to different quantities of waste.

Operations were studied by following refuse collection vehicles for the whole of a shift, and noting down times, quantities and distances, and observing methods and problems. This procedure was repeated for four shifts. The information that was recorded is reproduced in Appendices CC-I.1 to 4. Observations during this study were made with the full knowledge of the crew that was being observed, so it is likely that certain of their practices were modified because they were being monitored. To some extent this effect can be compensated for by adjusting recorded values (for example, if it is judged that labourers are working faster than normal, measured times for operations can be increased when used later in calculations). In this case, time is not as important a factor as it might be in other situations because the crews are accustomed to completing only one load per shift and so their output is not determined by the time taken.

Calculations of unit costs had already been performed by DCE Shri Panjwani of MCGB. A summary of his calculations are reproduced in Appendix CC-II His calculations showed that the transport cost per tonne is the least for the dumper placer system (Rs 65 per tonne), as compared with Rs 130 per tonne for compactors and Rs 235 for open trucks.

A computer program (known as *SENS*), based on a spreadsheet, has been developed at WEDC, Loughborough University of Technology, for calculating unit costs of collection systems. This program has been used in this case, and the calculations are shown in Appendix CC-II.2. *SENS* can also be used to investigate the effects of changes, to determine the sensitivity of the results to variations in any particular item of data and to estimate the costs of modified systems.

(i) Compactor trucks

The calculations shown in Appendix CC-II.2 and the computer program give the following results:

Table C-2.1 Unit cost results for compactor trucks.

Situation for which costs estimated	Costs Rs/ton
Compactor truck A, observed 25 November 1992	218
Compactor truck B, observed 30 November 1992	206
MCGB data	138
Proposed alternative	191

The first two situations are apparently the same, but the costs differ by 6%. However, they give an approximate value for the cost of collecting a tonne of refuse under the present conditions. The MCGB data is based on data used in the calculations of Appendix CC-II.1, where the cost was calculated to be Rs 130 per tonne. The small difference between the result here and the result calculated by MCGB (i.e. Rs 138 compared with Rs 130) is caused by the inclusion of the costs of the trolley containers, and minor differences in the methods of calculation, and errors caused by assumptions such as assuming every month to have 30

days. (If the price of the trolley bins is set to zero - meaning that they are ignored - the estimate for the cost per tonne using *SENS* is Rs 122.)

Though these three results are for the same situation, the differences are great, largely because of the different wage rates that are used. It appears that costs and wages have increased considerably since the MCGB calculation. Other differences are caused by the inclusion of the costs of the trolley bins for the first two cases, and the consideration of vehicle availability.

Calculations for A and C indicate that labour and supervision costs account for approximately 56% of the total cost; it is therefore important to try to keep these to the minimum. The proposed alternative does this by allowing the work to be done by a smaller crew. This alternative depends on improvements to the maintenance of the trolley bins, and on paving of the ground on which they stand. Such improvements would allow a smaller workforce with each truck, since a bin could be moved by a smaller team if all its wheels were in good condition and if it were rolling on a hard, smooth surface. This calculation also assumes that all of the waste is in the bins; this would need co-ordination with the street sweepers to ensure that the area was clean before the truck arrived. Some control over the rag pickers would also be of assistance to prevent the scattering of waste before the arrival of the collection truck. The saving in cost is in the region of ten percent.

Another advantage of the proposed alternative mentioned above is the reduction in the time needed to do the work. In this case the collection vehicle would be in use for less than 10 hours, instead of eleven to twelve. A further improvement would be to operate three shifts per day. If the mukadam and the cleaner would be willing to help move the trolleys when needed, and if three shifts were worked each day, the cost per tonne is reduced to Rs 162; if the life of the truck is reduced from ten years to seven years because of the extra wear and tear caused by the extra shift, the cost per tonne becomes Rs 169 - which still represents a saving of twenty percent.

Whenever changes to working practices are proposed, it is important to anticipate the likely reaction of the workforce, and to try to find ways of making the changes agreeable to them. It may be possible to persuade the workforce to accept such changes if they are paid the same amount for a shorter shift, and if the advantages of cleaner working conditions (i.e. no loading of refuse from the ground) are clearly presented to them. If three shifts are worked, some labourers might wish to work for two shifts each day to increase their income, or alternate, working one shift three days each week and two shifts on the other days. There may be particular resistance from the mukadams to returning to some manual work, but a small pay increment, and the fact that they would not be required to sweep or shovel refuse, but only to help move the trolleys, should help them to accept these changes. The need for supervision becomes less when there are only two labourers. There may also be problems in persuading the vehicle cleaner to help, but as his work involves so little activity, a small pay incentive may be sufficient (if the managerial problems of asking an employee of the transport section to do conservancy work could be overcome).

The key to reducing costs is to reduce the workforce, but this presents many problems because of trade union pressure to maintain the existing establishment. Redeployment of some of the workforce may be an option.

The advantages of the proposed modifications in terms of hygiene and the environment are considerable, since there would be no skin contact with the waste, and no waste lying on the ground.

(ii) Open trucks

The operation of two open trucks was studied. The data collected are in Appendices CC-I.2 and CC-I.4, and the input data are discussed in Appendix CC-II.3. The results from the *SENS* program are shown below.

Table C-2.2 Unit cost results for open trucks

Situation for which costs estimated	Cost per tonne [Rs]
Contractor's truck B 26 November (SENS)	381
Contractor's truck D 2 December (SENS)	298
Municipal open truck (MCGB data)	222

The first observation from the results above is that municipal operation of open trucks seems much more economical than the hiring of vehicles from contractors. This, however, is not the case, as is shown in table C-2.3 below. The reason for the large difference between the costs for B and D and the municipal vehicle in table C-2.2 above is in the data - the salary levels in the MCGB data are much lower than those used for the contractor's trucks. In order to examine this comparison, calculations were made for a municipal open truck using wages data similar to that used for the contractor's and compactor trucks. The life span of the open truck was increased to 15 years and the availability to 80%, both because open trucks are considerably simpler and more robust than compactors (for which the values were 10 years and 67% respectively). This result is compared with others in table C-2.3 below.

Table C-2.3 Unit cost results - comparisons of type and calculations

Type of vehicle	Average unit costs [Rs/tonne]	
	SENS program	MCGB calculations
Compactor	**212**	**130**
Municipal open truck	**389**	**235**
Contractor's open truck	**340**	**-**

The results here show that municipal operation of open trucks would be more expensive than the use of contractors' vehicles (in contradiction to the apparent conclusion from table C-2.2), and that both are very significantly (83% and 60%) more expensive than compactor trucks.

The difference between *SENS* and MCGB results is thought to be largely because of differences in wages: - Rs 1500 per month was used for MCGB calculations and Rs 2500 per month for *SENS*. The importance of the wages component is shown in table C-2.4 below.

Table C-2.4 The relative importance of wages and supervision costs

Type of vehicle	Method of calculation	Percentage of total cost that is wages and supervision
Compactor truck	MCGB	56
	SENS	62
Open municipal truck	MCGB	66
	SENS	72
Open contractor's truck	*SENS*	75

The results in this table show that the greatest impact on cost reductions can be made by reducing the wages bill.

A final conclusion, and one that has potentially a great impact on operating costs, is that there may be a considerable advantage in weighing the loads, or weighing a significant proportion of them at random. It is difficult for the JO at the checkpoint to verify visually whether each truck has been loaded to a satisfactory degree, because of the rush at the peak periods, because of the lack of parking spaces within view from the check point, and because the sides of the trucks are high and so it is not possible to judge the height of the central portion of the load. As a result, vehicles may be completing their loading and going to the disposal site with less than a full load. This was demonstrated very clearly by the observations of vehicle D. The observer was told that the crew had finished loading and was going to the disposal site. At this point he asked them to go first to the weighbridge to weigh the load. On hearing that the load was to be weighed, the crew or the mukadam decided that the load might be found to be too small, so they went to two more loading stations in order to increase the load that they were collecting. The extra load that was added was estimated by counting the number of bowl-loads that were put in; on this basis it was calculated that they added a further 62% before going to the disposal site. Table C-2.5 summarises the situation. The savings in unit cost terms is dramatic.

Table C-2.5 The effects of weighing on loads and costs

Parameter	**Initial - the situation that would have applied if weighing had not been required**	**Final - what was actually achieved because the load was to be weighed.**
Volume collected [m^3]	6.9	11.3
Weight of load {tonnes]	2.4	3.9
Unit cost [Rs per tonne collected]	**480**	**298**

C-2.2 GENERAL OBSERVATIONS

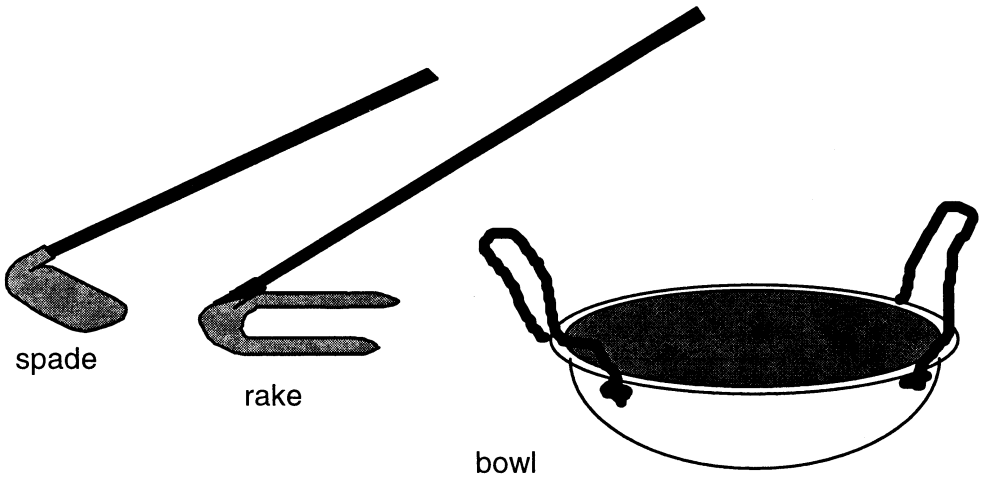
In solid waste management there is great benefit in observing operations to determine how the performance of tasks could be made more efficient or less hazardous. Observations often support the view that the *little things* are important, i.e. that attention to detail and the correction of seemingly small shortcomings can lead to comparatively large savings. There is also often great benefit in listening to the workforce at all levels to learn their opinions about factors that might be hindering the work. The aim of this section is to mention and discuss some of the minor observations that were made during the course of the study - observations which complement the quantifiable matters discussed in the previous section.

(i) Operations

The method of loading solid waste from the ground into either open trucks or compactors is impressive. It is clear that considerable thought has gone into the tools and techniques for this operation, and the results are clearly demonstrated in the speed at which waste is collected up and loaded. This speed and efficiency appears to be due to two factors: the tools that have been provided and the motivation of the workforce.

Each team is normally provided with two rakes, a spade, two brooms and a bowl. (One team of loaders that was observed had only one rake, and appeared to be operating less efficiently as a result.) Figure C-2.1 shows the types of tools that are used. The bowls are made of plastic, have rope handles, and can hold over sixty litres of some types of waste.

Figure C-2.1 Tools supplied to motor loaders
In addition brooms are provided, such as that shown in figure B-2.2(a)



The bowls have been developed using field trials, and are the key to the efficient loading of the vehicles. They cost Rs 600 each (in 1992), and are the item of equipment that causes most problems regarding replacement. They are said to have a useful life of 6 months. Some crews were seen to be using bowls that were partially broken; this would indicate some problems in providing replacements at the motor loader chowki.

The brooms that are used are a simple type which can easily be repaired, but their life was said to be only 20 days.

The crews working with compactor trucks are issued with steel 'T' bars for pulling and steering the trolley bins. These also cause problems because their normal life seems to be about 6 months, and some that were in use appeared damaged.

There was some evidence that the process of acquiring replacements for broken tools could be very lengthy, since tools were obtained from the AHS, the request going via the mukadam and the JO. If the supply of such minor items could be speeded up, perhaps by keeping a small stock at the motor loader chowki, there would be improvements in morale and efficiency.

At the beginning of each shift a roll call was taken by the Junior Overseer. It has been known, amongst large labour forces, for employees to be paid without actually appearing for work. Whilst there was no evidence that this was occurring, it would be possible for one person to answer to more than one name. The JO said that he recognised the voice of each loader, but with a large workforce this could prove difficult. It appeared that absentees were not marked as absent, but the space in the register was left blank. Such a practice might encourage later fraudulent entries to be made by unauthorised people, so it would be better if a clear mark were made after the second call to indicate that a particular man had not attended.

Some traffic congestion was caused by all the trucks parking near the chowki, but no simple solution was apparent.

The records at the motor loader chowki were well kept, and provide useful summaries of each day's work. Further extracts from these records are shown in Appendix CC-I.5

The motivation of the crews appeared excellent - they worked together well as a team, with each loader actively engaged, and they worked efficiently. This standard of work may have been because they were being observed, but the fact that their work for the day is over when they have finished one load encourages them to work well. (If loads were weighed more frequently there would be less chance of the crews stopping the loading before a full load had been collected.) The time when the morning shift is usually over can be compared with the time recorded when under observation to determine whether the crews were working faster when observed. The table in Appendix CC-I.5(i) shows that the usual arrival time at the disposal site is later than the time recorded during the observation. (On more than half of the twelve days for which the records are presented, the vehicle is logged in at the disposal site at 11.30 or later, whereas during the field observation the vehicle arrived at the disposal site at 10.58, after having made the extra visit to the weighbridge. In the twelve days for which records are shown, the truck arrived at the disposal site only once at 10.50, and once at 11.00 am.) This comparison suggests that the loaders may have been working a little faster than normal when under observation, which is entirely normal and to be expected. The records also show that unloading a compactor truck usually takes 10 minutes.

One of the compactor trucks was observed shedding dusty material and chippings from coconut shells through the gap between the hopper (tailgate) and the body. This shortcoming was therefore causing environmental pollution and adding to the loaders work as they needed to sweep up the material that fell through the gap during the compacting cycle. It might be possible to weld extra steel plates to the bodies or tailgates to prevent this happening.

It is not known how the wheels of the compactor trolleys become broken, but it was observed that the emptied trolleys were dropped onto the ground relatively quickly, so that the wheels were subjected to a considerable shock. It might be possible to reduce the incidence of broken trolley wheels by slowing the rate of descent of the loading mechanism by means of a constriction in the hydraulic system, or by training the operators to lower the trolley bins more gently.

The number of employees with each compactor truck - nine - is very high (driver, mukadam, cleaner and six loaders). Of these the cleaner does the least; he usually (but not always) operates the loading and compacting mechanism, but does little else during the collection round. Whilst it is understood that he is from the transport side of the MCGB, and not the conservancy side, and that the law requires a cleaner to accompany the driver of a heavy vehicle, it might be worthwhile to find ways of integrating the cleaner to a greater extent.

Some hotel waste was very unpleasant to load because it was very wet and it was not containerised. At one hotel the loaders were obliged to walk over the waste. On one occasion a plastic bag containing wet waste burst in the compaction mechanism, shooting a jet of waste over a distance of more than five metres. The ideal solution would be to find a way of utilising this waste, and that it should be collected separately, being kept in the same containers during both storage and transport. Considerable dripping from the truck was noticed after this waste had been loaded.

In most of the open trucks the full loads were covered before the vehicle set off to the checkpoint. This is a commendable practice, and the high degree of compliance with the instruction to cover the loads in open trucks is greatly to the credit of the supervisory staff. It was noted that covering the load with gunny took about two to three minutes.

Weighbridge results showed that the compactors may often be overloaded on the back axle. This is a common problem all over the world; the consequences can be road damage (in the

case of excessive overloading) and vehicle problems. The Maintenance Engineer at Santa Cruz mentioned that there had earlier been failures of the wheel studs, but that these had been cured by the fitting of stronger, ten tonne axles. The incidence of broken springs should be monitored to check whether overloading is causing significant problems in that way.

(ii) Health and safety

Skin contact The most obvious health hazard faced by the loaders is because of the skin contact that they have with the waste. Studies in India and Egypt have shown that refuse workers have a higher than average incidences of intestinal parasites; such parasites are present in faeces and can penetrate the skin. Loaders are at risk when they handle the waste without gloves or when they stand in the waste. A loader may be at risk when he props a bowl up against his leg in order to rake waste into it, or when he stands in an open vehicle, either to receive the waste during loading, or when the vehicle is moving, but the most hazardous activity is when open vehicles are unloaded manually, since the labourers are often standing in piles of waste that they have pulled off the truck and over their feet. Generally motor loaders wear only plastic slippers on their feet; these slippers provide some protection for the sole of the foot but none for the rest of the foot or the lower leg. Motor loaders rarely touch the waste with their hands since their tools are adequate for the tasks they are required to do.

The other hazard of skin contact is the danger of cuts caused by sharp objects such as glass fragments, razor blades, tin cans and, most importantly, hypodermic syringes. Not only is there the risk of cuts, but there is the more serious risk of infection from germs that enter through the cut - a risk that is particularly serious from syringes containing blood that is contaminated with HIV or hepatitis viruses.

The solution appears simple, namely to provide the labourers with rubber boots. There may be some problems in ensuring that the labourers wear the boots, and there may be incidences of labourers selling such equipment. More information on experiences of previous attempts to provide protective equipment and on the attitude and understanding of the workforce would help to determine how a scheme to provide boots should be managed. The boots provided to labourers who unload open trucks should be high enough to prevent any skin contact with the unloaded waste.

Traffic accidents Refuse collectors are always at risk from traffic accidents, but two practices were observed that pose special risks. The first involved the manoeuvring of trolley bins into position for loading - the labourer who was pulling the handle and steering the trolley was obliged to go ahead of the trolley into the road and was thus vulnerable to collision with passing traffic. The danger was particularly acute when trolleys with broken wheels were being moved, since the loaders would have less control over the movement of the trolley - it might suddenly move after resisting previous efforts. The risk can be minimised by ensuring that all trolley bins are kept in good condition and on paved surfaces, and by training and regular reminders for mukadams and labourers.

The contractors' vehicles usually have a small compartment between the cab and the refuse storage area for the crew to ride in. Sometimes it was used for storing a spare wheel, but some crews did not ride here. Some loaders rode on top of the cab - a very dangerous place to be in the event of sudden braking or a head-on collision - and others rode in the back with the refuse - a dangerous place because of the risk of falling off and because of skin contact with the waste. It would be worthwhile to ascertain from the crews why they do not ride in the crew compartment and to try to find ways of transporting the crew more safely.

Compactor trucks can accommodate more loaders in the cab, but for short journeys between collection points, loaders sometimes travel on the hopper - a very dangerous practice. The provision of steps and handles at the rear of compactor trucks (to allow loaders to travel short distances more safely) would be a reasonable compromise.

Rats build their nests in untidy areas where they will not be disturbed. If trolley bins were used more widely, collection points were paved, and solid waste was not left on the ground for more than a few hours, there would be fewer places for rats to hide and so control of rat numbers would be easier.

Regular medical examinations Some of the motor loaders mentioned the lack of medical check-ups as a problem, one saying that he had not had one for three years. It is suggested that each motor loader be given a free medical examination each year for the following reasons:

- employers have a moral responsibility for effects on the health of their employees that are related to their work;
- the provision of some medical care is a helpful motivating factor because it indicates to the labourer that his employer is concerned with his well-being, and solid waste workers are often worried about their health because of the risks of handling refuse;
- healthy labourers work more efficiently
- medical examinations can be used to generate statistics relating to the work - these statistics may be helpful in quantifying benefits of, for example, providing protective footwear or changing the loading or unloading methods.

C-3 VEHICLE MAINTENANCE AND AVAILABILITY

C-3.1 INFORMATION FROM THE MAINTENANCE ENGINEER

The central garage is Santa Cruz, and there are seven vehicle depots. One of these depots is Bandra, where the vehicles that work in K-West Ward are kept. There are 491 vehicles under MCGB management at Santa Cruz for a variety of municipal purposes; they are not kept at Santa Cruz, but are sent there for major repairs and maintenance.

There are two Executive Engineers responsible for transport, one for the city area and one for the suburbs.

Work done centrally at Santa Cruz includes accident repairs, preparation for the annual *RTO* test, servicing, springs, axles, body building and painting, and rebuilding of *units* - (that is, engines, gearboxes, dynamos, and radiators. These units are exchanged for faulty units which are fitted at the depots.) The main stores are at Santa Cruz, and the depots have sub stores which hold only a small number of fast-moving parts.

Machining work is done by outside contractors. Parts are purchased from authorised dealers without going out to tender each time. The Maintenance Engineer has an imprest of Rs 40,000; he has the authority to sanction expenditure of up to Rs 3,000 and can make cash purchases of Rs 400 at a time. The Maintenance Engineer is on the Technical Committee and so has an input into the selection of new vehicles.

The municipal vehicles are not insured, but there is a Rs 12 lakh reserve fund, which must be made up to that level every year by the end of March. The staff, including drivers and cleaners from all depots, totals 1348 people, and the monthly salary bill is Rs 50 lakhs. The

annual maintenance budget is around Rs 4 crores. (As a rough guide, the maintenance expenditure on a vehicle over a ten year period is equivalent to its capital cost.)

Entry to the workforce is as a labourer, cleaner or driver, with a 9th standard education. Labourers can progress to become Fitter II, then Fitter I, then Mechanic and on to Assistant Foreman, Foreman and Auto Technician. The turnover of the workforce is very little - staff like the security and pay.

Passenger vehicles are considered to have a seven year economic life, and larger vehicles a ten year life. However, 45% of the current vehicles are over ten years old, and some are thought to be as old as 25 years. (In 1986, two-thirds of the fleet was over ten years old.) The procedure for auctioning old vehicles takes about one year. The Scrap Committee decides on the minimum price, and if this price is not reached in the auction, the vehicle may be rehabilitated.

In the case of simple vehicles, 20% extra vehicles are purchased to act as standby's; for compactors the figure is 25%. Five spare engines are kept as standby units for every hundred held.

All vehicles are powered by diesel engines; it has been a policy decision that no petrol engined vehicles should be used. This policy enables fuel savings because of the higher efficiencies of diesel engines, and allows the mechanics to specialise.

C-3.2 DISCUSSION AND SUGGESTIONS

Enquiries showed that a good system of record keeping had been developed. The only area that was identified in which record-keeping might be improved is in the area of recording costs of repairs and operational costs for each vehicle. Such records could be of assistance in determining the economic life of the vehicles, and of identifying particular shortcomings of certain vehicles or certain types of vehicle.

The chart below (figure C-3.1) shows the time that was spent on the different types of maintenance for compactor vehicles in November 1992, based on data in Appendix CC-III.2. It shows that most time is spent on chassis repairs - three times as much as is spent on body repairs. This suggests that the chassis (motor, transmission, springs etc) have more problems or that the chassis repair crews have so much work that they cannot attend to new work without a considerable delay. This suggests that it might be worthwhile to study the type of fault to determine what action could be taken to reduce the downtime caused by chassis faults - such as changing the chassis specification, providing further training for the drivers or studying the operation and requirements of the repair workshop. Appendix CC-III.3 gives some more information about the types of faults encountered during a short period. The time required for preparation for the annual test seems to be considerable, taking nearly ten percent of the vehicle's time during the month in question; if that time could be shortened there would be a noticeable improvement in the availability.

Figure C-3.1 Availability and relative time spent on different types of repair, November 1992

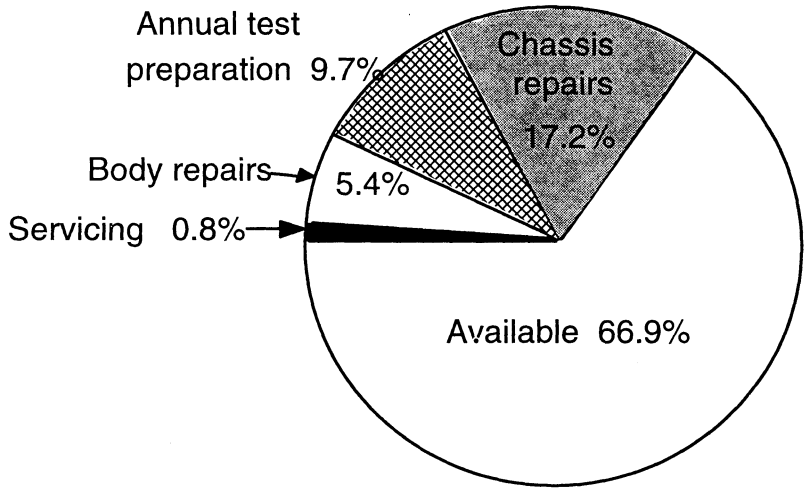


Figure C-3.2 shows the length of time that different maintenance tasks require. For example, it shows that routine servicing in November, which was undertaken on three occasions, took no more than 2 days on each occasion, whereas, on two occasions work relating to the annual test took more than 14 days.

The results for figure C-3.2 are taken for only one month (based on data in Appendix CC-III.2); repairs that were started before the beginning of the month, or may have continued after the end of the month cannot be included on the basis of the information in the Appendix, since the total duration of that particular incident of downtime is not known. However, this method of presentation may prove useful if based on more extensive data, as an indication of how long vehicles are off the road for different reasons.

The support of the Airtech repair team, based at Bandra, is clearly very useful in keeping the compactor trucks operational. It is suggested that a programme for the repair of the trolley bins be developed. Repairs could be done by a mobile crew, if the locations of defective bins were reported by the mukadams. Otherwise defective bins could be brought in to a depot (after having left a satisfactory bin to replace the broken one) by a special vehicle and crew. The third possibility is to have a trolley bin repair crew in each depot that has compactor trucks, with some mechanism of encouraging each compactor truck driver to pick up a defective bin on the way back from the disposal site. Each defective bin that is brought in for repair would need to be replaced by a sound one; perhaps this could be done by maintaining a few good trolley bins at each motor loader chowki, so that when one was used to replace a damaged bin, it could be replaced the next day by a compactor truck bringing a repaired bin from the depot. Incentives and supervision would be very important in ensuring that trolley bins are well maintained.

The maintenance of the municipal vehicles for Greater Bombay is already a huge task. If there were more municipal refuse collection trucks, and fewer contractors' trucks, the scale of the operation would need to be even larger.

Figure C-3.2 The frequency of the duration of different types of maintenance work

Note: The vertical axis shows the number of repairs, begun and completed within the month of November, that lasted for the period indicated.
Service means routine servicing
Chassis means repairs connected with motor, transmission, axles, cab etc
Body means repairs connected with the loading, compacting, containing, and ejecting systems
Test means work connected with the annual RTO test.