IMPLEMENTING A PERFORMANCE BUDGETING SYSTEM FOR MAINTENANCE MANAGEMENT

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•I UNDERSTAND that I have been asked to make this presentation because there is now general recognition of the need to use the so-called performance budgeting system for maintenance management and because we in Utah have gone through the complete cycle of implementation of the system.

We undertook the development of a new system for maintenance management in April 1967 for these reasons: (a) to stem the rising costs of maintenance by developing a system that would assure the maximum result from resources we could reasonably afford; (b) to establish desired levels of service consistent with available resources; (c) to obtain consistent levels of service throughout the state by ensuring each area of the state receives equal treatment; and (d) to upgrade the image and professionalism of the maintenance forces and to build esprit de corps within the organization.

A consultant was engaged to provide guidance and assistance in designing, testing, and scheduling implementation of the system.

A department organization was established for staffing and guiding the project consisting of the following: a maintenance planning engineer and a maintenance methods engineer; an advisory committee to guide the project; and a standards panel of maintenance operating personnel.

The new system, as developed, provides: (a) standards for significant work activities which set quality, quantity, work method, and staffing; (b) a performance-budget basis for planning the annual work program and supporting requests to the governor and the legislature; (c) a procedure for scheduling work in the field; (d) a reporting system which provides basis for performance evaluation; and (e) organizational additions to facilitate operation of the system.

I shall direct my presentation to answering several questions which highway administrators and maintenance engineers will likely have as they undertake to establish a performance budgeting system for maintenance management.

HOW LONG TO IMPLEMENT?

Twenty-six and one-half months were required to design, test, and prepare the system for full-scale statewide implementation. Figure 1 shows the schedule of the project.

The first phase of the project, the design phase, began in April 1967 and was completed in six and one-half months. The major work elements included: identifying and defining significant activities, defining units for measuring work quantities, and developing standards, planning and scheduling procedures, a reporting system, and a performance evaluation system.

Phase II involved 12 months of testing and refinement of the designed management system and its standards. This phase resulted in a demonstration to the road commission, in the form of a performance budget, of the potential benefits associated with the new system. This budget was then presented to the legislature as the basis for the highway maintenance budget request for fiscal year 1970.

Phase III, preparation for installation of the system, was completed in 8 months. The new system was implemented statewide July 1, 1969.

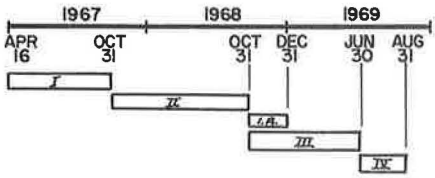
HOW MUCH COMMITMENT OF DEPARTMENT PERSONNEL?

During the design and testing of the system, the full-time efforts of an engineer and a technician plus secretarial support were required. Once the system was implemented,

increases in the staff at the middle (district) and top (office of maintenance) levels of management were required in order to provide the necessary control. The staff of the office of maintenance was increased by four people which comprise the maintenance planning section (Fig. 2). This section, consisting of a planning engineer, two maintenance methods engineers, and a maintenance planning clerk, is responsible for the continuous revision and updating of the performance standards to reflect the impact of new technological developments, improved techniques, or revised levels of service. It is also responsible for providing overall system surveillance to identify the need for and to implement system adjustments.

The increase in the district staff consisted of a district maintenance engineer and a district maintenance operations analyst (Fig. 3). The district maintenance engineers provide engineering advice and assistance to the district maintenance forces and assure conformance with authorized maintenance personnel, equipment, and material allocations and the district maintenance budget. A district maintenance analyst was placed in each of the six districts within the state to collect, tabulate, and make preliminary analyses of maintenance performance data submitted by the station foremen.

A maintenance standards panel meets at least quarterly for the purpose of reviewing performance standards (quality, quantity, methods and procedures, staffing, and productivity) and making appropriate recommendations to the engineer for maintenance. The panel is comprised of a district engineer acting as chairman, the maintenance planning engineer as secretary, the maintenance operations supervisor, the other five district engineers, the district maintenance engineers, and the district maintenance supervisors. Because the majority of the panel members are field people, and participated in developing the management system, they quite naturally played an important part in implementing the system.



Phase I - 6-1/2 Months

Design of Computerized Maintenance Management Information System

Establishment of Preliminary Quality, Quantity and Productivity Standards

Phase II - 12 Months

Refinement of:
1. Mgm't. Info. System
2. Quality, Quantity and Productivity Standards

Interim Report

To State Road Commission

Demonstrating Potential for Improved Maintenance Operations

Phase III - 8 Months

Preparation for Installation of Management System

Phase IV - 2 Months

Final Report Preparation

Figure 1. Summary schedule of the maintenance management research project.

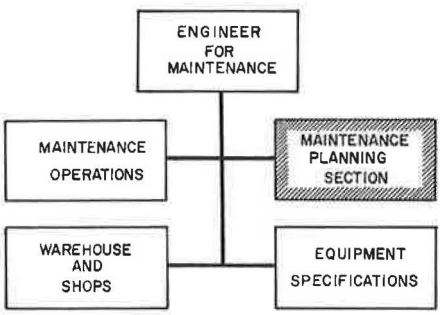


Figure 2. Office of maintenance organization.

HOW MUCH PAPERWORK REQUIRED?

As expected, the question of paperwork was one which arose early in the design of the new system. We knew that if we were to take advantage of the improvement opportunities offered by the new system, our maintenance personnel would have to assume new job responsibilities.

With the new system's emphasis on effective utilization of people, equipment, and materials, it demands formalized work scheduling, and work accomplishment reporting. Two basic documents were created to provide for these

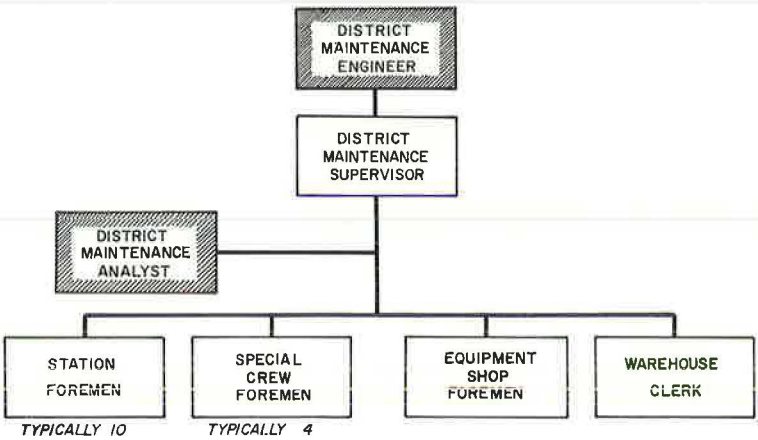


Figure 3. Typical district maintenance organization.

functions: a foreman's weekly work schedule and a semimonthly management reporting document (period activity record).

The weekly schedule is prepared by the foreman and submitted to the district supervisor. It sets out the planned work activities and personnel and equipment assignments for the coming week and serves as a basis for coordinating specialized or additional personnel, equipment, or materials needs.

The management reporting document (period activity record) was developed after evaluating the fiscal reporting system and finding it lacking in the essential management information necessary for operation of the system. It is prepared and submitted by the foremen to the district on a semimonthly basis and reports the work accomplished and resources used during the period.

The data recorded on the period activity record is used for short-term operational control of the foreman's work by the district supervisor and for quarterly and annual evaluations of performance and standards by higher levels of management.

WHAT HAVE BEEN PROBLEMS?

To alert and prepare others to some of the problems of implementation, the following areas have been selected for discussion.

Reducing Manpower

When we developed the manpower requirements for the maintenance work load and compared it with our existing complement we became aware of an overstaffing situation. If the new system was to operate effectively, we needed to take steps to align the number of maintenance people on the payroll with the number required for the work load. Unless manpower levels were in proper balance so that there was a real necessity to use manpower efficiently, then there would be no need for our foremen to schedule their resources. Figure 4 shows the magnitude of the adjustment that confronted us. We needed to reduce forces from an existing level of 670 man-years in fiscal year 1969 to a required level of 520 man-years. Alternatives we considered for solving this problem of aligning our staff included reduction in force, attrition, and transfers. Because some of our maintenance people had backgrounds that allowed us to use them in other divisions, transfers took care of part of the problem. The balance of the alignment was accomplished by attrition with a target date for full alignment of July 1, 1970 (12 months after system implementation). As shown in Figure 4, we met our goal.

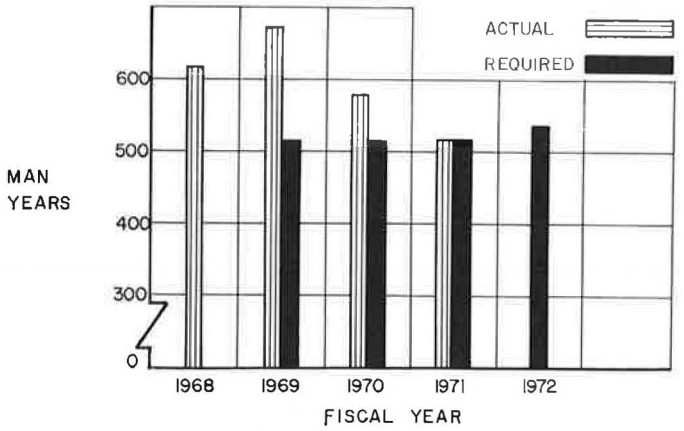


Figure 4. Impact on manpower levels.

Training Supervisors

It came as quite a shock to some of our first- and second-line supervisors when the data showed that highway maintenance to a great degree is plannable and that reasonable standards of performance and work quantity can be established and met. Some were willing to accept the new concepts without question. Others needed to be shown. But changing attitudes of many years' standing and accepting new job responsibilities required more than demonstrating the need or the desirability. It took and is still taking continued insistence on operating in conformance with the standards, frequent evaluations of performance with the supervisors and discussions about the reasons for deviating from the standard values, and periodic training sessions to ensure an understanding of the standard practices and procedures.

Reconciling Management and Fiscal Reporting Requirements

In order for the system to function, management data concerning work being done and the resources required is necessary. During the design phase of the new system, it became apparent that modifying the fiscal reporting system to serve both management and fiscal-data requirements was not practical. Because of the differences in types of data required, the degrees of accuracy required, and the degrees of timeliness needed, separate reporting systems were necessary. Traditionally all data collection had been the responsibility of the department's fiscal staff. The decision to establish separate systems necessitated a redefinition of their responsibilities and an assignment of responsibility for management data collection to the office of maintenance.

Initial Reaction of Legislature

In a period when there is great concern for reducing budgets, care should be taken in approaching the legislature with the first maintenance performance budget. Without a full understanding, they failed to recognize the need for a contingency fund to finance the transition to operation under the new system and to provide flexibility in handling unusual emergency maintenance requirements. However, after working with them, we demonstrated the need and the department's ability to judiciously administer such a fund.

WHAT ARE THE BENEFITS?

To this point, I have dealt with some of the concerns, problems, and challenges that must be faced when system implementation is considered. Now I will cover sig-

nificant new-system benefits related to levels of maintenance, work performance, program submission, dollar savings, and guidance for improvement.

Levels of Maintenance

Prior to the implementation of the system, considerable variations in the levels of maintenance that were being provided existed between each of our six districts and among the maintenance stations within the districts. We had never established, documented, and communicated our desired levels of service. This standardization process was an important part of the system design phase and has resulted in uniform statewide levels of maintenance service. During this standardization process we were careful not to sacrifice service and, in fact, in many cases, we established levels that were higher than previously provided. Evidence of the overall improvement in levels of service is provided by the fact that our first performance budget provided for an increase of $600,000 or 29 percent for materials. To the extent that quantity of materials to be used is an indication of the amount of work to be performed, then it is also an indication of the relative maintenance service level.

Work Performance

This is the area where the foremen have not only demonstrated an ability to work with the standards but have shown continued improvement. Examples of their success in reducing the unit cost per unit of work accomplishment are shown in Figures 5 and 6. An example of an actual unit of cost reduction attained is illustrated for the pothole patching activity. Figure 5 shows, for the pothole patching activity, the statewide average cost of placing a cubic yard of material in fiscal year 1968 was $72.00. In fiscal year 1969 a substantial reduction to $47.00 per cubic yard was experienced. In fiscal year 1970 the cost was reduced further to $39.00 per cubic yard which is below our standard unit cost of $41.50. Figure 6 shows the trend in cost per cubic yard of bituminous material placed for the lane leveling activity during the fiscal years 1968, 1969, and 1970. The cost per cubic yard in 1968 of approximately $25.00 was reduced in 1969 to $11.50 and reduced to approximately $11.00 in 1970.

The basis of the unit cost reductions shown in Figures 5 and 6 is to a large extent improved productivity. Figures 7 and 8 show for the same two activities, pothole patching and lane leveling, the dramatic year by year improvements in productivity as measured by the relationship of man-hours expended per unit of work accomplishment. On the man-hours per accomplishment scale, a decrease in the numerical value represents an improvement in productivity.

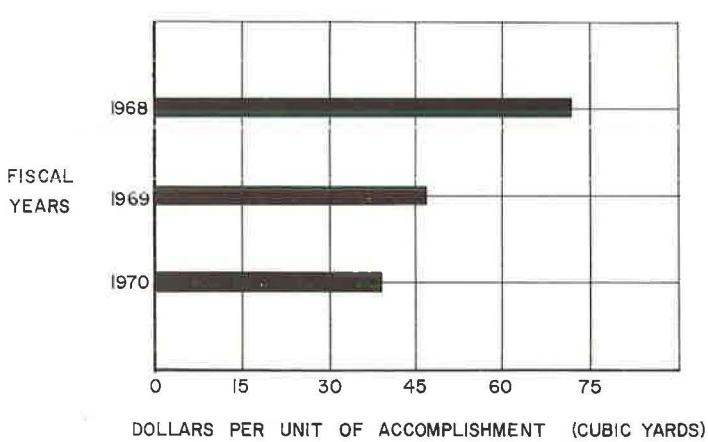


Figure 5. Statewide average cost per unit of accomplishment for pothole patching.

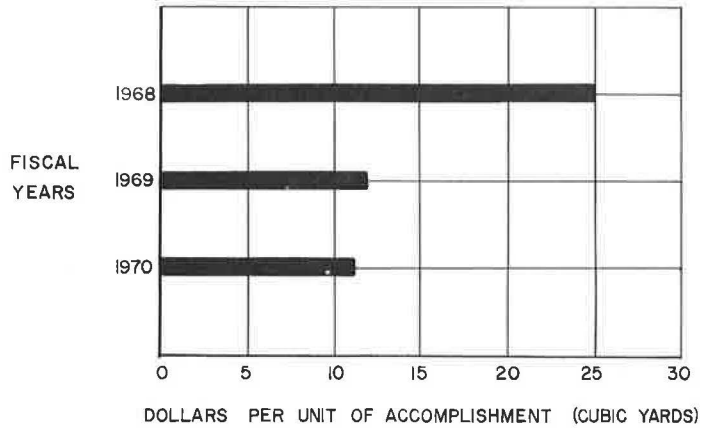


Figure 6. Statewide average cost per unit of accomplishment for lane leveling.

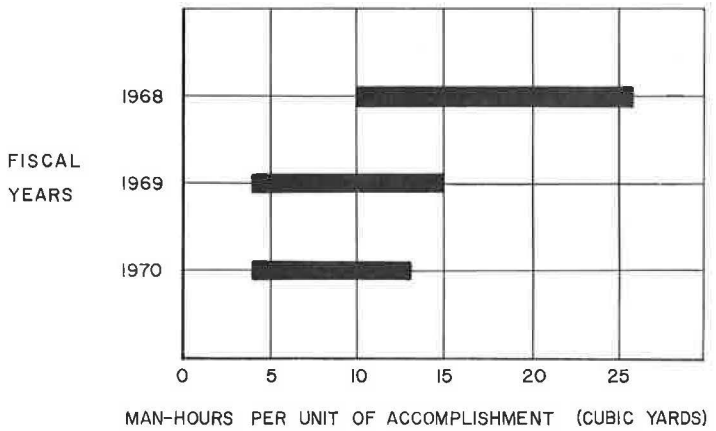


Figure 7. Statewide productivity ranges for pothole patching.

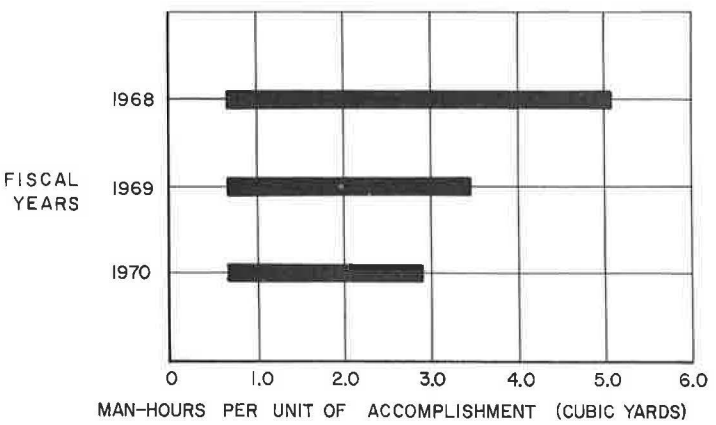


Figure 8. Statewide productivity ranges for lane leveling.

Figure 7 shows the productivity ranges for pothole patching. The first year prior to system implementation, productivity ranged from 10 to 26 man-hours per cubic yard. The operations were mostly outside the standard productivity range of 8 to 12 man-hours per cubic yard. After training the personnel and having them work with a crew size recommended by the performance standard, the productivity range lowered and narrowed in 1969 to 4 to 15 man-hours per cubic yard. A slight additional improvement was experienced in 1970 when the range was 4 to 13 man-hours per cubic yard.

Figure 8 shows the productivity range for placing a cubic yard of bituminous material for the lane leveling operation. A marked improvement in this operation is apparent. The range has been cut from 0.6 to 5.1 man-hours in 1968 to 0.6 to 2.9 man-hours in 1970. However, further improvement is necessary if the standard range of 0.7 to 0.9 man-hour per cubic yard is to be reached.

Program Submission

Preparing and submitting our annual maintenance budget requests has now become a straightforward process. The performance budget is prepared by applying annual work quantity standards, work production standards, and cost standards to the inventoried highway maintenance features for each district within the state. The budget is then reviewed by the department's top management and included in the budget package for submission to the legislature. Because our maintenance budget is now based on the men, equipment, and materials required to provide approved levels of maintenance service to our road system, the department is in a position to fully explain requested funds to the legislative committees. The impacts on our maintenance budget of additional road mileage or increased service levels are specifically identified.

Dollar Savings

Average cost per lane-mile serves as a common base for illustrating dollar savings. Figure 9 shows the change in the cost-per-lane-mile trend that has occurred since the implementation of the new system in fiscal 1970. Although the program was implemented in fiscal 1970 the full benefit was not realized until fiscal 1971 because of the department's decision to align the manpower by attrition. With the somewhat limited data, the system, in a period of rapidly rising costs, appears to be limiting the annual increase of the cost-per-lane-mile to approximately 3½ percent. This compares with the historical rate of about 7 percent per year.

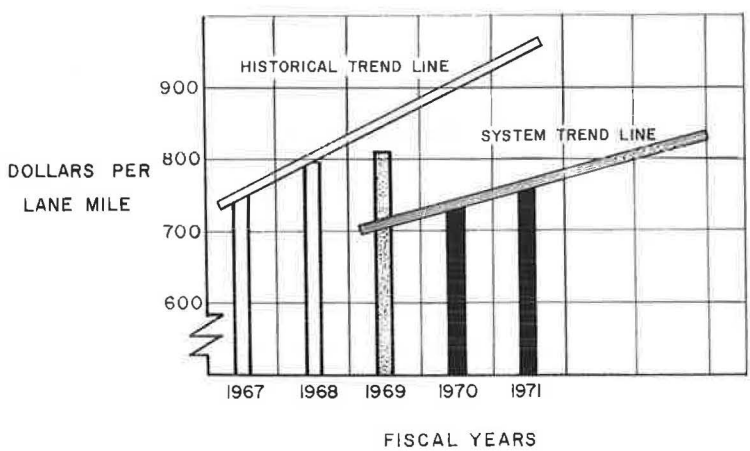


Figure 9. Average cost per lane-mile.

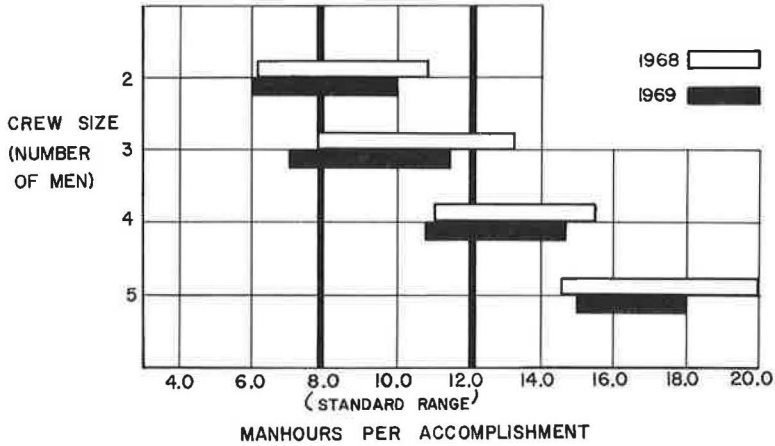


Figure 10. Impact of various crew sizes on productivity for pothole patching.

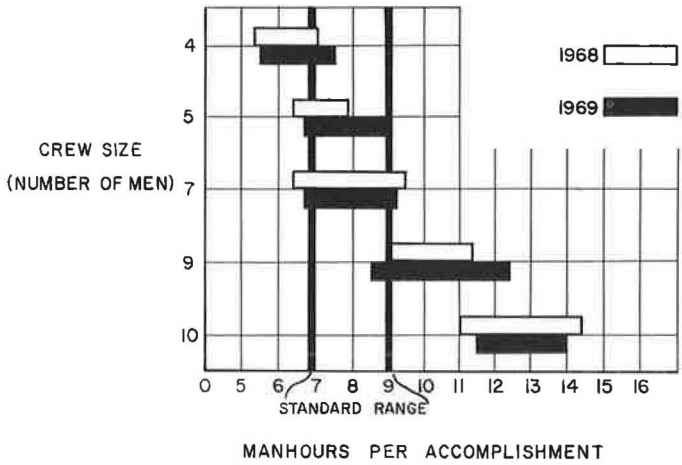


Figure 11. Impact of various crew sizes on productivity for lane leveling.

Guidance for Further Improvement

We cannot be content with our progress to date. Productivity is directly affected by crew size. By relating performance data provided by the new system to the crew sizes used, areas with potential for cost reductions are identified.

Figure 10 shows the results of such a data comparison for pothole patching. Opportunities for further improving productivity lie in eliminating or minimizing operations staffed with 4 or 5 men.

Figure 11 shows the same opportunities connected with the elimination of operations with 9 and 10 man lane leveling crews. Our office of maintenance through its maintenance planning section is charged with the responsibility for performing these kinds of analyses and designing and implementing programs to counter the continuous demand for more services and the increases in costs for labor, material, and equipment.

The completion of Interstate mileage and the higher levels of maintenance service these high-speed facilities require are placing a heavy additional burden on our maintenance organization. We are finding that this new system for maintenance management is a way of meeting the challenge.