PERFORMANCE STANDARDS AS A TOOL IN PREPARING THE MAINTENANCE PROGRAM BUDGET

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•MANY of you probably think of program budgeting as a recent phenomenon—a concept developed when Robert McNamara was Secretary of Defense. I am not sure that this is so. Some of you may also think of program budgeting as a difficult and impractical procedure—especially for highway maintenance. I do not think that this is necessarily true either.

Had I been responsible for setting up the first maintenance budget for a highway agency in the early 1920's, I think that I would have used some of the principles of program budgeting. When roads were rebuilt at that time to keep up with the growing popularity of the automobile, there was little practical experience or historical data that could be used to determine how much money was needed to maintain a mile of road, how many men were required, or how much equipment and how much material was needed. It would seem to me, then, that the most logical way to have prepared a budget would have been to start with the basic fundamentals of a highway maintenance program. This would have included a determination of the required maintenance operations, how well these operations had to be performed, and how often.

Perhaps some highway agencies did consider such information when they started to maintain roads but, after a few years of keeping records, these original efforts in maintenance program budgeting were forgotten and budgeting degenerated into a procedure whereby financial planning consisted mainly of applying the current rate of growth to the previous year's maintenance costs. Although these costs were often broken down into costs per mile and cost of labor, equipment, and materials, they had little relation to the amount of work that was being done.

Perhaps this system was adequate in its day. At least it was not seriously questioned. But today we must face a different situation. The costs of maintaining our roads are spiraling. A recent study indicates that highway maintenance costs in my state of Minnesota will triple in the next 15 years. You will be experiencing similar increases in your own states. Increasing freeway and expressway mileage, urban development, higher standards of maintenance, equipment, and material costs, and especially soaring labor rates are all contributing to the rising price of maintenance.

Highway agencies are presently in a financial squeeze. Construction, maintenance, and administration costs have gone up so much that construction programs have been cut back. We must also face up to the fact that there is an increasing demand to divert highway funds for other purposes. We may soon find ourselves competing with mass transit, education, welfare, and urban problems or for totally new uses of tax funds such as the war on pollution.

So, we have reached a point where it is no longer sufficient to merely request funds for maintenance. It is now more necessary than ever to justify not only every dollar that is requested but also every dollar that has been spent. To speak in terms of costs per mile is no longer sufficient; legislatures want to know what maintenance they have gotten for the tax dollars that have been spent and they want to know what they are going to get in the future. In Minnesota, to assure better justification of expenditures, the 1969 legislature passed a bill requiring some of the state departments and agencies to submit their budgets in the program format.

The basic program budget principle is quite simple. It is a means of projecting costs by analyzing the requirements of specific programs or activities. In highway maintenance, these activities could include surface repair, vegetation control, snow removal, and equipment repair, to name a few. In contrast, our familiar budgets by

line item only give us the cost of our total maintenance program. The line items give us only the total labor costs, total material costs, total contract costs, etc.

Some of the advantages of program budgeting are obvious. With this procedure, maintenance managers can more objectively determine maintenance needs. Manpower requirements can be based on programs rather than on vague precedents of miles per man. An increase in a given maintenance activity can be directly related to the budget and, conversely, budget reduction can be directly related to activity modification or elimination. The program budget process also lends itself to the establishment of monitoring methods that can provide cost controls not previously possible.

Before we can develop and implement a program budget system, there are some prerequisites that must be satisfied in order to make program budgeting a realistic procedure that can be effectively utilized by highway maintenance management. These prerequisites, which are called performance standards, are necessary tools to assure that the budget procedure is dependable, practical, and reliable. Performance standards defining quality, quantity, and productivity are essential elements in the preparation of a functional maintenance program budget.

QUALITY STANDARDS

Setting quality standards for maintenance is the first step in the budgeting procedure. A quality standard may define some or all of the following for a maintenance operation: a level of service; the degree of perfection required; the required frequency; and the allowable level of deterioration.

These standards will, in general, vary with traffic volumes, route classification, urban versus rural locations, etc. Some examples of statements from quality standards might include: bare pavement 6 hours after cessation of snowfall; mow two times per year; repaired surface must not vary more than ½ in. in 10 ft; gravel shoulders must not be allowed to wear more than ½ in. below the edge of the pavement; and equipment must have a preventive maintenance inspection at least every 10,000 miles.

Quality standards serve three purposes in the budget system: they are the basic foundation of a work planning guide; they provide a measure of district and statewide uniformity in maintenance practices, thereby increasing the predictability of maintenance costs; and they assist in controlling the budget by helping to reduce the instances of too frequent and unnecessary maintenance or too little maintenance which can result in emergency work and expenditure of unplanned funds.

Use and enforcement of quality standards, as can be seen from these three purposes, can be of great help in preparing the program budget.

QUANTITY STANDARDS

The second step in the budgeting procedure is to set standards for quantities. A standard quantity can be defined as the amount of maintenance work required to achieve the quality standard for a specific operation. Field quantities would most conveniently be defined in terms of quantity required per mile per year. Some examples of field quantity standards are: lane miles per mile per year for snow removal; acres per mile per year for mowing; and tons per lane mile per year for patching.

Examples of quantity standards for equipment shop operations could include: the number of inspections per equipment unit per year; and the number of tire changes per unit per year.

The standards can be refined to give quarterly or monthly outputs, thereby reflecting seasonal variation which, in turn, can provide a measure of quantity control. The standards themselves can be determined through the use of engineering judgment and experience, historical data, and field studies.

INVENTORY

Quantity standards, as defined here, cannot be fully utilized unless a maintenance inventory is included in the budgeting system. Such an inventory is used to keep a record of every item that affects the maintenance budget. The value of an inventory has

long been recognized for equipment maintenance. Using the example I mentioned before on inspecting equipment, the total number of inspections to be performed in a year can be computed by multiplying the standard quantity times the number of units from the inventory. A similar procedure can also be used in the field. Road inventory data for field maintenance has not until recently received the attention or use for which equipment inventories have been used. Road inventory can be applied to the quantity standards to arrive at work load. For patching, the inventory-quantity relationship would be determined by multiplying the standard tons per lane mile per year times the total lane miles of road for each road classification.

PRODUCTIVITY STANDARDS

Use of productivity standards is the third step in preparing the maintenance budget. A productivity standard is defined as the amount of time required to complete one unit of output by a qualified operator using normal skill and expending normal effort, with normal conditions and surroundings, during an 8-hour day, with allowances included for personal time, rest, and unavoidable delay. For example: 17.7 lane-miles can be cleared of snow in one hour. It takes 4.4 man-hours to place one tone of patching material. It takes 6.5 man-hours to equip one highway patrol car. Productivity standards can be set by experience and judgment, from historical records, or by time study and other work measurement techniques.

To determine the total number of man-hours required to complete a given operation, the productivity standard is multiplied by the quantity standard for that operation and also by the appropriate inventory quantity. In a simple example, let it be assumed that a maintenance district has an inventory of 1,000 acres which require two mowings per year to meet the quality standard. This means that 2,000 acres will be mowed in one season. If the productivity standard is 1.1 man-hours to mow one acre, 2,200 man-hours will be required to complete the district's mowing. The next step, of course, is to apply an average hourly dollar rate to arrive at the total labor budget for mowing. A similar computation can be made for the required equipment. Other operations will also require computations for materials. Some sample budget computations are given in Table 1.

TABLE 1

SAMPLE BUDGET CALCULATIONS

Activity	Standard Quantity	Subarea Inventory (miles)	Planned Annual Quantity	Productivity Standard	Units	Unit Cost	Budget
Mowing	4.84 acres/mi/yr (2 swaths, 2 times per year)	90	436 acres	1.1 man-hr/acre	479 man-hr	3.40/man-hr	1,630
				1.1 equip.-hr/acre	479 equip.-hr	3.70/hr	1,770
						Total	3,440
Skin patching	0.4 tons/mi/yr	90	36 tons	3.6 man-hr/ton	130 man-hr	3.40/man-hr	432
				1.0 truck-hr/ton	36 truck-hr	2.50/hr	90
				1.2 tar-kettle-hr/ton	43 tar-kettle-hr	0.90/hr	39
					36 tons bituminous mix	13.00/ton	468
						Total	1,029
Blade shoulders	3 passes/mi/yr	50 x 2 = 100	300 miles	0.6 man-hr/mi	180 man-hr	3.40/man-hr	612
				0.6 pull-grader-hr/mi	180 pull-grader-hr	1.00/hr	180
				0.6 tractor-hr/mi	180 tractor-hr	3.50/hr	630
	2 passes/mi/yr	20 x 2 = 40	80 miles	0.6 man-hr/mi	48 man-hr	3.40/man-hr	163
				0.6 pull-grader-hr/mi	48 pull-grader-hr	1.00/hr	48
				0.6 tractor-hr/mi	48 tractor-hr	3.50/hr	168
						Total	1,801

Preparation of a complete maintenance budget, then, involves identifying all of the operations, applying performance standards to each of them, and applying average cost rates for labor, equipment, and materials. The procedure is simple enough to be computerized. The computer files would contain the quantity standards for the various classes of road, the inventory, the productivity standards, and the cost rates. The computer would perform all the multiplications and print out the budget request.

PROBLEM AREAS

So far, I have made it all seem quite simple, but in practice maintenance program budgeting is somewhat more difficult. The idea of having the computer prepare the budget appears to be feasible but systems analysis work and programming for such a system has not even been started in Minnesota. The problems of developing computerization for maintenance management systems has faced many highway maintenance officials in recent years and our department have not been an exception. However, with the recent formation of a state computer services division, we hope to start making progress in computerization. In the interim, we are planning to implement a system that will employ manual methods.

Development of the manual system has provided us with an opportunity to involve our lowest maintenance management level, our foremen, in the budgeting process. The foremen in some of our maintenance areas have been trained in work planning and they are directed to submit annual requirements for all of their maintenance activities. The use of performance standards is stressed, and budgeted and actual cost figures are continually reviewed by the foremen.

Another problem is the personnel requirements needed to develop and maintain standards. In Minnesota, we have established an office of maintenance standards which is staffed with four engineers, one engineer-in-training, two technicians, an equipment supervisor, a stockroom supervisor, two part-time technical personnel, and two clerical personnel. In addition, one time-study technician has been assigned to each of the nine highway districts. To accelerate some of our work, we have also formed various committees composed of all our area maintenance engineers, assistant maintenance engineers, and some of the foremen. It is anticipated that these committees will expedite development of performance standards and implementation of our maintenance management system.

Another problem that must be contended with in the development of a program budget is the probable need to establish a new maintenance cost accounting system. In recognizing the need for a program-based accounting system, Minnesota is currently in the process of revamping the existing accounting systems for all of the state departments and agencies. It is anticipated that this project will involve nearly as much work as the development of program budgeting. In maintenance, we are designing a single system that will replace our existing maintenance cost accounting system, our budget reporting procedure, and our work-accomplishment reporting system. This is a task that requires the continued cooperation and understanding of all of our department's seven divisions. Extensive systems analysis work and computer programming will be required to handle unprecedented volumes of data. Retraining programs for office, field, and supervisory personnel will also be required.

At this point, it is probably appropriate to cover some pitfalls that should be avoided during the development of a maintenance program budget system. If caution is not exercised, there is a tendency to bury everyone in the maintenance organization in an avalanche of data. For example, we have identified over 530 field maintenance operations in Minnesota. Although some of our middle-management personnel have indicated interest in using such a detailed breakdown of their operations for evaluation purposes, it is obvious that upper-level managers would have no use for such data. The very size of the operations list would easily obscure the total maintenance picture. Snow and ice control accounts for one-third of our annual expenditures while total betterment maintenance accounts for only 0.7 percent. This fact tends to become lost as the listing of each operation appears to give equal significance to all of the operations. This problem can be overcome in part by combining operations into major activity

groupings. In Minnesota, we cover the 550 field operations in only 20 activity groups which is a much more manageable breakdown as far as upper management is concerned. Other measures will include designing management reports that contain only that information that is specifically needed by supervisors to manage their own operations. Information will be condensed where possible and only exceptions will be reported in some cases.

Another pitfall to avoid is the tendency for excessive accuracy in standards and in budgeting. This is not an easy task because the system must be sufficiently accurate to maintain the confidence of its users while, at the same time, the variables in maintenance such as weather, traffic volume, and location, must be recognized and allowed for. It must also be recognized that 20 to 25 percent of the maintenance expenditures do not lend themselves to standardization as they are performed too infrequently or sporadically. This means that only 75 to 80 percent of the budget can be prepared on the basis of standard data. Finally, it must be realized that program budgeting and the performance standards are not the answer to all of the problems encountered in highway maintenance. At best, the standards and the program budget can serve as a major part of a maintenance management system. The standards will give an indication as to where the problems are and perhaps some clues as to what the problems are if the accounting procedure is sufficiently developed and properly interpreted.

BENEFITS

In conclusion, I think the positive aspects of maintenance program budgeting and performance standards should be reviewed. One of the major benefits to be gained by the use of performance standards is that a budget request based on those standards has a degree of built-in justification. If we have the right standards and if we can support them financially, management will have little reason to change that request. This is especially true if the quality standards reflect public demands and have been approved at the staff level. A reduction in requested amounts, if necessary, is then directly related to a change in the quality standards—a reduction in the established level of service. It is hoped that through recognition and confidence in this procedure, maintenance budget cuts will not be nearly so drastic and maintenance managers will be better able to meet the increasing maintenance needs of the future.

Another advantage of performance standards is that they can be used to help find the reasons for overruns and underruns. Provided that a sufficiently sophisticated accounting system is available, a maintenance manager can obtain reports giving costs per unit of production, total units of production compared to planned quantities, and productivity rates compared to standard rates. This information can be broken down by local management units and it can also be combined to give statewide totals. As I mentioned before, the exception format can be used thereby calling the manager's attention to those activities that should be reviewed. The standards tend to keep managers "on their toes," they promote uniformity, they help discourage unnecessary expenses, and they provide a means for fair and objective analyses and comparisons.

I wish I could tell you that we in Minnesota are using this ideal system that I have discussed and that it is functioning perfectly. However, our system is still in the development stage and we have a lot of work to do to reach our goal of a fully automated maintenance management system. We are encouraged by the progress that other highway agencies have made in this field and we are aware that budgets employing performance standards have been prepared in recent years. From our experience to date, I believe that even a partial adaptation of these principles is a most worthwhile step to be taken by any highway agency—a step that will go a long way toward guaranteeing those needed additional maintenance dollars.