SECURING FURTHER IMPROVEMENTS IN REFUSE COLLECTION
AUDIT COMMISSION

SECURING FURTHER IMPROVEMENTS
IN REFUSE COLLECTION
A Review by the Audit Commission
August 1984

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SUMMARY

Refuse Collection is a local government success story. Productivity (measured in terms of cost per cubic metre collected) has increased in real terms by 25% since 1978.

The Commission's auditors have been examining refuse collection costs in 400 authorities in England and Wales to see whether further improvements are possible. They have been using a well tried computer-assisted diagnostic model developed by the Local Authorities Management Services Advisory Committee (LAMSAC), which takes all relevant local factors into account.

The investigations show that with no changes to existing standards of service, further improvements worth £20 million a year could be achieved. If all authorities were willing to adopt the lowest cost collection methods (and accept the service standards involved) a further saving worth some £50 million is possible.

This evaluation did not cover commercial rounds, overheads and vehicle utilisation that account for half the costs of the service. But auditors' work indicates a considerable further potential for savings in these areas.

Improvements can be achieved in various ways e.g.

(i) Changing collection methods

(ii) Reviewing those bonus schemes which are not resulting in higher performance

(iii) Changing rounds, to reflect local housing and economic conditions

(iv) Using different vehicles and adopting appropriate crewing levels

Authorities with room for improvement can see for themselves what the more successful have achieved and can learn from their experience.

Improvements of 5% or more appear possible in over 170 authorities on existing methods; and in 50 authorities the potential savings on the same basis exceed £100,000 a year.

Privatisation does not appear necessary to securing competitive performance provided that the DLO is well managed and the workforce suitably motivated. A quarter of direct labour organisations have refuse collection costs as low or lower than the average privatised service taking all relevant local factors into account.

The Commission's auditors are reviewing the results of their local evaluations with the responsible members and officers. They will be tracking performance in implementing any local changes that are agreed.
SECURING FURTHER IMPROVEMENTS IN REFUSE COLLECTION

A Review by the Audit Commission

1. Refuse Collection is one of the few local authority services that affects virtually everyone in the community. The "winter of discontent" brought the service into sharper public focus; and it drew attention to the consequences of failure to manage this particular service effectively. It is also a local government success story, in that productivity has improved markedly over the last five years or so. In 1983-4, costs per cubic metre of refuse collected were some 25% in real terms below the level in 1977-8. This reflects a 13% real reduction in collection costs and an 11-12% increase in volume of refuse collected.

2. Nonetheless, for the following reasons the Audit Commission for Local Authorities in England and Wales (the Commission) has asked its auditors to examine refuse collection costs in each authority in some detail, to determine whether further improvements are possible:

(a) Refuse collection costs £500m a year (gross) in England and Wales; and it is one of the most expensive services provided by shire districts.

(b) Output and standards of service are (relatively) easy to measure - at least when compared with many other local authority services. For example cost per household can be compared across similar types of district with similar collection methods; and it is reasonably clear whether or not refuse has been collected on time.

(c) Perhaps as a result, considerable management service and work study effort has been devoted to identifying and gaining employees' acceptance of standard times for different activities; and the impact on costs of policy decisions and of other independent variables such as housing patterns and local geography can be determined reasonably accurately.

(d) More recently, many local authorities have considered putting refuse collection out to private contract and at least 18 have done so. In several cases there is now practical experience of the problems and benefits of such a move.
Finally, there remain wide differences in costs between authorities of the same type, as Table 1 below shows. Much of these can be explained by differences in local geography and in the type of service provided. But, as this report will demonstrate, there are also further opportunities for improvement, if the performance of the higher cost authorities could be brought closer to that of the lower cost ones.

TABLE 1: REFUSE COLLECTION COSTS PER HEAD - 1984-5 ESTIMATES

<table>
<thead>
<tr>
<th>Type of Authority</th>
<th>&lt;£4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10&gt;</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner London Boroughs</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Outer London Boroughs</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td></td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Metropolitan Districts</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td></td>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>Shire Districts</td>
<td>18</td>
<td>30</td>
<td>67</td>
<td>69</td>
<td>34</td>
<td>14</td>
<td></td>
<td>296</td>
</tr>
<tr>
<td>TOTAL</td>
<td>19</td>
<td>31</td>
<td>76</td>
<td>79</td>
<td>85</td>
<td>43</td>
<td>31</td>
<td>364</td>
</tr>
</tbody>
</table>

3. Over the past several months the Commission's auditors have been examining refuse collection arrangements in each of the 400 districts and London boroughs, to identify where there appear to be significant opportunities to improve value for money and to help authorities agree on the appropriate action to be taken. These value for money projects have shown that there are indeed worthwhile opportunities to secure further improvements. Without any changes in collection methods perhaps £20 million a year could be saved. Changing to the most efficient collection method could save considerably more without any reduction in the standard of service provided. If authorities were prepared to change to the cheapest practical collection methods, the potential further saving could be of the order of £50 million a year; however this might involve a distinct change in the level of service provided and is a matter of local policy. These figures do not include possible savings in commercial rounds, administrative overhead or vehicle utilisation and operating costs.

4. This review describes the results of the auditors' work in refuse collection during the present audit round. It sets out in turn:

(i) How the potential improvements were identified, using the computer assisted diagnostic package developed by the Local Authorities Management Services Advisory Committee (LAMSAC)

(ii) The results of the various projects carried out in individual authorities
The steps to be taken at the local level to grasp the opportunities that seem to be available

The Appendix describes the LAMSAC refuse collection audit package (ROSS) in more detail.

CRITICAL FACTORS IN REFUSE COLLECTION

5. A typical shire district spends around £1m a year collecting refuse and uses ten or so specialist vehicles (each costing £30-40,000 to replace) to do so. Table 2 below shows the estimated cost of collecting refuse in England and Wales in 1983-4.

<table>
<thead>
<tr>
<th>Drivers and Loaders</th>
<th>£m</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Spare (stand by)</td>
<td>35</td>
<td>240</td>
</tr>
</tbody>
</table>

Vehicle Standing Costs

<table>
<thead>
<tr>
<th>Drivers and Loaders</th>
<th>£m</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Spare (stand by)</td>
<td>15</td>
<td>65</td>
</tr>
</tbody>
</table>

Vehicle Running and Maintenance

<table>
<thead>
<tr>
<th>Income</th>
<th>£m</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (inc sacks)</td>
<td>130</td>
<td>29</td>
</tr>
</tbody>
</table>

Income

<table>
<thead>
<tr>
<th>Income</th>
<th>£m</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (inc sacks)</td>
<td>130</td>
<td>29</td>
</tr>
</tbody>
</table>

TOTAL

<table>
<thead>
<tr>
<th>Income</th>
<th>£m</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (inc sacks)</td>
<td>130</td>
<td>29</td>
</tr>
</tbody>
</table>

6. Table 1 showed that there are substantial differences between authorities' unit costs. Much of these can be explained by differences in local practices e.g. whether the refuse is collected from the backdoor or kerbside - and geography, most notably the average walk distance for loaders on each property. Population density, the nature of the local economy, housing patterns (i.e. high rise, semi-detached, detached) also affect refuse collection costs.

7. Table 2 suggests that the most worthwhile improvements in value for money will be obtained by increasing labour and vehicle productivity. In practice, the main opportunities usually fall into one or more of the following categories which are interdependent - that is, they need to be looked at together, rather than in isolation.
(a) **Changing Collection Methods:** There is a wide range of possible methods of collecting refuse: it can be collected from the kerbside or from the back-door (or bins can be collected from the back-door and returned empty to the kerbside); it can be collected in bins or in sacks; there are various ways of collecting from bins, e.g. using skeps, bin-carriers or continental wheeled bins; loaders can pull refuse out in advance while the vehicle is travelling; and there is a wide variety of refuse vehicles that can be employed. Most methods have advantages in certain circumstances e.g:

- **material cost:** bins cost less than sacks (and plastic sacks less than paper)

- **collecting time:** sacks reduce walking time when compared with bins, when these have to be returned empty; but this saving must offset the cost of the sacks.

- **vehicles and drivers:** reducing collecting time normally also reduces vehicle waiting time, and hence the cost of employing vehicles and drivers. Vehicle time can also be saved by the pull-out in advance method, particularly when vehicles have a long run to the tip.

- **amenity:** some authorities prefer sacks on environmental grounds - while others take the opposite view.

- **convenience:** it is clearly more convenient for the collector (but less so for the householder) for refuse to be left on the kerbside to be collected, rather than at the back-door or even the premise boundary.

Changes in method can have considerable cost implications, particularly if kerbside collection is regarded as acceptable. A switch from back-door to kerbside collection in a densely populated urban area could easily reduce direct refuse collection costs by up to 50% - since both vehicle requirements and crewing on each vehicle can be sharply reduced. Sacks are better where there are relatively long walks on premise; bins are usually cheaper for kerbside collection.

(b) **Tightening Time Standards:** Many "task and finish" bonus schemes were originally based on work study, but have not been reviewed for five years or more. In the meantime, routes have often changed, the number of commercial premises has usually fallen, collection methods and vehicle capacities have altered. As a result,
many employees are earning a "bonus" of 33% whilst still managing to finish work by 2 p.m. (or even earlier). For example, in one Metropolitan district the District Auditor pointed out recently that the values built into the bonus schemes in operation had not been examined since 1971 at least (and probably earlier); and they included allowances for sorting and separating salvage collection even though this task was discontinued some years ago.

(c) Changing Vehicles and Crew Levels; Vehicle capacity can vary from 20 cubic yards to over 70 cubic yards and the right crew size can vary from one loader to six. It is essential to reflect the local operating environment in vehicle size and in crewing levels: in a densely populated urban area, with a long collection walk, a large vehicle with 5-6 crew may be the most economical; while in a sparsely populated rural area the best may be a small vehicle with only one or two crew.

(d) Increasing Vehicle Utilization: The annual cost of owning a new vehicle is typically around £9,000, including interest, depreciation, tax and insurance, but before any operating costs. However average vehicle utilization seldom exceeds 30 hours a week, and is often considerably less. Changing from one to two shifts per day or to a working week of four ten hour days could save a district now operating ten vehicles £25,000 in depreciation costs alone. Low vehicle utilisation is reflected in the ratio of reserve vehicles that is held. Most authorities should not need more than 25%, and a reserve level of 15% should usually be feasible with good maintenance practise, and occasional use of spot hiring (or co-operation with neighbouring districts). But many authorities have a reserve of 50% or more at present.

(e) Improving Vehicle Maintenance: Local authorities spend about £50 million a year on maintenance of refuse vehicles, with wide variations in the average cost per vehicle. Good maintenance is also critical to vehicle availability, and hence to the number of vehicles needed. The Commission is undertaking a special study of vehicle management which will be used by auditors next year. But simple observation can reveal opportunities which justify further examination. For example, the District Auditor in another district drew attention recently to the following:

- a vehicle reserve of over 35%. 

5
- six refuse collection vehicles (with a total annual depreciation cost of over £40,000) had an average "standing" time of 60%.

- eight vehicles spent an average of over 350 hours (i.e. ten working weeks) under repair, at an average cost of £3,200.

- two vehicles under two years old spent over 200 hours each under repair, at a cost of £1,900 each.

- the maintenance fitters had an incentive scheme based not on keeping vehicles on the road, but on having vehicles in the workshop on which repairs could be done.

(f) Charging Appropriate Rates for Commercial Refuse Collection: Local authorities are required to make reasonable charges for collecting commercial refuse and for special services - which can cost £70,000 a year even in a small district. The exact level of charges is a matter of local policy; but the District Auditor in one authority recently observed that:

- the charge for refuse collection of 5p a bin with the first bin collected free had not been altered since April 1976.

- the authority was losing almost £10,000 a year on commercial refuse collection.

- clubs, public houses, hotels, boarding houses and caravan sites were not being charged at all for refuse collection, despite the Court's decision in 1974 (Iron Trades Mutual Employers Insurance Association v Sheffield Corporation).

- accounts for trade refuse collection were being rendered annually in arrears, rather than in advance as is the practice in many districts.

Correcting these weaknesses generated income* in excess of £30,000 in the district concerned, representing almost 15% of gross refuse collection costs.

* There are, of course, other ways of generating income from the refuse collection service. One small shire district expects income of up to £25,000 a year from selling advertising space on its nine refuse vehicles.
8. Establishing the appropriate local arrangements for refuse collection requires detailed work. All the factors identified above need to be examined, to produce proposals for detailed changes to collection methods, collection rounds, vehicle specification and numbers, crewing levels and working practices. The proposals will also need to take account of the council's policy on refuse collection service standards.

AUDITORS' APPROACH

9. Given the limited time available to complete audits - in some small shire districts less than 80 man-days are available to complete the entire audit - the Commission decided that auditors should apply the LAMSAC ROSS Audit and Predict models (described in the Appendix), having first checked the efficacy of the ROSS approach with a number of authorities with prior experience of it. All the costs involved were absorbed within the agreed audit fee. Basically, the following approach was adopted in each authority.*

(i) Auditors completed a fairly detailed questionnaire providing information on current collection methods, the number of vehicles, drivers and loaders and then bonus arrangements, as well as local conditions known to affect refuse collection costs such as

- the average distance from the bin to the collection vehicle
- the number of prime containers in each premise
- the number of premises
- the distance to be travelled, both walking and driving within the collection round, and the driving distance to the depot and tip
- vehicle capacity and average utilisation

* Of 400 refuse collection authorities, all but 50 have now completed the exercise. Of these, about half are currently in process of completion, while most of the balance were omitted because they had recently undertaken a full ROSS analysis.
LAMSAC then ran the ROSS audit model for each authority's data, and as a result were able to calculate how many loaders, drivers and vehicles the authority ought to require given their local circumstances, and given the collection method being used. The only assumption imposed by the model is that the work is undertaken at a reasonably good speed, based on known standards achieved by authorities that have been studied.

In addition every authority was able to run one ROSS Predict - exactly the same model, but giving them the opportunity to test the impact on their costs of any selected changes in their methods or in other local circumstances.

10. Clearly, the Commission's approach depends heavily on the validity of the ROSS Audit model. The Commission is satisfied that this is 'soundly based. The ROSS Audit model reflects the cumulative experience of LAMSAC in applying the full ROSS system, which has been used in over 60 authorities in England and Wales (at a cost of around £20,000 a time) - and also in many countries overseas. This system is based on detailed work study findings which have been agreed with the trades unions concerned at the national level. Finally, those authorities contacted by the Commission last year who had direct experience of the full ROSS package, and of the Audit model were generally satisfied with the results - and had secured substantial benefits by applying it. The assumed speed of working, which is at the heart of the model, was specially calibrated by LAMSAC at the request of the Commission to a level where it was expected that about two authorities in three would be working slower, and one in three would be working faster - thus setting a yardstick that is manifestly feasible, but would nonetheless represent a distinct challenge to a large number of authorities.

11. Once the computer runs were completed, authorities and their auditors were able to compare the results as shown by the model with the current costs, manning levels and vehicles deployed in the local service. The next section summarises these findings.

POTENTIAL IMPROVEMENTS IDENTIFIED

12. As has been the case in other local authority services which the Commission has so far had the opportunity to examine in detail, there is a wide difference in performance between the best and worst. In this case the highest cost authority is some 70% more expensive than the ROSS audit suggests that local service standards might warrant; and several authorities are 25% lower than the ROSS figures suggest, again for the same standard of service. Exhibit 1 displays the results for the authorities covered in the review. Table 3 overleaf summarises these figures and shows that there are worthwhile opportunities in at least 170 authorities, where a saving of 5% or more on current collection methods is possible.
Exhibit 1

Refuse collection costs vary considerably, against a common standard

REFUSE COLLECTION COSTS:
ACTUAL vs ROSS AUDIT

No. of Authorities

Source: Audit Commission analysis of ROSS Audit results
July, 1984
### TABLE 3: POTENTIAL IMPROVEMENTS IDENTIFIED BY ROSS

<table>
<thead>
<tr>
<th>Actual Cost vs ROSS standard</th>
<th>No. of Authorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 50% higher</td>
<td>2</td>
</tr>
<tr>
<td>35-50</td>
<td>8</td>
</tr>
<tr>
<td>20-35</td>
<td>41</td>
</tr>
<tr>
<td>5-20</td>
<td>120</td>
</tr>
<tr>
<td>Within 5%</td>
<td>104</td>
</tr>
<tr>
<td>Over 5% lower</td>
<td>61</td>
</tr>
</tbody>
</table>

13. If every authority that is currently worse than the ROSS standard were able to close this gap, the improvement would be worth about £20 million a year. This figure only takes into account the costs of loaders and drivers working on domestic refuse collection, and the standing costs of their vehicles. As was shown in Table 2 these account for some £205 million out of the total £500 million gross annual cost of the service. Thus the potential improvement amounts to some 10% of the costs involved. The same order of improvement in the costs not covered by ROSS – e.g. commercial collection, spare vehicles and men, vehicle operating costs, and overhead costs, would of course result in further savings – and auditors' examination of individual authorities has also shown up substantial opportunities in such areas.

14. The majority of the ROSS Predict runs that showed worthwhile savings achieved this by switching to kerbside collection, which is more economical but not necessarily more effective in meeting local needs. Extrapolation of these results indicates a total potential saving of some £50 million, or 25%, if every authority made this change. However a number of authorities could show savings from changing to more appropriate methods without loss of service. For example one large metropolitan borough district where refuse collection costs are already relatively competitive in ROSS terms is considering a possible change in collection method that would be worth a further £500,000 a year – without any effect on service standards.

15. These general results mask some differences in the performance of different types of authority. In particular, it seems that:

(i) The improvement potential is usually greater in urban authorities (London boroughs, metropolitan districts and provincial cities) than it is among the smaller shire districts.

(ii) Bonuses are not very effective in securing better than standard performance.
(iii) Competitive costs can be achieved by direct labour organisations. Those authorities who have put their refuse collection services out to private contract do indeed enjoy relatively low costs, against the ROSS standards. But many authorities continuing to use direct labour are achieving costs as low - or even lower.

While the above statements are generally true, there are some notable exceptions. For instance, there are large authorities paying high bonuses which are doing as well as the average "privatised" service both in London and in the provinces. The key determinant of better than predicted performance seems to be management. As was the case with management of council tenants' arrears, good management can produce better than expected results.

The rest of this section presents the evidence for each of these findings in turn.

**Greater Potential in Urban Authorities**

16. As is made clear from the its handbook on Economy, Efficiency and Effectiveness, the Commission favours a policy of maximum delegation of responsibility and authority; and smaller authorities might be expected to be more cost-effective in collecting refuse than larger ones. Whereas a small urban district might employ 20 or so loaders for its refuse collection services, a typical London borough might employ 70 and a large provincial City as many as 250. The size of the management task is thus quite different in different types of authority.

17. Exhibit 2 shows that the "small is more efficient" theory tends to be true of refuse collection, at least to the extent that most larger urban authorities are rarely achieving ROSS standards at present. By contrast, many smaller shire districts are already performing at better than ROSS standards, some significantly so. The Exhibit displays the position as revealed by auditors' returns for urban and rural authorities; and Table 3 summarises the results by class of authority.

<table>
<thead>
<tr>
<th>TABLE 3: AUTHORITIES' RESULTS COMPARED WITH ROSS STANDARD – 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Cost per Premise</strong></td>
</tr>
<tr>
<td><strong>Actual</strong></td>
</tr>
<tr>
<td>London Boroughs</td>
</tr>
<tr>
<td>Met Districts</td>
</tr>
<tr>
<td>&quot;Urban&quot; Districts</td>
</tr>
<tr>
<td>Other Districts</td>
</tr>
</tbody>
</table>

* Assumes average vehicle standing cost of £9,000 p.a. in every case.
Very few Urban Authorities are achieving ROSS standards

**ACTUAL vs ROSS AUDIT**

% difference

Source: Audit Commission analysis of ROSS Audit results

*July, 1984*
18. In view of the possibility that the ROSS model might in some way be biased against urban refuse collection services, the Commission has checked the results by comparing the difference between actual and audit costs standardising for a number of factors for which a bias might be present e.g. the number of yards walk per premise, round mileage, collection method, the size of the authority as reflected in the number of premises served. None of these analyses suggested any significant bias within the model against urban areas - with one exception, namely that the slower driving speed in the most urban areas might increase their cost by some 2% compared to the average (and the opposite adjustment for the most extremely rural authorities would reduce their cost by up to 4%). Nor do urban authorities appear worse simply because they have had to pay higher "bonuses" in order to attract labour in high-wage areas. The average bonus paid in urban authorities is only 3% higher than elsewhere; but their average speed of working is 9% lower, or at least 7% even after adjusting for driving speed. Thus, given the good performance against ROSS standards of a number of large metropolitan authorities, it is difficult to avoid the conclusion that there are indeed generally more opportunities for improvement in the efficiency of urban refuse collection services than in rural ones.

19. The Commission's earlier reviews of the management of tenants' arrears and purchasing suggest that authorities in London are generally less successful than similar sized authorities outside London. For example, even though the GLC is so successful in purchasing, there are only four London boroughs in the top 50 most effective large purchasing authorities as assessed by the Commission's recent survey; and there are 19 boroughs in the lowest 50. Similarly, Inner London authorities account for 26 percent of estimated tenants' arrears at 30 September 1983, and only 8 percent of council houses.

20. Refuse collection shows a similar picture. London authorities, particularly those in Inner London, tend to have higher costs relative to ROSS standards than authorities of similar size outside London. Table 4 illustrates the phenomenon.

<table>
<thead>
<tr>
<th>TABLE 4: LARGER AUTHORITIES' PERFORMANCE RELATIVE TO ROSS STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Authorities</td>
</tr>
<tr>
<td>Inner London</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Standard or Better</td>
</tr>
<tr>
<td>Within 10%</td>
</tr>
<tr>
<td>Over 10%, Worse</td>
</tr>
</tbody>
</table>
The table also shows that there are some exceptions to the general rule, for example in London Greenwich, and among metropolitan districts Bury and Trafford.

Many Bonuses Ineffective in Securing Better Performance

21. Most refuse collection services operate what are known as "task and finish" bonus schemes — loaders and drivers qualify for a given bonus for an agreed level of performance. Though bonus rates seldom fall below 30%, they vary widely above this level, up to 80% or more of the basic wage. And, as shown in Table 5 total bonus payments to refuse collection loaders and drivers now cost around £60 million a year in England and Wales.

<table>
<thead>
<tr>
<th>TABLE 5: ESTIMATED BREAKDOWN OF DIRECT LABOUR COSTS - 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average £/week</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Basic Pay &amp; Overtime</td>
</tr>
<tr>
<td>Bonuses</td>
</tr>
<tr>
<td>National Insurance and Pension</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Thus, bonuses constitute a sizeable part of the total cost of the service (and their administration accounts for a sizeable part of the overhead cost of the service).

22. Previous Inspectors of Audit have drawn attention to the problems inherent in many bonus schemes. For example, the report of the Chief Inspector of Audit for the year ended March 31, 1979 stated:

"Given the advice and guidance that has been available to local authorities it might be supposed that by now bonus schemes would be consistently soundly based on work study principles. In fact this is not so. Defects and weaknesses are commonplace and continue to figure frequently in either audit reports or memoranda to Chief Officers. They can be classified broadly under three headings: defective schemes, defective or weak supervision of the detailed operation of schemes, ineffective control of expenditure on bonus earnings"

23. That report, which set out the details of the weaknesses under each of these headings, was issued five years ago. Given the pressures on local authorities in the
Exhibit 3

There is no clear relationship between bonus received and bonus 'earned'.

COMPARISON OF BONUS PAYMENTS AND RELATIVE PERFORMANCE
(Excludes Special Payments)

* Relative speed at which men/vehicles work, as shown by ROSS Audit

Source: Audit Commission analysis of ROSS Audit monthly July, 1984
intervening period, it might be expected that many of the weaknesses have now been corrected. At the very minimum, authorities operating bonus schemes - particularly those where payments are well in excess of the standard level of 33% - should have assured themselves that their payments are producing better performance than might otherwise had been expected.

24. In view of the importance of the bonus question, the Commission has compared the level of bonus payments with the actual speed of working at each authority. If bonuses are effective in securing better performance, it might be expected that higher bonuses would be associated with a higher speed - and the reverse - since in theory, most bonuses are determined by the speed at which the men work. There is of course no shortage of examples of authorities where high bonuses are paid for high productivity. However Exhibit 3 demonstrates that this is far from being the rule. The Exhibit shows on the vertical axis the bonus actually paid by each authority and on the horizontal axis the bonus "earned" - i.e. the bonus level that corresponds to the speed at which the men are actually working. It shows for example that there are almost as many cases of people earning well over the standard bonus of 33% whose performance falls well short of standard as there are of the converse; and there is a number of cases of unusually high performance rewarded by little better than average bonus levels. The bonuses shown in this Exhibit exclude "special payments" i.e. payments above the basic wage that are not even in theory related to performance. A number of authorities pay quite substantial sums of this kind. Had these payments been included in Exhibit 3, the disparity between bonuses and performance would appear even steeper.

25. While disturbing, this finding is not surprising. There are evidently some services where bonus systems rather than management effectively determine the way a service is delivered. In refuse collection, as in other local government services, there is no substitute for effective management. The former Chief Inspector of Audit's comments appear as relevant today as they were five years ago:

"Many bonus schemes have become little more than a complicated and expensive method of calculating a man's pay and have weakened local authorities' financial control over an important part of their budget. Having lived with bonus schemes for so long and enjoyed their benefits, workmen will not readily agree to change course by accepting a new wage in which basic pay is more closely related to rewards available in the private sector and bonuses, preferably based on the simplest serviceable schemes, form a much smaller part of gross earnings and become a true reward for above standard performance. There is nevertheless a strong case for moving this direction."
26. A number of authorities have sought to secure better value for money by putting refuse collection out to private contract. These so called privatisation initiatives have attracted considerable interest. For example, Local Government Chronicle reported in June that 18 authorities had so far decided to put their refuse collection services out to private contractors while almost 100 authorities had considered privatisation but rejected it.

27. The Commission has compared the results of those authorities who have put their refuse collection out to private contractors with those (the overwhelming majority) who continue to use direct labour. The results show that privatised services are indeed generally achieving competitive costs against the ROSS standards and thus better results than the average local authority Direct Labour Organisation (DLO). But the better DLOs compare favourably with the performance of the privatised services covered in the survey - against the same standards. Table 6 summarises the findings.

<table>
<thead>
<tr>
<th>% Above or Below Ross Audit Cost</th>
<th>Privatised</th>
<th>DLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best 25%</td>
<td>- 4</td>
<td>- 4</td>
</tr>
<tr>
<td>Average</td>
<td>- 2</td>
<td>+ 4</td>
</tr>
<tr>
<td>Worst 25%</td>
<td>0</td>
<td>+16</td>
</tr>
</tbody>
</table>

The conclusion is clear. Competitive performance is possible with direct labour; but many DLOs are not close to their potential at present and are not cost competitive either with better DLOs or private contractors.

28. The Commission has also examined in more detail the experience of eight authorities who have privatised their refuse collection. All had gone out to tender for their refuse collection and had as a result let the work to contractors and closed their own organisations. All authorities achieved indisputable savings by contracting out. Contractors' tenders totalled £6.2m compared with total estimated direct labour costs of £7.9m (for the same method of collection in each case). Both figures are for 1983-4 (or for the nearest available year, converted to 1983-4 price levels). Any overhead costs which could not readily be saved straightaway were treated in the same way in both totals. A saving of nearly 20% was thus realised, in cash. Each authority made redundancy payments and incurred various other types of severance cost. These are once-and-for-all costs; so they were not included in direct labour costs quoted here. In six of the eight authorities they were however recovered within 12 months by the savings from contracting out.
29. For two of the eight authorities the quality of the service provided is below the standards of the former DLOs. For one authority (which had previously had serious labour difficulties) the contractors' standard is markedly better. For the rest there appeared to be no difference in the standard of service. Five authorities found however that contractors needed greater pressure and higher levels of inspection. As far as possible, the cost of this greater effort is included with the contractors' costs quoted above.

30. Vehicles and depots were made redundant as well as men. Any losses in disposing of them would be hard to calculate but must be set off against savings. One authority leased some but not all its depots (so far as previously used for refuse collection) to its contractor; two depots were therefore underutilised. Another arranged at first to maintain the contractor's vehicles in its own workshop (at cost) but has since allowed the contractor to make his own arrangements. The workshop is no longer viable. Apart from these cases, however, the authorities reviewed appear to have sold or leased their vehicles and depots satisfactorily. There is no reason to suppose that capital losses are inevitable when contracting out.

31. For five of the eight authorities, direct labour tenders (and costs) took credit for recent, or planned and accepted, improvements in productivity. All five authorities appear to have been surprised that contractors' tenders were nevertheless substantially lower. The other three authorities had recognised for some years the low productivity of their own organisations. All attempts to negotiate better arrangements had however failed, even in the face of competition. All three authorities had clearly been confident of their ability to economise by contracting out.

32. For seven of the eight authorities it was possible to calculate approximately whether equal or greater economies might have been made by retaining direct labour, but raising it to the ROSS standard of productivity, assuming this to have been possible and acceptable to all parties. Two of the seven might have done so, one by a comfortable margin. Both are large and relatively prosperous towns. Both had had exceptional labour problems and low productivity, and it appears that their contractors have not been able to better ROSS standards. For another two of the authorities, contractors' costs appear to be about on a par with those of direct labour working at ROSS standards. The remaining districts in the sample are predominantly rural, but include some small dormitory towns. For all four, contractors can work with fewer vehicles and fewer men than ROSS suggests are needed.

33. Comparison of the performance of privatised refuse collection with DLOs thus shows that it is not inevitable that privatised services should be less costly. Indeed, many DLOs are doing as well or better than those services that have been privatised. The difference is likely to be
attributable as much as anything to the quality of local management. The Commission has noted some correlation between authorities' relative performance in those services which it has so far had the opportunity to examine in detail - at least at the extremes. Authorities that are markedly effective in one service tend also to be above average performers in others; and the reverse also appears to be the case.

**NEXT STEPS TO REALISE THE POTENTIAL**

34. Where there are clear opportunities for improvement, it is for local management (members and officers) to decide what changes are appropriate and to negotiate with their work force to secure the necessary improvements. This section therefore covers in turn the action to be taken by authorities and that to be taken by auditors.

**Action by Authorities**

35. Where either the ROSS Audit or Predict suggests that there are worthwhile savings opportunities, the authority in question will want to take the following steps:

(i) Decide the type of collection method that is appropriate to the local situation

(ii) Determine whether to put the service out to private contract or to retain a direct labour organisation (DLO)

(iii) Establish the best way of delivering the required level of service

(iv) Negotiate the necessary changes with the work force.

Each of these steps is discussed in turn below.

36. **Collection Methods.** The first decision to be made is what collection method to use. This is partly a matter of the desired standard of service and of environmental considerations (to the extent that these are separable). Householders receiving collection from their back-door are receiving a "better" service than those required to place their refuse on the kerbside. Authorities will have their own views on what standards are and are not acceptable in local circumstances; these views are not a legitimate concern of the Commission or its auditors.

37. However the decision has economic implications as well. The main influence on refuse collection costs is the walk distance on premise. Typically, annual collection costs increase from around £5 per premise for kerbside collection to perhaps £15 per premise where the average walk distance is 40 yards or more. As Exhibit 4 suggests, bins are generally preferable to other methods for short walks.
Collection method and walk distance are the key determinants of cost

RELATIONSHIP BETWEEN COST, WALK AND METHOD-1984

(Average round mileage)*

* With long round mileage, loose sacks are preferred to skep

Source: Audit Commission analysis
July, 1984
(because the cost of sacks is not offset by the time saved). Where kerbside collection is not acceptable, the short return bin is the preferred method from an economy point of view - the loader collects the full bin from the backdoor and leaves it at the kerbside, for the householder to carry back.

In the course of the various local projects, auditors examined the local cost implications of changing methods using the ROSS Predict model referred to earlier. The results are summarised below for those authorities where the change showed potential savings over current methods. The Table is expressed in terms of annual saving per premise (a typical authority collects refuse from 30-40,000 premises).

**TABLE 7: RESULTS OF ROSS PREDICT**

<table>
<thead>
<tr>
<th>Change</th>
<th>High</th>
<th>Average</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Bin to Short Bin</td>
<td>£7.7</td>
<td>2.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Long Sack to Short Sack</td>
<td>6.3</td>
<td>3.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Long Sack to Short Bin</td>
<td>7.4</td>
<td>6.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Long Bin to Short Sack</td>
<td>3.7</td>
<td>2.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Bin Carrier to Sack</td>
<td>3.7</td>
<td>3.1</td>
<td>2.5</td>
</tr>
<tr>
<td>Short Sack to Short Bin</td>
<td>2.0</td>
<td>1.7</td>
<td>1.4</td>
</tr>
</tbody>
</table>

38. Although many authorities employ more than one method of collection (as is often appropriate in their local situations, but sometimes for purely historical reasons), 160 authorities examined by auditors employ predominantly one collection method. Table 8 shows the methods now in use.

**TABLE 8: COLLECTION METHODS USED 1984**

<table>
<thead>
<tr>
<th>Method</th>
<th>% of Authorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sack with Bin Liner**</td>
<td>35%</td>
</tr>
<tr>
<td>Back-door Bin**</td>
<td>26</td>
</tr>
<tr>
<td>Skep</td>
<td>23</td>
</tr>
<tr>
<td>Kerbside Sack</td>
<td>6</td>
</tr>
<tr>
<td>Kerbside Bin</td>
<td>6</td>
</tr>
<tr>
<td>Short-return Bin</td>
<td>2</td>
</tr>
<tr>
<td>Loose Sack POA*</td>
<td>2</td>
</tr>
</tbody>
</table>

* Pull out in advance (POA)

** Includes POA
Relatively few authorities use kerbside collection, or the short-return bin which might be seen as a reasonable compromise between the economy of kerbside collection and the greater effectiveness from the householder's standpoint of a back-door service. Exhibit 5 shows the average yards walked on premise for the authorities covered in the survey.

39. The authority will therefore need to weigh the service standards against the costs involved. Value for money judgements that can only be made at the local level are called for. Table 7 illustrates the scale of the decisions involved. Moving from back-door bin collection to kerbside bin might well save a typical district authority £200,000 a year and a typical metropolitan district £500,000. The question to be decided is: "is the extra service inherent in back-door collection worth the additional costs - given all the other local uses to which the savings could be applied?".

40. **Direct Labour or Private Contractor?** In view of the findings cited earlier (paragraphs 26-33), that many DLOs are fully competitive with private contractors in refuse collection, the Commission is neutral on the general question of which is preferable. The answer depends on local circumstances and on political philosophy - which is not a legitimate concern of the Commission.

41. The issue was the subject of a conference organized by the Royal Institute of Public Administration (RIPA) in May 1983; the proceedings, Contracting Out in the Public Sector were published earlier this year. The case for contracting services out to private firms was summarised thus:

(a) Because in-house services and direct labour departments are not subject to competition, they are likely to be relatively less efficient in supplying a given output and to over-spend - as "budget maximisers", their budgets are likely to be too large since they tend to overstate the demand for their services and underestimate the costs of their preferred activities.

(b) Private firms are more responsive to change and to customer requirements, since they are reputed to be better managed, technically more efficient, more innovative and willing to introduce new ideas, new techniques and new equipment.
Most authorities provide a back-door service.

**AVERAGE WALK DISTANCE ON PREMISE**

No. of Authorities

*Source: ROSS returns  
July, 1984*
(c) Since there is no ultimate financial sanction of bankruptcy, the public sector is less concerned with costs; the DLO is therefore less influenced by the rewards or penalties of a fixed price contract and more likely to bid low to eliminate contractors - in the knowledge that they can seek a higher budget later.

In similar vein, the Confederation of British Industry* details the merits of contracting out as: financial savings to the authority arising from increased competition, better financial control, more flexibility to adjust service levels without major labour relations problems, less risk of industrial action in some services and lower capital cost for the public to bear.

42. The proceedings of the RIPA conference also summarize the contrary view, as put forward by the Trades Union Congress, for example:

(a) In-house units and DLO's offer a better quality and more reliable service.

(b) Large private concerns are just as subject to monopolistic and bureaucratic tendencies as the public sector.

(c) Private industry lacks the capacity to meet more than a small fraction of a potential demand, so increased competition is unlikely to be a reality in many parts of the country.

(d) Local authorities must still meet the costs of administering and monitoring delivery of the service in question.

(e) Once the DLO is disbanded there will be no going back and thus few effective safeguards against non-performance or excessive price increases by the contractors, when contracts come to be renegotiated.

43. These arguments - on both sides - are presented as universal truths. Proponents regularly argue from the particular to the general. For example, those in favour of privatisation point to the savings achieved in the United States and in some UK authorities resulting from contracting out - or threatening to contract out - services such as refuse collection and school cleaning. Opponents of privatisation cite contrary examples, of contracts where the contractor has allegedly bid low to secure the business and has then failed to meet the terms of the contract.

* Contracting Out for the Provision of Local Authority Services.
44. Unfortunately for the protagonists of both sides, universal truths are rare. The reality is less clear: in some circumstances privatisation may lead to better value for money in refuse collection; in others, where a DLO is well managed and the workforce is suitably motivated, direct labour can be fully cost competitive. Moreover these are early days and one of the most important tests of the economy of privatised services will not come until the initial contracts are renegotiated.

45. In summary, therefore, there is no reason why a well managed DLO should not be comparable in cost with a private contractor, as Exhibit 6 indicates; and the fact that there is competition should keep both groups of suppliers on their toes, as it were. It is for authorities to decide whether the prospects for improving the performance of their DLO are poor enough to warrant the disruption that may well follow a move to privatisate the service.

46. **Action Programmes.** The ROSS models will indicate whether, for the desired collection method, the authority has too many loaders or vehicles - given all the relevant local circumstances. What the model will not do is answer the question: how can the apparently achievable lower costs be realised? This involves detailed examination of rounds, vehicle specifications, manning levels and working practices.

47. Where members decide that changes are required, two possible approaches to developing a detailed action programme are worth considering. LAMSAC, or one of its competitors in this field like the Local Government Operations Research Unit (LGORU) or Inbucon, could be commissioned to review the service and recommend changes to realise the lowest practical cost for the desired collection method. Such a study will cost of the order of £20-30,000, so the potential annual savings will need to be commensurate. Table 9 shows that many authorities should be able to justify the investment.

<table>
<thead>
<tr>
<th>TABLE 9: POTENTIAL SAVINGS IDENTIFIED BY ROSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Authorities</td>
</tr>
<tr>
<td>Annual Saving</td>
</tr>
<tr>
<td>Potential</td>
</tr>
<tr>
<td>&gt;£200,000</td>
</tr>
<tr>
<td>150-200</td>
</tr>
<tr>
<td>100-150</td>
</tr>
<tr>
<td>50-100</td>
</tr>
</tbody>
</table>

48. Alternatively, the work could be done in-house by the local management services staff. They will want to visit LAMSAC, to discuss their methodology and to extract the maximum possible benefit from the ROSS models that have already been applied locally in the course of the audit. They will also be well advised to visit similar authorities which have successfully introduced the kind of changes which
Exhibit 6

There is no reason why DLO's should not be competitive

PERFORMANCE OF 11 PRIVATIZED DLO's vs ROSS

% difference in cost per premise

Source: Audit Commission analysis
are being aimed for locally. Officers in interested authorities can always approach their opposite numbers directly.

49. **Negotiating Changes.** Finally, whatever changes the authority would like to see will have to be negotiated with the workforce. (It is perhaps more than a coincidence that several of those authorities who have put their services to private tender had a history of poor labour relations in their refuse collection services). This is not the appropriate place to discuss the principles of sound labour relations. In any case, there have been many articles on the subject in the local government press; and there have been a number of seminars or conferences on the topic. Moreover, any authority contemplating changes would be well advised to discuss the labour relations aspects with senior officers in one of the authorities which has successfully negotiated major changes in payment systems and working methods. However it is perhaps worth observing that:

(a) All the time standards incorporated into the ROSS models have been agreed at the national level as reasonable by the trades unions concerned - this was an important consideration for the Commission in deciding to use the model in the first place.

(b) It can be done: many of those authorities using direct labour have achieved lower costs by agreement with their workforce and usually without any compulsory redundancies*. Retirements and leavers will mean that staffing levels in many refuse collection services can be reduced by 10-15% a year with no redundancies at all.

(c) The time scale need not be protracted. Even in the very largest refuse collection services, the elapsed time from deciding to reorganise the service to achieve lower costs to implementation of (agreed) changes has been as little as six months.

(d) The benefits can be substantial for all concerned. In one authority, operators' productivity increased by 60%, as a result of changes in working practices and new collection

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* For example, the Birmingham DLO bid for the City's refuse collection contract included a voluntary redundancy package reducing the number of refuse collectors from 544 to 334.
methods; the number of rounds was reduced by 42%; and the number of vehicles was reduced by 56% — all with the agreement of the three trades unions involved and their local membership.

Most important of all, previously unproductive resources were redeployed (from not particularly attractive work) to meet new needs and demands for local services.

**Action by Auditors**

50. The Commission's auditors are now reviewing the results of the ROSS audits at each authority and preparing project reports. These reports provide a basis for discussion with officers and members, describing the analysis that has been completed, setting out the findings, and (where appropriate) identifying possible changes and their cost implications.

51. The immediate next steps for auditors are as follows:

(i) Agree follow-up action to be taken in response to the value for money project report, with specific performance milestones (i.e. what will be done) and a timetable.

(ii) Report the agreed action programme and expected results to the Commission, so that these can be reflected in the Commission's Annual Report — thus underlining to the general public and Parliament the extent to which positive steps are in hand within local government to secure better value for money in this particular service.

(iii) Monitor progress in the course of future years' audits, to ensure that the agreed action programme moves ahead and that the expected results are being achieved.

52. If, at any time, the auditor is not satisfied that appropriate progress has been made it is his duty under the Commission's Code of Local Government Audit Practice to bring his concerns to the attention of the members of the authority in question. If this, in turn, proves unsuccessful in securing the necessary action he will have to consider whether or not to issue a public report. The local residents and ratepayers will then be aware of the unsatisfactory situation and can themselves take the appropriate steps.

* * *

53. As was stated at the beginning of this review, refuse collection is a local government success story. Productivity gains of 4-5% a year over the past five years must compare favourably with those achieved in UK industry, central government and by many nationalised industries. But
the present economic climate is not one in which authorities can afford to rest on their laurels. There is no shortage of unmet needs for local authority services. If, as this review suggests, further substantial gains are possible, the Commission expects that local authorities will wish to pursue them vigorously.

August 1984
1. Five factors can influence the resources requirement of the refuse collection service. These are detailed in Table A - 1 below.

**TABLE A - 1: FACTORS INFLUENCING REFUSE COLLECTION COSTS**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Considerations</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy</strong></td>
<td>Method of Collection</td>
<td>Bin, sack, skep etc.</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>Weekly, fortnightly etc.</td>
</tr>
<tr>
<td><strong>Physical or Geographical</strong></td>
<td>Depots</td>
<td>Existing, selected alternative, etc.</td>
</tr>
<tr>
<td></td>
<td>Disposal Locations</td>
<td>Existing, selected alternative, etc.</td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td>Vehicles</td>
<td>Existing/new, capacities, types etc.</td>
</tr>
<tr>
<td></td>
<td>Disposal</td>
<td>Land fill, incineration pulverisation, etc.</td>
</tr>
<tr>
<td><strong>Workforce</strong></td>
<td>Hours</td>
<td>Working week, over-time performance, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Driving hours, Participation etc.</td>
</tr>
<tr>
<td><strong>Finance</strong></td>
<td>Vehicle</td>
<td>Depreciation, maintenance, running costs, etc.</td>
</tr>
<tr>
<td></td>
<td>Labour</td>
<td>Wage rates, bonus, oncosts, etc.</td>
</tr>
</tbody>
</table>

2. Conventional work study techniques can successfully measure a refuse collection workload and a proposed requirement of vehicles and operators can be produced for a pre-determined level of performance. However, since the task of detailed workload scheduling is a long and involved
process, the first practical solution which appears suitable will usually be the one utilized. Management are therefore inhibited from evaluating a range of alternative proposals as this would be prohibitive in terms of cost and time. More importantly nothing will indicate whether the proposed solution is the most economic one. Furthermore, if the authority has a rising population, manual updating and re-evaluation of the implemented system involves a continuing expense.

3. LAMSAC had for a number of years operated a simulation cost model designed to evaluate a limited variety of collection permutations. This system utilised computer facilities; but although there was a significant saving to authorities in calculating premise/street values considerable manual work study input was still required. In 1978 a complete reappraisal of the system was undertaken. The new system was designed to:

(a) be readily understood by both management and operatives alike
(b) enable regular vetting at each stage of the exercise
(c) reduce manual calculation and input to a minimum
(d) be capable of withstanding detailed challenge
(e) be able to analyse all collection permutations including, if required, by premise type.

The result of this exercise - ROSS - is not a modified version of the earlier model, although it embodies a number of similar principles, but a considerably more flexible and comprehensive system. It is able to stimulate an answer, normally accurate to within 2%, for any permutation of the five factors identified in Table A-1 above for either part or the whole of an authority.

4. The ROSS system consists of a family of programmes which can be utilized as a whole or in part. These are:

(i) ROSS Operation - This provides a detailed and individualized service for an authority.
(ii) ROSS Audit - This programme provides an audit of the existing service from data supplied by an authority by means of completing a simple questionnaire. The accuracy of the result reflects a full ROSS exercise to within 5%, subject to the accuracy of the data supplied.
(iii) ROSS Predict - This programme provides a predictive function to ROSS Audit thereby enabling the overall effect of, for example, a change from a bin to sack service or a change in department location.
It is not anticipated, in either of the above ROSS services, that survey or study work is necessary. The information required is normally available within an authority or can be readily assessed by officers with experience of the service.

5. The models are applied in a five-stage process which is described below, using ROSS Operation for illustrative purposes.

(i) Data input and printout. A survey sheet has been so designed that the premise data from either on-site survey or existing information can be input directly to the computer.

The time data is normally work study based. It can either be obtained locally or provided by LAMSAC, subject to minimal verification work. In the case of data for methods of collection not operating in the authority, it will be necessary either to undertake a pilot scheme for study purposes in the authority or to utilize LAMSAC data. In the latter circumstances the data provided by the authority for the existing method of collection will be statistically compared with LAMSAC's and the LAMSAC data for the new methods adjusted to reflect any local differences indicated.

The data input to the computer must be acceptable to management, trade unions and operatives. For this purpose a printout is provided of the premise input data. This printout can be checked by both management and men and, in changes are necessary, the computer file is corrected accordingly. A similar facility is available for the time data input.

A further facility enables the input to be analysed onto a separate printout to define, for example, either by street or in total, the different types of premise or all premises that have in excess of ten bins, etc.

(ii) Data processing. An initial computer run will calculate the collection workload for the method of collection currently operating. The result of this "primary" run will indicate the economic resource requirement and provide an initial datum point for comparisons.

Subsequent "method" runs can be carried out to indicate the resource requirement of alternative methods of collection stipulated by the authority. All of the input data will be automatically converted to the chosen method of collection and calculated accordingly. For example, the data used in the "primary" run,
which may have been backdoor bin, would be converted to data for use in the chosen method run which could be kerbside bin.

Currently the system will deal with 17 basic methods of refuse collection which can be readily extended to around 45 if the continental automatic lift wheeled bin service, use of dustless vehicles, the difference between paper and plastic sacks, use of specialised containers for sack bin liner etc., are included.

The 17 basic methods are:-

- Backdoor bin
- Kerbside bin
- Backdoor bin short return
- Backdoor bin - pull out in advance
- Backdoor bin carrier
- Backdoor bin carrier - pull out in advance
- Backdoor skep
- Backdoor bin transfer
- Backdoor sack - loose
- Backdoor sack - loose - pull out in advance
- Backdoor sack - cage holder
- Backdoor sack - cage holder - pull out in advance
- Backdoor sack - clamp holder
- Backdoor sack - clamp holder - pull out in advance
- Backdoor sack - bin liner
- Backdoor sack - bin liner - pull out in advance
- Kerbside sack

Additionally, a maximum distance on-premise walk can be imposed for any method as can a maximum off-premise walk.

The system, in addition to normal refuse collection, is able to evaluate other services, e.g.:-

- Backdoor salvage
- Kerbside salvage
- Backdoor salvage - pull out in advance
- Bulk container

The collection workload results of the "primary" and "method" runs requested are printed as totals, together with any appropriate sub-totals.

(iii) Calculating resources required. The principle of the simulation model is based upon extracting the time available for collection work from the loaders total availability and dividing it into the workload.
The required number of loaders needed is calculated as follows:

\[ y = \frac{C}{480 - \frac{M}{x}} \]

where \( y \) is the number of loaders, \( C \) is the collection workload, 480 is total minutes per day, and \( \frac{M}{x} \) is time spent travelling etc. \( M \) is amount of travelling required and \( x \) is the number of vehicles. Loaders and vehicles are complementary resources, and the above could equally well be expressed as the number of vehicles required equalling the travelling/tipping load divided by the time available for travel (480 minus collection time, during which the vehicle is idle).

The computer prints out the values of \( x \) and \( y \).

The results of this calculation are divided into the total collection workload for each method of collection. By varying any of the input factors and relating the costs of vehicles, drivers and loaders to the results, differing permutations of input data to the model can be examined.

The following input factors are considered within the application of the model:

- Total workload
- Loader availability
- Daily allowance
- Travel depot to round
- Travel tip to depot
- Returns to depot
- Travel round to tip
- Tipping
- Travel tip to round
- Number of loads (bins, sacks, excesses etc.)
- Vehicle capacity
- Vehicle utilisation
- Walk between premises
- Vehicle travel between streets
- Vehicle travel within streets
- Mount/dismount vehicle
- Vehicle cost
- Driver cost
- Loader cost
- Fixed cost
- Driver participation

Initially the model calculates the cost optimum solution which may or may not be practical for a variety of operational reasons, i.e. the solution could recommend 4 man teams whereas the vehicles available may have 3 man cabs fitted.
In these circumstances the model would calculate a 3 man team solution for immediate operational purposes. The increase in cost can be compared readily to the cost optimum solution and future vehicle purchasing policy formulated.

The model can be applied to an authority as a whole or in part i.e. rounds, days, areas etc. with results calculated to 0.10 of a vehicle related to both costs and operational constraints. It will readily evaluate the long term effects of development, expansion and/or any changes that affect the service thereby providing for long term planning to a detail unknown before.

(iv) Final printout. This includes details of all street and individual premise input data together with appropriate evaluations.

The primary aim of this printout is to provide a fully detailed cross check of the total exercise for discussion with the trade unions and operatives. For an authority not utilizing the ROSS Schedule CASc (Computer Aided Scheduling) system it will additionally provide the necessary data for manual scheduling of the service. This is achieved by the computer calculating the scheduling values for collection teams varying in size from 1 - 6 men and detailing them on the printout. (Team sizes can be determined by the simulation model). Provision is made within the calculations to allow for drvier participation or not, depending upon Council policy.

(v) ROSS Schedule. This programme extracts the data required for the scheduling of rounds from the LAMSAC main computer file and collates it as a separate file. The scheduling file is then transferred to disc to enable the authority to undertake the scheduling of rounds locally on an appropriate micro computer.
6. The ROSS Audit and Predict programmes use the same basic time standards and apply the relationships derived from application of ROSS Operations between the variables identified in Table A - 1 and the key determinants of cost: number of rounds, vehicles and loaders. However, the programmes rely on much less detailed input; and, as a result, the output is also less detailed - being presented in the form shown opposite.

7. The benefits of implementing a revised service will be short lived without adequate maintenance. Changes in equipment, depot and tipping locations, new building and demolitions, etc. will quickly erode the system. To date, authorities using ROSS have been able to update via LAMSAC or undertake the task manually using ROSS Audit periodically to check their results. The introduction of ROSS Maintenance provides a total microcomputer based maintenance function within the local authority.

8. An authority having undertaken a full ROSS exercise is unlikely to consider another major overhaul of the service for a number of years. It follows, therefore, that a ROSS Operation service with all its facilities is not necessary to an authority for maintenance purposes - it only requires a means of maintaining its selected service. This is achieved by separating ROSS into individual methods of collection maintenance programs, i.e. an authority operating a backdoor bin service would have the ROSS Maintenance backdoor bin version, a back door sack authority would have the back door sack version, etc.

9. The individual programme facilities include premise and time data updating, modelling with the predictive functions relative to the selected service, result printing, etc. - in fact all of the functions required to maintain the service at the standard in which it was implemented.

* * *

10. Of the 60 authorities that have used the full ROSS system, the great majority have reported substantial savings in operational costs. The extent of these savings have been identified in the media i.e. a London borough saved £700,000 a year, approximately 30% of total cost; a District Council saved £130,000 a year approximately 25% of total cost.

11. The values and procedures within the ROSS system are valid internationally. ROSS is used successfully in both large and small municipalities in the USA, Australia etc. Discussion have taken place with a development consortium to plan a refuse collection service for a town which is currently only a green field site.