

AN
ACCOUNTING
SYSTEM
for
solid waste
collection



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This report (SW-271s) was written by

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AN ACCOUNTING SYSTEM

for solid waste collection

Eric R. Zausner*

The increasing costs and complexities of solid waste collection require new, more sophisticated management techniques. Because data on performance and the costs of operation and ownership are essential for the use of these management tools, an adequate information system is a prerequisite to effective management. Although cost accounting represents only one part of the total information system, its design, installation, and utilization can represent the most significant step in the development of effective solid waste management.

Present information on collection activities and associated costs is both inadequate and nonstandardized. The proposed system provides a guide to the type and quantity of information to be accumulated, its classification, and the method of collection. It is intended to be of use to municipal or private personnel involved in collection operations. Because of the complexity of solid waste collection, this system is only intended as a guide to the types of data to be collected, reduced, and presented. The system can work as presented, but will be most efficient when modified to meet the specific requirements of a given operation.

Installation of a cost accounting system can aid the collection supervisor in controlling the costs and performance of the operation and also in planning for the future.

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System Benefits

Installing a system such as the one described herein has several important advantages:

1. The system facilitates orderly and efficient accumulation and transmission of all relevant data. In fact, much of the recommended data is probably being collected already, although haphazardly and inefficiently. Hence, the added cost of installing the system is minimal.
2. Reports are clear and concise and present only the data required for effective control and analysis. Because the personnel can complete and understand the reports, the system can operate in a relatively foolproof manner.
3. The data are grouped in standard accounting classifications. This simplifies interpretation of results and comparison with data from previous years or other operations, and in turn, allows analysis of relative performance and operational changes.
4. The system accounts for **all** relevant costs of operation.
5. Accumulated data from the system can, over a period of time, lead to standards of performance and efficiency. These standards are used to control costs. They indicate which costs are high and the reasons. The supervisor of operations may then take corrective action.
6. The system includes automatic provisions for accountability. Cost control becomes more effective when the individual responsible for cost increases can be ascertained.
7. Use of the collected data aids in short- and long-range forecasting of operating and capital budgets. Future requirements for equipment, manpower, cash, etc., can be more accurately estimated; this, in turn, aids planning at all levels of management. The data are also available for later evaluation and analysis with the use of operations research techniques.
8. With only minor modifications, the system is flexible enough to meet the varying requirements of communities with collection activities of different size, scope, and operational procedures.

Cost Centers and Cost Allocation

Two general types of costs are incurred by collection activities: operating costs and the cost of financing and ownership (Table 1). Operating costs include labor, oil and gas, parts and supplies, utilities, supervision and administration,

TABLE 1
SUMMARY OF COST TYPES

Labor	_____	
Oil and gasoline	_____	
Parts and supplies	_____	
Utilities	_____	
Supervision and administration	_____	
Charges from other departments	_____	
External contractual services	_____	
Miscellaneous	_____	
TOTAL OPERATING COSTS		=====
Depreciation	_____	
Interest	_____	
TOTAL FINANCING AND OWNERSHIP COSTS		=====
TOTAL ANNUAL COSTS		=====

charges by other departments, external contractual service, and other miscellaneous expenses. Labor costs include direct wages, overtime pay, and all associated fringe benefits. Included in fringe benefits are vacation pay, sick pay, group life and medical insurance, social security payments, and pension contributions.

Ownership and financing costs are those associated with the loss in value of fixed assets (both equipment and facilities) and the costs of funds required to purchase and retain the fixed assets. More commonly, the terms depreciation and interest are used.

Generally, most operational costs are expressed in the terms mentioned above. As operations become more complex, however, a more sophisticated method of accounting is required to facilitate analysis and control. To accomplish this, collection activities are assumed to consist of several inter-related suboperations, each of which is analyzed separately. These suboperations are usually denoted as cost centers, because costs are accumulated separately for each of them. Analysis and control are simplified if excessive costs or inefficiencies can be traced to a functional activity or area of the operation; in large and complex operations, tracing may be impossible without cost centers.

The ideal number of cost centers increases as the size and complexity of operations increase. More cost centers require the collection of more data, however, and, therefore, increase the accounting costs. For moderately sized collection operations, without transfer operations, three cost centers appear to collect adequate information without incurring excessive data accumulation and reduction expenses. A separate accounting system should be employed to handle the transfer operation.

The three cost centers are: Route Service, Waste Hauling, and Repairs and Maintenance. The first two cost centers are termed direct cost centers because they include activities directly related to collection. The Route Service cost center accumulates all costs associated with the collection of wastes on the routes themselves. The Waste Hauling cost center accumulates all costs associated with hauling solid wastes from the routes to the processing and disposal site or sites. This cost center also includes the costs of going to and from the garage or vehicle storage and repair area.

The Repairs and Maintenance cost center, an indirect cost center, accumulates all costs associated with the repairs and maintenance of all collection facilities and equipment. Because repairs and maintenance activities can represent a substantial proportion of costs, these activities and their associated costs are analyzed by a separate cost center; however, these costs are then allocated to the two direct cost centers because they use the repair and maintenance services.

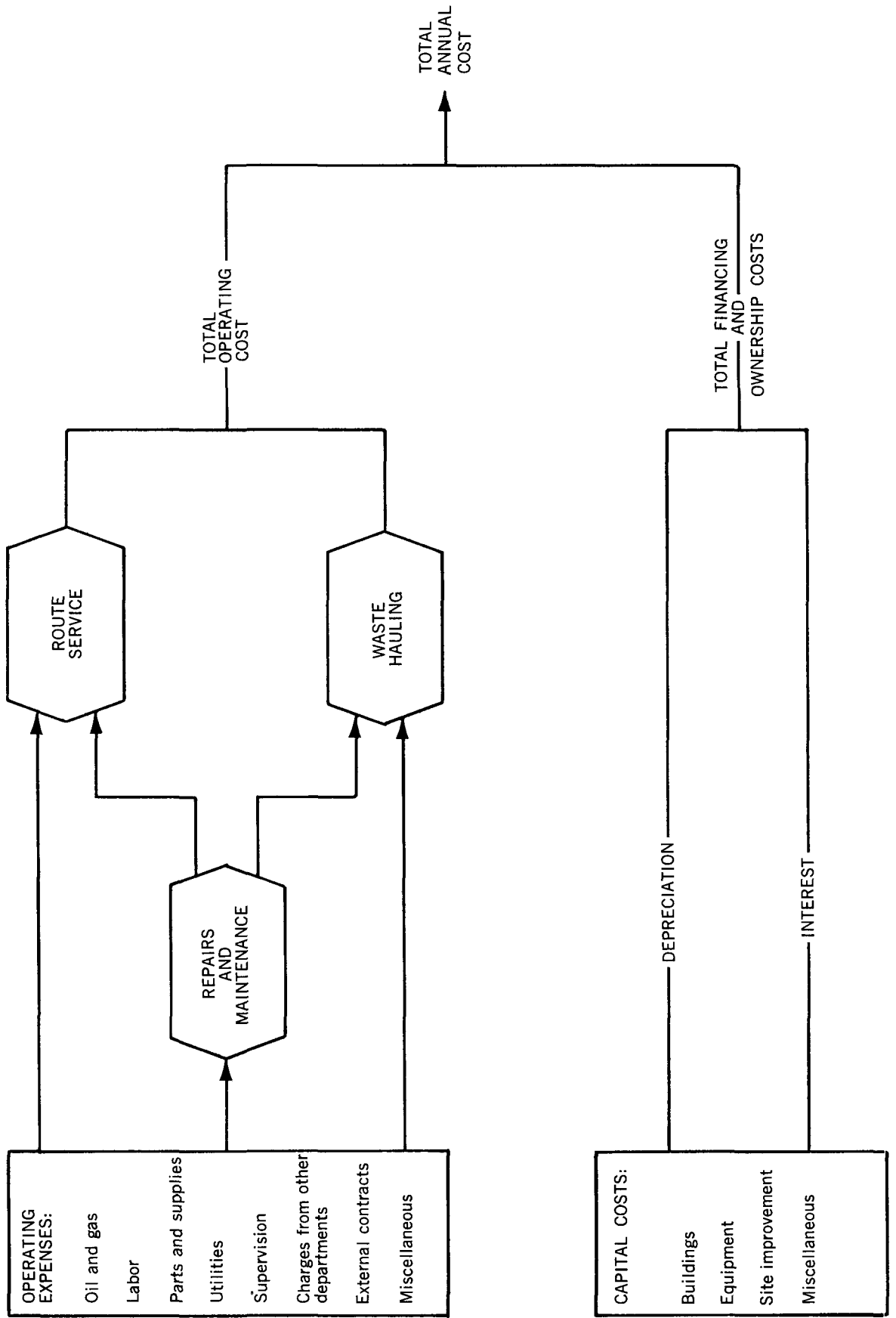
The operating costs must be allocated to the three cost centers in an accurate and representative manner. Although financing and ownership costs can be allocated to individual cost centers, the benefits do not justify the additional calculations. For general analysis and control, operating costs are sufficient for cost center analyses. At infrequent intervals, when the additional data are required (for lease-buying decisions, etc.), reconstruction is easily accomplished. The procedure for allocating the operating costs to the three cost centers and the relation of these operating costs and the financing and ownership costs to the total annual cost has been illustrated (Diagram I).

The method of allocation for each type of operating cost is as follows:

The labor cost allocated to the cost centers is based on the actual number of employees in each cost center and their associated total wages and benefits. For instance, maintenance personnel would have their total labor costs assigned to the Repairs and Maintenance cost center. Drivers and loaders would have their associated costs divided between the remaining two cost centers based on the percentage of their time utilized in each center.

Oil and gasoline costs are accumulated in total as well as for each vehicle. They would be proportionately allocated to the Route Service and Waste Hauling cost centers. The percentage of total equipment hours traveled while engaged in each cost center's activity is an adequate method for allocating these costs. Parts and supplies and utilities would be charged totally to the Repairs and Maintenance cost center since this center first incurs these expenses. General overhead, which include supervision, administration, and charges from other departments (payroll, accounting, other levels of the sanitation department, etc.), could be allocated equally

DIAGRAM I
ALLOCATION OF COSTS TO THE COST CENTERS



to each of the three cost centers or charged on the basis of the number of employees utilized in each cost center. The latter technique is recommended.

The costs of the Repairs and Maintenance cost center would finally be allocated to the two direct cost centers; the allocation would be based on the number of equipment hours each utilized. Note that in the route service area, repair costs per hour can be higher for certain types of expenses such as brakes, clutches, etc.; whereas, in the Waste Hauling cost center, tires, etc., may incur more wear and be a greater expense. Until more definitive data are available, however, the "coarser" approach is suggested.

The sum of the costs of the Route Service and Waste Hauling cost centers is the total operating cost. The actual system is designed to facilitate the accumulation and later allocation of costs to these cost centers.

Reports and Information Flow

Information flows through the cost system by the use of reports, the vehicles that transmit information between the transmitter and the receiver (Diagram II). The reports or forms can be classified as those that are primarily used to collect data and those that are used to reduce and present this data for effective management analysis and control.

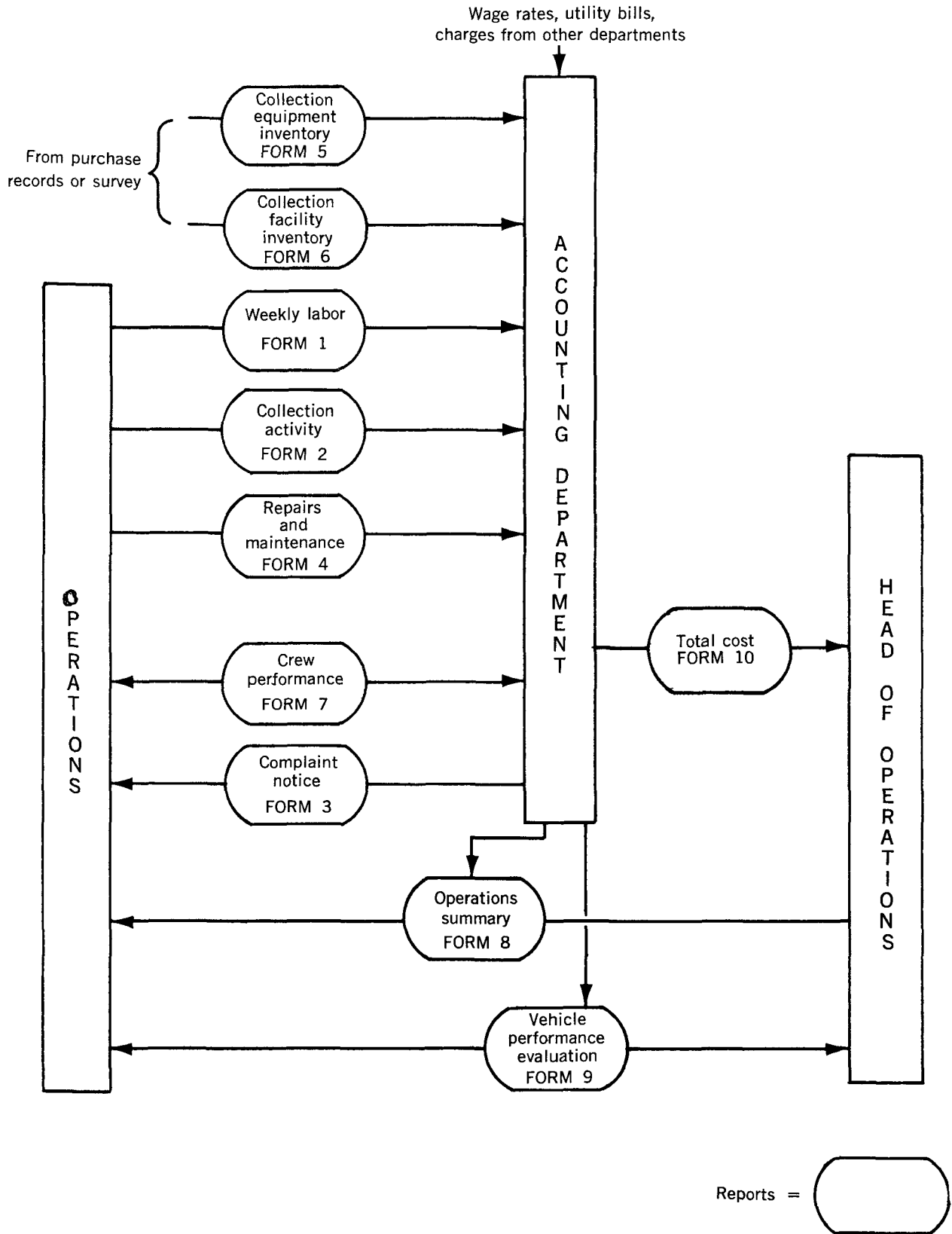
Data Collection Forms

Cost analysis and control through the preparation of periodic summary reports cannot be accomplished without recording all pertinent activity and cost information. Data on activities and costs, to be retrievable at some later date, must be recorded at the time it is generated.

Weekly labor record (Form 1). The foreman or supervisor records daily labor activities at the garage. One copy is forwarded weekly to the payroll department for determining payroll checks. Another copy is forwarded to the accounting department (or used by the supervisor) for computing total labor hours and assigning these hours to the various collection activities and related cost centers.

Daily collection activity report (Form 2). Each day the collection vehicle driver records data on the collection crew's routes, activities, and performance. Of particular importance is the check list for equipment operation; many potential equipment failures are routinely noted. This aids

DIAGRAM II
REPORTS AND INFORMATION FLOW



DAILY COLLECTION ACTIVITY REPORT

FORM 2

Time out _____ Mileage out _____
 Time in _____ Mileage in _____

Date: _____
 Truck # _____
 Crew # _____
 Net time _____
 Net miles _____
 Gas purchased (gal.) _____

Driver: _____

Remarks:

Loader: _____

Loader: _____

Check if abnormal:

Eng. temp.
 Oil press.
 Ammeter
 Packer
 Brakes
 Lights
 Other

Check if relevant and report to supervisor:

Personal injury
 Automotive accident
 Property damage

Time start	Time finish	Weight	Route #	Nonproductive time	
				Hrs.	Cause
Total weight					

Instructions: The driver is to complete this form each day. "Time out" and "Mileage out" are to be completed when the truck leaves the garage in the morning. "Time in" and "Mileage in" are to be completed at the end of the day when the truck is back at the garage. When the truck reaches the first route, the time is noted in the "Time start" column and the route designation is also noted. When the truck is full or the route is left for any reason, "Time finished" is entered. Upon returning to the same route or another (after a trip to the disposal site), the next "Time start" entry is made. At the disposal site, the net weight of wastes collected is entered. Accidents, injuries, or any equipment malfunctions are to be noted in the boxes provided and a detailed explanation given in the "Remarks" box.

the foreman in scheduling equipment maintenance. The form also collects the data needed to determine total time to service routes and to haul refuse to the disposal site, as well as the weight of waste collected. Data on accidents and injuries are also routinely noted. Important data are recorded in the left and bottom margins for easy reference and sorting. Detailed instructions for completing this form are included on the form.

Complaint notice (Form 3). The person receiving public complaints records the complaint and sends the completed form to the operational foreman (supervisor). From the collection activity form that corresponds to the date and route of the complaint, the foreman can locate the proper driver and loaders. If necessary, the supervisor may warn the crew orally.

Repairs and maintenance record (Form 4). Activities of the maintenance department and the costs incurred in maintaining each collection vehicle are recorded. One form is on file for each vehicle, and entries are made only when maintenance or repairs are undertaken. Total costs for the department as well as the costs for each truck are accumulated. The data are needed to assign the costs to the other two cost centers and to evaluate the efficiency of individual trucks.

Collection equipment inventory (Form 5). Data required to calculate vehicle depreciation and interest costs and allocate them to operations are collated on this report. The form, which can include active and inactive vehicles, should be completed when the accounting system is installed and updated only when new equipment is purchased or old equipment is sold. It would not be required where similar forms for these data are already in use.

Collection facility inventory (Form 6). On this form, which contains data similar to that in the previous form, total facility costs and their associated interest and depreciation costs are recorded and allocated to the proper operation. This form should be completed when the accounting system is installed and updated when improvements or modifications are made to existing facilities or when additional fixtures are purchased. As with Form 5, this form may be deleted if a similar form is already in use.

Data Reduction and Presentation Reports

Reports 7 through 10 are completed at less frequent inter-

TOTAL COLLECTION FACILITY INVENTORY

FORM 6

DATE: / /

Facility	Description	Date put in use	New cost	Estimated total life	Other comments	Annual depreciation	Monthly depreciation
Land						XXXXX	XXXXX
Buildings							
Garages							
Roads							
Lights							
Fences							
Surveys							
Other							
Totals	X	X		X	X		

(FOR USE BY ACCOUNTING DEPARTMENT ONLY)

Financing data — Equipment and facilities

Bond type	Face value	Premium or discount	Interest rate	Yearly interest	Monthly interest

Instructions: To be completed by supervisor or accounting department if they have data available. "Estimated total life" should be based on remaining life as estimated by the supervisor. Depreciation may be either on a straight-line or accelerated basis.

vals than the data collection forms. These intervals depend on the type of information transmitted. To be effective, certain types of control and analysis require more frequent feedback than other types. All of the following forms reduce the data collected in Forms 1 through 6 in addition to other data available to the accounting department.

Crew performance evaluation report (Form 7). The accounting department should compile the data on labor performance and efficiency weekly. This information, taken from data in the Daily Collection Activity Report (Form 2), is forwarded to the supervisor or foreman for his use and makes possible short-term action to control costs.

Operations summary report (Form 8). In this report, the collection activity and its associated operating costs are summarized. The report can be for the whole system or for each district if the size of the system warrants it. As a cost control report, routine and frequent preparation is critical; monthly intervals should be sufficient. The accounting department prepares the report and forwards copies to both the supervisor and his superior (head of the sanitation department). The report is particularly useful for cost control; the total unit cost, as well as unit costs for the various cost centers, indicates where excessive costs were incurred. In addition, various measures of efficiency are presented to isolate the cause or causes of high operating costs. For instance, "tons per number of trips to disposal site" adequately measures truck utilization and the effectiveness of the routing schedule to ensure full truck loads during and at the end of the day. Detailed definitions of terms and computations are included on Form 8 — Supplement.

Vehicle performance evaluation report (Form 9). The data accumulated on this form represent the total and individual costs of operating the collection vehicles. Because data are accumulated separately for each piece of equipment, individual equipment efficiency and cost can be evaluated and when to sell or trade presently owned equipment for more economic alternatives can be determined. Since this decision involves long-term assets, only quarterly or semiannual reports are necessary. More frequent preparation would not substantially improve making decisions that would minimize the costs of operating these assets. It may be desirable, however, to prepare reports on any given truck if and when it

OPERATIONS SUMMARY REPORT

FORM 8

PERIOD: _____ from _____ to _____

	Factor	Amount for this period	% Variance from	
			Budget	Budget last period
Totals	Tons collected			
	Total operating cost			
	Total operating cost/ton			
	Collection labor cost/ton			
	Equipment operating cost/ton			
	Overhead cost/ton			
	Number of accidents			
Route Service Cost Center	"Cost Center" cost/ton			
	% Time on route			
	Tons/ direct labor hours on route			
Hauling Cost Center	"Cost Center" cost/ton			
	Tons/number of trips to disposal site			
	% Time hauling			
	Average miles/hour			
Repairs and Maintenance Cost Center	"Cost Center" cost/ton			
	Repairs and maintenance cost/equipment hour			
	% Time equipment down			
	Parts cost			

DEFINITION OF TERMS

Tons collected

Include the total weight (in tons) recorded during the period on all completed Form 2's. This figure is used for all unit cost calculations.

Total operating cost

Include all labor costs and fringe benefits (vacation pay, medical and life insurance, etc.), parts and supplies, utilities, supervision, charges by other departments, and external expenses incurred for repairs and other services.

Collection labor cost

Include wages and fringe benefits of drivers and loaders.

Equipment operating cost

Include gas, labor, parts, supplies, and external repair charges for all equipment repairs.

Overhead cost

Include supervision and other labor expenses, utilities, charges by other departments, and miscellaneous expenses not included in other areas.

Route Service Cost Center cost

Multiply the collection labor cost plus equipment operating cost plus overhead by the percent of time on route. Percent of time on route can be computed for each truck, each crew, and the total collection system from time data on Form 2.

Hauling Cost Center cost

Multiply the collection labor cost plus equipment operating cost plus overhead by 1 minus the percent of time on route.

Repairs and Maintenance Cost Center cost

Add the costs of repair and labor plus parts plus supplies plus external charges plus overhead.

Equipment hours

Include total hours on all trucks for total period (recorded as net time for each truck on Form 2).

exceeds a given level of repair charges. For instance, each vehicle's repair expenses can be compared with the average of all vehicles, and when a vehicle exceeds this average by 25 or 50 percent, it can be singled out for further analysis. The accounting department, which prepares this form, sends a copy to the operational supervisor and the head of the sanitation department.

Total collection cost summary (Form 10). All the activities and costs associated with collection activities during the period are compiled on this report from data available in the Operations Summary Report (Form 8) and the Collection Equipment and Facility Inventory forms, (Forms 5 and 6). The combined operating costs and the depreciation and interest costs represent the total cost of collection activities for the period. The accounting department can complete this form quarterly or semiannually and send it to the head of the sanitation department or his equivalent. Form 10 — Alternate can be used instead of Form 10 if user charges or other types of revenues are associated with collection operations.

Report Flow Summary

A brief summary may help to put the system in perspective. The personnel directly engaged in collection activities complete data accumulation forms daily. These are transmitted periodically to the accounting department. The accounting department collates the information received and adds additional information it already possesses to complete the summary reports on performance, activity, and costs. These forms are then fed back to the supervisor for control purposes. In addition, selected summary reports on total cost and equipment performance are compiled and forwarded to the supervisor and his immediate superior.

TOTAL COLLECTION COST SUMMARY

DISTRICT: _____ PERIOD: from _____ to _____

Data	For this period	Budget period	Year to date	Budget-year to date
Tons of refuse collected				
Total operating cost				
Total financing and ownership cost				
Total cost				
Operating cost/ton				
Financing and ownership cost/ton				
Total cost/ton				

Instructions: To be completed periodically by the accounting department from data available in Operations Summary Report (Form 8) and the capital cost reports (Collection Equipment and Facility Inventory, Forms 5 and 6). Copies sent to the city manager (or his equivalent).

TOTAL COLLECTION COST SUMMARY

FORM 10 -- Alternate

DISTRICT: _____ PERIOD: from _____ to _____

Data	For period	Budget period	Year to date	Budget-year to date
Tons of refuse collected				
Total operating cost				
Total financing and ownership cost				
Total cost				
Operating cost/ton				
Financing and ownership cost/ton				
Total cost/ton				
Residential revenues				
Commercial revenues				
Industrial revenues				
Miscellaneous revenues				
Total revenues				
Total revenues/ton				
Net cost (profit)				
Net cost (profit)/ton				

System Utilization

Only with efficient and intensive utilization of the information generated from the accounting system and forms can the additional time, effort, and money required to implement and maintain the system be justified. The system's intensive use promotes two major objectives: quality control and cost control. Reduced costs must be accomplished without deteriorating operating quality. Similarly, quality is inter-related with the costs of obtaining it.

All the factors that affect the quality and effectiveness of collection operations can be translated into costs. Cost control does not call for economizing at the expense of quality. On the contrary, once a level of acceptable operation has been determined along with the attendant costs, the cost control system can help the supervisor maintain that level of operation.

Effective cost control requires timely recognition of excessive costs and identification of responsibility for the increased costs. Comparing units costs (cost per ton of waste collected) with both the current budget and the corresponding period last year helps indicate excessive costs. The use of unit cost facilitates the analysis of costs, independent of changes in the level of activity. The cost-center breakdowns help single out the responsible factor or person. This system allows both of these critical factors to be determined, corrective action may then be effectively initiated.

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