# Indiana's Maintenance Management Information System

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In 1986 the Indiana Department of Transportation (INDOT) realized that its computerized maintenance management system was not meeting the needs of the department. Problems included a cumbersome mainframe system that necessitated sequential running of programs, an inordinate amount of paperwork, and, most important, lack of meaningful feedback to district and subdistrict managers and foremen. INDOT's Maintenance Management Section studied several alternatives to eliminate or reduce the problems. The alternatives included the development of a new system using INDOT's data processing resources, the use of existing systems in operation in other states and agencies, and a contract with a vendor-consultant for a product already in use in a public agency. The Pennsylvania Department of Transportation's Maintenance Operations Resources Information System (MORIS) was reviewed as part of the evaluation. A team consisting of specialists in maintenance management, equipment and inventory management, and data processing was sent to Pennsylvania for 2 days. Although the team was impressed with the highly integrated nature of MORIS, the team eventually rejected its use for Indiana. The use of MORIS in Indiana would have required a major upgrade to the department's mainframe computer, a major reworking of the software to fit Indiana's legal and financial requirements, and some departure from existing well-accepted maintenance management practices. The Maintenance Management Section selected a commercially available product that matched, in theory, the existing maintenance management system. The product is generic, operates on a personal computer, and permits data to be uploaded to the department's data base for use by other functions. The selected product is used by the National Park Service to manage maintenance activities.

The Indiana Department of Transportation (INDOT) is responsible for roadways classified as Interstate routes, federal routes, or state highways, including toll facilities but not county roads or city streets. Of the 28,250 lane-mi for which INDOT is responsible, 16.9 percent is in the Interstate system.

INDOT is organized into 6 districts, 37 subdistricts, and 122 maintenance units. Cities and counties do not contract with INDOT to provide maintenance or snow removal. A force of approximately 2,000 maintenance workers is responsible for road maintenance activities. The department contracts for a considerable amount of work each year, including mowing, herbicide application, sweeping, guardrail maintenance, resurfacing, and wedge and level. Excluding toll facilities, approximately $16 million supports work program materials and another $16 million supports work performed by commercial contractors.

Indiana's maintenance management system has been used since the mid-1970s to control the state's roadway maintenance program. The system was developed by Roy Jorgensen Associates, Inc., to operate on the department's mainframe computer.

Because it was one of the last systems of its type to be implemented, INDOT's system benefited from the development work done for other state systems. Since its installation, new programs have been written, and the system has evolved to take advantage of new computer technologies. Still, the improvements could not overcome some major problems, including excessive paperwork, sequential program runs, and lack of information for district and subdistrict managers and foremen. Most managers viewed the system as belonging to the central office even though the system was well accepted at the foreman and crew leader levels. The theory behind the system became an integral part of how maintenance operations were accomplished in Indiana. However, the department needed to provide more support for all managers and to simplify the data processing to make it responsive to current and projected needs.

In 1986, the department's Maintenance Management Section began to study ways to provide better data processing without seriously changing the accepted theory of maintenance management. Three options were considered:

- Use the department's data processing section to write software for a new system to reside on the mainframe computer (Option A),
- Find a state or other large public agency with a system that would fit projected needs (Option B), and
- Find a vendor-consultant with a maintenance management system in production and in use at a large public agency (Option C).

## OPTION A

Option A was found to involve several problems. The data processing staff believed that the department should retain the existing package as a nucleus for the new system. A number of enhancements would be designed cooperatively by the Data Processing and Maintenance Management sections. The Maintenance Management Section was not in favor of this option because many problems with the old system might carry over to the new system.

The maintenance management staff also believed that the section lacked the knowledge of data processing required to properly instruct the Data Processing Section in its desires for the new system. After extensive discussion, the department's Data Processing Management Committee, which had oversight responsibility, rejected Option A.

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## OPTION B

Of the state department of transportation management systems evaluated, Pennsylvania's Maintenance Operations Resources Information System (MORIS) was the most highly recommended because of its integration of personnel, equipment, and materials information. A three-member team from Indiana spent 2 days as guests of the Pennsylvania Department of Transportation.

The team represented the Maintenance Management Section, the Division of Information Services, and the task force working to develop a new equipment and inventory management system. MORIS was viewed at Harrisburg and at a district office to see the system from two perspectives. After the demonstration of its capabilities, the team was certain that MORIS was a state-of-the-art system.

From Indiana's viewpoint, several obstacles would have to be overcome to use MORIS. They would be inherent in any system developed to meet the needs of an individual state and included the following:

- MORIS was designed with Pennsylvania's legal and financial requirements in mind. Major modifications would be required to tailor the programs to Indiana's needs.
- MORIS had not only maintenance, equipment, and inventory management modules, but also pavement management and payroll modules and others that Indiana was not prepared to accept. The integration of programs that made MORIS so appealing prohibited the selection of specific modules by Indiana unless the whole system were adopted.
- MORIS required computer resources in excess of those available to INDOT.
- MORIS uses a theory of maintenance management different from INDOT's. Indiana's system is essentially the original resource management concept developed by Roy Jorgensen Associates, Inc. Maintenance requirements, resources, and unit costs are identified; performance standards that guide crew size and equipment needs are provided; work is planned; schedules are generated; work is performed; and work accomplishment and resources used are measured and reported. The evaluation team believed that a number of accounting features had been added to MORIS. They satisfied the equipment and inventory task force member. The member representing maintenance management believed the changes to be too great a departure from Indiana's existing system. In addition to operational training in MORIS, theoretical training would be required to prepare field staff if MORIS were adopted.

Indiana was forced to abandon this option and look for a system that would meet its needs without a large financial expenditure for software modification, training, documentation, or hardware.

## OPTION C

After reviewing several software packages and proposals, Indiana selected a package developed by De Leuw, Cather & Company and applied in the National Park Service. The following is a description of the system as it will be applied at INDOT.

A maintenance management system is intended for use by front-line managers as daily, weekly, and yearly management decisions are made. The vendor-consultant and INDOT share a concept of maintenance management. Central to this con-

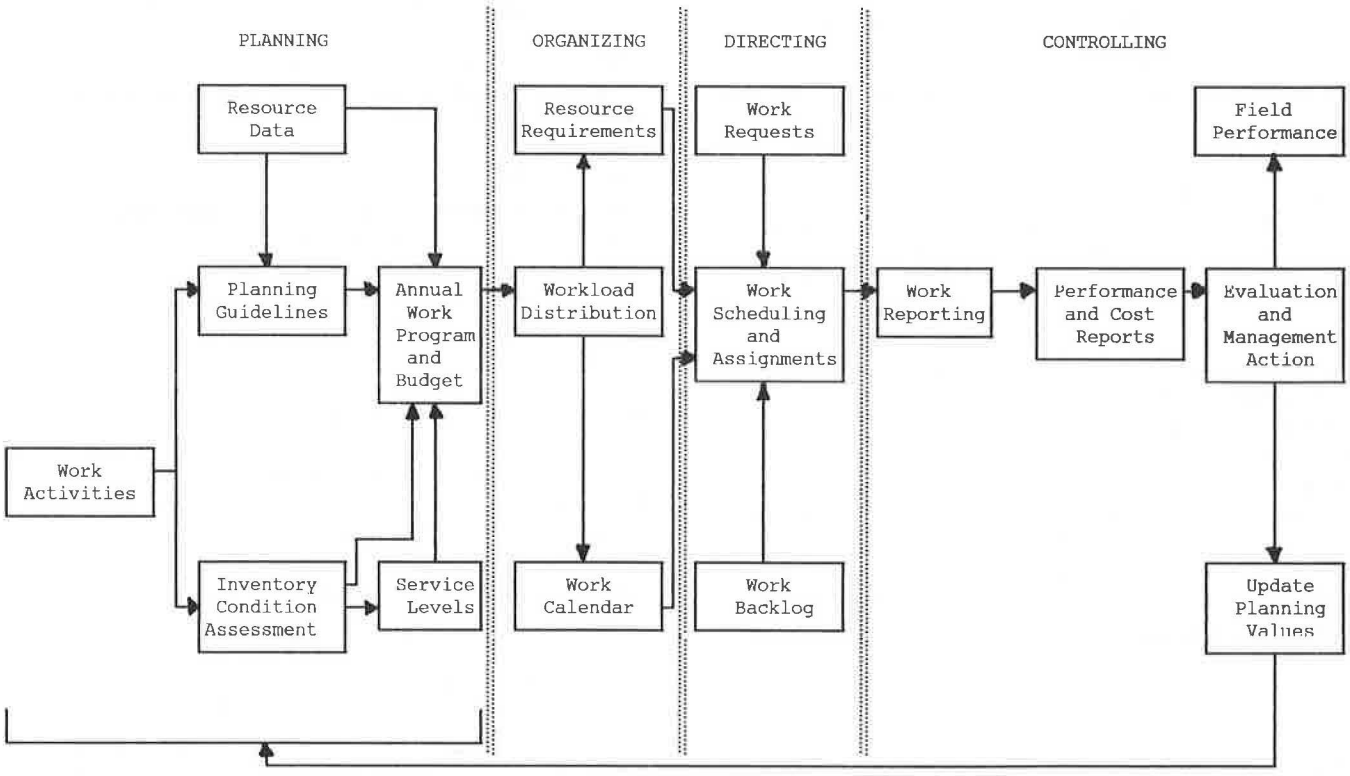


**FIGURE 1 Maintenance management information flow.**

cept are inventories, quantity standards, performance standards, identified resources, unit costs, work programs, schedules, budgets, work reporting, productivity, and reports of accomplishment and deviation (Figure 1). The software applied in the National Park Service used these concepts and structures and was compatible with Indiana's existing system. Though operational training in system use would be required, little theoretical training would be required to familiarize field personnel with the concepts behind the system.

The system is generic. It is not bound by the legal and financial requirements of any end user. In Indiana the software will replace the system used for management of field maintenance activities. In addition, it will be used to control work activities, prepare budgets, and track work performed by traffic operations and by the buildings and grounds function. The Division of Toll Roads, whose financial and data processing operations are independent of the rest of the department, will also use the software. Finally, the Indianapolis Department of Transportation will use the software, as modified for INDOT, as its maintenance management system.

The software operates on a personal computer (PC). This is both an advantage and a disadvantage. From the standpoint of the end user, the field manager, operation on a PC is an advantage over a mainframe system. The user has direct control of input and output, giving a feeling of ownership. The feeling that the field only supported a system that belonged to the central office would be eliminated. All resource files, work programs, budgets, work schedules, and a variety of reports would be available to the field manager at any time (Figure 2), including weekends, when the mainframe computer in Indianapolis is turned off.

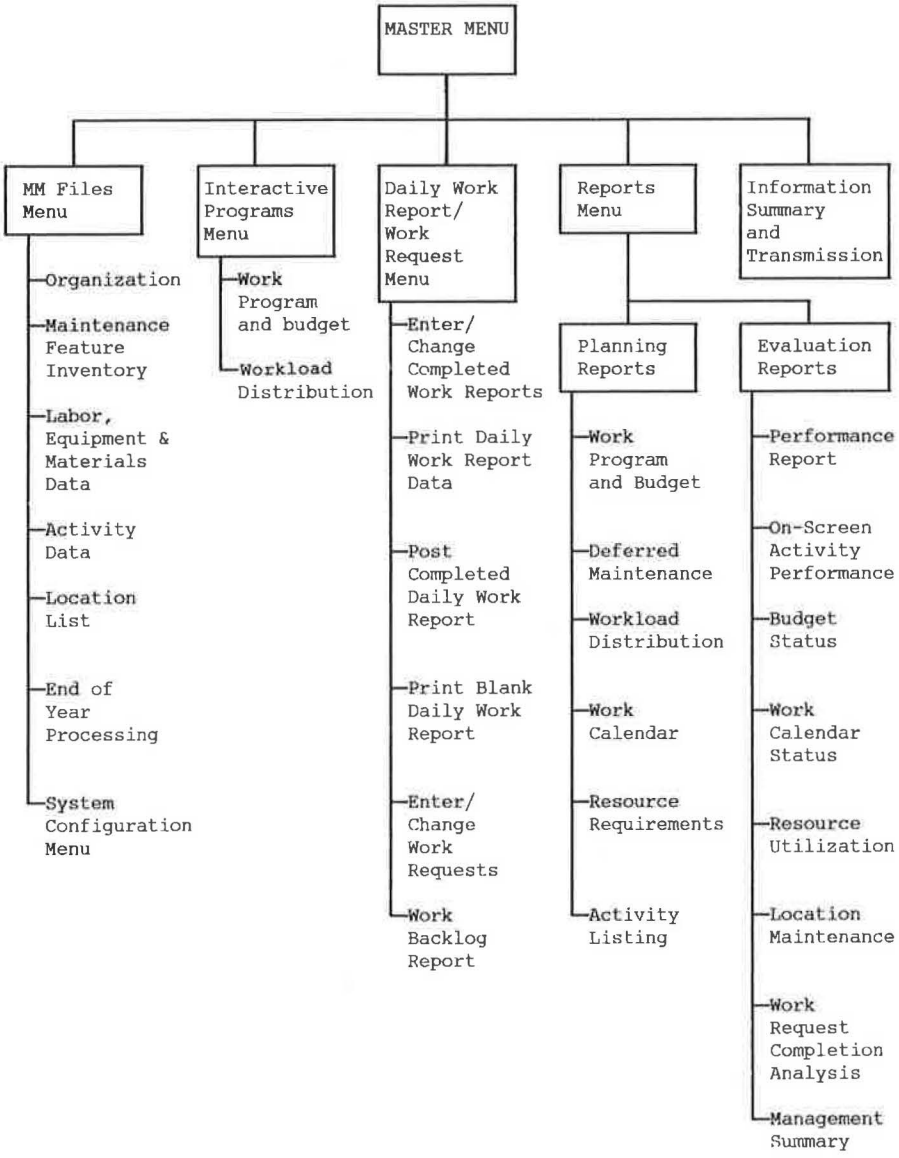


**FIGURE 2 Menu of screens and reports available from the De Leuw, Cather & Company maintenance management system.**

The software, residing locally in the PC, allows users to

- Keep track of inventories, resource tables, unit costs, and performance standards;
- Prepare jointly (subdistrict, district, and central office) annual work activities and quantity standards, resulting in a completed budget, work program, work calendar, and resource requirement listing;
- Record work performance on crew day cards prepared locally and enter the results into the local PC, where edits are performed; and
- Obtain results from various reports showing accomplishment, deviations from the program, cost per unit of production, and other items (Figure 2).

The PC is also a disadvantage. Although the system's primary function is to support field managers in maintenance subdistricts, the information from the system is needed to support decision making at the district and central office levels. In addition, by mandate of the department, the system must support the pavement and bridge management function and other users needing information from the system. The major problem is the transfer of data from 37 subdistrict maintenance PCs and 6 district traffic PCs to the department's central computer system. Local responsibility for system maintenance, including file backup, is also a potential disadvantage.

The department and the vendor-consultant worked together to solve the data transfer problem. The PC software places data into an ASCII file. The data can then be imported into a PC data base or transferred to the central mainframe computer. At the subdistrict PC the data will be entered and checked for accuracy. At regular intervals subdistrict personnel will use the PC software to prepare and transmit summary files to the central mainframe. Some detail records will also be transmitted. The department's Division of Information Services, which is responsible for data processing, will provide the communication software, file storage, and interface with the department's central data base. This data transfer process would have been facilitated by a centralized system operating on the department's mainframe computer. Under the new system, district and central office personnel will obtain maintenance management information by using on-line query capabilities on the central data base after files have been transferred from the PCs to the mainframe (Figure 3).

INDOT determined that the cost of modifying the software to meet departmental needs was reasonable. The contract cost for software modification, training, and documentation was $418,979. This includes $55,000 for work done for the Indianapolis Department of Transportation. In addition, approx-

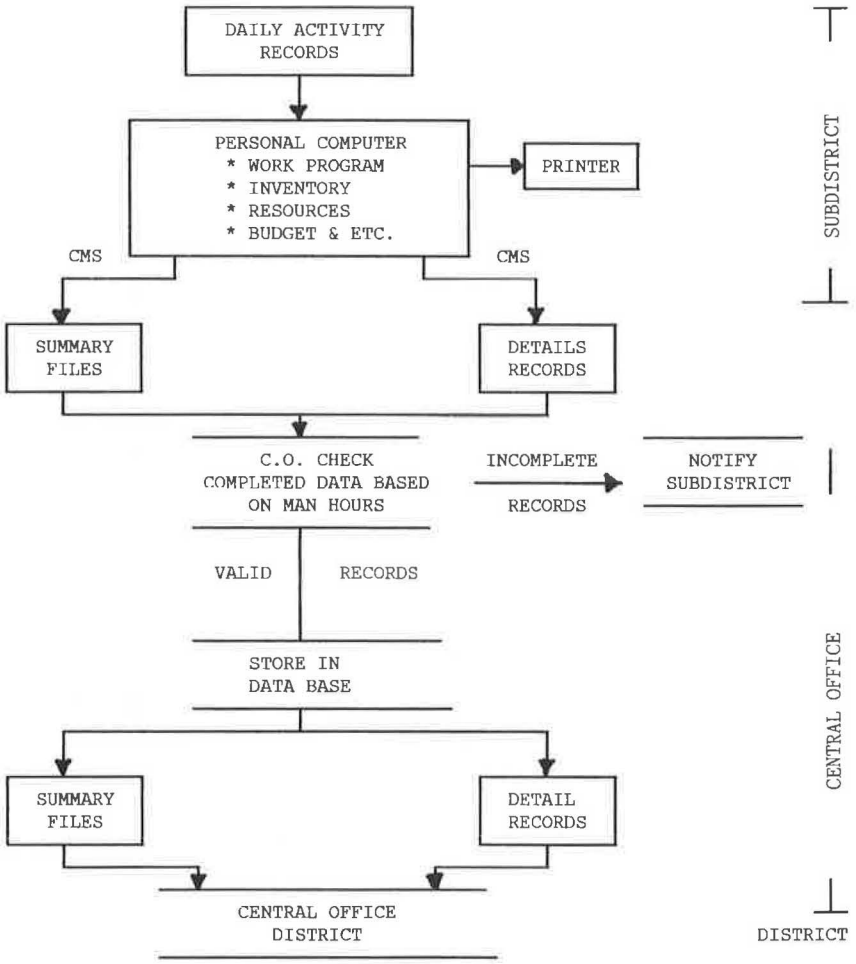


**FIGURE 3 Flow diagram of data transfer.**

imately $250,000 was spent for IBM PS/2 Model 60 PCs for districts and subdistricts. These PCs were the first placed by the department in the subdistricts. They support other software besides the maintenance management system.

An additional $55,000 is anticipated in labor and data processing development costs within the department to fully implement the new system. The total cost for the system will be approximately $724,000. The Maintenance Management Section estimated potential savings of between 5 and 10 percent in better utilization of labor, materials, and equipment, either as reduced costs or as increased productivity. These are estimates, but it is certain that, compared with the total cost of the system, benefits will be realized as payback within the first calendar year of operation.

## CONCLUSION

Though the option INDOT selected does not give the complete integration of multiple systems that MORIS does, Indiana is confident that ease of use, familiarity with the system, local ownership, reduced paperwork, and transfer of data to central users will provide a dramatic improvement for a reasonable cost, and that the system will provide for INDOT's needs for some time to come.