

fectively communicating the benefits of sound equipment management to key decisionmakers. Resource management concepts have come to Louisiana with the objective of redesigning accounting and data processing systems so that users' needs for fast, reliable information can be addressed. A maintenance simulation model is being used to provide equipment managers at all levels with a means of evaluating equipment capacity and numbers with greater understanding and appreciation for the problems of operating personnel. Finally, inventory management with attendant equipment parts management potential is on the horizon and may be implemented as soon as the resource management effort is completed.

The Department believes that the issues have been faced squarely and an environment for improving equipment management has been developed. Support systems have been planned and programmed to provide the field manager with objective data on which to base fundamental equipment decisions. Flexibility has been built into the design to enable rapid response to improve concepts. The entire system has been tested and will work. It still remains to be seen whether field managers can actually produce the

anticipated savings and effectively realize the potential created by this effort.

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Abridgment

Maintenance Managers Versus Equipment Managers: Their Adversary Relationship

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There is a natural adverse relationship between the highway maintenance hierarchy and the equipment procurement and maintenance hierarchy within the same highway agency as a result of the difference in their primary functions. Modern highway maintenance techniques require the use of substantial varieties and amounts of equipment. Due to declining availability of funds, maintenance managers are becoming increasingly cost conscious and more aware of all expenses contributing to total cost. Tighter control over activities has resulted in a decline in the per-unit use of equipment, and the income or transfer of funds to equipment sections has not kept up with depreciation. Slower replacement of older equipment has caused an increase in downtime due to equipment malfunction. As efforts are made to increase funding for equipment sections, maintenance managers perceive that they are receiving less service for more money. At the operational level, equipment operators believe that equipment downtime is caused by poor equipment selection and repair, and mechanics believe it is caused by operator carelessness and abuse. Recognition of the adversary relationship and its causes can result in increased efforts to design and implement effective equipment management systems that are responsive to change and track all equipment costs and use in a timely manner. In addition, the training programs used to introduce changes or make additions to equipment management systems can be far more effective if both the potential for resentment and the difference in viewpoints are taken into account.

The adversary relationship that tends to occur at essentially all levels of the highway operations-maintenance and equipment procurement-repair hierarchy is the natural result of the generally erratic evolutionary growth of most state highway agencies. When highway commissions or departments were first formed in the early 1900s, the fledgling highway industry was a very labor-intensive one. Federal legislation in 1921 established a federal-aid highway system, but the law also limited the mileage to 7 percent of a state's total public highway mileage. As a result, the various state legislatures assigned responsibility by law for highway construction and, therefore, maintenance in a bewildering array of

combinations and permutations. Highway maintenance programs evolved from the abutter working off his taxes to a publicly paid highway patrolman maintaining "his" section of highway using his own equipment and assisted by a helper.

In addition to owner-operated, horse-drawn maintenance equipment and then trucks, \$139 million worth of surplus military equipment was provided to states in 1920 as a result of federal legislation to assist them in highway construction and maintenance. As more highways became hard surfaced, the need for specialized equipment arose in the late 1920s and early 1930s with the advent of formal tar or resurfacing crews. Equipment operators working after hours with the assistance of their oilers, which was a usual practice at one time, could no longer supply the necessary upkeep and maintenance for this equipment, and so full-time mechanics became necessary. This evolutionary process produced a great array of management approaches by highway departments, but by the early 1950s most states had fairly well-established formal management relationships between highway equipment and highway maintenance organizations. During this same period, individual patrolmen were being assigned to patrol crews under the direction of a foreman, and private trucks were being replaced in increasing numbers by state trucks. Equipment operators were becoming less responsible for the care and upkeep of their equipment and more dependent on formal equipment management organizations and their mechanics.

In the 1960s, highway maintenance management systems were introduced and, concurrently, equipment maintenance management became more specialized and complex. As a result, highway maintenance managers

became increasingly concerned with productivity in terms of ton miles and similar measurements. The equipment managers, on the other hand, tended to concentrate on technical aspects of equipment. At the lower end of the equipment and highway maintenance hierarchies, many equipment operators believe equipment downtime is caused by improper equipment selection and poor maintenance, whereas many other mechanics believe that downtime is caused by operator carelessness and abuse. Most administrators in the highway maintenance field have had all too many opportunities to attempt to resolve personnel difficulties arising from these two points of view.

This controversy has undoubtedly existed since equipment operation and maintenance were first separated, but as long as fleets were expanding and new equipment was frequently purchased it did not have a particularly serious effect on work or employee efficiency. Since the early 1970s, however, when inflation started increasing faster than revenues, competition for the highway dollar has become greater. Equipment costs started increasing faster than the general inflationary trend, replacement programs slowed, and average equipment downtime started to increase. The equipment-using side of agencies became more conscious of unit costs and improving production by using large amounts of equipment but for shorter periods of time. There are equipment costs, however, that occur regardless of use, and hourly rates of use rose rapidly. Fewer dollars, higher charges, and more downtime could only result in worsening relations and increasing turmoil between the highway maintenance personnel and the equipment specialists.

The disagreements that naturally arise between two segments of an organization that have different goals and only one source of insufficient funding cannot be eliminated, but they can be greatly reduced by a logical approach to the problems that create the disparity of opinion. In this case, only a businesslike, precise, well-designed, and responsive equipment management system will suffice. All costs of equipment must be collected without excep-

tion; and, based on these costs, rental or use rates that are fully auditable and justifiable to everyone must be established. These rates should be dual in nature, and charges should be made based on daily possession of equipment for fixed costs such as depreciation and insurance. No possession charge should be made for equipment that is inoperable or unavailable for use, and consequential costs should be absorbed by the equipment section. On the other hand, maintenance managers who are working with correctly structured budgets and who are charged realistic rates for possession of equipment will have ample incentive to ensure that they have no more equipment than necessary. The operation portion of the rate must also be precise and accurately reflect true costs. Obviously, collecting and assigning all costs and correctly recording all use require that joint decisions be made by equipment managers and maintenance managers as part of the development of an effective equipment management system. This cooperative effort is a major step in reducing the effect of the adversary relationship of the two sides.

Not only will improved relationships and better efficiency result from a soundly designed equipment management system, but also direct and sizable financial benefits will accrue to the parent organization. As an example, one only needs to compare the fuel cost per hour between the bestand poorest-operated and maintained equipment to realize the possible savings to an agency that employs properly trained drivers operating correctly maintained equipment.

In summary, the common ground between the equipment manager and the maintenance manager is concerted action to hold down equipment costs, but only a correctly constructed and operated use-rental rate system will suffice as a tool. In addition, each manager must be assigned responsibility for work performed by his or her organization and funds budgeted for its performance.

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Development of Parts and Materials Inventory System

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The Parts and Materials Inventory Subsystem (PMIS), one of four interrelated subsystems in the equipment management system under development by the Arkansas State Highway and Transportation Department (ASHTD), is described. The established user objectives of PMIS are to (a) maintain parts inventory balances, (b) support established fill-rate objectives, (c) set efficient limits on stock levels, (d) control stock replenishment actions, and (e) evaluate inventory management performance. Additional desired features include interdistrict checking to locate a needed item stocked elsewhere in the state and error-free distribution records for accounting. Due to various inadequacies in the existing method of numbering stock, new numbering schemes were devised for all inventory items and stockpile locations. All stock items and locations were then converted to the new numbers. The PMIS design specifies on-line computer terminals in each district stockroom to process normal accounting transactions and meet user needs. Inventory transaction information is input at the district and subjected to detailed editing to ensure data integrity. Balancing and editing routines permit all error correction to be made at the data source. Various stock management reports are provided in on-line and batch modes for district and Central Headquarters. PMIS operations were tested in two ASHTD districts. Preparations are under way for statewide implementation.

In April 1979, the Arkansas State Highway and Transportation Department (ASHTD) entered into a contract with the Federal Highway Administration (FHWA) to test and evaluate an equipment management system (EMS) based on an EMS Manual developed by a consulting firm under another FHWA contract. Since an EMS must be tailored to the particular needs of the user, ASHTD was authorized to make whatever changes in the Manual recommendations it deemed necessary to accomplish this task. The contract term is three years, and FHWA is funding approximately 25 percent of the total cost.

An interdepartmental project team was formed within ASHTD to plan and carry out implementation of the EMS and monitor progress. The team is composed of representatives from the Fiscal Services Division, Computer Services Division, and Equipment and Procurement Division. Advising the project team are