

Maintenance Management System

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San Diego County is about 4,260 square miles in size, measuring approximately 80 miles from the Pacific Ocean to the east boundary and about 60 miles from the Mexican border to the north boundary (Fig. 1). The topography varies from coastal hills and inland valleys, to 6,000-foot mountains in the central portion of the county, and to the Imperial Valley floor in the eastern portion. Climate varies as does the topography, and requires maintenance of roads in mild, sometimes foggy, coastal areas, in heavy rainfall and snow removal areas in the mountains, and in desert areas subject to flash floods and high temperatures. Because of the high growth rate and urbanization of the unincorporated areas surrounding metropolitan San Diego, our road maintenance function also involves many miles of city-type streets and their inherent needs such as sweeping, pedestrian control and sophisticated channelization and signalization.

COUNTY ENGINEER DEPARTMENT

The San Diego County Engineer Department, with an annual budget in excess of \$13 million and over 500 permanent employees, has the prime responsibility of operating and maintaining approximately 2,100 miles of roads, ranging in types from less than two-lane dirt-surfaced facilities to major eight-lane expressways.

Activities are not strictly limited to road maintenance, but include road planning, road design and construction, contract services to cities, land subdivision and grading administration, county-wide mapping, building inspection, and county-wide communications responsibilities (Fig. 2).

The Road Operations Division (Fig. 3) primarily performs those central administrative services necessary for operation of the three road maintenance divisions. Each road maintenance division centrally operates an equipment repair and maintenance shop and various division-wide specialty crews such as traffic operations, construction and repair crew, road oil and pit crew, tree-trimmers and motor sweepers (Fig. 4). Road Maintenance Divisions are further subdivided into twenty road maintenance stations. Each Road Maintenance Division, including its road maintenance stations, has approximately 75 personnel assigned.

EARLY MAINTENANCE MANAGEMENT PRACTICES

Early efforts in routine maintenance management took the form of scheduling according to need, of the division-wide specialty crews. A more comprehensive cost accounting program was instituted with the development of maintenance reporting codes. Work orders were issued for projects previously reported as routine maintenance but that in reality constituted a road betterment. A pilot program was initiated in six road maintenance stations to schedule routine maintenance one week in advance and to report actual man-hours and equipment use on each scheduled maintenance project.

DEVELOPMENT OF FORMAL MAINTENANCE MANAGEMENT

In October 1967, in an effort to formalize and improve road maintenance scheduling, planning, and the cost accounting system, a management consultant was retained.

Included as part of the program was the selection and training of a technician team to develop necessary data, apply time standards, and aid in the planning and scheduling process. Twelve individuals, four from each maintenance division, were interviewed for possible assignment as maintenance technician. Six of the twelve were selected to undergo special training under the guidance of the management consultant representative.

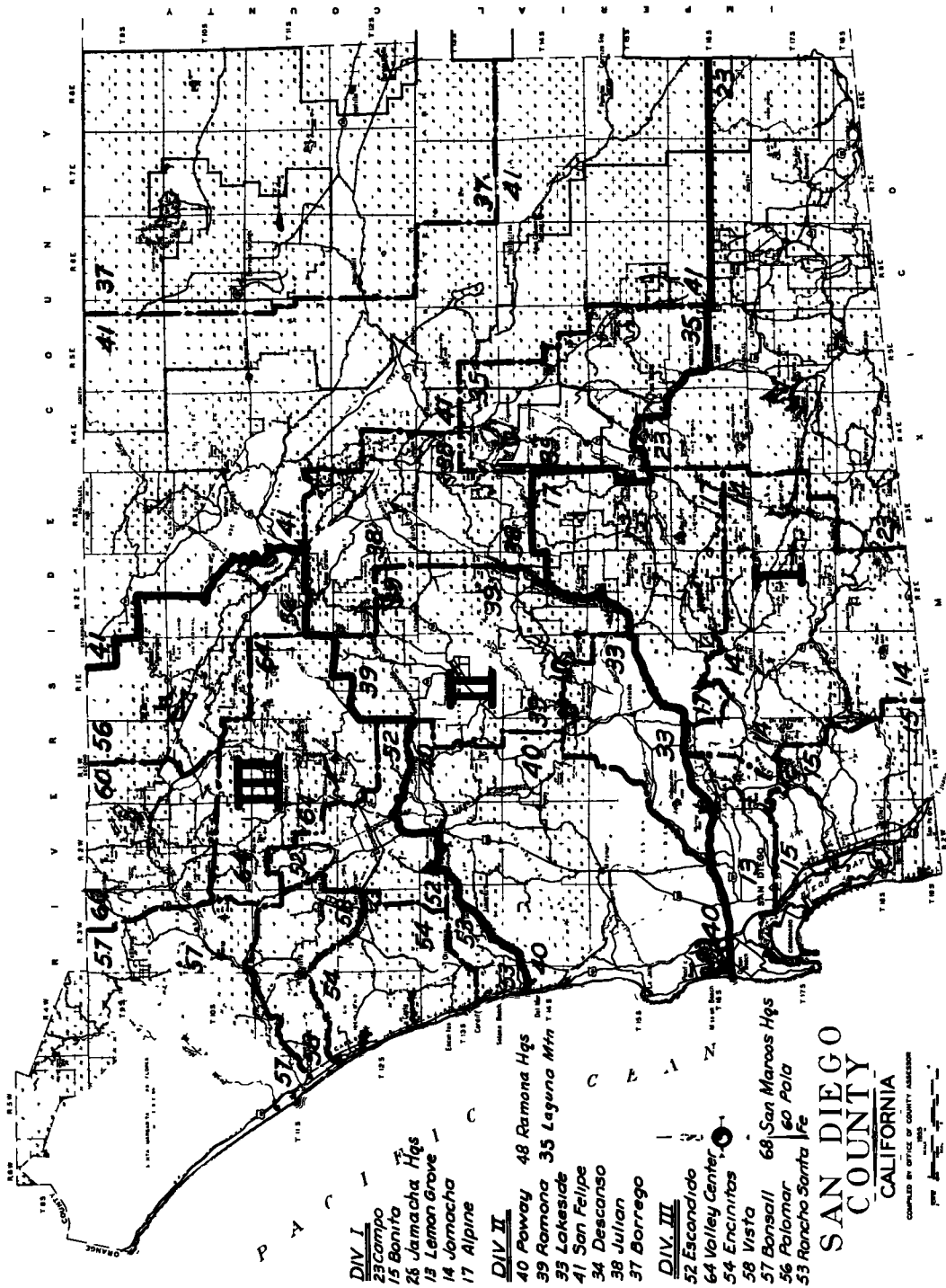


Figure 1.

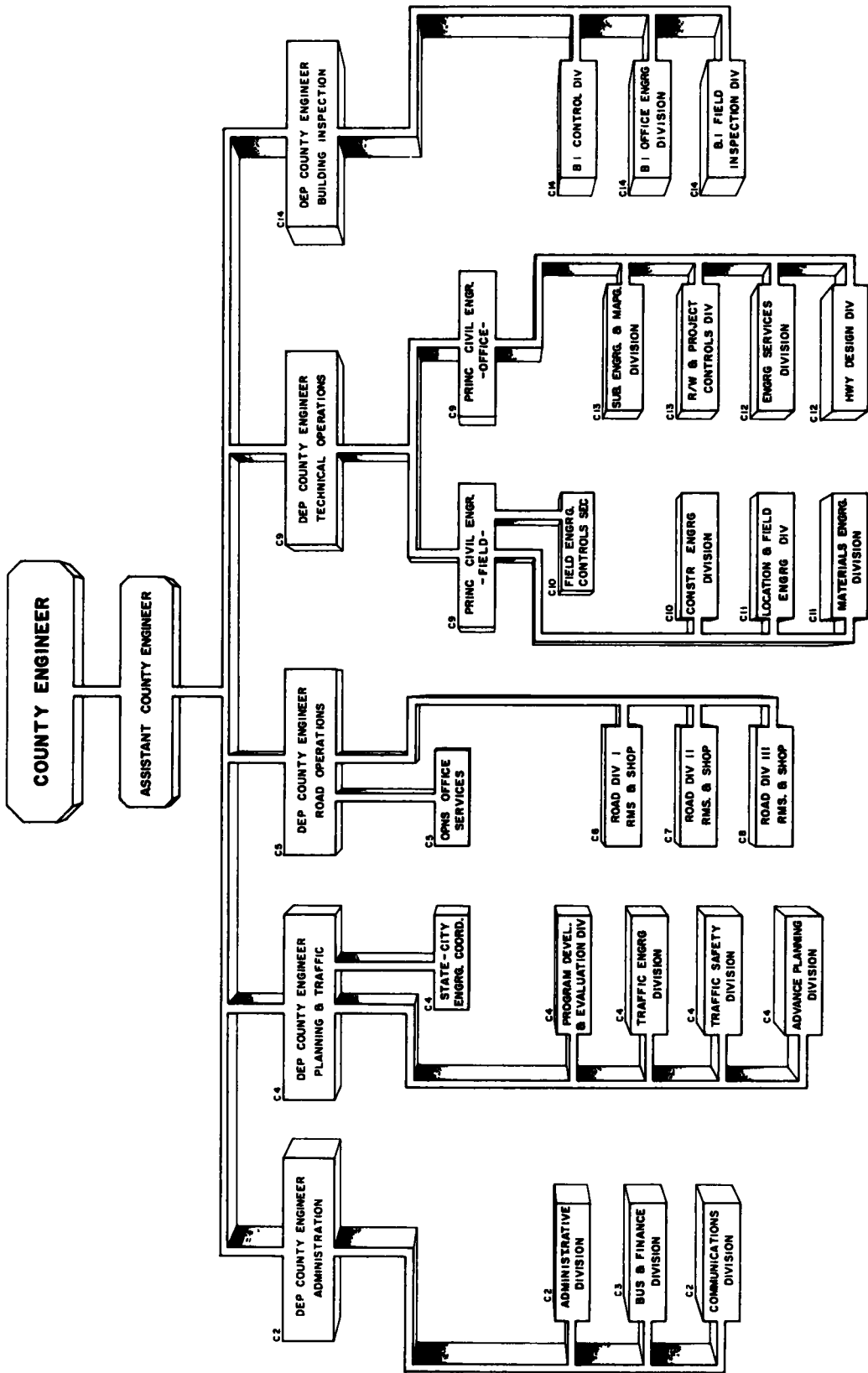


Figure 2.

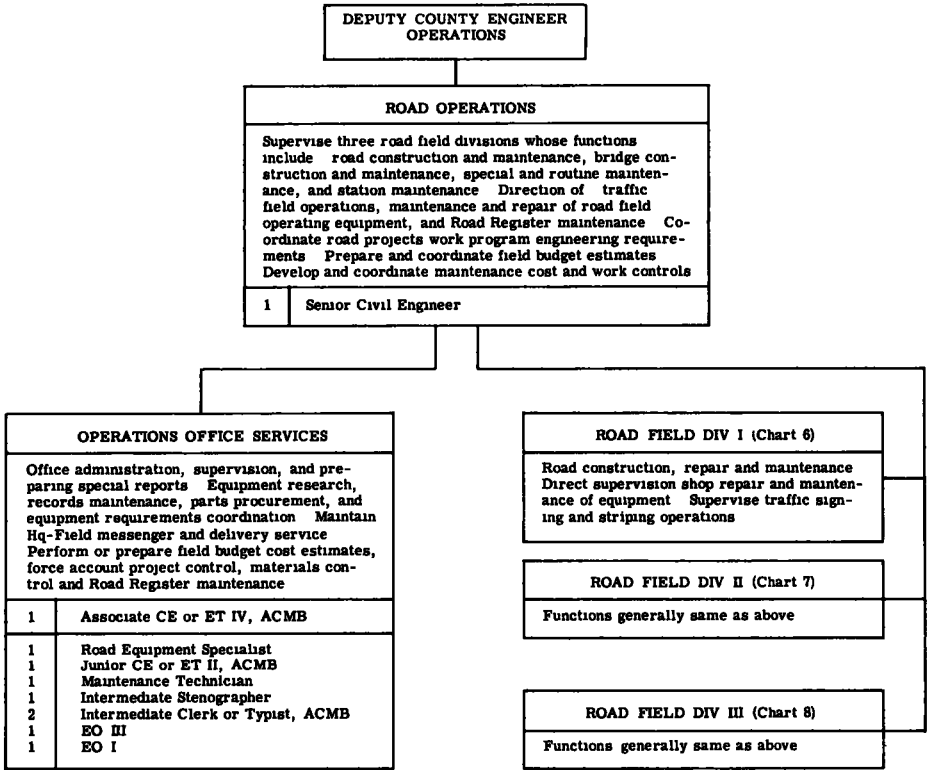


Figure 3.

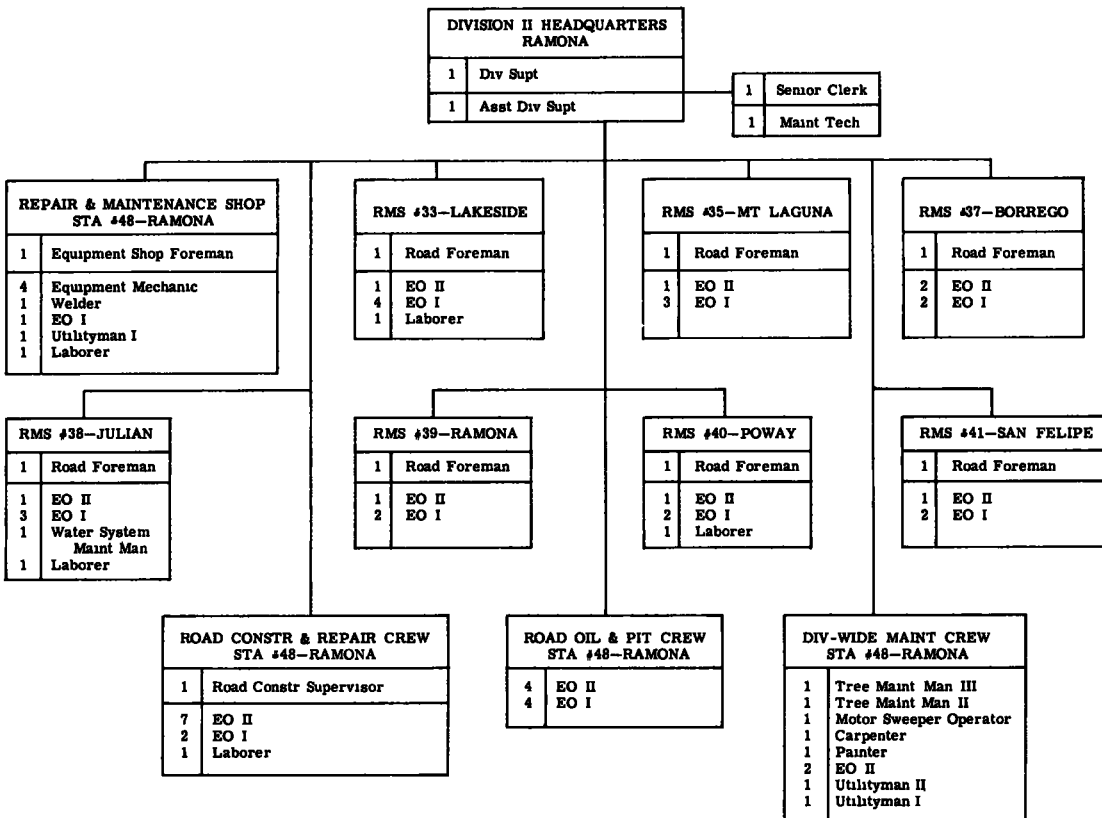


Figure 4.

The first four weeks were spent in a self-teaching program on methods time measurement. This involved learning the basic practices needed to develop standard times for the simplest of movements.

The technicians were then exposed to a series of maintenance standards developed by the consultant. These were then used to develop new standards conforming to the department's operations. Additional standards were and are continuing to be developed.

As the present system was taking form, necessary reports and forms were developed by the consultant and technician team.

Training sessions were given by the consultant's representative to acquaint management personnel with the proposed maintenance management program and the principles and techniques of planning, scheduling, and method time measurement.

Four of the six technician trainees were then selected for promotion to maintenance technician and assigned one to each road maintenance division and one to the operations division. The primary purpose of the maintenance technician assigned to operations is threefold, (a) continue the development of additional standards to reduce non-ratable projects to a minimum, (b) coordinate the activities of the division technicians to maintain standard and uniform practices throughout, and (c) act as a fill-in for other maintenance technicians when they are absent.

OPERATION OF PRESENT SYSTEM

The backbone of the present system is the combined use of the routine maintenance work order and the shop work order (Figs. 5 and 6). The work orders are of two types: "Open" (scheduled) and "Closed" (unscheduled or completion of a previously scheduled one).

Open Work Order Procedure

An Open work order is conceived by recognition of a project in need of doing. The road foreman identifies the project and assigns a priority for the work. Priority I is work that should be accomplished within one week, Priority II work should be done within four weeks and Priority III should be completed in less than four months. The shop foreman, upon recognition of the need for repairs or maintenance, fills out the work order similarly. Project identification must be complete and as accurate as possible in order to facilitate the next step—project time insertion.

Upon completion of project identification and priority, the foreman passes the Open work order to the maintenance technician assigned at the division headquarters. Project time is then entered. The time is based on developed standards. If a standard has not yet been developed, project time is estimated.

At this stage a backlog is created. The backlog is available in two formats. The first is present in the form of work order files at division headquarters and secondly as an Open-order report produced by the data processing section (Fig. 7). This report is the direct result of data accumulated by routing a copy of each work order to data processing. The material is keypunched and inserted into the IBM 360 system. The report is issued weekly and distributed to upper management and others directly connected with the scheduling process.

The Open order report presents a listing of routine maintenance or shop repair projects identified by road maintenance division, station, crew or equipment number, work order number, date initiated, and type of work by code. Also indicated, and totaled by station and division, are the standard hours required for the work order. Project standard hours are further broken down by priority and totaled by station and division.

Scheduling

Using this knowledge of backlogged projects, with standard times and priorities inserted, weekly, and sometimes monthly or longer, schedules of work are produced. Each road maintenance foreman schedules the work under his supervision. In addition, all of the specialty crews operating out of division headquarters are scheduled by the

division superintendent or his assistant. The maintenance technicians are used to aid in the scheduling.

All of the road maintenance divisions have equipment boards that are used to indicate reservations for and locations of pool equipment at all times. Although somewhat different in physical makeup between divisions, they all accomplish the same purpose. Integration of the equipment board and the routine maintenance scheduling and planning is necessary and easily accomplished. A work order will frequently request a piece of pool equipment for the project. Priority rating of the project then enables proper scheduling of the equipment. The maintenance technician keeps the board up to date based on the superintendent's decisions concerning the pool equipment.

Closed Work Order Procedure

A Closed work order either completes a previously scheduled or Open work order, or is initiated upon completion of a project not previously scheduled. This applies to routine maintenance and shop projects alike.

The road foreman inserts the actual times required for the work, the equipment use and travel time, materials used, and any remarks that are necessary to explain delays, obstructions or other items that would affect the standard times previously filled in or to be applied by the maintenance technician. This information is inserted on a retained copy of an Open work order, or, in case of unscheduled work, a new work order is initiated and an indication is made that it is unscheduled.

Initiation of the Closed work order for unscheduled work affords an opportunity to rate project and crew performance and, additionally, to accumulate data on types of work for which no standards have as yet been produced.

COUNTY OF SAN DIEGO - COUNTY ENGINEER DEPARTMENT								
WEEKLY CLOSED WORK ORDER REPORT								
WEEK ENDING 5-10-68								
DIV	STATION OR CREW NO	SCHED. WORK ORDER	UNSCHD WORK ORDER	WORK CODE	STANDARD HOURS REQD.	ACTUAL HOURS USED	PERFORMANCE PERCENT	NON- STANDARD HOURS
1	14-0	2814		SC	4 2	5 4	77%	
				ME1	7	1 1	63%	
				14B	0		****	1 5
	WORK ORDER	002814	TOTAL		4 9	6 5	75%	1 5
	STATION TOTAL				4 9	6 5	75%	1 5
1	23-0		534	TW1	5 4	6 3	85%	
				ME1	1 4	1 8	77%	
	WORK ORDER	000534	TOTAL		6 8	8 1	83%	0
	STATION TOTAL				6.8	8 1	83%	0
DIVISION 1 TOTAL					11 7	14 6	69	1 5

Figure 8.

When the Closed work order is received by the maintenance technician, the remarks section is first acknowledged for adjustment of standard time. Craft and travel hours are totaled and performance is calculated.

Transmittal of the Closed work order to data processing ultimately creates the weekly Closed-order report (Fig. 8). The format of this report is somewhat similar to the Open-order report. Division, station, crew, or equipment number, work order number and work code all serve to identify the project. Standard hours required and actual hours used determine performance percent. The last column, non-standard hours, indicates those reported hours that the maintenance technician was unable to rate because of the absence of developed standards for those types of projects. These three columns are totaled by road maintenance station and division.

As indicated before, continued development of new standards is necessary to reduce non-standard hours to a minimum. One of the prime objectives of a management program of this type is to reduce the number of non-ratable and unscheduled projects to a minimum. Only in this manner can one ascertain true available time for unforeseen emergencies. Progress in this direction will be reflected in the balance of the scheduled and unscheduled columns and in the totals under the non-standard hours column of

METHODS IMPROVEMENT PROPOSAL

(Attach Routine Maintenance Work Order for Betterment Projects)

NAME _____ DATE OF REPORT _____

SUBJECT _____

Note If improvement will result in an elimination of a safety hazard or better service to the County, rather than dollar savings, state details in Method Descriptions.

PRESENT METHOD DESCRIPTION

PROPOSED METHOD DESCRIPTION

SAVINGS CALCULATION (Use Other Side For Calculation Details)

	*Yearly Cost Of Present Method	Installation Cost	Yearly Cost Of Proposed Method
Labor	_____	_____	_____
Equipment	_____	_____	_____
Material	_____	_____	_____
TOTAL COST (A)	_____	(B) _____	(C) _____
PRESENT METHOD (A) _____ LESS INSTALLATION (B) _____ LESS PROPOSED (C) _____			
EQUALS NET FIRST YEAR SAVINGS _____			
APPROVED BY	FOREMAN _____	DIV SUPT _____	DEP CO ENCR _____

*May be yearly and reoccurring or a one-time savings

Figure 9.

the Closed-order report. Progress is also periodically illustrated using a simple graph indicating percentage of total reported hours covered by standards and, additionally, overall performance of reporting units.

Betterment Work Orders

Early efforts in routine maintenance management involved issuance of work orders to cover projects that were primarily routine maintenance, but also resulted in a betterment to the road and reduction or elimination of maintenance problems. Normally, projects of this type exhibit a project cost somewhat in excess of the normal routine maintenance projects and usually involve installation of new material such as culverts and other drainage installations and extended areas of paving instead of spot patching.

This system has not been formalized with the use of the "Methods Improvement Proposal" (Fig. 9). This proposal summarizes present and proposed maintenance procedures or methods, tabulation of present annual cost, installation cost, and annual maintenance cost after improvement. The proposal is usually initiated by the road foreman who fills in a normal routine maintenance work order and routes it through the maintenance technician for application of standard hours and subsequent cost determination. Necessary approvals are then obtained and an authorization issued to proceed with the project.

CONCLUSION

Our maintenance management system has to this date been in operation only about four months and, as yet, it is still too early to recognize any tangible quantitative benefits. Dollar savings are, however, anticipated and data have been and are currently being accumulated from which to make this determination.

Immediate qualitative benefits have been realized in the form of increased effort on the part of our maintenance personnel to recognize and use methods improvements, priority ratings, and overall planning and scheduling.

Although this management system is currently only in effect in our road operations and maintenance divisions, the program has been widely publicized in the department. Our ultimate plan is to apply this new tool, scientific measurement of project time, and subsequent development of standards as widely as possible to aid in the planning and scheduling of all San Diego County activities.