

# Modernizing Orange County's Maintenance Management System for the Environmental Management Agency

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## ABSTRACT

In September 1981 Orange County, California, requested proposals to evaluate and make recommendations for improving its Maintenance Operations Planning and Scheduling System (MOPSS). MOPSS, which was designed by in-house personnel, was not achieving management's objectives. Computerization of the system had become so complex that it was incapable of functioning properly. Phase I of the study was an evaluation of MOPSS and phase II was the development and implementation of phase I recommendations. Orange County obtained a consultant to assist with the evaluation of MOPSS and to develop and implement the modernization of the system. The implementation was completed on July 1, 1983. The results are documented savings in excess of \$790,000 per year. The savings have occurred through (a) more efficient identification and scheduling of work, (b) improved work methods, (c) improved productivity, and (d) optimized crew size. In addition, all data processing is accomplished on a microcomputer at the public works site. Rapid turnaround measured in hours, efficient input of data, and ease of update are some advantages of this computerized system. The system operating in Orange County is a dynamic system. It was implemented with the full cooperation of all management levels who maintain and assure that the system is responsive to today's challenges.

The Environmental Management Agency's (EMA) Public Works Operations of Orange County, California, undertook, in September 1981, to enhance and modernize its Maintenance Operations Planning and Scheduling System. The first phase evaluated existing operations and recommended improvements to the existing system. The second phase developed and implemented the improvements based on the first phase recommendations.

The modified system is being used to plan, organize, schedule, direct, and control the daily activities of more than 215 employees. The implementation included a strong emphasis on communications up and down the organizational ladder. The system also includes the latest in microcomputer technology. System processing in Orange County is done on an in-house microcomputer and is believed to be the first such operational system in the country. This type of system processing allows operations division personnel to perform and monitor operations at the operations site.

## BACKGROUND

Orange County is the second most populous county in

California. It is 782 square miles in area and has a population in excess of 2 million. The operations division of the EMA is responsible for 1,664 lane miles of roadways, 350 miles of flood control channels, and provides some maintenance support for the harbors, beaches, and parks division. The annual operating budget for the division is \$13 million. The operations manager is directly responsible for the efficient use of this budget. An organizational chart for the Orange County EMA is shown in Figure 1.

In 1976 the county set out to design and develop a management system using in-house personnel and a private consultant with no experience in public works. The system was designated the Maintenance Operation Planning and Scheduling System (MOPSS). The objective of the system was to plan, schedule, and control the agency's responsibilities for maintenance of roads, flood control channels, and some harbors, beaches, and parks.

The first step in the MOPSS was to identify maintenance work. This was accomplished in the field by full-time inspectors who identified work quantities and estimated the resources required to perform the work. Management directives and some routine maintenance plans also identified some work. However, the majority of work was determined from inspection reports prepared by the eight area inspectors. The inspectors determined the estimated work quantities and resources required at each location, using their best judgment.

The inspection reports were forwarded to the scheduling section where priorities were set and the work was assigned to the appropriate field personnel. The assigned foreman then performed the work using the resources specified by the inspector and scheduling section. After completion of the work, the foreman reported back to the scheduling section, on a daily work sheet, the actual resources used.

The scheduling section compared the resources used and work conditions with a list of 967 tasks to find the one that best fit the situation. Then the work performed was compared with a base daily production quantity and a weekly summary report was prepared. The summary report was reviewed weekly by the supervisors and schedulers to discuss crew performance.

This process was computerized on a mainframe system with a remote terminal at the maintenance yard. The crews received work assignments at the main Katella Maintenance Yard to which approximately 90 percent of the field personnel report. The other 10 percent report to the smaller yard in San Juan Capistrano (about 45 minutes travel time away). Work orders and completed crew cards are transmitted from the Capistrano Yard by the yard supervisor.

This system had several inherent problems. The meetings to review crew performance produced staff conflicts. The supervisors said that crew performance was the problem. The scheduling function was unable to meet overall goals set by county managers. The aim of the MOPSS was to set schedules daily by reacting to problems rather than to schedule re-

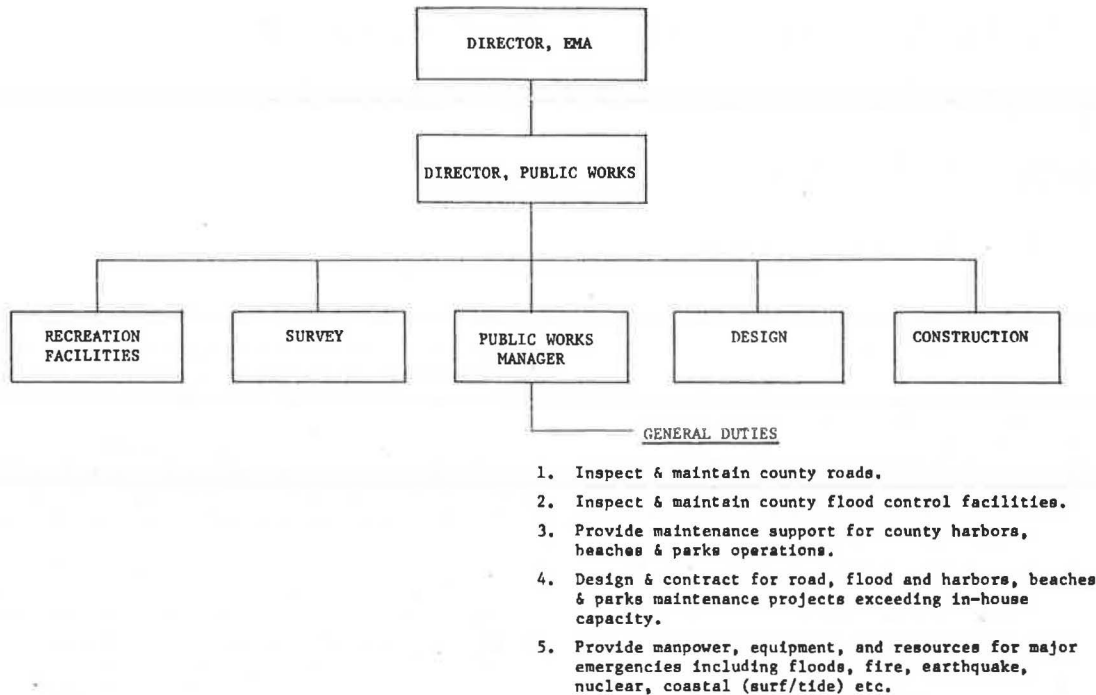


FIGURE 1 Organizational chart for Environmental Management Agency of Orange County, California.

sources according to routine plans. Daily schedules had become a reaction to maintenance deficiencies (putting out fires) and were not being used as a tool to prevent the deficiencies.

The computerized system became unusable for several reasons. The number of task standards grew too large to be managed effectively. The complexity of the software and the limited computer time available made it almost impossible to run some programs. Almost daily software problems were either patched to run that day or were not addressed at all. Also, considerable resistance to MOPSS developed in the field. Because of the complexity of the system, none of the supervisors understood its use or value. MOPSS had become a system that compared crews rather than identifying work performances. The field crews saw it as a system that tried to measure individual performance.

As a result of these problems, the county requested consultant assistance to evaluate MOPSS and to recommend improvements so the system could be a useful, effective, and efficient management tool. The results of the initial study (phase I) to evaluate MOPSS indicated that the following actions were necessary:

- Simplify the system,
- Plan and schedule maintenance work,
- Improve information management, and
- Improve operations.

The results of phase I were accepted by Orange County. The county hired the consultant to develop these improvements, which produced both significant savings and operational effectiveness in the county's maintenance operations.

#### RESULTS

The results of modernizing the maintenance management system (MMS) for Orange County are dramatic. During the first year of operation, Orange County saved or redirected resources that exceed the cost of developing and implementing the improvements by

400 percent. A summary of the annual savings is listed below:

Improvements in scheduling	\$618,110
Optimizing crew size	121,850
Improvement in work methods	<u>52,800</u>
<b>Total</b>	<b>\$792,760</b>

These savings were estimated from (a) additional man-days of work provided for new programs with the same staff, (b) reduction of crew sizes while accomplishing the same amount and quality of work, (c) improvements in production using the same or smaller crew size, and (d) the use of lower cost methods or materials in work methods.

These savings could not have been accomplished, however, if the resistance to MOPSS had not been overcome. Nor could all of the savings be realized without modern data processing methods, which allow EMA personnel to control and process their own information.

How were these savings realized and what makes the Orange County modernization unique? The following four areas had the most impact:

- Successful involvement of managers at all levels,
- Improved scheduling,
- Optimized crew size, and
- Use of a microcomputer.

#### Successful Involvement of Field Management

In 1981 when the evaluation of MOPSS was performed, 967 activities were used to identify work. The modification of MOPSS began by reducing the number of activities to a more workable number. Less than a hundred activities are used today to plan, organize, schedule, direct, and control maintenance work in Orange County.

The most important aspect of reducing the number of activities, however, involved the participation of the supervisors and foremen. The consultant

began a systematic process in the early stages of the project to draw all field supervisory personnel as well as inspectors and schedulers into the development, and later implementation, of the modification of MOPSS. These personnel were directly involved in developing the reduced activity list. Once the list was approved by upper management, these same supervisors, foremen, inspectors, and schedulers assisted in developing the standards. The resistance to MOPSS that had existed for years began to erode once these supervisors felt they were a part of the development process.

Several factors contributed to the successful involvement of the field supervisors. First, the field supervisors were thoroughly trained in the process of defining activities and preparing standards. Next, and probably foremost, the supervisors were placed in a controlled situation to develop the standards. Any historical data that were relevant were analyzed, and examples of typical activities and standards were defined, determined, and prepared. All of this information was assembled before the meeting with the supervisors; therefore, the

supervisors participated in the final development of the standards for Orange County operations.

As soon as these supervisors started to participate in the development process, a major portion of the resistance to the previous system began to disappear. Cooperation increased with the development and use of the system modifications.

Improvements in Scheduling

Modifications to the scheduling process brought about most of the significant changes that produced savings in excess of \$618,110. The work flow is shown in Figure 2.

The previous MOPSS scheduling process had been designed around the concept of preparing daily computerized schedules. Variables that would affect scheduling changes had to be updated daily for schedules to be effective. For example, the labor, equipment, and material used on a job had to be recorded and entered into the system on the day the work was completed for schedules to be available the next morning. In addition, the inspectors estab-

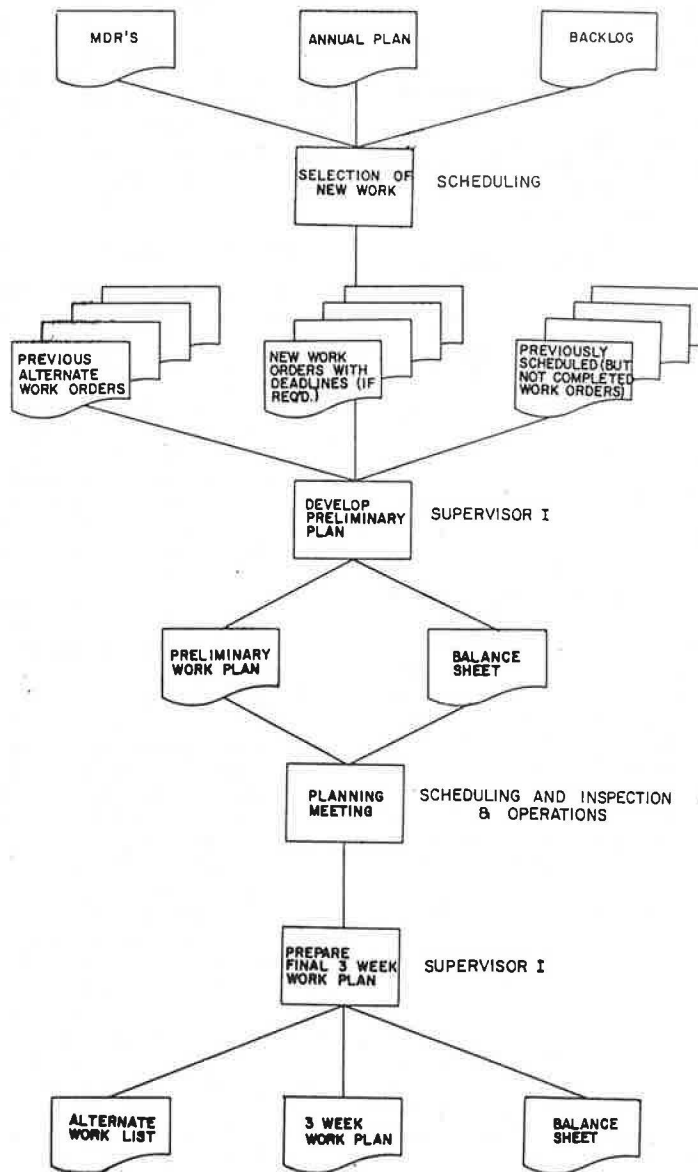


FIGURE 2 Work planning process.

lished priorities daily. The majority of work was identified by the inspectors who also estimated the resources needed and the amount of time necessary to perform the work. Therefore, only limited work was scheduled on a routine basis.

The new system eliminated the previous attempt to provide automated daily scheduling. Instead, a biweekly scheduling process was implemented with flexibility included for emergency work situations. The modifications implemented in scheduling include

1. Routine scheduling of maintenance activities, and
2. Biweekly scheduling meetings.

Approximately 42 percent of the activities are scheduled routinely now rather than waiting for an inspector to identify maintenance needs. For example, striping is now performed on a routine basis rather than waiting until an inspector verifies, by a field investigation, that the centerline or edge-line needs to be restriped. Examples of other major activities that are scheduled routinely are stenciling and drain cleaning. Routine scheduling has not only simplified the scheduling process, but has also improved production and is responsible for a large percentage of the documented savings. Routine scheduling of additional activities is continually being implemented in the county. In addition, the remaining activities are scheduled by grouping packages of work requests by geographical areas.

Although meetings were held before scheduling modifications were implemented, the biweekly meetings play a large part in the success of the modified system. These meetings are structured to encourage open communication while making certain maintenance operations are being reviewed and compared with the plans and standards. Continued emphasis is being placed on whether

- Work performance is in compliance with the annual work program;
- The crew size is the optimal size outlined in the standard;
- The equipment is available and used as planned; and
- Work production is in compliance with the performance standard.

The scheduling, inspection, and operations supervisors actively participate in each scheduling session. The operations manager places emphasis on compliance with the plan and the efficient use of resources while assuring that the resources needed to perform forthcoming scheduled work are available. The emphasis placed on scheduling and the direction given by the operations manager is evident in the success of adhering to the schedule. As shown in Figure 3 adherence to biweekly schedules has increased from 30 to 40 percent to 70 to 80 percent for all operations. This has been possible even though 9 percent more work has been generated than was budgeted. The savings, noted previously, are largely due to the improved ability to adhere to schedules.

#### Optimization of Crew Size

The optimal crew size for each activity was determined at the time the standards were developed. Crew sizes were determined jointly by the foreman, supervisors, and the consultant. This was done by reviewing past practices, available equipment and materials, experiences of other agencies, and using the consultant's experience. Activities such as curb and gutter repair, roadway striping, and rodent

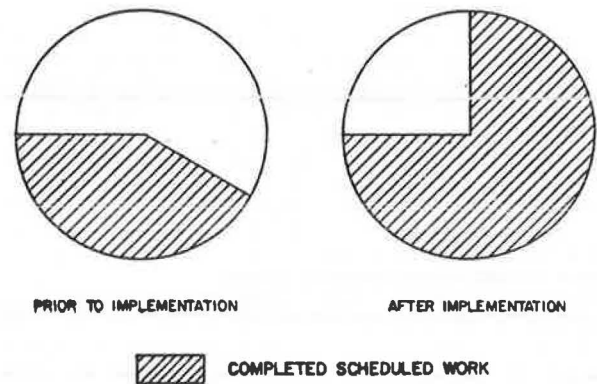


FIGURE 3 Completion of scheduled work.

control are examples of work that is now being performed by more efficient smaller crews. Not only has the increased efficiency resulted in more work being performed, but a higher quality of work has resulted, which produces even more potential for savings. An additional 1,100 man-days have become available to do other work as a result of using optimal crews on these activities.

The key to this success was involving the field supervisors in determining crew sizes. Most important, however, is the continued emphasis in each scheduling meeting that crew size must comply with the standards. Therefore, as the previously noted savings show, using the optimal crew size for each activity resulted in significant savings.

#### Use of a Microcomputer

The first known implementation of a comprehensive MMS on a microcomputer has eliminated the data processing problems inherent in most current MMSS. Operations supervisors can now control their own data needs.

The system implemented in Orange County uses a \$5,000 IBM personal computer (PC). The computer is located in the operation manager's office and he controls its use. Because the computer system is simple and easy to use daily work performance reports for all of Orange County can be entered in less than 4 hours every week. Updating labor rates, equipment rental rates, and material costs is done by accessing one file. The file can be updated as fast as the new information can be typed.

One effective aspect of the system is the interactive programs. By selecting an activity in the work program, crew days, total costs, level of service, and annual work quantity can be manipulated to determine how changing them would affect the budget. In the old system, this process would take days if it could be done at all. Now these "what if" questions can be asked and the impacts determined in seconds. Work distribution is another key interactive program. The process of leveling the workload is accomplished in minutes rather than the weeks required under the old system.

A two-week turnaround for work control reports used to be considered ideal. With the new systems reports can be turned around in minutes. For example, Orange County accumulates its daily reports and enters them weekly. Once a month, at the end of the fourth week when weekly data are entered and edited, control reports are printed.

All of the data processing needs of the Orange County MMS are provided by the microcomputer. With today's technology, microcomputers can be easily and economically expanded to handle the data processing needs of a maintenance agency for an entire state.

## CONCLUSIONS

The improvements to the Orange County MOPSS have been implemented, and the system is being monitored and updated by the EMA staff. The consultant has been retained to provide guidance in scheduling and annual updates. It has been determined that the modified system will remain dynamic and responsive to needs. The system will be updated annually to account for changes in costs, operating procedures, and technology.

Important management tools that the system provides, but which are not documented in this report, are

- Guidelines for work activity,

- Performance-based budgeting,
- Distribution of work,
- Leveling manpower,
- Work control methods, and
- Use of equipment.

The Orange County MMS provides up-to-date information rapidly so that managers can make timely decisions. Orange County is convinced that the revised system fully meets the objectives established 8 years ago for a maintenance management system.

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# Modernizing Pennsylvania's Maintenance Management System

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## ABSTRACT

Pennsylvania's maintenance management system (MMS) was developed in the early 1970s and was operating statewide in 1975. When the system was developed it was state of the art, but computer technology has advanced significantly since that time. Thus the staff of the Pennsylvania Department of Transportation has been prompted to review and update its procedures for handling information. The primary objective for many modifications is to make the information collected available promptly to the field offices. On-line Flash reports have been developed. Each organization manager inputs the parameters for the information desired and receives a report on the screen of the organization's terminal that was generated in the central office computer. If the manager wishes a hard copy the report may be printed at the organization's printer. For example, a manager may obtain information on activities performed by each foreman so that the foreman's recent jobs may be reviewed and evaluated; or ask for information by Legislative Route to show what activities were performed and how many dollars were spent to maintain that highway. Recently reports have separate entries for units of work and the dollars spent by contractors and the activities performed by department forces.

of the art, but computer technology has advanced significantly in the last 8 years. This advancement has prompted the Pennsylvania Department of Transportation (PennDOT) to review and update the handling of information within the computerized MMS as well as to review the overall objectives of the system.

The rewriting of the programs for the computerized system is to be completed within the next 2 years. These revisions will clean up the patches in the system and integrate the data bases for MMS, the equipment management system, and the automated inventory system.

## MODERNIZATION

The primary objective of the most recent improvements to PennDOT's MMS was to make the production and equipment information available to field offices as quickly as possible. Field personnel collect and enter the data so they should have access to the data as soon as the computer data bases are updated. The file containing the activity units and the personnel and equipment costs for that activity is updated daily.

To provide this information, on-line reports were developed. Because the computer responds instantly to on-line requests, these reports were named "Flash" reports in the central office at Harrisburg. By inputting certain parameter codes, the manager can select one of 10 reports and receive it at the screen on the county terminal. If a hard copy of the report is desired it may be printed out on the local printer. The following reports are available:

1. Activities on a selected Legislative Route (Figure 1),

Pennsylvania's maintenance management system (MMS) was developed in the early 1970s and became operational in 1975. The system at that time was state