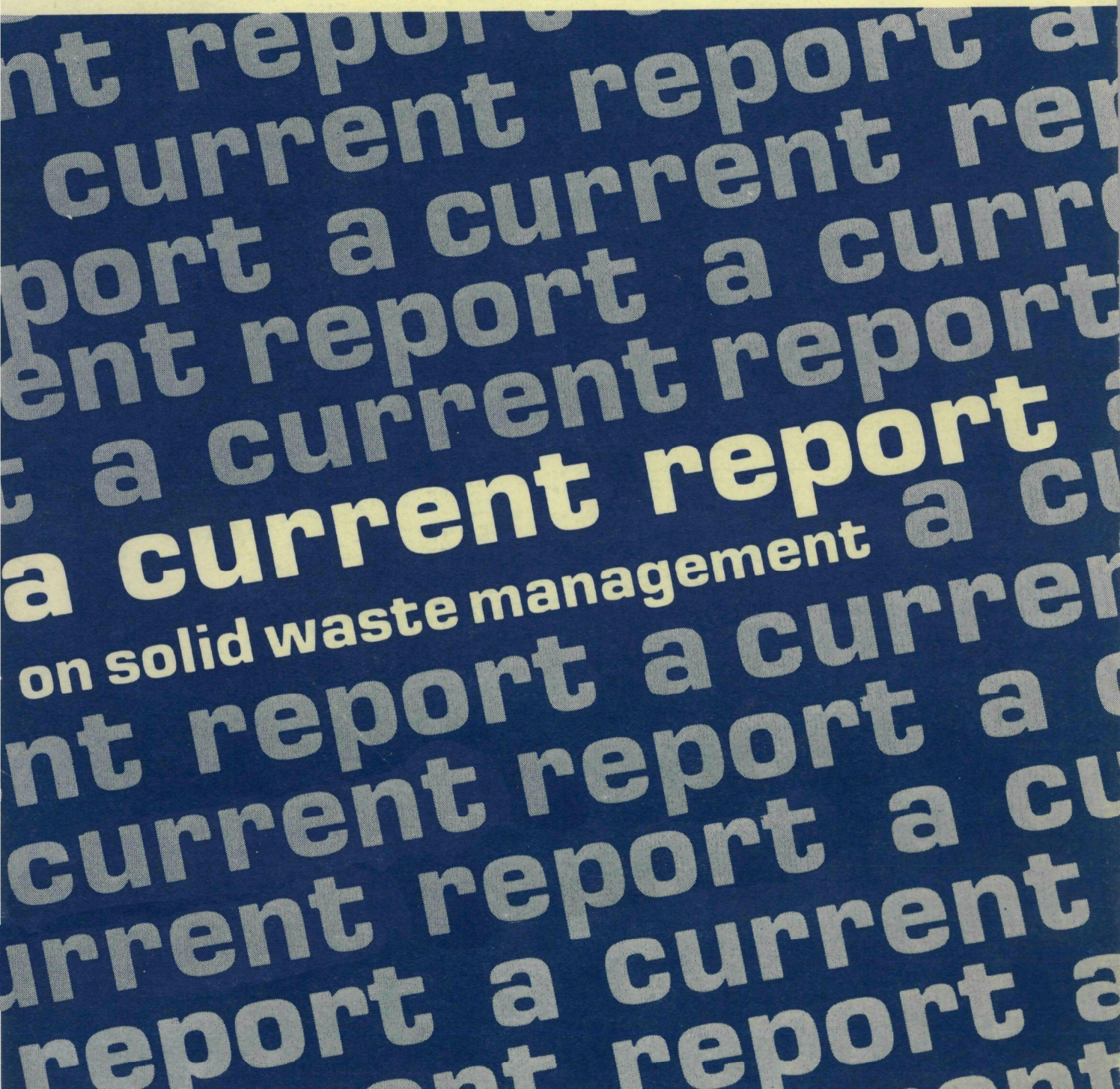
EPA/530/SW-85d
AUGUST 1975

a handbook for initiating or improving commercial refuse collection



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A HANDBOOK FOR INITIATING OR IMPROVING

COMMERCIAL REFUSE COLLECTION

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THE CITY OF SCOTTSDALE, ARIZONA
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U.S. ENVIRONMENTAL PROTECTION AGENCY

1975

FOREWORD

For those in the business and those contemplating entering it, commercial refuse collection is a dynamic, challenging operation with high potential return both to the community and the collection operation. As with any other business, preliminary planning, careful management, and operational control are essential elements of efficient and effective service.

To attempt to address all the issues of commercial refuse collection in this document would be folly. Some are too complex, some are too detailed, and some are applicable only to specific types of systems. Therefore, this document will attempt to outline the major components of a commercial refuse collection operation, applicable to the public as well as the private sector. The information contained herein should be valuable both to those who are contemplating a collection operation and to those who desire to improve the efficiency and effectiveness of an ongoing operation.

The City of Scottsdale gratefully acknowledges the financial and technical assistance from EPA, which made this study possible. Certainly this type of research is both helpful and essential to those of us that provide a most necessary and vital public service.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SECTION I

PRELIMINARY INVESTIGATIONS

Introduction

The single most important question concerning almost any operation, public or private, is cost -- what are the revenues and what are the expenditures. Before this question can be adequately addressed a thorough examination of the service area must be made and legal questions have to be fully researched and costed. For a municipality entering the business the question may be one of whether or not the commercial refuse collection operation should generate a profit, break even, or be subsidized. For a private hauler, the question is whether the return of investment (ROI) is adequate to compensate for the capital and operating costs.

Service Area Assessment

The following questions about service area need to be fully explored in order to assess conditions affecting collection:

1) Who is doing collection now, and to what extent? Is commercial collection simply an extension of residential collection? What is the competition, and what is the franchise situation with respect to commercial collection? What are the service charges for comparable areas?

To state the obvious, if service is presently being provided in a satisfactory manner by an existing organization holding a franchise for such an operation the probability of being successful are significantly reduced. Such an

examiniation should include researching all governmental entities (state, county, and local) to determine what permits, licenses and regulations apply to such operations. For example, a city business license, a county hauling permit, and a state permit are usually required for operation. The legal parameters within which a collection operation must operate should be studied before additional investigations are pursued.

2) What are the customer and service area characteristics? Specifically, how many potential customers are there from apartment houses, retail stores, industrial plants, institutions, etc. How far apart are the customers? How accessible are they? What kind of and how much refuse do they generate? What is the general physical (topographical) layout of the area?

The above questions request necessary data for computing both the costs and the revenues of a commercial collection operation. For example, the number of customers and the refuse they generate gives an approximation of equipment and container needs. Likewise, the distance between customers and the general topography of the area are major determinants of route requirements and equipment specifications. Finally, general accessibility and type of customers will in large part determine the hours and method of collection. A comprehensive inventory of customer and service area characteristics is invaluable, and cannot be over emphasized as the major data base used in decision making.

3) What are the disposal options available, and what are their locations in relation to the service area? Also, what is the potential market for "recoverable" materials, and what systems are presently in operation?

Many of the major problems surrounding solid waste management deal with disposal of refuse rather than collection. Enviromnental guidelines and regulations have restricted many cheaper methods of disposal, thus making the disposal portion of solid waste management quite costly. Resource recovery holds a high potential for both reducing disposal costs and recovering valuable natural resources. However, most recovery systems are still in a preliminary stage.

Once the above questions have been answered and the potential service area and scope of operations have been defined, the necessary resources to effectively and efficiently service that area need to be defined.

Service Resources

Like any other organization, a commercial refuse collection operation needs resources -- men, machinery and materials. In case of a private operation the money for these resources comes from the revenues generated through user charges. In the case of municipal operations they may be financed from either user charges or from general fund expenditures. To initiate a collection service requires significant capital funding, which can be obtained in the conventional

manner. As outlined in appendix I, equipment may be leased or purchased. Lending institutions, the Small Business Administration, and other sources of funding should be consulted for financing possibilities.

The following sections outline in detail the options available for equipment, route personnel, and facilities. It should be kept in mind throughout the entire section that the closer the personnel, equipment and facilities match the needs and characteristics of the customer and service area the more successful the collection operation will be.

Marketing

An effective marketing effort will be required to initially obtain customers in the service area. The degree of marketing will depend on the competitive situation in the area. Advertising, personal contact, efficient operation, and satisfied customers are necessary to maintain accounts once they have been obtained.

SECTION II

EQUIPMENT CONSIDERATIONS

Introduction

Service area characteristics such as accessibility to waste storage areas, customer density, quantity and type of waste generated, distance to and from the disposal site, and topographical conditions all affect the type, size, and number of various types of equipment -- collection vehicles and containers. By the same token, equipment requirements dictate the number of operating personnel, maintenance yard and service requirements, and office and clerical needs. Therefore, the single most important initial resource is the equipment system to be used.

Collection Equipment

There are several types of vehicles used in commercial refuse collection, with numerous variations and modifications to each. The major types are:

1) Front-end Loading Vehicles. Front-loading vehicles handle containers up to 12-cu-yd capacity by use of a mechanical lifting mechanism. These vehicles have been widely used for commercial collections. In an optional mode of operation, the container may be carried near the ground on the lift mechanism and used to receive manually loaded residential wastes.

The major limitation of this equipment is an overhead clearance requirement of up to 22 feet during container dumping. The vehicle can be easily operated by one man. The lift mechanism and controls allow the driver to engage, lift and empty readily accessible containers without leaving the cab.

The front-end loader is used by a majority of all commercial collection operations. It is especially productive in areas where container placement permits the driver to engage the container without leaving the cab.

The front-end loader collects mechanical (self-loading) containers (bins) that range in size from .5 to 12 cubic yards, fabricated from sheet metal. In a typical operation, the front-end loader is maneuvered into position and the fork lifts engage the container. The container is then lifted over the front of the vehicle and emptied into the body.

Figures 1 and 2 show the front-end loader and how it operates. Figure 3 shows the representative costs for these containers. Note that the cost of additional capacity decreases as the size of the container increases.

2) Side-loading Vehicle. Side-loading vehicles can be manually and/or mechanically loaded with up to 4-cu yd containers. The proximity of the loading hopper to the driver's seat, particularly if the vehicle is

Figure 1. Front-end loader.

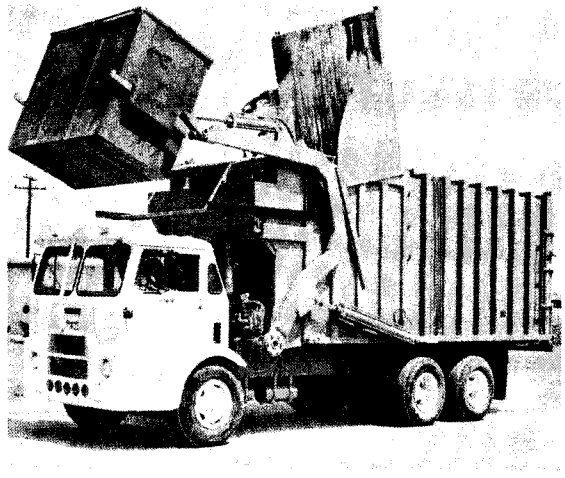


Figure 2. Front-end loader dumping container.

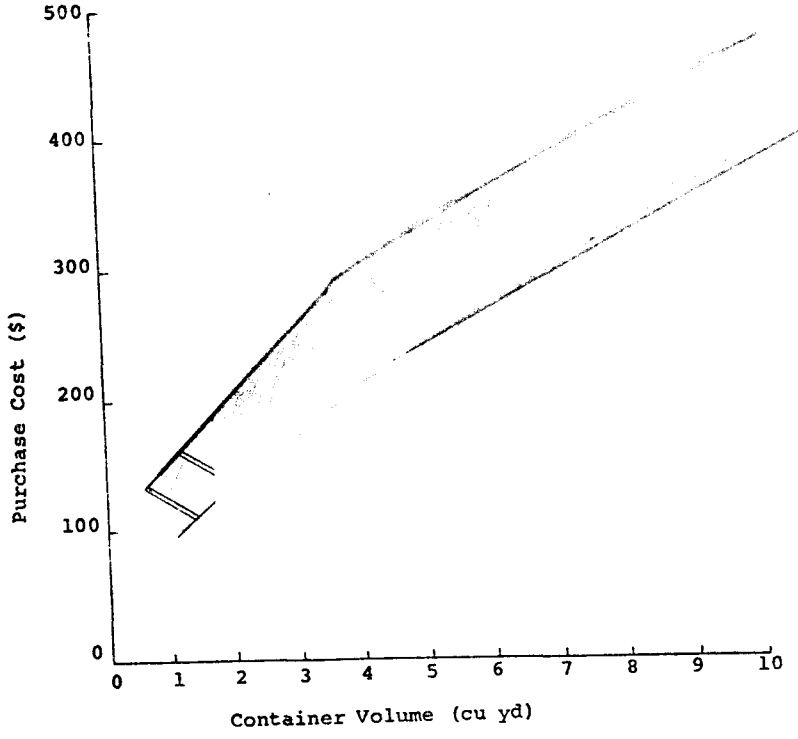


Figure 3. Representative cost of self-loading containers used for front-end, side, and rear-end loaders.

equipped with optional right-hand drive, facilitates efficient one-man collection in residential areas. The relatively restricted container handling capacity of the side-loading vehicle provides limited value for commercial collections. Commercial areas characterized by small container requirements and restricted access may make the side-loader a feasible choice.

Side-loading vehicles are used for commercial collection operations and are operated primarily in areas where residential and commercial collection are performed by the same vehicle. The main disadvantage of the side-loader is that it requires the operator to leave the vehicle, roll the container out to the truck, align the container with the lifting mechanism, engage the lifting mechanism and then roll the container back after dumping. The above method results in driver fatigue, especially if there are heavy or numerous containers. In addition, castor sets for containers cost about $50.00 installed, thus significantly increasing container cost.

The City of Scottsdale, as part of this EPA grant, experimented with a commercial side-loader that would operate much like a front-end loader in the fact that it would have forks that could be extended to engage the container without the necessity of leaving the vehicle. However, the project has been unsuccessful to date. The reasons are detailed

in Appendix II.

Figure 4 shows a typical side-loader.

3) Rear-end Loading Vehicles. Rear-loading vehicles receive wastes in a rear hopper and have limited value for commercial collections. Containers up to 6-cu-yd capacity can be mechanically loaded with the addition of special hoisting equipment. Rear-loading vehicles can best be used in areas where both residential and commercial service is provided by the same vehicle and commercial customers can utilize smaller containers. A two-man crew is normally required for this vehicle.

Rear-end loaders are used by about one third of commercial refuse collection operations. The increased costs of the additional man on a crew usually makes this system less attractive than the one-man, front-end loader, especially in commercial operations where the collection vehicle is utilized exclusively for commercial collection of standard containers. Figure 5 shows a typical rear-end loader and the method of emptying the container. The collection cycle of the rear-end loader is similar to the side-loader.

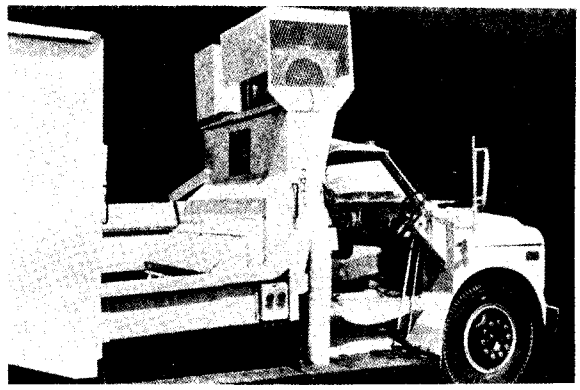
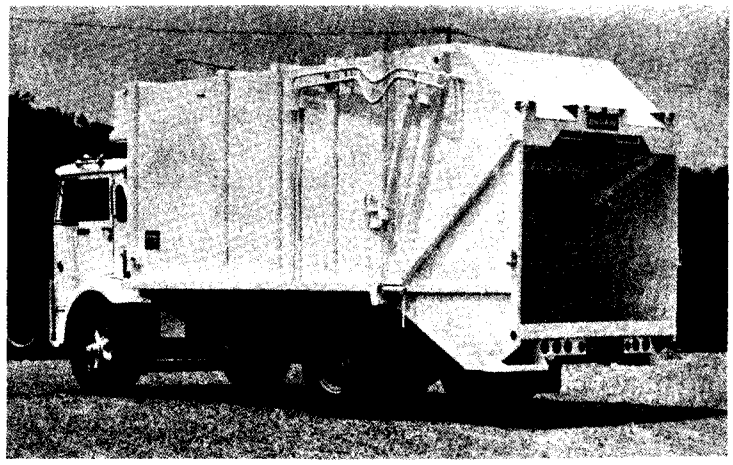
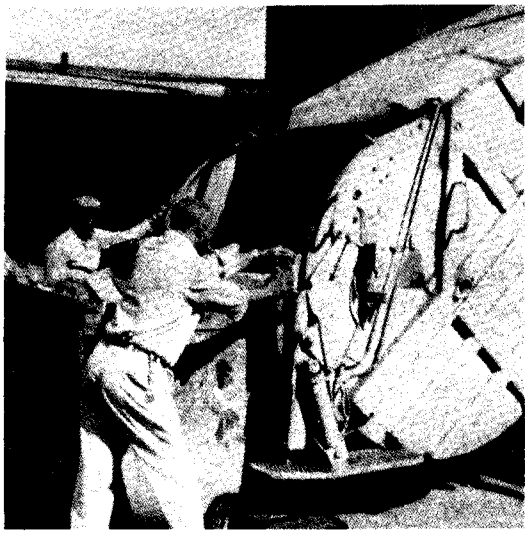


Figure 4. Typical side-loader.



HOOK ON



DUMP

Figure 5. Typical rear-end loader, method of dumping container.

4) Container-Haul Vehicles. In certain limited instances where special types of waste area involved (such as metal scrap, sludges, semi-liquid, and large quantities of heavy wastes) it is preferable to transport the storage container to the disposal site. Thus, the container is hauled to the disposal site, dumped, and returned to the customer's premises for refilling. There are basically two types of container-haul vehicles, lugger-box hoist vehicles, used to collect lugger boxes, and tilt-frame vehicles, used to collect roll-off containers.

In general, lugger-box hoist vehicles consist of a chassis and a hydraulic hoisting mechanism mounted on the frame. Hydraulic cylinders activate the lifting arms for container lifting and emptying the container at the disposal site. All operations can be accomplished by one man. The lugger-box system is most useful and economical when haul distances are short, when large quantities of heavy wastes are generated, and where the use of conventional compactor vehicles is not practical.

Heavy wastes that could damage the vehicle body, sludges and other semi-liquid wastes are often collected by hoist vehicle systems to eliminate spilling and personal exposure during handling. Hoist vehicles

have initial costs ranging from $16,000 to $25,000 and can haul containers with capacities ranging from 1.5 to 22 cu-yd.

Lugger-box containers generally range in size from 2- to 15-cu yd, are of sheet metal design and equipped with special attachments for hoisting, transporting, and emptying. Figure 6 shows a typical lugger-box vehicle and container. Figure 7 shows the representative costs of containers as a function of size.

Tilt-frame vehicles may be employed where large waste quantities are generated by a single source, and haul distances are relatively short. Dumping is achieved by opening the rear doors of the container and tilting the truck frame with the container secured. Initial investment costs range from $16,000 to $26,000 for vehicles. Tilt-frame vehicles are typically used with containers having capacities of from 15 to 50 cu yd.

Roll-off containers are similar to lugger-boxes. Roll-off containers, however, are generally larger. They vary in capacity from 10- to 50-cu yd and instead of being hoisted onto the truck they are pulled onto the truck tilt-frame using a winch or hydraulic cylinder. Roll-off containers are constructed of welded sheet metal reinforced vertically and horizontally, and are

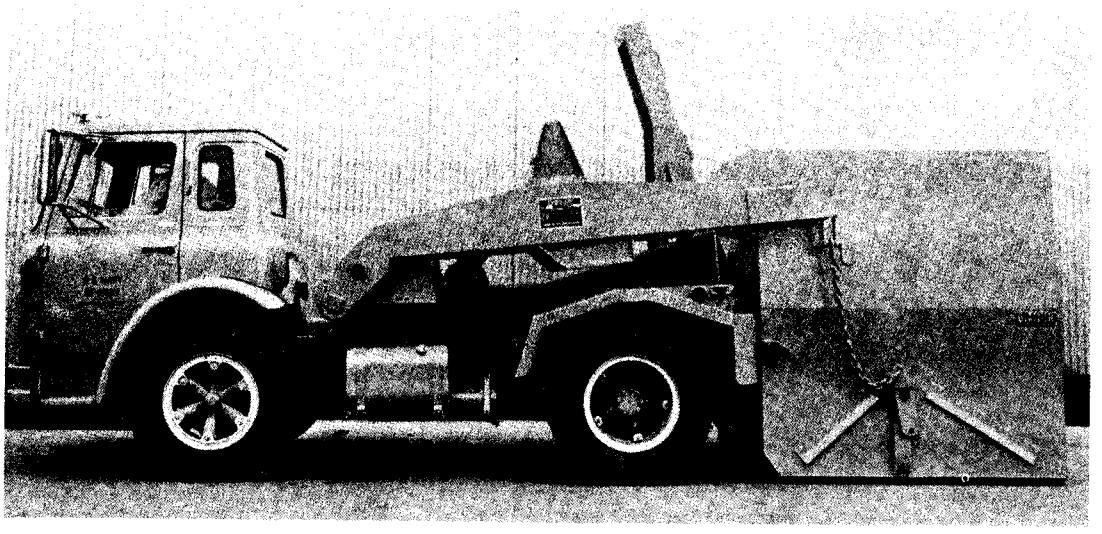


Figure 6 Typical Lugger Box Container with Collection Vehicle

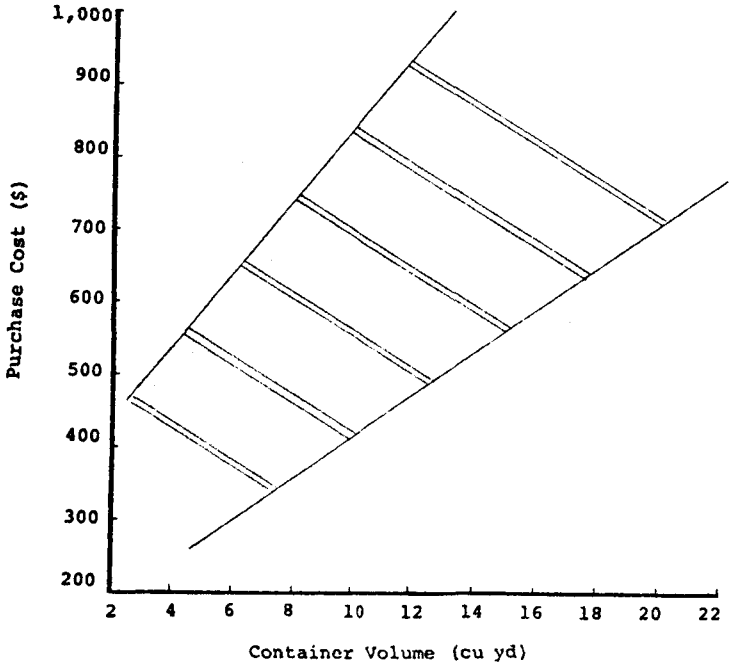


Figure 7. Representative Lugger Box container costs.

especially suited for collection of bulky commercial wastes. They are either open top or compaction containers. The cost of each type is shown in Figure 8. The higher cost in the compaction container is due to the additional steel needed to withstand compaction forces. Figure 9 shows a typical tilt-frame vehicle with roll-off container.

Compaction VS Non-Compaction Vehicles

Except where the refuse collected is of a high density, practically all of the commercial refuse vehicles are compaction vehicles. This is in spite of the fact that initial acquisition and operating costs are significantly higher in compaction vehicles than non-compaction vehicles. Front-end, side, and rear-end loaders with compaction mechanisms cost from $15,000 to $50,000 per vehicle, depending on the chassis, body size, and compaction mechanism selected, while non-compactor vehicles range from $7,500 to $17,000 per unit.

The cost differential between the two vehicles is more than made up by the increased service of the compactor vehicle. Most commercial refuse compacts at about a 5:1 ratio, allowing the compactor vehicle to collect at least 5 times as much refuse per load. Thus, "non-productive" time or time out of the route

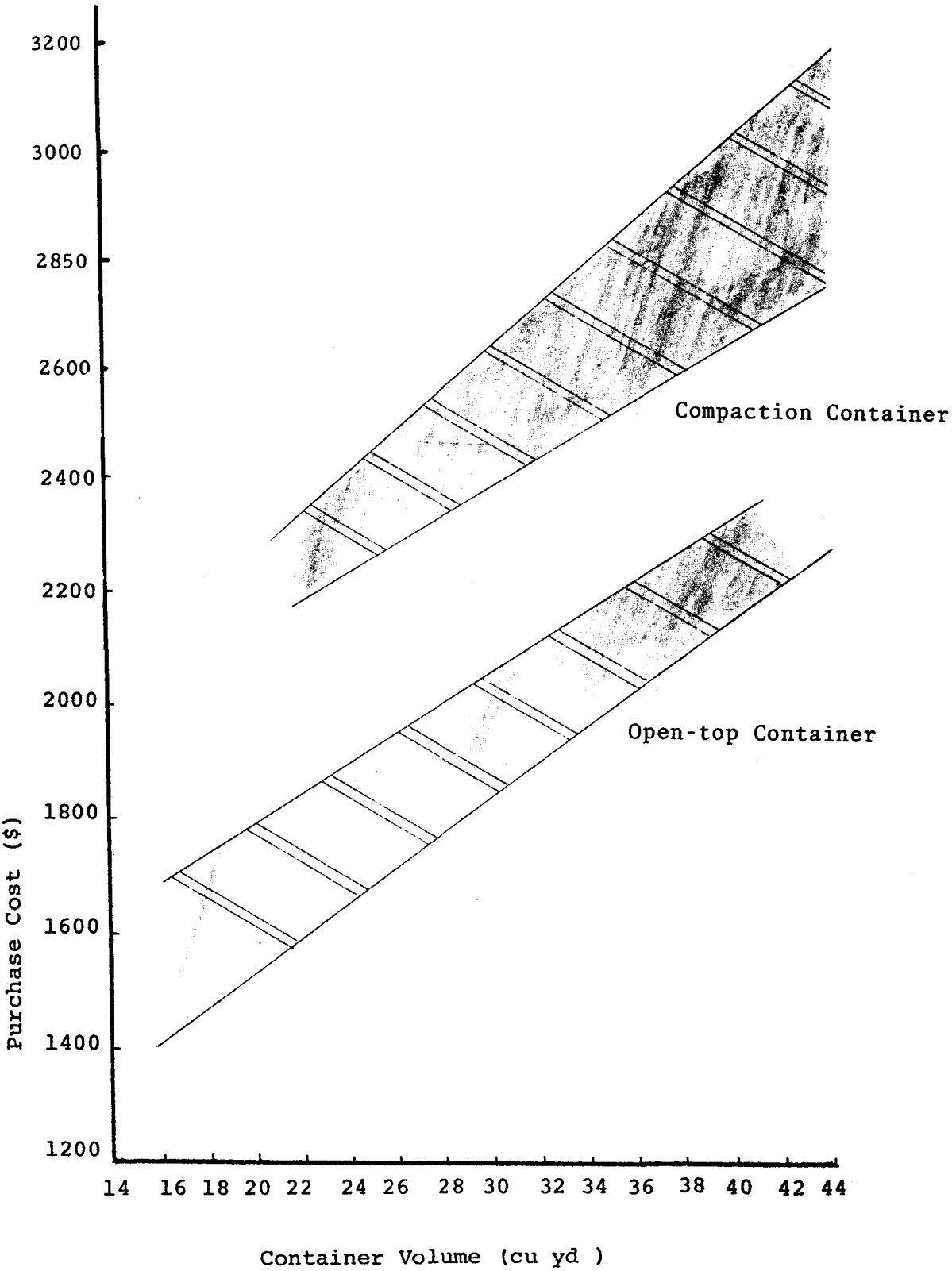


Figure 8. Representative cost of open-top and compaction roll-off containers.

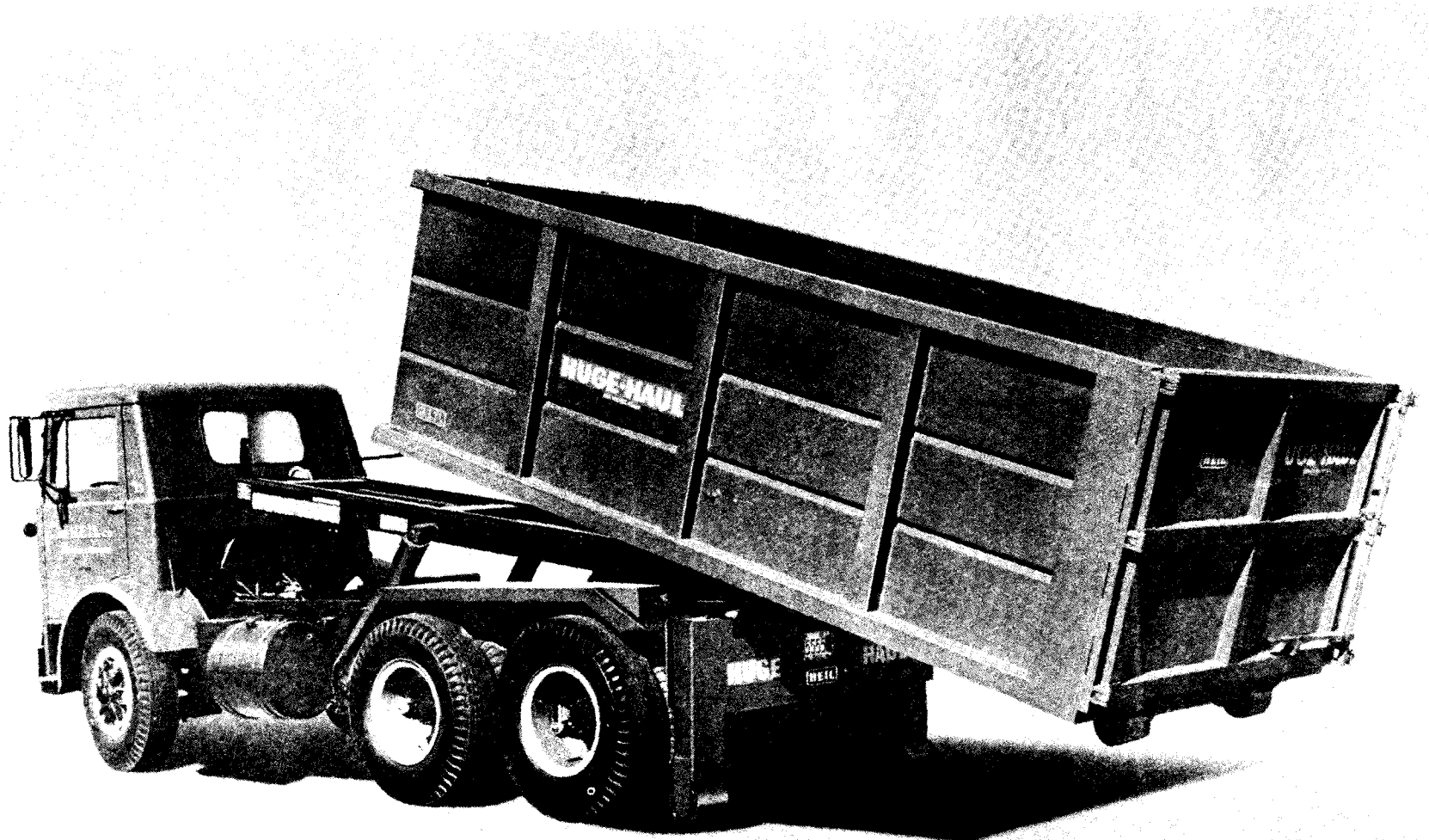


Figure 9 Typical Roll-Off Container with Collection Vehicle

area is reduced. In addition, the refuse is enclosed during both collection and haul, thereby minimizing litter and odor problems.

An alternative to the compaction vehicle is the stationary compactor, or the compactor located on the customer's premise. This system of compaction is used where large quantities of bulky, highly compressible waste is generated at a single location. Basically, the system consists of depositing wastes in a hopper by manual or mechanical methods; activating a ram, and compressing the waste into an enclosed container. When full, the container is unhooked from the compactor unit and hauled by a tilt-frame vehicle to the disposal site.*

Stationary compactors are not widely used in commercial collection because of their high cost and the necessity to use tilt-frame vehicles. Figure 10 shows a typical stationary compactor and its operation.

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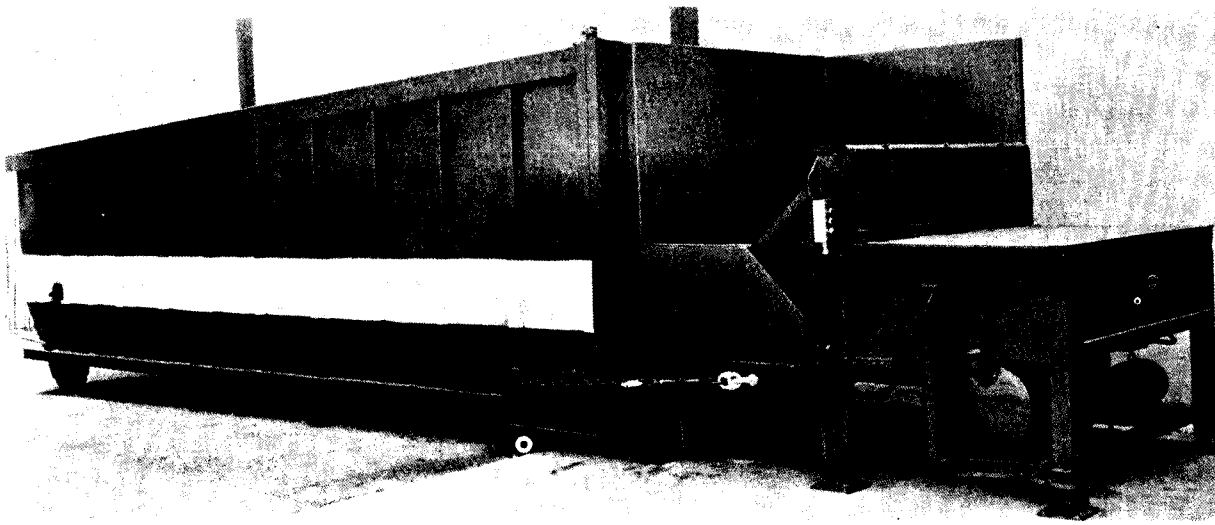
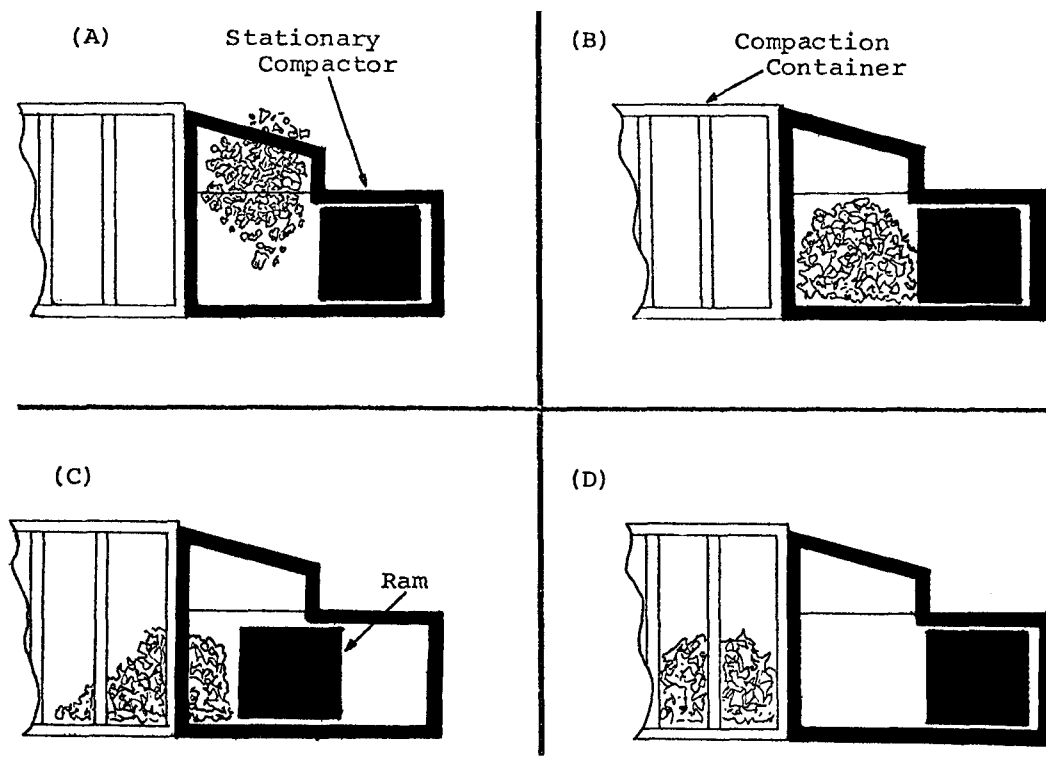
*There are a wide variety of stationary compactors available. The National Solid Waste Management Association (NSWMA), in cooperation with manufacturers, developed a stationary compactor rating system. This system uniformly measures a number of compactor features to facilitate comparison of available models. The listing is updated and published annually. It is available by writing the NSWMA, 1730 Rhode Island Avenue, N.W., Washington, D.C. 20036.

An eight-part series: Pollock, K. M. The use, selection, and economics of stationary compactors. Solid Wastes Management, 14(12)-15(7), Dec. 1971-July 1972, can be consulted to further aid in assessing compactor suitability for conditions in the proposed service area.





(A) Loading
(B) Fill Charging Box
(C) Ram Compacts Refuse
(D) Ram Withdrawn, Cycle Starts Again

Figure 10. Stationary Compactor and how it operates.

Collection Alternatives Summary

In summary, the goal of commercial refuse collection equipment is to most effectively and efficiently service the collection area. The most predominant type of vehicle used today is the front-end loader, especially in medium-size and large cities where the collection vehicle is used almost exclusively for commercial collection. The rear-end loader is used by about one-third of commercial collection operations, especially in smaller cities and towns where the collection vehicle is used for residential and commercial collection.

There are specialized systems that can be used for service areas with unique refuse characteristics; however, these systems are not widely used because of their high cost and their incompatibility with other collection needs.

Practically all of the containers used by front-end, side, and rear-end loaders are mechanically dumped. The number and size of these containers is based on estimated refuse generation rates.*

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*Waste generation may be estimated based on observations at the customer's location, discussions with the customer, historical records of the customer's service fee, or records of similar customers.

Studies of various commercial waste generation rates have been made by the U.S. Environmental Protection Agency, Office of Solid Waste Management Programs: DeGeare, T. V., Jr., and J. E. Ongerth. Empirical analysis of commercial solid waste generation. Journal of the Sanitary Engineering Division, Proceedings, American Society of Civil Engineers, 97(SA6):843-850, Dec. 1971; Esco/Greenleaf. Solid waste handling and disposal in multistory buildings and hospitals. Washington, U.S. Government Printing Office, 1972. 2 v.; Greenleaf/Telesca. Solid waste management in residential complexes. Environmental Protection Publication SW-35c. Washington, U.S. Government Printing Office, 1971. [419 p.] (cont.)

Except where special condition requires, the size of the container for each customer should be maximized so that the frequency of collection may be minimized.* The size of containers provided should be limited in variation in order to reduce inventory requirements. Due to container servicing and replacement needs, it is recommended that a 10 percent inventory be kept on hand.

(continued)

Waste generation data are also published in such periodicals as Solid Wastes Management, Public Works, and Waste Age.

After the generation rate is established, consideration should be given to seasonal variations which might alter an average generation rate. As a rule of thumb, an additional 25 percent of container capacity should be allowed each customer to account for seasonal fluctuations.

Once the "ground rules" are established, the number of containers required per customer may be determined by dividing the weekly waste generation rate by container capacity and collection frequency. For example, a customer generating 48 loose cubic yards per week could be provided with two - 8-cu yd containers if a collection frequency of three times per week were desired.

*Considerations may dictate that smaller containers and more frequent collection be provided, such as:

- Restricted loading and storage area.
- Highly putrescible wastes requiring more frequent collection.
- Local rules and regulations.

A more comprehensive analysis of service area requirements and vehicle comparison standards is presented in Appendix III. A case study of the different components of vehicle performance, and their relative contribution or importance to the total vehicle performance is presented in Appendix IV. It is recommended that potential equipment purchasers carefully study both of these sections prior to selecting any combination of vehicles and containers.

Equipment Maintenance and Repair

Commercial refuse collection is extremely hard on equipment. The equipment is operated extensively in start-stop-turn situations. It is driven on rough roads and landfills. It transports corrosive and abrasive materials under pressure for long hours everyday. It is no wonder, therefore, that maintenance and repair represent the largest single operating expense for a piece of refuse collection equipment. In fact, under normal circumstances, an owner may expect to spend 100 percent of the purchase price over a five-year period to properly maintain a piece of equipment. Under severe conditions, a hauler can expect to spend that much in as little as three or four years. If considered alone, maintenance and repair costs would encourage trade-in of the equipment annually because of ever rising costs and a higher cumulative cost per hour for operation.

It should come as no surprise, then, that effective maintenance is essential to the efficient operation of refuse collection systems. Vehicles must be continually available to do the work; they must be kept in good operating condition to minimize breakdowns; ample reserve equipment must be on hand ready for use; idle equipment time must be kept within reasonable limits; and the total cost of owning, maintaining, and operating the vehicles must be as low as is consistent with sound operating policy.

The key to effective maintenance, whether performed internally or by contracting with an outside source, is an aggressive PM (Preventive Maintenance Program).

Preventive Maintenance

The essence of preventive maintenance is a set of regularly scheduled inspections for each piece of equipment by qualified mechanics and the immediate correction of any weakness or incipient failure that may be disclosed by such examinations. Daily servicing of the quipment should also be part of the plan. The hydraulic systems, crankcase oil, radiator water, tire pressure, lights, and horn should be checked daily.

Preventive maintenance can be peformed at night to assure units are avilalble during the regular working hours. Skillful work scheduling will stagger service dates so that an even flow of work may result from the PM Program.

Table 1 summarizes the PM Program recommended by General Motors Truck and Coach Company. While the program addresses itself to engine and chassis maintenance, similar procedures have been developed for compaction bodies and other pieces of equipment. The program calls for perforamance of required maintenance of specific operations and specific mileages. Basic work is outlined on a work sheet rather than being left to the judgment of the mechanic.*

Vehicle Cost Accounting

Historical records of all operating and maintenance costs should be kept for each vehicle. Continuous examination of the operating records and the maintenance history charts will assist in discovering operational abuses, unsatisfactory parts and accessories, and equipment replacement projections.

The City of Scottsdale uses MAINSTEM, a vehicle cost accounting system, to track costs. Sample printouts are shown in figures 11-13. This report provides a detailed record of each vehicles operating and maintenance costs, compares this cost with budgeted costs, and shows per mile cost of the vehicle over the current reporting period and the life of the vehicle. While this type of system is not required in smaller operations, the basic cost data should be gathered on each vehicle.+

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*For more information on vehicle maintenance see: American Public Works Association. Refuse collection practice. 3rd ed. Chicago, Public Administration Service, 1966. 525 p.

+For further information on MAINSTEM see: Stragier, M. How to manage your city motor pool. Western City Magazine, 44(9):64, Sept. 1973.

Under the plan, there are four mechanical inspection services:

A Service: This service is rendered every 1,000 miles throughout the life of the vehicle, or its equivalent in operating hours, or, on low mileage vehicles, every 30 days. It includes the adjustment of units affecting operating economy and a thorough lubrication and general inspection. Timing is checked, carburetor adjusted, spark plugs cleaned and spaced, etc.

B Service: This service is suggested at 5,000 mile intervals. All "A" Service items are included, plus others requiring attention at this mileage. For example, wheel alignment is checked, grease retainers and bearings checked, brakes inspected and adjusted, the crankcase ventilator cleaned, and the generator checked and charging rate adjusted.

C Service: This service is suggested every 15,000 miles or yearly. It incluldes all A and B items and replacement of inexpensive minor parts which have served their economic usefulness. Certain concealed units are examined and adjusted to prevent abnormal wear and costly failure. The cooling system is thoroughly cleaned, valves ground, springs replaced, and the fuel pump overhauled or exchanged. Distributor points, rotor, condensor, and high tension wires are replaced.

D Service: This service is suggested at 30,000 miles. It includes A, B, and C items, together with an examination of all major units. The thoroughness of this service insures continued satisfactory performance and reliability at a mileage which normally introduces an era of uncertainty. The transmission and differential are removed, cleaned, inspected, and adjusted; spindle bolts, bushings, and tie rod ends are replaced; the clutch is disassembled and discs, linings,etc. replaced. Universal joints and center bearings are overhauled; wheel bearings washed, inspected and repacked; brakes relined and brake mechanism overhauled, a general check and reconditioning of the engine takes place - pistons and rods are removed, bearings and cylinder walls checked, valves ground and parts replaced where necessary.

TABLE I: Representative General Motors Preventive Maintenance Program

PERIOD 11 1974 CO 215 CITY OF SCOTTSDALE REPORT 236 PAGE 1

COMMERCIAL REFUSE COL. 02-4530

VEHICLE	YR	MAKE	USAGE	BASE COST	ADDED COST	TOTAL COST	ACCIDENT COST	DAMAGE COST	TOTAL COST	TOTAL M&O	DEPREC COST	INSUR &TAXES	TOTAL COST
224	68	CHEV	250	60.00		60.00			60.00		60.00		60.00
231	69	FORD	224	60.00		60.00			60.00	228.95	60.00		288.95
246	65	IHC								1473.98	700.00		2173.98
247	67	WESCO	108		1080.00	1080.00			1080.00	437.55	700.00		1137.55
248	69	IHC	115		1150.00	1150.00			1150.00	2709.55	700.00		3409.55
264	72	DRESSEL	138		1380.00	1380.00			1380.00	655.35	700.00		1355.35
266	73	DRESSEL	134		1340.00	1340.00			1340.00	1560.87	700.00		2260.87
269	73	MADSEN	166		1660.00	1660.00			1660.00	835.47	700.00		1535.47
285	69	SHOP								40.15	25.00		65.15
2203	74	CHEV	362	60.00		60.00			60.00	30.64	60.00		90.64
2204	74	CHEV	445	60.00		60.00			60.00	29.60	60.00		89.60
2401	73	DRESSEL								5431.89	700.00		6131.89
2407		DRESSEL	147		1470.00	1470.00			1470.00	1489.53	700.00		2189.53
246A	65	IHC								138.57			138.57
247A	67	WESCO								16.12			16.12
248A	69	IHC								81.97			81.97
2601	74	CAT	86		172.00	172.00			172.00	19.44	75.00		94.44
		TOTALS	2175	240.00	8252.00	8492.00			8492.00	15179.63	5940.00		81119.63

FIGURE 11. MAINSTEM Summary Report.

PERIOD 11 1974 CO. 215 CITY OF SCOTTSDALE COMMERCIAL REFUSE COL. 02-4530 MAINSTEM REPORT 121 PAGE 1

EQUIPMENT COST SUMMARY

VEHICLE	YR	MAKE	CURRENT PERIOD MAINT COST	CURRENT PERIOD OPER COST	CURRENT PERIOD USAGE	CURRENT PERIOD MPG FUEL	CURRENT PERIOD MPG OIL	PREVIOUS PERIODS (UP TO 10) MAINT COST	PREVIOUS PERIODS (UP TO 10) OPER COST	PREVIOUS PERIODS (UP TO 10) USAGE	PREVIOUS PERIODS (UP TO 10) MPG FUEL	PREVIOUS PERIODS (UP TO 10) MPG OIL	LIFE MAINT COST	LIFE USAGE	CENTS PER MILE PREVIOUS MNT	CENTS PER MILE PREVIOUS OPER	MILE LIFE MNT	PD
5043		COM REF CO						40					164					32
CLASS																		
224	68	CHEV			250			566	163	5480	16.3	5480	2052	23068	10.3	3.0	8.9	39
CLASS 2101		TRK PU 2DR																
231	69	FORD	229		224			1340	539	8833	8.0	1104	6707	27678	15.2	6.1	24.2	39
2203	74	CHEV	31		362			192	620	10118	8.1		222	10480	1.9	6.1	2.1	11
2204	74	CHEV	30		445			226	420	7408	8.3		255	7853	3.0	5.7	3.3	11
CLASS 2201		TRK PU 2DR	289		1031			1758	1580	26359	8.1	3295	7185	46011	6.7	6.0	15.6	3
246	65	IHC	1474					11072	763	1164	.4	23	66951	6448	951.2	65.5	1038.3	39
247	67	WESCO	348	89	108	.4	7	15591	1309	1406	.3	15	48795	5916	1108.9	93.1	824.8	39
248	69	IHC	2610	99	115	.3	13	13481	1217	1956	.5	11	62260	6642	689.2	62.2	937.4	39
264	72	DRESSEL	580	76	138	.5	17	8086	992	1752	.5	13	31705	7000	461.5	56.6	452.9	29
266	73	DRESSEL	1477	84	134	.5	17	14954	1266	1676	.4	15	23137	2329	892.2	75.5	993.4	23
269	73	MADSEN	753	83	166	.6	18	10776	1062	2017	.5	16	16396	3768	534.3	52.7	435.1	21
2401	73	DRESSEL	3237	61				13514	879	1917	.6	15	16758	1917	704.9	45.8	874.2	19
2407		DRESSEL	1329	161	147	.4		7921	1102	592	.2	24	9250	739	1338.0	186.2	1251.6	12
CLASS 2733		TRK REF COM	11808	652	808	.4	15	95394	8590	12480	.4	15	275252	34759	764.4	68.8	791.9	8
285	69	SHOP	40					143					588	105			560.1	31
CLASS 3111		TLR FLT BD																
245A	65	IHC											683					39
246A	65	IHC	139					2980	395				7711	1858			415.0	39
247A	67	WESCO	16					1135		46			10960	1550	2466.8		707.1	39
248A	69	IHC	82					636					7703	1587			485.4	39
257A	64	IHC						21					999					27
2601	74	CAT	19		86			49	69	311	2.0		68	397	15.8	22.1	17.2	9
CLASS 9099		MISC. CLASS	256		86			4821	464	357	.2	89	28124	5392	1350.3	129.9	521.6	6

CURRENT DOMICILE TOTAL

MAINTENANCE COST	12394
OPERATING COST	652
TOTAL COST	13045
USAGE	2175
VEHICLE COUNT	20

FIGURE 12. MAINSTEM Actual vs. Budget Control Report.

ANALYSIS OF EQUIPMENT MAINTENANCE, FUEL, ADD OIL, & UTILIZATION MAINSTEM REPORT 112

247 67 WESCO D (2733)TRK REFI COMP 26

		CURRENT PERIOD				PREV 10		LIFE39	LIFE		ROADCALLS			CURR	PREV	LIFE	W=R
	REP ORD	COMM COST	PTS COST	LAB COST	TOTAL COST	REP ORD	TOTAL COST	TOTAL COST	COST /100	WRNTY RECOV	CUR	PREV 10					
103 INST/GUAGE						1	56	159	2.69				345POW.P A				
111 AXLE F/ ND													342COOL A				
112 AXLE R/ ND						1	15	28	.48				343EXHAU A				
113 BRAKES=MAJ						3	1156	2495	42.17				344FUEL A				
213 BRAKES=MIN						14	328	986	16.67				330ELECT A				
114 FRAME						1	29	196	3.31				326TRANS A				
115 STEERING	1			10	10	12	963	3451	58.33				320POW.T A				
116 SUSPENSION						11	1194	3538	59.80		1		445POW.P B				
118 WH/RIM/H/B						4	338	699	11.81				442COOL B				
121 AXLE DR/FR						1	14	14	.24				443EXHAU B				
122 AXLE DR/R						6	122	1952	33.00				444FUEL B				
123 CLUTCH=MAJ													430ELECT B				
223 CLUTCH=MIN													426TRANS B				
124 DRIVESHAFT	1		35	29	64	1	84	957	16.18		1		420POW.T B				
125 P. T. O.						2	19	206	3.48				381HEAT UN				
126 TRANS=MAJ								1432	24.20				382MECH.RE				
226 TRANS=MIN						8	141	395	6.68				383NITROGN				
128 TRANS=AUX													384COLD HD				
131 CHARGE SYS						3	133	320	5.41				180CONDEN				
132 CRANK&BATT						2	34	758	12.81				280EVAP				
133 IGNITION								16	.26				380PLUMB			4	
134 LIGHTING	1		4	19	24	12	267	644	10.89		1		480CONTROL				
141 AIR INTAKE	1		20	5	25	1	5	75	1.27				580OTHER			17	
142 COOLING						8	269	495	8.37				397PUMP		204	1286	
143 EXHAUST						3	26	144	2.44				494CYL&PST		3842	6662	
144 FUEL						1	11	560	9.47				394L/H/F	10	708	1718	
145 POWER=MAJ						1	133	198	3.34				477PIV&PIN		182	203	
245 POWER=MIN						3	83	121	2.05		1		377FRM&SUP			43	
*** SUB=TOTAL	3		60	63	123	70	5418	19840	335.36		1		598CONTROL		39	226	
L U B E	1		1		1			780	13.19				398VALVES		303	558	
P M = A						7	193	532	9.00				498METERS				
P M = B	1		34	24	58	2	139	197	3.34				391BLOWER				
P M = C													392COMPRS				
ACCESS&EXPEND	3		6		6	74	956	2822	47.71		2		594FL.R.TK		27	94	
POWERTAILGATE													190BLADES				
RADIO EQUIP						3	68	195	3.29				290BUCKETS				
WINCH & VCS													390CABLES		24	84	
AC/HEAT/VENT								130	2.20				490CHN&SPR			4	
CAB&SHEETMETAL	2	43		10	53	3	53	235	3.98				590ROL/BOG				
TIRES						24	2369	7933	134.10		2		690TR/T/CL				
BODY & DOORS	1			15	15	14	713	3241	54.78				790HOIST	5	87	292	
CLEAN & PAINT	1			78	78	3	112	1004	16.98				890BRM/BRS				
TOWING&OTHER						9	139	444	7.50				373IN SHEL				
MOUNTED SYSTEM								328	5.55				374OUT JAC				
*** TOTAL	8	43	101	190	334	128	10159	37683	636.97		4		375MANHOLE				
													FLT/LUB/PM		14	18	
											4	*** TOTAL		15	5431	11109	
FUEL GALLONS					306		4603	19158									
OIL QTS. MAKE=UP					16		94	596									
MISC. OPERATING @																	
TOTAL OPERATING @					89.09		1308.89	4370.65									
UTILIZATION					108		1406	5916									
PER GALLON FUEL					.4		.3	.3									
PER QT. MAKE=UP OIL					6.		14	9									
COST /.100 (MAINT & OPER)					391.64		815.65	710.85									

FIGURE 13. MAINSTEM Analysis of Equipment Costs.

Container Maintenance

Container life depends upon the quality of containers purchased, the refuse they hold, the use (or abuse) they receive, and the maintenance given them. A reasonable life expectancy on a high quality container should average around ten years. Maintenance costs includes cleaning, painting, and welding the container. As previously mentioned, a surplus inventory of ten percent should be kept on hand for service needs.

Maintenance costs will vary with usage. Costs will generally range from 50 to 100 percent of initial purchase costs over the economic life of the container. Roll-off container and lugger box maintenance costs will approximate the 50 percent level while costs for bins will be nearer the 100 percent level since bins are fabricated of lighter weight steel than lugger boxes and/ or roll-off containers. Also, bins are commonly emptied by "banging out" the contents into the collection vehicle. A container inventory showing the cost of each container should be kept and shown as part of a Management Information System (for example, see Appendix VI).

Equipment Replacement*

Every commercial refuse collection operation, from the single-truck operator to the multi-fleet manager, must decide if and when to replace collection vehicles and containers.

*For more information on this subject see: On trading in used equipment. Solid Wastes Management, 16(6):31, 62, 78, June 1973.

Since equipment represents the major cost of collection, this is a very significant decision.

In determining the most economical replacement time, the significant point to bear in mind is that accurate maintenance and repair cost figures must be kept on each and every piece of equipment. In addition, a thorough study should be made of the factors that have a bearing on the final result, incuding adjustments for price increases and the changing value of the dollar. These factors generally can be identified as follows:

- Depreciation
- Investment
- Maintenance and repair
- Downtime
- Obsolescence

Table 2 shows representative costs for these four factors. It is assumed that the equipment operates for 2,000 hours per year, and that the vehicle was originally purchased at a cost of $40,000. Maintenance and repair has already been discussed, and the other factors are briefly presented below:

1. Depreciation. Depreciation represents the difference between the purchase price and resale or trade-in value. In other words, this is the cost of the equipment attributed to usage and general condition. Depreciation costs favor keeping the equipment for longer periods of time since hourly costs of depreciation decrease in later years.

2. Investment. With increasing prices, and a trend toward use of larger and more productive equipment, capital investment required for purchase and replacement of equipment rises with each passing year. Whether the equipment is purchased for cash, on installments, rental-purchase, or lease agreement, some type of interest charge, finance expense, insurance and taxes must be allocated to the vehicle. To keep the example simple, it will be assumed the hauler purchased the equipment for cash, with the cost of insurance, interest, and taxes equal to 12 percent of

the average yearly investment for the equipment.

As can be seen from the tabulated information, the investment cost per cumulative hour decreases as the equipment ages. So investment costs, similar to depreciation, also favor retaining the equipment for longer periods of time.

3. Downtime. Downtime should be considered as an operating expense. Inasmuch as downtime will vary greatly according to the make, model, age, and preventative maintenance, it also is important to record these costs accurately and on an individual-machine basis. Excessive downtime means missed collection schedules, overtime payments, or extra equipment.

   In Table 2, downtime charges are based on an assumed average owning and operating cost of $25 per hour. It becomes apparent that downtime costs favor trading in for a new piece of equipment each year if this factor alone were considered.

4. Obsolescence. Obsolescence is often overlooked in equipment replacement considerations.

   The productive capacity of available collection equipment has increased slowly over the past ten years. The increased productivity does not follow a smooth curve, such as increasing 2 percent per year, but rather an erratic one which rises with the introduction

of new models.

For illustrative purposes, assume that a new model every three years increases productive potential by 2 percent annually. This would mean that if equipment were operated 2,000 hours a year, it must operate an average of 40 extra hours (2 percent of 2,000) for each year the equipment was retained after it had been superceded by a new model. Again using $25 per hour as the average owning and operating cost of equipment, the actual cost of keeping obsolescent equipment would increase $1,000 annually, as shown in Table 2.

Summary

Table 3 summarizes the cumulative effects of the five factors and points to the optimum replacement time for the example cited. It indicates that the sample equipment should be traded in after the second year. It should be pointed out, however, that this data is somewhat hypothetical. The critical point to remember is that with accurate records for each piece of equipment, and informed projections, losses resulting from improper replacement of equipment can be avoided. Not only will a planned equipment replacement program upgrade the quality of the equipment on the job, it also develops a cost-minded atmosphere, increases overall efficiency and saves dollars that otherwise would have to be spent in maintenance costs.

	Depreciation				
Year	1	2	3	4	5
Trade-in value (% of delivery price)	75%	60%	50%	40%	35%
Trade-in value	30,000	24,000	20,000	16,000	14,000
Yearly depreciation	10,000	6,000	4,000	4,000	2,000
Cumulative depreciation	10,000	16,000	20,000	24,000	26,000
Cumulative hours of operation	2,000	4,000	6,000	8,000	10,000
Depreciation $/hr	5.00	4.00	3.33	3.00	2.60

	Investment Costs				
Year	1	2	3	4	5
Investment, start	40,000	30,000	24,000	20,000	16,000
Year-end value	30,000	24,000	20,000	16,000	14,000
Average yearly investment	35,000	27,000	22,000	18,000	15,000
Investment cost @ 12%	4,200	3,240	2,640	2,160	1,800
Cumulative investment cost	4,200	7,440	10,080	12,240	14,040
Cumulative hours of operation	2,000	4,000	6,000	8,000	10,000
Cumulative investment $/hr	2.10	1.86	1.68	1.53	1.40

	Maintenance and Repair Costs				
Year	1	2	3	4	5
Availability	95%	93%	90%	88%	85%
Maintenance & repair cost	2,000	3,000	4,500	6,000	7,500
Cumulative repair cost	2,000	5,000	9,500	15,500	23,000
Cumulative hours operation	2,000	4,000	6,000	8,000	10,000
Cumulative repair $/hr	1.00	1.25	1.58	1.94	2.30

Table II: Equipment costs for a $40,000 vehicle over a five-year period.

	Downtime Costs				
Year	1	2	3	4	5
Availability	95%	93%	90%	88%	85%
Hours not available	100	140	200	240	300
Rental cost @ $25/hr	2,500	3,500	5,000	6,000	7,500
Cumulative downtime cost	2,500	6,000	11,000	17,000	24,500
Cumulative machine hours	2,000	4,000	6,000	8,000	10,000
Cumulative downtime $/hr	1.25	1.50	1.83	2.13	2.45

	Obsolescence Cost				
Year	1	2	3	4	5
Obsolescence factor	2	2	2	2	2
Extra hors required to match production of new model	40	80	120	160	180
Cost @ $25/hr	1,000	2,000	3,000	4,000	5,000
Cumulative cost	1,000	3,000	6,000	10,000	15,000
Cumulative hours of operation	2,000	4,000	6,000	8,000	10,000
Obsolescence $/hr	0.50	0.75	1.00	1.25	1.50

Table II; (Cont.)

Year	1	2	3	4	5
Hours	2,000	4,000	6,000	8,000	10,000
Depreciation costs	5.00	4.00	3.33	3.00	2.60
Investment costs	2.10	1.86	1.63	1.53	1.40
Maintenance & repair costs	1.00	1.25	1.53	1.94	2.30
Downtime costs	1.25	1.50	1.83	2.13	2.45
Obsolescence costs	0.50	0.75	1.00	1.25	1.50
Total cumulative $/hr	9.85	9.36	9.42	9.85	10.25

Table III: Total equipment costs over a five-year period.

SECTION III

ROUTING

Introduction

To understand the importance of routing, consider the following: A collection vehicle and crew are generating revenue only during collections; travel time between customers and to and from the disposal site are necessary, but in essence represent lost or non-productive time. Therefore, proper routing of collection vehicles to minimize travel time between collection stops (i.e., customers), between the yard and route and between the route and the disposal site is essential to maintaining cost-effective operations and assessing equipment and personnel requirements.

Basically, routing is simply the order in which customers are serviced -- the chronology of the service area. It should take into consideration many factors: potential hours of operation, customer density, topography, haul distance, vehicle size and type, container types and locations, frequency of collection, waste generation rate, etc. Each factor determines, to some extent, the productive work capability of the vehicle and crew.

Types of Routes

Crew assignments for routes may be made on a "daily route" or "task" basis. Under the daily route method, a specific route is determined for completion each day. When the route is completed,

the crew is sent home or assigned to other work. This is the most prevalent type of route for several reasons. First, customers are usually billed for frequency of pickup, and usually expect to be serviced on specific days. Second route makeup can be balanced and changed according to changes in customer numbers and needs. Third, the crew is given a certain area (route) to collect, after which they can go home, thus providing an incentive for the collection crews. Finally, the route represents a standard against which both performance and cost can be measured. A slight modification of this concept, where a number of routes are serviced on a given day, is to provide that the drivers may go home when all routes to be serviced that day are collected, thus providing a means of assuring proper completion of each and every route.

The less utilized "task" method defines the route as a much larger area, for example, a full week's collection area. A crew collects for the full work period each day and commences collections where operations were ceased the preceding day. The entire area is completed by the end of the week.

Routing Techniques

Routing can be accomplished by manual means or with the use of electronic computers. The former method is more widely used. Once again, the importance of a working knowledge of the service area cannot be overemphasized as the single most important determinant of routing. Regardless of the method employed, routes

should be regularly reviewed to assure maximum efficiency of operations.

Manual routing ranges from random collection to formalized decision models. The random collection is based on driver knowledge and competence, and should be used with discretion and caution. Decision models are characterized by two primary approaches: (1) the hueristic approach developed by the EPA - Office of Solid Waste Management Programs, and (2) routing instructions developed by Public Technology, Incorporated (PTI).

The hueristic approach applies "rules" or "hueristics" to obtain an acceptable although not necessary optimum, collection route. Hueristic routing determines the path the collection vehicle is to follow as it services each customer on a route by asking decision questions. The method reduces driving time on the collection route by minimizing the 'dead' distance (street segments having no customers or those that are transversed more than once), backing of vehicles, U-turns, left-hand turns, and collection on major streets during rush hour traffic. An example of a decision model is shown in Figure 14. A full description of the EPA hueristic approach to routing is available by writing to:

Systems Management Division
Office of Solid Waste Management Programs
U.S. Environmental Protection Agency
Washington, D.C. 20460

Routing instructions developed by PTI incorporate mathematical techniques to minimize retracing of areas within a "district" (a

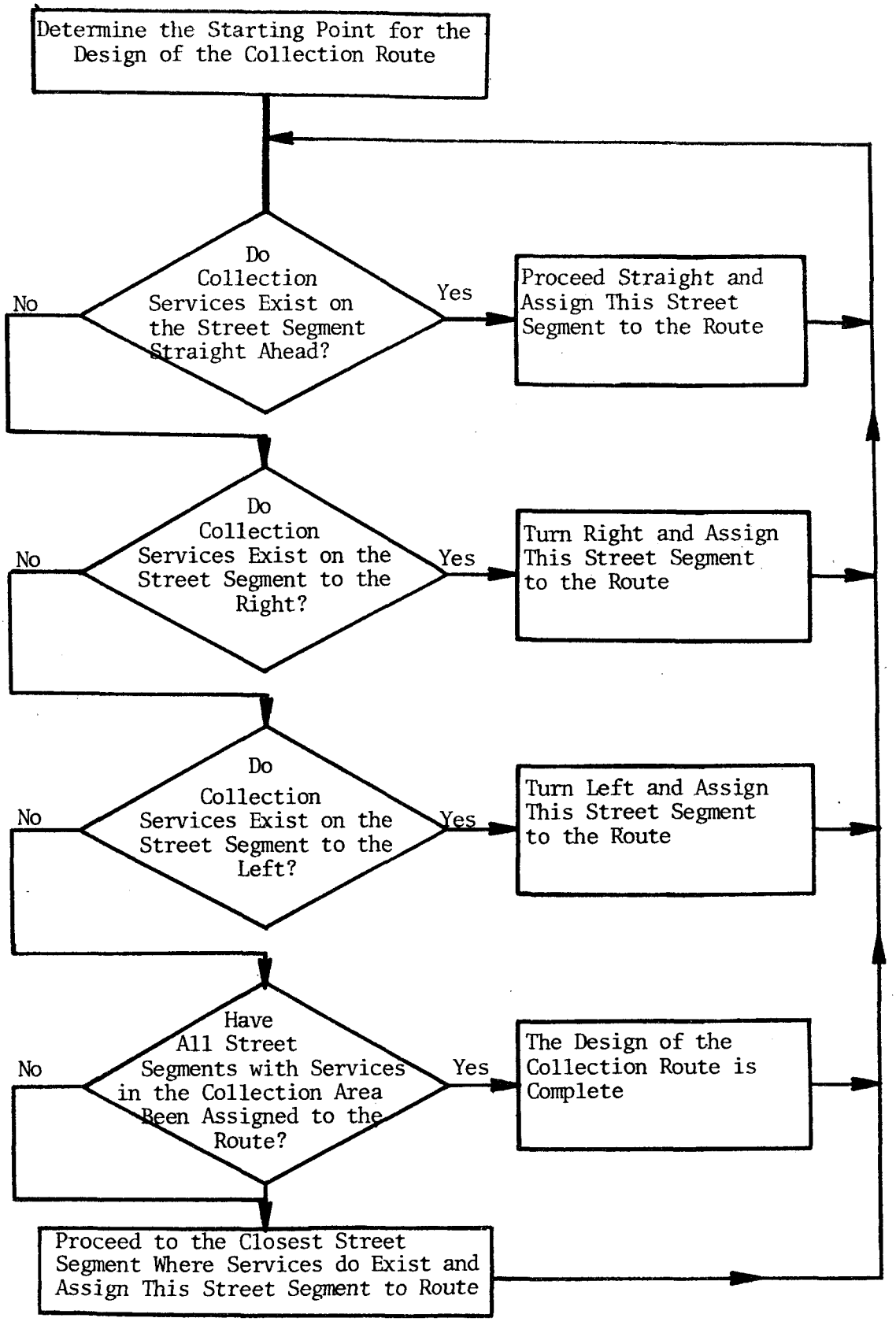

Figure 14. Heuristic Routing Segment Selection Procedure for collection from both sides of the street.

district, as defined by PTI is the area covered by one truck per day; a "route" is defined as a tour through the district). The PTI system is currently being published and should be available for dissemination about June 1974, (PTI, 1140 Connecticut Ave., Washington, D.C.)

Computerized routing services are available from several firms including IBM, Boeing Computer Systems, and PTI. Computerized routing does not replace the need for service area assessment; in fact, this method requires substantial data gathering for necessary input. Existing routing models can create balanced workloads and optimal routes provided sufficient service area information is available. Their major drawback is the insensitivity to certain service area factors, such as climate, topography, and seasonal variations which are often difficult to quantify for use in computers. For example, load quantities in cubic yards may vary significantly from day to day or month to month. For small to medium sized commercial collection operations, manual routing would be the more cost-effective alternative, since programming, processing, and data collection and updating represent fairly significant costs.

Some have suggested that psychological considerations (such as pointing the end of the route toward the yard) may positively affect performance on the route. Certainly, equipment operator considerations are a major factor in routing.

Routing determines the number of vehicles of a given type and

size required to properly service customers in the proposed collection area. This number, when increased to compensate for maintenance and backup requirements, can be used to estimate capital and personnel requirements as previously discussed. The collection fleet size also relates to the need for support facilities.

SECTION IV

FACILITIES

Facilities and yard requirements are important considerations for a commercial collection operation. A municipal operation is usually housed in a city yard along with other municipal equipment and vehicular operations. Private collectors, however, should select facilities considering several factors including convenience to the collection area and disposal site, appropriate zoning, sufficient space for current operations and future expansion, and the amount of operational and spare equipment. Functions requiring space consideration include the following:

(1) Office space to house supervisory, bookkeeping, and clerical functions, with adequate record keeping and filing space.

(2) Employee parking during working hours.

(3) Vehicle storage - overnight parking of operational and spare collection vehicles.

(4) Container storage for extra containers purchased to supplement assigned containers during maintenance and repair.

(5) Maintenance. Pending an on-site or contractual maintenance decision, varying amounts of space will be required to maintain collection vehicles and containers. Assuming on-site maintenance is to be performed, garage space must be allocated as well as a painting area for both vehicles and containers.

(6) Circulation and fueling space, adequate space for maneuvering and for refueling equipment.

(7) Employee convenience - depending on the number of amenities offered to employees, consideration should be given to conference rooms for training, lunch rooms, and shower and locker rooms.

Of the preceding functions, the vehicle maintenance area is probably the most sensitive. Servicing heavy motorized equipment has many peculiarities not comparable with other types of equipment. When planning such a shop, one should be very familiar with the problems involved. Much of the maintenance equipment presently available is for automobile shops and not suited for a truck shop.

Consideration should be given to centralized grease, motor oil, air, heavy duty electrical, and drain oil lines with taps at strategic locations in the shop. Hoists of various types and floor loadings should be of adequate capacity to handle the heaviest equipment in the fleet, fully loaded. Ceiling clearance should be adequate to raise the longest dump bodies to full height.

The shop should be designed for minimum aisle space and movement within the building. An ideal layout would allow trucks to enter and leave any shop bay from the outside without disturbing any other truck in the building. To accomplish this, the building could be constructed with two rows of shop bays facing each other. Shop benches and equipment would be down the center, and the two outside walls would have overhead doors for their entire length. Bridge cranes could then be installed to run the entire

length of the shop and cover any part of the floor. Proper exterior striping would direct and restrict the flow of traffic to and from the shop.

Truck storage can also be a problem. It is usually desirable to locate storage areas so as to minimize interruption of local traffic. As the trucks are large, noisy and, at best, unattractive, they should be parked and stored away from residential neighborhoods.

Indoor versus outdoor storage should be weighed in terms of whether the added cost of buildings and the like can be justified by lengthened life and reduced maintenance. There is no way to determine this accurately without long years of comparative experience in a specific operation. Indoor versus outdoor parking, therefore, becomes a rather academic question when considered structly on its own merit. Other factors which must be considered are:

(1) Building costs.

(2) Availability of unused space.

(3) Availability of temporary or portable buildings and whether they are acceptable.

(4) Administrative policy with regard to public relations insofar as appearance of trucks and lots is concerned.

(5) Importance of geographical distribution of the trucks relative to operating cost.

(6) Zoning requirements and regulations.

SECTION V

PERSONNEL CONSIDERATIONS

Introduction

In most instances, refuse collection is viewed as a mundane and necessary task, neither glamorous nor challenging. As a result, collection personnel often reflect this attitude. Apathy, absenteeism, poor work habits, and injuries follow. Thus, proper selection and training of collection personnel is important to operations.

Effective personnel administration requires policies that: *

1. Attract qualified people to the field of refuse collection through a reputation for fairness, career opportunities, able management, and working conditions that are as favorable as possible.
2. Provide wages that are at least equal in pay to similar work in other industries, with emphasis on the fact that work must sometimes be performed under unfavorable physical conditions.
3. Encourage continued service on a career basis through dependable and stable employment, with opportunities for advancement and eventual retirement.
4. Guarantee equal opportunities for all qualified persons to compete for hiring and promotion under impartial and high-standard examinations.

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*Technical knowledge is a must for new employees. Solid Wastes Management, 15(3):47, 84, Mar. 1972.

5. Train employees to do their work better and easier as a means of increasing competence and achieving advancement.
6. Protect employees from arbitrary separation for trivial or personal reasons, but provide a means of discharging incompetent and other undesireable workers for justified cause.

Selection

Selection of personnel may pose a considerable problem due to the stigma generally attached to refuse collection. Many refuse collectors are "drifters", continually jumping between municipal and private collectors when a more favorable condition (usually salary) exists. Personnel turnover is expensive and inefficient: retraining is necessary and it takes time for a collector to become route and crew oriented. Obviously, mechanized systems allow for greater employee stability, particularly systems where a one-man crew can collect a route without having to leave his vehicle. There are several important employee attributes to consider in selecting the relative importance of each and varies with the collection method utilized. Physical strength is required to cope with refuse collection. Some small commercial accounts may place their refuse in 30 to 60 gallon containers. Manual collection of these containers is akin to residential refuse collection problems: overloaded containers, hazardous materials, etc.

When collecting bins for side and rear-end loaders it is often necessary to position the bins (rolling them out from an enclosed area or turning them around). Although castered, a large bin may weigh several hundred pounds, and the effort required to start rolling a bin is often very straining. Rigid physical examinations should therefore be provided to candidate personnel to determine physical qualifications. Determining physical qualifications before employment will minimize some of the problems with employee turnover due to injuries sustained in prior jobs and minimize subsequent insurance claims.

Many municipalities classify their commercial collection drivers as equipment operators, and use comparable jobs in the private sector to establish benchmarks for salary range. Certainly the skill of the operator in handling and maneuvering the equipment is critical to both speed and productivity.

Downtime is an evil that all collection operations must face. Although preventive maintenance can circumvent many unexpected maintenance problems, collection equipment is prone to eventual failure for any number of reasons. Should small maintenance problems occur on route, personnel with mechanical skills can reduce downtime by making on-the-spot corrections and continuing on the route. In small commercial operations where crewmen may also be required to perform equipment maintanance, such skills as welding may be important to look for in

prospective personnel.

Congeniality of refuse collectors is an attribute often overlooked during personnel selection. Often the only contact with a customer (aside from billing) will be made during collection operations. A congenial employee can do a great deal toward promoting a healthy customer relationship.

Intelligence (not to be confused with educational level) is an extremely important attribute when selecting personnel. Highly sophisticated and costly equipment must be properly operated. Collection personnel will have to make many decisions each day, fill out forms correctly and completely and have technical understanding of collection operations and procedures.

Figures 15-17 show representative sample of job descriptions and qualifications needed for "line" personnel in commercial refuse collection.

Training

Training collection personnel is of the utmost importance. Knowledge of the equipment used, routes covered, and procedures to follow must become second nature to drivers (and leaders if used). Drivers must have a chauffers license and should be subjected to tests which measure depth perception, peripheral vision, color vision, etc., as part of the training. Although the initial expense of such testing may appear to be substantial, they will prove to be economical over the course of time when costs for maintenance are considered.

CITY OF SCOTTSDALE

REFUSE COLLECTION SENIOR FOREMAN

DEFINITION:

Under direction, plans, directs and reviews the operations of the Municipal refuse collection devision.

TYPICAL TASKS:

Reviews the work of subordinate foremen, each supervising several crews of equipment operators and laborers engaged in refuse collection; resolves personnel problems; reviews schedules and work assignments; compiles unit production and cost statistics; assists management with long range planning, equipment modification and other improvements; prepares preliminary division budget and reviews expenditure of allotted funds; confers with equipment maintenance division concerning equipment operation, repair, purchase and preparation of specifications; supervises the ordering of materials and services; supervises the skill and safety training of all employees; and performs related work as required.

EMPLOYMENT STANDARDS:

Any combination of training and experience equivalent to completion of high school plus considerable experience as a refuse collection foreman or as a manager or supervisor in fleet operations in any large materials handling organization.

FIGURE 15. Personnel job description for collection senior foreman.

Considerable knowledge of effective and efficient methods and procedures for scheduling and accomplishing refuse collection work; considerable knowledge of the operation of large automotive equipment; ability to plan, lay out, coordinate, inspect and schedule the work of a large refuse-collection division; ability to keep accurate records and make reports.

FIGURE 15. (Continued)

CITY OF SCOTTSDALE

REFUSE COLLECTION FORMAN

DEFINITION:

Under direction, supervises and coordinates the activities of several refuse collection crews, and performs related work as required.

TYPICAL TASKS:

Plans, assigns and reviews the work of several crews of equipment operators and laborers engaged in a city-wide refuse collection program; makes certain that all necessary tools and equipment are provided and that they meet safety standards; checks equipment and arranges for maintenance and repair as needed; performs time studies of new and existing accounts, and designs and modifies collection routes as necessary; resolves customer complaints; directs and assists in the training and evaluation of new employees; helps develop safety programs and conducts safety meetings; maintains records such as activities, accidents, equipment usage and condition, time sheets, and inventory; submits related reports.

EMPLOYMENT STANDARDS:

Any combination of training and experience equivalent to completion of high school, plus considerable experience as a labor foreman, preferably in public construction, maintenance or refuse collection and disposal.

FIGURE 16. Personnel job description for collection foreman.

Good knowledge of the materials, methods and techniques commonly used in refuse collection; good knowledge of the operation and maintenance requirements of trucks and other heavy automotive equipment; ability to acquire and apply knowledge of supervisory techniques; ability to plan and coordinate the work of a large number of subordinates; ability to keep accurate records and to make reports; ability to deal effectively with the public.

FIGURE 16. (Continued)

CITY OF SCOTTSDALE

EQUIPMENT OPERATOR III

DEFINTION:

Under general supervision, operates heavy automotive equipment having complex operation requirements and entailing considerable manipulative difficulty, and performs related work as required.

TYPECAL TASKS:

Drives heavy garbage truck with hydraulic lifting, loading, and packing controls on established route or special assignment; operates controls to pick-up large refuse containers or trailers, empty into body of truck, and replace in proper position; compacts refuse to rear of truck; empties load of compacted material at landfill or into transfer-trailer; performs routine maintenance checks of equipment and notifies mechanics of any malfunctions or needed repairs; keeps simple records of mileage, activities, tonage and equipment down-time; may operate other heavy trucks or equipment as required.

EMPLOYMENT STANDARDS:

Any combination of training and experience equivalent to completion of eighth grade, plus considerable experience or formal training in the operation of complex automotive equipment.

FIGURE 17. Personnel job description for collection foreman.

Good knowledge of the operation and maintenance requirements of heavy trucks and automotive equipment; ability to operate heavy duty equipment skillfully and safely; ability to keep simple records, read maps and follow oral and written directions; good manual and finger dixterity.

NECESSARY SPECIAL REQUIREMENTS:

Possession of, or ability to obtain, a valid Arizona Class A Chauffeur's license.

FIGURE 17. (Continued)

When assigned to a new route, a man should spend a minimum of five days with an experienced member of the collection force to learn proper procedures and use of the equipment.

Initial training should also include first aid and fire-fighting techniques (at minimum, orientation to fire extinguisher use). Safety precautions (discussed in the following section) should also be detailed during training. Training course methods and outlines can be obtained from the National Solid Waste Management Association. (See address on page 17).

On-going training is also necessary to continually keep efficient operating procedures foremost on the minds of collection personnel. Training, however, should not be conducted on the "employee time". If training is conducted at the end of a collection day, the men will likely be too weary from their work to be attentive. Thus, training might well be given on "company time" even if it means paying for a few overtime hours. Again, long-term benefits will likely become evident.

Safety*

The more then 200,000 persons directly involved in the collection and transportation of solid waste presently lead the nation in injury frequencies - some 10 times the average for all industries combined. While the accident rate is higher for residential than commercial, and higher for manual than mechanical systems, every effort to minimize accidents should

*Marceleno, T. Building safety into refuse collection. APWA Reporter, 40(2):18, Feb. 1973.

be made. The Environmental Protection Agency (Office of Solid Waste Management Programs), in cooperation with the American Public Works Association (APWA), American Mutual Insurance Alliance, Governmental Refuse Collection and Disposal Association (GRCDA), and the National Solid Wastes Management Association (NSWMA) is seeking to promote on-the-job safety through Operation Responsible, a public-private training effort. Additionally, the GRCDA's Committee on Safety Standards has issued Safety Standards for Solid Waste Management, covering safety procedures, equipment safety specifications, and ordinances. The latter is available by writing to the local chapter of GRCDA.

Operation Responsible basically focuses on the key individuals in the safety issue - the collection supervisor, the man in direct charge of refuse collection activities. Before headway can be made with the individual collectors, supervisors must be convinced that safety pays off in terms of increased production, reduced inconveniences, and perhaps promotion.

Supervisors can be familiarized with the program through one day seminars conducted by the various participating organizations mentioned earlier and by the state solid waste agencies. Since the specially developed materials are readily available from the National Audio-Visual Center in Washington, D.C., they also can be used by other interested organizations. (Write National Audio-Visual Center, General Services Administration, Washington, D.C. 20409).

The 1970 Occupational Safety and Health Act (OSHA) requires practically all employers to maintain records of work-connected injuries and illnesses. Such documents must consist of (1) a continuing log of injuries and illnesses, (2) a supplementary record of each individual mishap and sickness, and (3) an annual summary of all work-related injuries and illnesses. These logs must be retained for 5 years. The full details of OSHA requirements may be obtained by writing to the regional office of the U.S. Department of Labor or the Occupational Safety and Health Administration.*

Non-Collection Personnel

Non-collection personnel are required in every commercial collection operation. Included are those of the following classifications: Supervisory, Mechanical, Bookkeeping/Clerical, Data Processing if the operation is large, and Container repair personnel. Municipalities are in a better position than private firms to provide for these positions because portions of a person's time may be allocated to similar requirements in other municipal departments. For example, in a small municipality that provides commercial service, management of collection operations may be only one of many tasks under the jurisdiction of the Director of Public Works. Similiarly, a mechanic may maintain refuse collection vehicles as well as city-owned automobilies, road maintenance vehicles, street sweepers, etc.

*Occupational Safety and Health Act of 1970, Public Law 91-596; 84 Stat. 1590, Dec. 29, 1970.

Conversely, the small private hauler must often utilize collection/non-collection personnel in dual roles. For example, the owner of a small commercial collection firm could be the field foreman while also assuming responsibilities as office manager and even the bookkeeper. Once a business grows, however, the owner can relinquish lesser responsibilities to other personnel.

Bookkeeping personnel should have an understanding of accounting principles and understand the billing rate structures. Without qualified bookkeeping personnel, account information and billings may suffer.

Secretarial/clerical positions should be filled with qualified personnel who are capable of understanding the general workings of the company. Often these persons are subjected to the public via customer questions and/ or complaints. Amiable employees in these positions can assist in many facets of an organization if properly screened and trained.

As previously discussed, collection crews may also serve as mechanics in many small commercial operations. Again, as operations grow, full time mechanics will be required if maintenance work is to be performed in-house (versus contract maintenance). When hired, mechanics should be screened carefully to obtain the services of those with foresight to see the advantages of preventative maintenance and the capability of carrying out specified maintenance functions.

SECTION VI

CONTRACTUAL CONSIDERATIONS

Contractual considerations are applicable to a private contractor performing commercial collection service. Municipal commercial collection service is normally exempt from contractual requirements as an ordinance provides collection service specifications.

A formal contract between a small individual customer and a private commercial hauler may not be necessary. However, when a large waste generating customer or a city franchise is involved, a written contract is normally provided. A written contract for large accounts may be necessary to define and/or specify collection procedures, frequencies, and equipment needs at a prescribed cost.

When more than one contractor is qualified to provide collection service to a city or other well-defined service area, a bidding situation may evolve. There are many requirements that may have to be met when submitting a bid:

(1) Satisfactory evidence of waste collection credentials (experience, manpower, equipment)

(2) Compensation required to cover equipment and manpower requirements, applicable overhead, billing, etc.

(3) Bid bonds to bind the bidder to indemnify the customer/city against losses should the bidder not accept the contract.

(4) Performance bond to guarantee adequate job performance.

A joint effort in 1971 by the EPA, Office of Solid Waste Management Programs and the NSWMA provided recommended bidding instructions for private haulers.*

Detailed information is available through the NSWMA. Bidding is very competitive and should not be taken lightly. If a bidder is unfamiliar with the collection area under bid, a detailed inspection should be conducted to become familiar with the work contemplated by the contract. Projections of commercial growth should be obtained or estimated if a multi-year contract is envisioned. (Multi-year contracts are desirable if new equipment purchase is required. The multi-year contract enables a contractor to amortize costs and to be assured that costs will be covered for providing efficient service with modern equipment). When more than one firm is bidding for a contract, accuracy of bid preparation is of great importance. The contract will normally be awarded to the best-qualified bidder with the lowest bid cost. A bidding error may result in loss of a contract, as corrections are often not accepted.

The sample contracts in Appendix V for "Collection and Disposal of City Refuse," and "Compactor Agreement" were published in the 1974 Sanitation Yearbook (an annual supplement to the Solid Waste Management/Refuse Removal Journal). The contractual specifications in these two samples exemplify the stipulations that bids may be required to cover. The third contract is a sample agreement between a customer and a private hauler.

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*Recommended bidding instructions for private haulers. Solid Wastes Management, 14(6):44; 74-75, June 1971.

SECTION VII

BILLING/INFORMATION SYSTEMS

Information needs of system managers grow as the operation expands. Managers must have ready access to management information on such variables as productivity, labor hours, quantities hauled, and a host of other technical and cost factors for effective operational management and control. A billing and information system, prepared by automated equipment, is eventually an essential element of the efficient commercial collection operation.

The informational needs of a manager were addressed in this project;Appendix VI describes a simple, straightforward Management Information System which can be used in conjunction with customer billing to obtain important cost accounting figures. Any person or organization interested in commercial refuse collection is strongly encouraged to review this appendix. It should be pointed out that the MIS described in Appendix VI is available from the Solid Waste Management Division of EPA.

Billing systems for small operations normally follow a fairly typical pattern. A bookeeper prepares invoices based on the number of containers emptied during the billing period. At the same time, outstanding balances are also checked. Overdue amounts are entered on the new invoice. An inevitable problem evolves as the operation grows: the billing and

accounting requirements exceed capabilities of manual methods. At that point, computerized billing is the logical step to maintain a current billing profile.

One of the objectives of this project was to develop a user charge system upon which customer charges could be based. The user charge system described in Appendix VII provides a method of allocating collection costs to each customer. The system has sufficient flexibility for adaptation by either public or private collectors. It provides a method of computing and matching revenues and expenditures. Finally, the methodology described in Appendix VII can be performed manually using straight forward measurement.

SECTION VIII

PUBLIC RELATIONS

Introduction

Few services are more visible to the public than refuse collection. Good public relations depend on competent, polite employees rendering efficient and effective service. In fact, collection personnel continually demonstrate the public relations policy of the collector. If the employee is slow to respond, seems to lack interest, is poorly informed, slovenly in appearance, or generally not helpful, the citizen is likely to conclude that he is typical of the collection service as a whole. Thus, the caliber of the collection personnel employed, the quality of their performance, and their attitude and manner determine the public's reaction.

Employee Morale

Obviously care should be taken in the recruitment and selection process to obtain the highest caliber of employees possible. Once employees are chosen, however, the ability to improve the quantity and quality of his performance is largely dependent on management techniques, capabilities, and concern. It should be remembered that handling refuse every day is not the most pleasant occupation, and for the sake of morale the task be surrounded with as many positive attractions as can be

provided. If grumbling and discontent are allowed, the critical attention of the public is soon drawn to the service.

Various means may be used to establish positive employee morale. Vacations, sick leave, hours of work, and physical surroundings all affect the conditions of service. We have found that one of the most critical environments of collection is the vehicle cab. Customizing the cab (additional insulation, air conditioning, and even tape-deck stereos) has made that environment much more pleasant.

Credit unions, safety training, and recreation programs also aid in improving general employee morale. Open forum meetings, suggestion boxes, and even questionnaires are among the devices used to obtain employee support.

Employee-Customer Relations

In the eyes of the customer every employee represents the refuse collection firm or agency, so employee actions are of vital importance to the maintenance of good public relations. It is generally conceded that refuse collectors should undergo some training in public relations. Group lectures, formal classes, procedure manuals, and personal instruction have all been proven effective as training devices. Of course, the size of the collection work force affects the manner in which instruction have all been proven effective as training devices. Of course, the size of the collection work force affects the manner in which instruction is given. Demonstrations before

larger groups of employees are of great assistance to collectors as well as to foremen, inspectors, and supervisors. In smaller operations, however, such methods may not be practical. Regardless, one excellent means consists in stating clearly the firm's public relations policy and then presenting satisfactory methods of dealing with particular situations.

Some collection agencies delegate to inspectors the authority to adjust controversies and to explain possible difficulties. In many areas, supervisors combine such public relations work with other duties.

While contacts between citizens and collection employees are often face to face, there are also contacts via correspondence and/or telephone. Each request for information should receive a prompt and courteous reply. Correspondence should be "personal" in tone rather than like a legal code. Each written inquiry should be routed immediately to the person best equipped to answer it, and those responsible for handling inquiries must be properly trained.

Handling Complaints

While much of what has been said about handling requests for information applies equally to the treatment of complaints, the latter merit special consideration because of their importance in public relations. Complaints furnish a measure of the success of the collection service and offer an opportunity to create good will.

Good complaint procedure involves four principal stages: (1) receiving the complaint; (2) assignment of responsibility for investigation and correction; (3) follow-up; and (4) notification of correction.

In small operations, or where there is no central information bureau, telephone operators should be supplied with enough information of a routine type so as not to interfere unduly with their work and yet take some of the burden from the shoulders of the administrators. When the operator cannot answer a question, connection should be made with the inquirer to the person who has been assigned to reply to such queries.

The attitude of the person receiving the complaint is of particular importance because the customer filing the complaint is seldom in the best of temper. Tactless employees, or those who like to argue, are not suited to dealing with the public in such situations.

To ascertain the underlying cause of complaints, records should be maintained and analyzed periodically. Monthly analysis are desireable to show the total number of complaints for the month and to classify their causes. In addition, a distribution by district, crew, or route is needed to keep supervisors informed of the need for remedial action. Recurring complaints should be given prompt attention.

Good Relations Through Effective Operation

Effective and economical operation of the collection system is one of the best ways to gain the good will and approval of customers. This may call for the careful training of employees in the proper ways of doing their work, thus eliminating many complaints and promoting better public relations.

Spilling refuse cannot always be avoided when containers or vehicles are overloaded, but spillage resulting from employee neglect should be cleaned up by collection personnel. A supervisor can discuss over-filled containers with the customer.

Collection at night or in the early morning hours also causes problems which can be largely overcome by training. Reduction of noise is especially important. While it is impossible to collect refuse without some noise, the amount can be reduced through an examination of operations and training of the employees. The language and the tone of voice used by the workers during collection should also be considered.

Cleanliness

Customers may associate the collection of refuse with the idea of uncleanliness - a negative picture which may be the only one presented. To substitute a different picture, the idea of cleanliness must first be instilled into the habits of the collection personnel. A start in this direction can be made by improving the personal appearance of the collection force. Furnished uniforms, laundered at frequent intervals,

go a long way toward relieving the stigma attached to collection work. Even if uniforms are not worn, provision of clean, standardized apparel can accomplish the same ends.

Cleanliness should also apply to the collection equipment. Equipment should be frequently cleaned, body work performed as needed, and the paint maintained. Often collection vehicles are unattractive either through lack of paint or soiled condition. Regular cleaning is needed in order to remove dirt, particles of refuse, and unpleasant odors. The method and frequency of cleaning can be brought to the attention of the employee during the training process. Some designers have conceived of bright, imaginative designs and colors for refuse equipment which make it both attractive and aesthetically pleasing.

Driver Courtesy

The impression which collection equipment makes on the citizens depends on its use as well as on its appearance. A reckless driver or "road hog" is not liked under any circumstances, but if he is driving a refuse collection vehicle his offense is magnified. Operators of refuse collection vehicles should be exemplary in courtesy and safety on the road. The provisions of all related laws should be followed to promote safety. Arguing with others as to the right of way, trying to "beat" the stoplights, and double parking which may lead to hazardous traffic conditions, should not be permitted.

*U.S. GOVERNMENT PRINTING OFFICE:1975 631-376/907 1-3