

## Maintenance and Operations Personnel

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Maintenance and operation of the transportation roadway infrastructure in the new millennium will be very different from what existed only 30 years earlier. These tasks will be increasingly important, even critical to providing mobility and economic support services to the users of nearly 4 million miles of roadway in the United States.

In this paper, we present the current macro trends that affect transportation organizations and their workforces, the state-of-the-art responses of current transportation organizations, characteristics of the new millennium for which transportation organizations are now preparing, and the impact on and requirements of personnel who will perform maintenance in the early years of the new millennium.

Many current forces and trends in the United States and worldwide economies ultimately affect the personnel who perform maintenance work on transportation assets. These forces will continue to shape the requirements of transportation organizations that provide maintenance as we begin a new millennium.

### CURRENT TRENDS

#### U.S. Political Climate

The political climate reflects an erosion of public trust and confidence in government. This environment places great pressure on governments to reduce size and costs, to avoid raising taxes, and to become more accountable for their performance.

- Legislatures have limited the number of personnel employed in government agencies, specifically, in the departments of transportation (DOTs).
- Typically, one-third to one-half of the personnel in a DOT are maintenance employees. Thus, the impact of reducing staffs and stabilizing costs is felt more strongly in maintenance than in other functions.
- Many state DOTs are initiating surveys to determine the level of customer satisfaction and which roadway infrastructure services have the highest priority for customers. Response data are used as input to their planning of roadway maintenance and operations.
- The Transportation Research Board has created a subcommittee that focuses on nothing but performance measures in transportation.

#### Technologies

Several areas are changing dramatically: the products or services that must be maintained; the tools used to perform maintenance; and the information technology used to record, measure, track, and plan maintenance.

- Advanced intelligent transportation system (ITS) information technology is being built into the infrastructure to increase capacity and safety. It provides users with real-time information so they can avoid delays and accidents. People who are responsible for providing services are alerted to current conditions, which helps them prioritize work activity. For example, on Interstate Route 66 in Northern Virginia, variable message signs—controlled from a traffic management center located miles away—provide real-time information to motorists. Cameras monitor traffic conditions, and traffic management center personnel can change signals, direct police, and dispatch wreckers or maintenance crews to trouble spots, as needed.
- Equipment of all kinds is becoming more automated and computerized. For example, filling potholes historically required one truck and a crew of four to seven maintenance workers, who spread approximately 2724 kg (6,000 lb) of material per day. New methods automate this process, reducing the labor to as little as only one operator; productivity has more than tripled. At the same time, the durability and quality of the patch have increased. Even though more expensive equipment is required, personnel are no longer exposed to traffic without protection. Using milling machines to excavate larger potholes has speeded up production, but the repair uses more patching material.
- In several states, integrated management systems (or enterprise systems) are under way that will integrate all information about the inventory of infrastructure assets and their perpetual condition, help prioritize the maintenance work to be done, allocate the required resources, and track work completed. The components of these systems include pavement, bridges, signage and signals, pavement markings, equipment, materials, responsible maintenance organizations, customer feedback, and finances.

### **Preservation of Our Environment**

Preserving our environment is a strong human desire that, coupled with a growing adult population, has motivated policy makers and legislatures to enact regulations that can dramatically impact the planning and practices of maintenance work activity. In Colorado, for example, air pollution regulations severely limit the amount of abrasives used in snow and ice control activities, and the abrasives must be swept from the pavements immediately after the storm has passed. These requirements necessitate very expensive street sweepers, each of which is operated by a maintenance worker. In addition, sweeping requires about the same amount of time and effort as the initial spreading of abrasives.

### **Customer Expectations**

Customers are demanding more value, better quality, and faster service in all economic components of our society. The private sector has influenced the reinvention of government as a service provider, leading the way with improved productivity, customer responsiveness, and profitability.

Within our economy, telecommunications and the Internet are significant areas that shape our expectations. An individual can have real-time picture and voice access to other people and access to worldwide information on demand, both professionally and personally.

Distribution also has affected public expectations dramatically. As consumers, we can purchase and receive almost any product in two or three days and, most likely, from alternative suppliers. Just-in-time delivery has become the normal way of conducting business between manufacturers and vendors. Consequently, maintaining the

transportation system has become a critical consideration when locating manufacturing facilities; it is the means to economic survival.

As better services are provided, they become expected. What is received in one sector is transferred as an expectation in another, so all economic sectors are affected. Naturally, then, customers of the transportation infrastructure demand higher quality service. They are unwilling to wait for roadway repairs to be made in the course of regular scheduled maintenance; they expect repairs within a few days, if not today. Motorists are unwilling to accept delays while roads are being repaired and expect repairs to last. They demand a smooth and safe driving surface under all weather conditions. Studies have shown that highway users expect to be able to use the roads at legal speeds under all circumstances.

### **Competitive Forces**

The demand to stay ahead of competition for economic survival has led to drastic measures, as organizations battle for growth in predominantly stable or low-growth markets. Industrial, commercial, and governmental organizations seek to satisfy customers as the only means of creating loyalty, profits, or rights to continue operations. These pursuits have forced organizations to identify and assess their core skills and abilities.

Organizations that want to survive in this competitive climate must eliminate functions that do not produce adequate financial returns. Some partner with other organizations—including competitors—in relationships that will enable them to provide the products or services that customers demand. Manufacturers frequently sell products and sell components or materials to competitors that sell related products.

Business relationships are not fixed. New partnerships are formed depending on the competitive landscape and financial or customer pressures. Recent consolidations in the automotive industry are well-known examples of changing economic relationships. Consequently, transportation organizations are seeking partners from both private and public sectors that can support the mission of the organization and deliver services more efficiently and effectively.

### **Infrastructure Limitations**

Within the transportation infrastructure, maintenance is increasingly important to the efficient and effective delivery of products and services to meet the transportation demands of the nation.

Approximately 4 million miles of roadway exist today in the United States. It is difficult to estimate the total miles that are added or replaced each year; however, the number is quite small. Federal-aid roadway projects (new and reconstruction) under way averaged only 16,389 miles per year between 1993 and 1997. Federal-aid roadway projects make up a small percentage of the total new and reconstruction projects in the United States; therefore, the vast majority of the roadway depends on maintenance to ensure accessibility and performance.

The total number of miles traveled on U.S. highways increased 68 percent between 1980 and 1997. High volumes of traffic (especially considering truck travel) cause roadway assets to deteriorate quickly and increase traffic congestion. As a result, service is disrupted more frequently, and each disruption of the transportation infrastructure causes delays to and jeopardizes the safety of more users.

Transportation and especially maintenance organizations are required to respond to more incidents caused by deterioration and to respond more quickly because customers demand better service.

## STATE-OF-THE-ART PRACTICES

In response to—and consistent with—current forces and trends, transportation organizations have been adapting and adopting practices that dramatically affect the historical personnel organizations and the individual personnel who maintain the transportation infrastructure. The state of the art is illustrated in the following examples.

### Recruiting Personnel

A county maintenance organization in Wisconsin has developed a working agreement with a local contractor to share seasonal employees. The employees work for the contractor in the summer and for the county in the winter months, providing winter services. Consequently, the contractor does not have to pay unemployment in the winter, and the county has a source of temporary employees for the winter and does not have to hire excess permanent staff only to ensure adequate staff for the winter months.

The Pennsylvania DOT has been working with two trade schools to develop programs that will prepare graduates for positions within the DOT.

### Training the Workforce

All organizations are spending more time training and cross-training employees to provide field operations. Individuals are certified or qualified to meet the need for a greater breadth of skills.

The Virginia DOT has maintained a centralized academy for training its field staff. This system has become inefficient because many skills need to be taught and numerous field personnel require training in at least a few of the skill areas. So, the academy's focus has shifted from conducting centralized programs to packaging training on a much broader skills base, then helping field organizations implement on-the-job training.

States in rural America as well as urban corridors are implementing technology. The Montana DOT is installing computers in 130 section houses, including remote areas, to provide advanced weather information and management communications via the Internet. Having critical information, including real-time pavement temperatures and temperature forecasts, the field force can change operating practices to meet actual conditions. Consequently, field staff must become computer literate. Increased training is planned for new practices; however, access to training is difficult. As one alternative, a mentor program has been instituted. Each primary user is assigned a mentor within the organization who is available to provide guidance in using computers and the Internet.

### Organization, Relationships, and Worker Responsibilities

The Minnesota DOT identified several critical aspects of these issues: increased workload in program delivery, limited workforce growth, limited workforce flexibility, and workforce competitiveness. One answer to these problems was to establish a new labor classification system. This Transportation Specialist Series collapses the existing job classifications from all departments into four categories; each job is defined by the kinds of skills and capabilities required for employees in the category. Workers in each category have the flexibility to learn and perform functions within the broad category, therefore increasing their own skills. The combined inventory of worker's skills creates a talent pool that can be consulted when deciding whom to choose to staff projects, perform seasonal work, and fill vacancies.

The Pennsylvania DOT has been implementing a service exchange program called Agility. The state DOT at the county level is encouraged and challenged to establish

formal agreements with municipalities for exchanging services that will benefit both organizations by capitalizing on each other's skills, talents, and assets. The result is that the customer receives better service and a seamless transportation system.

County managers are spending more time than before establishing relationships and writing contracts. As a result, field supervisors and foremen take on more managerial roles. Technology supports this shift in function; with voice and data transmission available to and from the field, foremen can schedule work, buy materials, report production and worker time for payroll, and respond to customer inquiries and complaints.

The Virginia and Florida DOTs have developed contracts with the private sector for providing all maintenance functions on defined corridors or roadways. These contracts are performance based and provide accountability for delivering specific levels of roadway service to the public.

### **WORK PRACTICES OR PROCEDURES THAT AFFECT PERSONNEL**

The Pennsylvania DOT is implementing differential work hours to meet the work requirements and public demand for roadway accessibility. Off-peak and/or nighttime positions are increasingly being used for both maintenance work and servicing the equipment used for maintenance work. These practices provide longer up times for equipment in during peak hours and fewer restricted lanes during peak driving periods.

The Oregon DOT has implemented a work team structure that allows and encourages the work team to set its own goals and schedules. Self-directed highway maintenance teams were implemented to bring the decision process to the people closest to the work performed. The intent was to reduce management levels, improve the work product, and reduce the required financial resources simultaneously.

### **Pay Systems for Maintenance Personnel**

The Arizona DOT implemented an incentive system for compensation that started in maintenance and has expanded to construction and other departments. Crews establish targets in three performance areas: productivity, customer feedback, and employee feedback. When crews meet the monthly targets, each crewmember receives a bonus based on the crew's rating for that month. Participation is voluntary, and more than 90 percent of the crews currently participate.

The Virginia DOT has installed a competency-based pay system that pays an individual worker based on several factors, which include his or her competency in various skill areas and work results. Each worker has the opportunity, at his or her own initiative, to become competent in skill areas other than those required for the current position. In this system, the worker takes on much responsibility for his or her own career and current pay level.

Utah also has implemented a program that links an employee's pay level to skill levels achieved.

### **IN THE NEW MILLENNIUM**

Only 50 years ago in some parts of the United States, maintenance supervisors were required to take work mules home with them for care and feeding. When we consider the magnitude of changes in maintenance from that era until now, it is quite difficult to predict what the new millennium will bring.

However, we believe that in the first part of the new millennium, the automobile and the truck will continue to be the modes of transportation most desired by the public and industry. The current infrastructure will not experience dramatic growth; in other words, what we have already will serve future needs for mobility and economic growth. The ITS, made up of more than 30 user services, will be the key to providing efficient and safe traffic flow.

The nature of maintenance work will change to keep the existing system in good repair. Operations that include surveillance and crash prevention, improving traffic flow, and identifying deficiencies will dominate maintenance activity. Additionally, the maintenance of the technology supporting these operations will be the responsibility of the maintenance organization.

The emphasis on providing the technology, materials, procedures, and work practices that guarantee up time of the transportation infrastructure will increase. In many urban areas, the travel corridor probably will replace the geographical area as the focus of management and worker control.

Technology will drive infrastructure assessments and maintenance practices. Specifications for work put to competitive bid will be increasingly performance based, and the work will require more and more specialization and automation.

State and county department labor probably will become more consumed with contracting, inspecting, and advocating on behalf of the customer and less oriented toward performing maintenance.

### **IMPACT ON MAINTENANCE PERSONNEL**

Maintenance personnel will need new skills for negotiating with contractors and managing and evaluating contractor performance.

Maintenance workers will need greater computer knowledge and skills to operate an ever-expanding range of equipment. In addition, they will need computer skills to maintain both the equipment and the assets that use computers to function. Related skills in using computer-generated analysis and information for making assessments and decisions for implementation also will be needed.

Infrastructure performance will be the goal of maintenance, and consequently, work and workers will be evaluated on the basis of performance—that is, the efficiency with which desired outcomes are achieved. Workers will need to learn the implications of such evaluations in terms of how to change practices to bring about the desired outcomes.

Maintenance workers will take on more of the role of an ambassador and communicate with the public. This role will require new skills and even personality characteristics that are not required in current roles.

Maintenance personnel will work in shifts; shifts will operate 24 hours a day, 7 days per week. Therefore, attracting workers to this kind of environment may require different policies and pay practices. Work functions will be more specialized, and positions more varied. They will cover a broad range of skills, which will increase the demand for training and certification. Recruiting maintenance workers will become a more significant challenge; competition from private contractors for workers will foster a variety of partnership relationships with the focus on performance.

Maintenance organizations in the new millennium will recruit workers who have skill sets different from those of today's typical employees. Increased time and effort will be devoted to skills enhancement for existing workers and skills training for new workers.

Employees will take far more responsibility for their own careers, and employers will offer training and job function flexibility for individuals to develop expanding skills.

Organizational relationships will be far more fluid and focus on the customer and desired outcomes, rather than the internal organization.

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