

# Maintenance Management In Indiana

KENNETH M. MELLINGER  
Maintenance Management Director  
Indiana State Highway Commission

## INTRODUCTION

Highway maintenance, as defined by AASHTO, is the preservation and upkeep of a highway, including all of its elements, in as nearly as practicable its original as constructed condition or its subsequently improved condition.

Management is a science, meaning that there is an organized body of knowledge that can be learned and applied.

Management is also a process, a system by which resources—men, money, materials—are acted upon or utilized so as to produce results.

The practice of management is an art, a skill that combines what we know with what we are, with the result that what we do as managers is a blend of all our talents, both natural and acquired.

If we accept management as the process of utilizing resources to achieve organizational goals, then managers are those who are responsible for the use of resources. A manager in the highway organization is found at many positions—from crew foreman through subdistrict superintendent, district engineer, division head, to the chief executive.

Maintenance can be managed. There are those who say that weather conditions, daily emergencies, shortage of trained personnel, inadequate equipment, politics, etc., etc., make management impossible. All of these are obstacles which must be recognized but cannot be used as excuses for nonperformance.

The concept of a modern maintenance management system evolved from an extensive research and development project in the Virginia Department of Highways almost 11 years ago. It was found there for the first time that, contrary to popular belief, most maintenance work was not of an emergency nature and that a large proportion of the workload could be planned, scheduled, and accomplished in an orderly manner through the development of annual programs based on performance standards. In the past ten years over half the states as well as many cities and counties have developed and implemented maintenance management systems.

The maintenance management system developed in Indiana is a joint effort of managers from all levels of maintenance with guidance from Roy Jorgensen Associates. The Jorgensen firm has been a pioneer in the field of maintenance management and brings vast knowledge of tested and proven techniques. This project is not a study—it is an action project for the development, implementation, and operation of a maintenance management system to provide an effective and efficient highway maintenance program for the unique characteristics of Indiana.

The management system designed for Indiana is not complicated. It involves taking an orderly, logical approach to managing our maintenance operations. The elements of the system are based on well known management principles: management by objectives; plan with results in mind; organize efficient combinations of resources; direct according to plan; and control by exception.

A brief description of each of the major system elements follows.

## MAINTENANCE OBJECTIVES AND POLICIES

In order to provide an efficient and effective maintenance program, specific objectives must be established and communicated to all maintenance managers. The specific objectives are: to establish desired levels of maintenance service and assure that they are applied uniformly throughout the state; to provide an objective basis upon which the maintenance program can be planned and carried out; to utilize labor, equipment, material, and financial resources in the most efficient and economical manner; and to provide the means by which managers can compare actual performance against planned performance and take corrective action where required.

## WORK PLANNING

The annual maintenance work program defines the kinds and amounts of work which are required to provide the desired level of maintenance service consistently and uniformly throughout the state. This maintenance work is identified for each management unit—37 subdistricts, six district maintenance and six district traffic locations—and summarized for six districts and the total state program.

The development of the maintenance work program and budget involves the following: definition of maintenance work activities, inventory of maintenance features, establishment of quality and quantity standards, establishment of performance standards, calculation of workload and budget, distribution of workload throughout the year, and allocation of resources.

### 1. *Maintenance Work Activities*

The development of the maintenance work program begins with the establishment of routine maintenance work activities and their associated work measurement units and inventory measurement units.

Maintenance work activities identify the major maintenance work and include only those activities which are performed frequently and in amounts that make them a significant part of the total maintenance work program. Each activity must be clearly defined so maintenance personnel at all levels of management have a uniform understanding of the operations to be performed and the type of deficiency to be corrected.

A work measurement unit and an inventory measurement unit is identified for each maintenance activity. The work measurement unit provides a basis for describing how much work is planned, as well as reporting how much work was accomplished for each maintenance activity. The number of activities must be kept to a realistic minimum for ease of system operation at all levels. Fifty activities, which account for about 85% of the total work effort were identified. All other work was provided for in eight catch-all type activities such as Other Roadside and Shoulder Maintenance.

### 2. *Maintenance Feature Inventory*

Inventory measurement units identify roadway and bridge elements that must be maintained and are a key element in the development of the annual maintenance program. These units must be practical, well-defined, and readily understood by all maintenance personnel.

After the maintenance activities and their related inventory measurement units were defined, an inventory of roadway and bridge features was taken and compiled for use as the basis for the routine maintenance work program. This inventory was compiled and summarized for each subdistrict.

### 3. *Quantity and Quality Standards*

Annual work quantity planning values were established for each maintenance activity. These values identify the quantity of work required for a desired level of service and are expressed in terms of number of work units per year to be planned for each identified unit of the roadway feature inventory applicable to the particular work activity. Some standards are based on the frequency of operation—such as mowing, or blading and shaping of shoulders, or seal coating. Others are established on the basis of experience and judgment, reflecting average annual needs for specific conditions. For example, one-half ton of

premix per bituminous two-lane mile—for pothole patching or one manhour per road mile—for brush cutting.

#### *4. Performance Standards*

The most effective crew size, equipment, materials, and work methods to be used are defined for each maintenance activity. The expected average daily production of a standard crew was established for use in the work planning process.

These standards were developed on the basis of experience and judgment and will be modified and improved on the basis of controlled observations and analysis of reported work data.

It is important that all field personnel become thoroughly familiar with the standards and follow them closely. The manner in which crews are staffed and equipped and the methods and procedures used to perform work activities are the principal factors which determine the rate at which work is accomplished and the effectiveness with which resources are utilized.

#### *5. Work Program Computation*

When work activities have been defined, quantity standards and performance standards established, and the roadway feature inventory compiled, the computation of the routine maintenance work program is a simple arithmetic procedure.

The program is developed by multiplying the quantity standard by the appropriate unit of roadway inventory—thus identifying the number of annual work units for each activity. The work units are then divided by the average daily production as specified in the performance standards to obtain the total number of crew days planned. The number of crew days is then multiplied by the crew size (number of men per crew day) to determine the number of man days required.

When all of the maintenance activities have been treated in this manner, the annual work program defines the amount of each work activity, the number of crew days required for that effort, and the total man days required.

#### *6. Performance Budget Calculation*

The completed maintenance program serves as the basis for preparing budget estimates, allocating resources, and for defining labor, equipment, and material needs.

The funds for the entire program are identified in terms of labor, equipment, materials, and contractual services and are allocated to each management unit based on actual program needs.

Since the budget is built from the work program, a cut or addition to the budget means a change in the amount of work planned, on a specific activity-by-activity basis.

### 7. *Workload Distribution*

The workload has to be scheduled. Certain activities must be performed only during certain months. Some work should be performed during certain periods but can be shifted slightly one way or the other. Other work can be performed almost anytime during the year.

Effective scheduling of these types of activities will reduce the peaks and valleys in the maintenance workload. A workload that is distributed uniformly throughout the year enables the management unit to staff with a uniform number of personnel throughout the year.

### 8. *Resource Allocation*

The staffing requirements for each management unit are identified by the work program. Most routine maintenance is the responsibility of the subdistrict and will be performed by personnel assigned to those units. Some specialized work activities and major work operations are an assigned responsibility of district personnel. The staffing requirements for these activities are also identified. In a similar manner, the equipment and material needs of each management unit are determined—the kinds and numbers of equipment and materials required. The allocation of resources—labor, equipment, and materials—is made to each subdistrict and district in accordance with the planned maintenance program.

## WORK EXECUTION

The most critical element of a maintenance management system is the effectiveness with which maintenance program objectives are communicated to field personnel. Field personnel must know and understand what the maintenance program objectives are as well as how to achieve these objectives.

### 1. *Work Authorization*

The maintenance program is transmitted by issuing authorized work orders or crew day cards. Each card represents one crew-day of work on a particular activity and authorizes the subdistrict superintendent and general foreman to schedule one day of work on the activity using the standard crew size, equipment, and materials. The general foreman still is required to make decisions regarding which crew day card to select and the locations which are most in need of attention, but his decision making process is simplified and he has positive guidance in

the proportionate emphasis to place on each type of work and most most appropriate timing for the work.

## 2. *Work Scheduling*

Effective utilization of the maintenance work force demands a fairly uniform workload throughout the year. Also, the types and amounts of work to be performed by the maintenance work force must be planned and scheduled on a regular basis.

Scheduling should be done carefully to avoid peak and slack periods in the workload. During peak periods some necessary work often must be slighted. During slack periods work must be found to keep people busy—work that may not be really necessary.

To avoid these situations, the superintendent and general foreman get together twice a month and prepare a schedule identifying kinds of work and specific locations for the work. This schedule is then used by the general foreman in making daily work assignments.

A work schedule provides a written record of work planned and allows the subdistrict and district personnel to schedule specialized equipment and obtain materials needed to do the work. Emergencies, bad weather, or manpower availability for a given day may require deviation from the schedule, but a definite work plan has been identified and work priorities have been coordinated.

## 3. *Work Reporting*

The work reporting system enables field personnel to report work performance data in terms of labor, equipment, materials, and units of work accomplished. This work performance data provides maintenance managers with information required to plan annual work programs, develop work performance—based budgets—and to evaluate compliance with the planned work program and maintenance standards.

The crew day cards also serve as a simple means of reporting the maintenance work accomplished. The crew leader fills in the hours worked for each man, the equipment usage, the type and amount of materials used, and the amount of work accomplished.

The crew leader returns the completed card to the general foreman, for his review to make sure the work has been performed according to the standards and reported correctly. The card also provides information necessary for the preparation of work assignments for the next day.

## WORK EVALUATION

Work performance evaluation is required to assure that the maintenance program is completed as planned and to assure that the designated levels of maintenance and standards of performance are attained.

The maintenance management system provides maintenance managers at central office, districts, and subdistricts with data to assist them in conducting evaluations of the maintenance effort.

### 1. *Maintenance Activity Summary*

A work summary is prepared monthly at the subdistrict level from work accomplishment data reported on the crew day cards. This report provides a current comparison of work performed in relation to work planned and identifies those activities that are ahead or behind schedule.

Field supervisors are able to evaluate their own performance and take corrective action as required to remain within the total planned work program.

### 2. *Quarterly and Annual Reports*

Electronic data processing at central office is utilized to prepare quarterly and annual work evaluation reports. The data for these reports is taken from the completed crew-day cards that are sent to central office on a semi-monthly basis.

These reports compare actual performance with program objectives and established maintenance standards. Exceptions to planned performance can then be identified for analysis and corrective action.

### 3. *Field Inspections*

Periodic reports provide data concerning areas of potential problems. It is difficult to positively identify causes or determine solutions solely on the basis of reported data. Periodic field reviews of workmanship and service levels will help identify causes and solutions to specific problems.

## EXPECTED RESULTS

Public awareness of improved maintenance operations will be slight. Poor maintenance attracts attention—good maintenance is taken for granted and is unnoticed. Improved maintenance operations will shift the emphasis from emergency or corrective maintenance to preventative maintenance which will result in improved driving conditions and extended service from all our facilities.

We also expect many of the same benefits reported by other highway agencies after implementation of a maintenance management system. These are:

1. Reduced budget requests—a reversal of the trend for larger annual budgets.
2. Increased attention to betterments and improvements—work that could be undertaken because of savings in routine maintenance activities.

3. More equitable budgetary allocations—distribution of resources among districts and subdistricts based on specific work programs and defined resource needs.
4. Consistent levels of service—a reflection of uniform interpretation of standards.
5. Less seasonal variation in the workload—a result of careful planning and scheduling.
6. More responsive field personnel—through improved procedures of communication.

## SUMMARY

Maintenance can be managed. It really is not important if we think of management as a science, a process, an art, or just common sense. It is important that we think. With highway maintenance expenditures increasing rapidly due to the completion of the interstate system, rising traffic volumes, trends toward higher standards, and more extensive traffic services, it becomes increasingly important that maintenance programs be based on sound planning. Only through good maintenance procedures can we provide the desired standard of maintenance service at the lowest cost. We might as well face the fact that maintenance cost cannot increase in the future as it has in the past if we expect to see any modernization of our present highway system.

With the development of this system we have the basis—the foundation upon which to build. A maintenance management system on paper does not perform maintenance on the highways. It does provide the tools—the procedures for managers at all levels of the organization to use in planning, performing, reporting, and evaluating the total maintenance program. It is important that each manager understand and perform his designated function if the full potential of modern technology is to be obtained.