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**an accounting system
for solid waste shredders**

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AN ACCOUNTING SYSTEM
FOR SOLID WASTE SHREDDERS

by Steven J. Hitte*

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

Present information on solid waste shredder activities and associated costs is both inadequate and nonstandardized. Furthermore, the use of shredders will continue to expand as urbanization causes increased concentrations of solid wastes and a scarcity of proximate disposal sites. The proposed accounting system provides a guide to the type and quantity of cost information to be gathered, its classification, and the method of collection. It is intended to be of use to municipal or private personnel involved in solid waste shredder operation and ownership.

Installation of a cost accounting system can help the shredder plant manager control the costs and performance of operation and also plan for the future. The system can be implemented as presented or modified to meet the specific needs and problems of the potential user.

Systems Benefits

Some of the more important advantages of a cost accounting system are:

(1) The system facilitates the orderly and efficient collection and transmission of all relevant data. In fact, most of the data to be recorded are probably being collected already, although

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perhaps only sporadically and ineffectively. Hence, the added cost of installing the proposed system is minimal.

(2) Reports are clear and concise and present only the amount of data required for effective cost control and analysis. They can be understood and completed easily by station personnel.

(3) The data are grouped in standard accounting classifications. This simplifies interpretation of results and comparison with data from previous years or other operations. This, in turn, allows analysis of relative performance and operational changes.

(4) The system accounts for all relevant costs of operations.

(5) Because the system detects high costs and identifies their underlying causes, the supervisor can control expenses more effectively. Similarly, performance and efficiency may be monitored and controlled. Accountability therefore is superimposed on the system to indicate who or what is responsible for the increased costs.

(6) The data provided are in a form that aids in the short- and long-range forecasting of operating and capital budgets. Requirements for equipment, manpower, cash, etc., can be estimated to aid budgeting and planning at all levels of management. The data are also available for later evaluation and analysis using operations research techniques.

(7) The system, with only minor modifications, is flexible enough to meet the varying requirements of different sizes of solid waste shredders.

Cost Centers and Cost Allocation

Two general types of costs are incurred by solid waste shredder operations (Table I): operating costs and the cost of financing and ownership. Operating costs include labor, utilities, parts and supplies, and overhead. Financing and ownership 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.

The complexity of solid waste shredder operations requires a breakdown and description of operations to facilitate cost analysis. In the proposed system, the shredder is assumed to consist of several

TABLE I
SUMMARY OF COST TYPES

Labor (1)	_____	
Parts and supplies (2)	_____	
Utilities (3)	_____	
Overhead (4)	_____	
TOTAL OPERATING COSTS		=====
Depreciation (5)	_____	
Interest (6)	_____	
TOTAL FINANCING AND OWNERSHIP COSTS		=====
TOTAL COSTS		=====

- (1) Labor includes all direct wages, overtime pay and fringe benefits. Fringe benefits include the costs of group insurance, social security, pensions, vacation benefits, etc.
- (2) Parts and supplies include welding rods, oil, gas, grease, repair parts, miscellaneous supplies, etc.
- (3) Utilities include electric, natural gas, water, etc.
- (4) Overhead includes supervision, payroll and accounting services by other departments, liability and property insurance, taxes, and external charges. External charges include audits, contractual services, etc., when they are performed by other municipal departments, private contractors or consultants.
- (5) Depreciation may be calculated using either straight line or accelerated methods.
- (6) Interest should represent actual costs of funds.

interrelated suboperations, each of which is analyzed separately. These suboperations are called cost centers because expenses are accumulated separately for each of these functional activities (Figure 1). Analysis and control are simplified if excessive costs or inefficiencies can be traced to specific functional activities or areas of the facility.

The number of cost centers required increases as the size and complexity of operations increase. In most cases, shredder operations would include activities at the shredder as well as the final haul to the disposal site. In this event, three cost centers would probably suffice to gather adequate information without incurring excessive data collection costs.

The three cost centers are: Solid Waste Shredder, Shredded Waste Hauling, and Repair and Maintenance. The first two cost centers are termed direct cost centers because they include activities directly related to shredding and hauling operations. The Repairs and Maintenance cost center, which accumulates all costs associated with the repairs and maintenance of the shredder facility and equipment, is an indirect cost center. Because repairs and maintenance activities can represent a substantial proportion of costs, these activities and their associated costs are analyzed as a separate cost center; however, these costs are then allocated to the two direct cost centers because they receive 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. Figure 1 illustrates the procedure for allocating the operating costs to the three cost centers and the relationship of these operating costs and the financing and ownership costs to the total annual cost.

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

- ° The labor charges should be allocated to the cost centers based on the number of hours employees worked in each and on their respective wage rates.

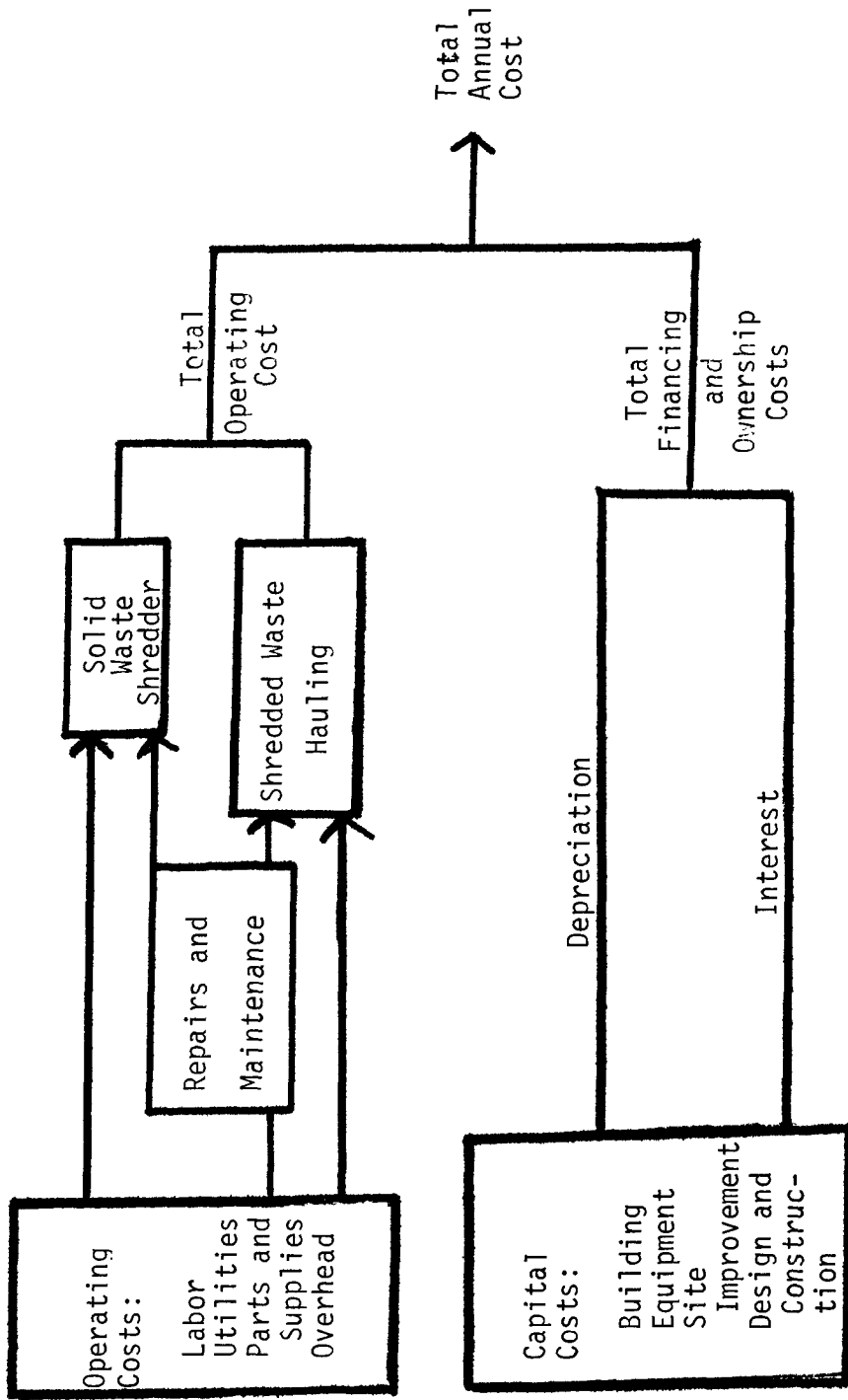


Figure 1. This diagram illustrates cost centers and cost allocation in a cost accounting system for shredders.

- Parts and supplies include oil and gasoline as well as any materials used for repairs and maintenance. For example, gasoline costs are assigned directly to the Shredded Waste Hauling cost center because they are incurred by its vehicles.
- All other parts and supplies are allocated to each direct cost center after being recorded in the Repairs and Maintenance cost center.
- Repair charges levied by other municipal departments or private firms are also allocated to the direct cost centers after being recorded in the indirect cost center.
- Utility costs are incurred by the Repairs and Maintenance and the Solid Waste Shredder cost centers.
- General overhead, which includes supervision, administration and charges from other departments (payroll, accounting) can be allocated equally to each cost center or on the basis of the number of employees each has.

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 expenses each has incurred.

The sum of the costs of the Solid Waste Shredder and the Solid 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.

Forms and Reports

Information flows through the cost system by way of eight reports (Figure 2). They transmit data collected in the field for use at various levels of supervision and management. The reports are most easily grouped into those that are primarily used to collect data on operations and those that are used to reduce and analyze data for decision-making and control.

Reduction and presentation cannot be accomplished unless all pertinent activities and cost information are recorded daily. If this is not done, the data cannot be retrieved later. Shredder personnel, supervisors, and others involved in operations primarily use Forms 1 through 8 to record the data required. These forms are designed so that the shredder supervisor or personnel can readily record the necessary data. If more than one shredder unit is

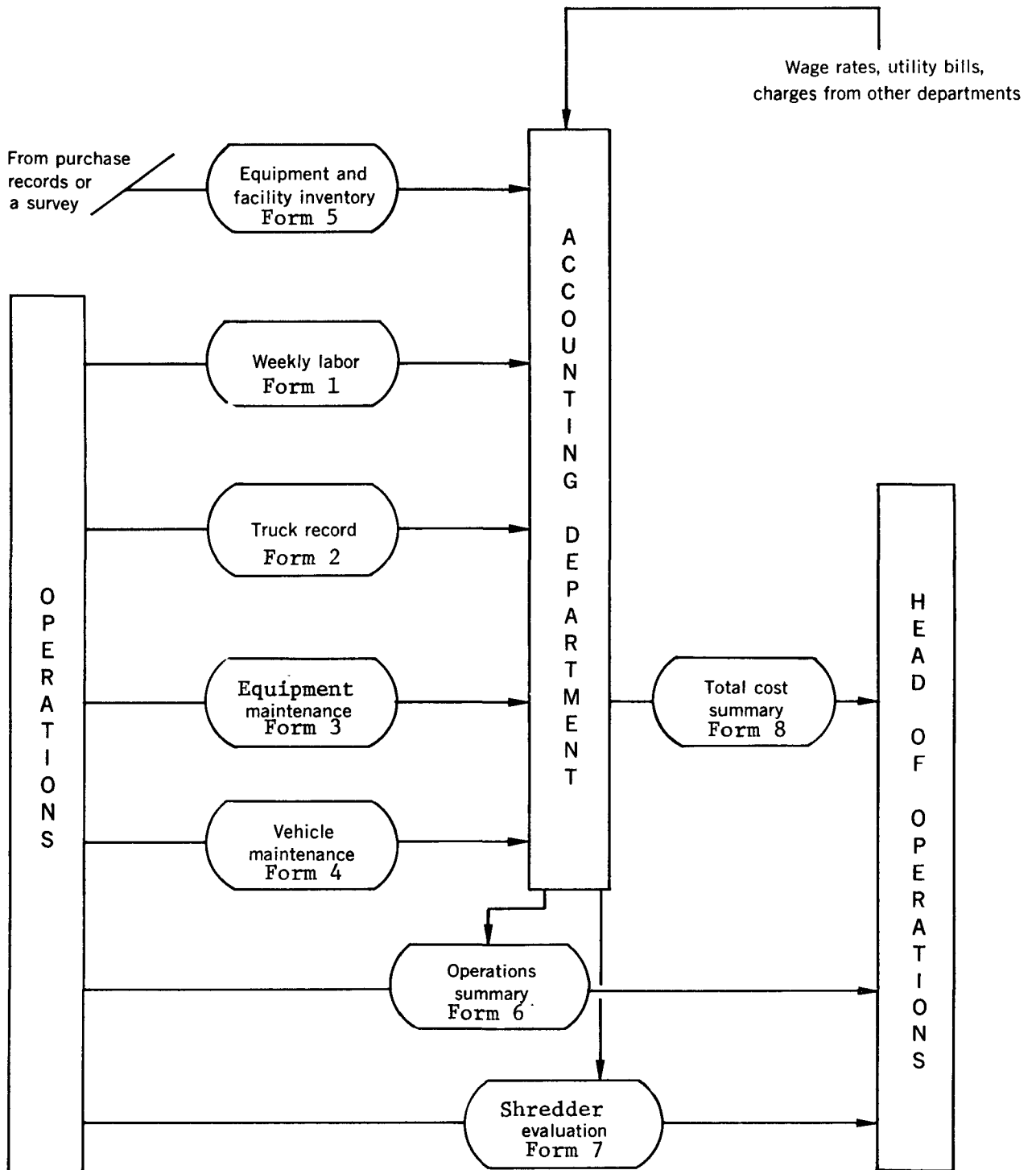
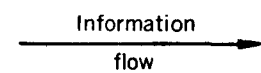
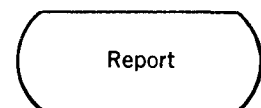


Figure 2. This diagram shows the relationship between reports and information flow.

Key:



installed at a particular location, whether it be of the same type or not, some of these forms should be filled out for each unit. The shredder identification line at the top of each form is to identify each shredder either by manufacturer brand, serial number, or local identification system.

Weekly labor report (Form 1). Daily entries of labor activity are recorded in duplicate at the site by the foreman or supervisor. One copy is forwarded to the payroll department for determining weekly wages. The supervisor or the accounting department uses the other copy to compute the total hours worked and to assign the time and associated costs to the cost centers.

Truck record (Form 2). This form shows the quantities, sources, and types of solid waste delivered to the shredder. The number, identification, and net weight of outgoing vehicles are also recorded. Each delivery or departure is entered by the weighmaster. The form is forwarded to the accounting department at the end of each month. In addition to using recorded weight data to bill public and private users later, the sources and types of waste data are useful in special analyses of trends, compositions, and distributions of solid wastes in the community. This data should also be useful in correlating possible ties between the types of wastes being shredded and the equipment wear rates or utility increases.

Equipment maintenance record (Form 3). This form accumulates the activities and associated costs of repairing and maintaining the shredder equipment. Entries are made only when repairs including routine maintenance are undertaken. These data are particularly useful in analyzing maintenance department performance, equipment availability, and equipment repair costs in the Solid Waste Shredder cost center.

Vehicle maintenance record (Form 4). This form accumulates the activities and associated costs incurred in maintaining the vehicles. A separate sheet is kept for each vehicle, and entries are made only when maintenance or repairs are undertaken. These data are useful in analyzing individual truck efficiencies and repair costs in the Repairs and Maintenance cost center.

Equipment and facility inventory (Form 5). This form is completed when construction is finished or when the cost system is first implemented. It is updated only when improvements or new equipment are constructed, purchased, or sold. In addition to collecting the data required to calculate depreciation for the period and allocating it to cost centers, the form also summarizes the bond and interest information needed to arrive at total costs of financing and ownership.

DAILY TRUCK RECORD

Shredder Identification _____

DATE: ____ / ____ / ____

SIGNATURE _____

No.	Truck ident.*	Time	Incoming wastes		Weighted load	Weight empty or tare wt.	Net amount of wastes	
			Source	Type			Incoming	Outgoing
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
TOTALS		X	X	X	X	X		

Instructions: To be completed by weighmaster for each delivery of wastes or departure of transfer vehicle.

Symbols:

Source: R (residential), C (commercial), I (industrial)

Type: T (tires), G (garbage), etc.

*Truck ident. is # of public truck; if private vehicle list name of company for billing purposes. Also identify transfer vehicles by number and driver's name.

FACILITY AND EQUIPMENT INVENTORY

Date ____ / ____ / ____

Equipment description	Capacity (cu yd)	Model No.	Model year	Manufacturer's name	Date of purchase	Purchase price	Estimated life	Annual depreciation	Monthly depreciation
TOTAL	X	X	X	X	X		X		

Facility description	Description (quantity, size, etc.)	Date put in use	New cost	Estimated total life	Other comments	Annual depreciation	Monthly depreciation
Land						X	X
Buildings							
Equipment							
Site improvement							
Other							
TOTALS	X	X		X		X	

Financing Data

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

*Interest must account for effect of premium or discount on bond sale.

Forms 6 through 8 are completed less frequently; the intervals depend on the type of information transmitted. To be effective, certain types of control and analysis require more frequent feedback than others. Forms 6 through 8 reduce the data contained in the first five forms as well as other information available to the accounting department.

Operations summary (Form 6). This report summarizes system operations and associated operating costs. The report can be for the whole system or for individual stations, since it is a critical cost control mechanism. The report should be prepared monthly. The accounting department compiles it and forwards copies to the supervisor and the head of the sanitation department. The total unit costs presented, as well as unit costs for the various centers, indicate where excessive expenses were incurred. In addition, various measures of efficiency are shown to isolate the cause or causes of high operating costs.

Shredder evaluation report (Form 7). The data accumulated on this form represent the total and individual costs of operating the shredder based on the information gathered from the daily maintenance forms. Statistics are accumulated separately for each piece of shredder equipment such as the push pits, feed conveyor, shredder, and out feed conveyor; these statistics allow efficiency and cost to be evaluated. The data may also be used to determine the life expectancy or wear rates of each mechanical piece. Since this decision involves long-term assets, only quarterly or semiannual reports are necessary. More frequent preparation would not substantially improve decision-making that would minimize operating costs.

Total cost summary (Form 8). All the activities and costs associated with shredder operations for a selected period are compiled on this report from data available in the shredder operations summaries and on the facility and equipment inventory forms. The combined operating expenses and the depreciation and interest figures represent the total cost of operations for the period. The report also summarizes the sources and amounts of revenues associated with the system's operation. The accounting department can complete this form quarterly or semiannually and send it to the head of the sanitation department or his equivalent.

Report Flow Summary

A brief summary may help to put the system in perspective. The personnel directly engaged in shredder activities complete data accumulation forms daily and transmit them periodically

OPERATIONS SUMMARY

For period _____ to _____

	Factor	Amount for this period	Percent variance from	
			Budget	Budget last period
TOTALS	Tons received			
	Average tons/day operated			
	Total operating cost			
	Total operating cost/ton			
	Labor cost/ton			
	Parts and supplies cost/ton			
	Utilities cost/ton			
	External charges cost/ton			
	Overhead cost/ton			
SOLID WASTE SHREDDER COST CENTER	"Cost center" cost/ton			
	Tons/hr. of operation			
	Percent volume reduction †		X	X
WASTE HAUL COST CENTER	"Cost center" cost/ton			
	Tons/number of trips to disposal site			
	Labor hrs /ton			
REPAIRS AND MAINTENANCE COST CENTER	"Cost center" cost/ton			
	Repair and maintenance cost/hr. of operation			
	Waste haul percent		X	X
	Shredder percent		X	X
	Percent time vehicles down		X	x
	Percent time shredder down		X	X

Instructions: This form is to be filled out by the accounting department based on information from the previously compiled forms.

SHREDDER EVALUATION

Shredder Identification _____

For period _____ to _____

Equipment identification	Hrs. down	Hrs. down/total hrs.	Repairs and maintenance cost	Repairs and maintenance cost/hr.	Total cost/hr.
TOTALS		X		X	X
AVERAGES					
BUDGET					

Instructions: This form is to be filled out by the accounting department based on previous data forms.

TOTAL COST SUMMARY

Surrender Identification _____

For period _____ to _____

DATA	FOR THIS PERIOD	BUDGET THIS PERIOD	CUMULATIVE (YEAR TO DATE)	BUDGET (YEAR TO DATE)
Tons of waste received				
Total operating cost				
Total financing and ownership cost				
TOTAL COST				
Operating cost per ton				
Financing and ownership cost per ton				
17				
TOTAL COST PER TON				
Public revenues (participating communities)				
Private revenues (industry, etc.)				
Miscellaneous revenues				
TOTAL REVENUES				
TOTAL REVENUES PER TON				
NET COST (PROFIT)				
NET COST (PROFIT) PER TON				

to the accounting department. The latter collates the information and adds additional data it has on file to complete summary reports on performance, activity, and costs. These forms are then sent back to the supervisor for control purposes. In addition, selected summary reports on total costs and equipment performance are compiled and forwarded to the supervisor and to his immediate superior.

System Utilization

Only with efficient and intensive utilization of the information generated by the accounting system and its forms can the additional time, effort, and money required to implement and maintain it be justified. The system's intensive use promotes two major objectives-- quality control and cost control. All the factors that affect the quality and effectiveness of shredder operations can be translated into costs, but cost control should not be equated with economizing at the expense of quality. On the contrary, once an acceptable level of operations and costs has been achieved, the system can help the supervisor maintain quality control.

Effective control requires timely recognition and assignment of responsibility for any increased costs. Comparing unit costs (cost per ton of waste shredded) with the current budget and that for the corresponding period of the preceding year helps pinpoint excessive expenses. This approach facilitates the analysis of costs, independent of changes in the level of activity. Cost center breakdowns help single out the factor or person responsible for increased expenditures, and this allows corrective action to be initiated.

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