

*Standing Committee on Maintenance and Operations Personnel (AHD15)*  
*Dave Bergner, Chair*

## **Transformation of the Roadway Maintenance Operations Workforce**

**DAVE BERGNER M.A., PWLF, CPWP; Monte Vista Associates, LLC**

### **COMMITTEE OVERVIEW**

The AHD15 Maintenance and Operations Personnel committee is “concerned with the personnel policies of the various transportation organizations relative to maintenance and operations; and the selection and training of maintenance and operations personnel.” In recent years the committee has recognized that this traditional focus should be broader to explore the effects of rapid demographic, technological, economic, social-cultural and legal trends. These factors influence how state and local transportation agencies, and contractors performing outsourced or privatized maintenance functions for these agencies, can recruit, train and retain qualified employees. This workforce has evolved from “shovel and a truck” days to complex machinery and equipment, sophisticated work management systems, advanced communications, improved materials and performance-based best practices. Additionally, maintenance operations employees must be aware of and comply with more environmental, safety, workplace conduct, drug-testing, and other policies and regulations. Agencies have also evolved; many have flattened their organizational structures; revised job descriptions and classifications; increased mandatory and voluntary training; instituted performance-based pay and promotions; and introduced benefits changes conducive to employee morale. Yet there is much more that is needed to attract and keep a highly proficient and diverse workforce. The AHD15 committee seeks to promote and promulgate timely practical research to guide transportation agencies in meeting the challenges of maintenance workforce transformation.

### **ADDRESSING TRB’s CRITICAL ISSUES**

TRB in late 2018 released the twelve Critical Issues in Transportation that will guide further research and other activities. The ones that are most pertinent to AHD15, as noted by the number in the report, are:

1. Transformational Technologies and Services;
4. Resilience and Security;
8. System Performance and Management;
11. Institutional and Workforce Capacity.

Each will be examined as to the impact on the maintenance and operations workforce and relevance to this committee’s purpose. But first, a review of the U.S. roadway system and a profile of the current and future workforce.

### **INTRODUCTION**

State and local transportation agencies recognize that their roadway maintenance and operations (M&O) workforces are in a transformative phase as employees with many years of institutional knowledge are retiring at an increasing rate. Furthermore, significant technological,

demographic, economic, legal-regulatory and political influences affect the size, scope and composition of this often overlooked but very important element. While much attention has been given to training and education of civil and transportation engineers, there has been little recognition that the field maintenance workers and supervisors, and even support personnel, are essential for ensuring the reliability, safety and capacity of the transportation infrastructure.

Roadway maintenance is regarded less than planning, design and construction; however, it requires substantial organization, logistics, flexibility and versatility. Whether performing preventive and reactive maintenance, or responding to all-hazard emergencies and major traffic incidents, the work requires commitment, persistence, adaptability and versatility.

The roadway infrastructure is seriously deteriorated and will require billions of dollars for repair, rehabilitation and replacement. But preventive and rehabilitative maintenance has long been underfunded and agencies sharply curtailed even basic work. Furthermore, M&O workforces are smaller; many positions eliminated during the Great Recession and subsequent vacancies due to retirements and resignations are left unfilled. Agencies have turned to privatization and outsourcing with varying results but even contractors are faced with personnel shortages.

The M&O workforce must be better trained, skilled and flexible as new technologies, materials, methods and equipment are introduced. Therefore, transportation agencies, professional organizations and academia must identify the essential skills, knowledge and abilities needed by the evolving workforce. They also need innovative ways to interest students, military veterans, minorities, females and those pursuing a more rewarding career.

### **THE INCREASING ROADWAY MAINTENANCE BURDEN**

The roadway system of the United States is comprised of all public streets, roads and highway, bridges, and vehicle tunnels. There are 4.12 million roadway center-line miles (about 8.3 million lane-miles) in the United States according to the Federal Highway Administration (FHWA). About 2.7 million miles are paved and the rest, 1.4 million miles, are gravel or dirt roads. Local governments are responsible for 3.18 million miles of road or 77.3 percent of the total. State highway agencies are responsible for over 780 thousand miles of road (*including Interstate highways*) or 19.0 percent. The federal government is responsible for about 150 thousand miles of road or 3.7 percent, in national parks, forests, military bases and Indian reservations.

The U.S. spends far more each year repairing and maintaining existing roads and bridges than building new ones, according to the FHWA. In 2013, the latest available data, the Federal highway program committed \$30.1 billion for improving 65,500 miles of highway and 4,887 bridges; 43.7 percent of that total was *to maintain or preserve* existing roads and bridges. Furthermore, in 2013 state transportation departments spent \$111 billion on highway improvements; 36 percent of that total went for routine maintenance of highways and bridges. Nonetheless, this was quite insufficient to meet current needs. The American Society of Civil Engineers (ASCE) 2017 Infrastructure Report Card rated the nation's roadway system as a "D" noting that:

America's roads are often crowded, frequently in poor condition, chronically underfunded, and are becoming more dangerous. With over four million miles of roads [in] the United States, one out of every five miles of highway pavement is in poor condition and our roads have a significant and increasing backlog of rehabilitation needs. The U.S. has been underfunding its highway system for years, resulting in a \$836 billion backlog of highway and bridge capital needs. The bulk of the backlog is in repairing existing highways.

ASCE's recommendation to, "prioritize maintenance and the state of good repair to maximize the lifespan of roads," underscores the urgency of the situation. Continual attention and effort by local and state maintenance operations is critical to sustaining the rehabilitated roadways in the best possible condition. Aside from massive funding, this requires a workforce that fully understands the structure of roads; the causes of deterioration; identification of various defects; and the best methods and materials for long-term preservation. Engineers and engineering technicians have long been responsible for most of these processes. However, as agencies contend with shortages of civil engineers and technicians, they are relying more on the M&O staff, who have "eyes on the road" nearly every day, to provide essential data and information, determine priorities and take appropriate action consistent with agency policies and plans. Dr. Teresa Adams of the Midwest Transportation Workforce Center noted in *Workforce News*, May 2017: "As highway maintenance organizations are charged with more responsibilities, the people doing this work will need to be more highly skilled and bring a broader range of technical expertise to the table."

### **THE EVOLVING MAINTENANCE OPERATIONS WORKFORCE**

Roadway workers are retiring in greater numbers as the "Baby Boomer" Generation ages. Filling vacancies is more difficult as younger people seek other employment opportunities. Midwest Transportation Workforce Center (funded by U.S. Department of Transportation), in 2017 proposed a vision to "Elevate the Role of Highway Maintenance Workers":

- The highway and multi-modal corridors are managed by a credentialed workforce.
- Activities and decisions occur through a lens of Resiliency and Sustainability.
- The workers are recognized as a vital part of the first-responder-team that provides the technical and heavy equipment resources to make relief efforts successful.
- The workers focus on the safety and welfare of the community and travelers.

Redefining, re-shaping the perceptions of roadway maintenance may help attract a younger, more diverse population to this sector. The M&O workforce in most states, counties and municipalities is mainly comprised of white males, typically from a rural or small-town background. But, as noted in "NDDOT Workforce Analysis: A Necessary Step in Creating an Effective Strategic Human Capital Plan" (Kalnbach, 2004):

The availability of the traditional rural white male workforce is disappearing. The Department needs to expand and reform its recruiting effort in order to attract the kind of workforce that will be available in the future. In order to have workers, the Department must shift to a more diverse workplace that is attractive to female and minority workers as well as white males. The Department should reach out to female and minority individuals at younger ages in order to encourage them to prepare for the exciting careers in transportation and to expand its partnership with people at college, high school, and elementary levels.

Additionally, according to an Iowa Workforce Development 2015 report, "Middle Skill Jobs in Iowa", highway maintenance workers are considered as middle-skilled. (Middle-skill jobs require education beyond high school but not a four-year degree and make up the largest part of the U.S. labor market, per the National Skills Coalition.) Also, the median salary for highway maintenance workers is comparable to many other middle-skill jobs, according to the Iowa report. (The U.S. Department of Labor's wage report of May 2018 shows a mean hourly wage of \$19.92.) This should be better publicized to stimulate interest among young people, minorities, females and workers contemplating a career change.

Furthermore, the New Jersey Institute of Technology's 2017 report "Increasing Representation of Minorities, Females and Underrepresented Individuals in Journey Level Jobs on Highway Construction Projects," for the New Jersey Department of Transportation, is also applicable to highway maintenance:

Approximately 36 percent of the workforce in the United States are people of color, including Hispanic, African-American and Asian. As our nation becomes more racially and ethnically diverse, the number of people of color in the workforce is also expected to increase. Diversity in our workforce is also seen across gender. Currently, women make up 47% of the workforce...[and] is expected to increase by 6.2% over the next 10 years with women outnumbering men in the workforce by 2020. [W]omen and minorities are still underrepresented and underutilized in highway construction employment.

Also, a 2015 report, "When Working Hard Is Not Enough for Female and Racial/ Ethnic Minority Apprentices in the Highway Trades," funded by Oregon DOT, identified the difficulties in recruiting and retaining females and minorities:

Specifically, we found a workplace culture that is hostile to women and people of color as well as women and racial/ethnic minorities' lack of access to interpersonal relationships and professional networks. Similar to other white male-dominated occupations, the highway trades face challenges with the recruitment and retention of women and people of color. Our findings demonstrated that female and racial/ethnic minority apprentices face more challenges than their white male counterparts.

Due to the expected major demographic changes now occurring in the roadway M&O workforce, this committee will promote further research and discussion on this very critical issue.

## **TRAINING AND DEVELOPMENT**

Looking ahead, leaner workforces and the growing maintenance backlog means agencies will need better skilled, informed and motivated employees to maximize efficiency, productivity and reliability. Specific training and certifications are increasingly needed to qualify for advancement. Many agencies recognize formal apprenticeships, trade school or equivalent military occupation specialty schooling as valuable qualifications. Agencies also encourage employees to pursue certificate programs and associate degrees at local community colleges. The Front Range Community College, in partnership with Colorado LTAP, Colorado Department of Transportation, the American Public Works Association and others, will initiate the Associate in Applied Science in Highway Maintenance Management program in 2019 for current and aspiring supervisors or managers.

According to *NCHRP Synthesis 483: Training and Certification of Highway Maintenance Workers (2015)*, the most common required training and certification is general maintenance skills, highway safety and reliability, and roadway/roadside. Agencies provide certification because of concerns about safety, liability, and insurance considerations. Many recommend training for maintenance workers to improve performance and promotability. However, impediments to providing training for maintenance employees include:

1. organizational inertia and resistance.
2. shortage of funds.
3. scheduling time.
4. methods of delivery
5. suitable facilities.

*NCHRP Synthesis Report 503, Leveraging Technology for Agency Workforce Development (2017)*, describes training delivery methods that can be useful in overcoming some of the impediments. Smaller agencies, and particularly those in rural areas, have lacked the resources to provide training. Expanded high-speed broadband, cheaper computers and software and a newer generation of managers will make web-based training more accessible.

## **ADDRESSING TRB'S CRITICAL ISSUES**

### **Transformational Technologies**

*"Driverless vehicles... may revolutionize transportation. Perhaps even sooner, vehicles connected to one another with advanced high-speed communication technologies..."*

Connected and autonomous vehicles (C/AV) will have a profound impact on roadway maintenance to an extent that is still difficult to determine. These vehicles will "read the road" through a multitude of sensors. Thus, agencies must significantly increase maintenance of pavement markings, traffic signs, signals, street lights, ITS devices, roadside appurtenances such as guardrails and paved surfaces to minimize liability exposure.

Furthermore, advanced traffic management will depend upon adaptive coordination among signals and communication with vehicles. This Infrastructure to Vehicle (I2V) technology will also be used with roadway lighting, electronic message boards, fixed traffic signs, temporary work zone and incident management traffic control devices and even pavement markings.

Transportation agencies will adopt C/AV technologies for their own fleets; many already use Automatic Vehicle Location (AVL) for winter maintenance operations, street sweeping, pothole patching and other routine work. The following C/AV research projects relate to the roadway maintenance workforce:

- *NCHRP 20-102(15) Impacts of Connected and Automated Vehicle Technologies on the Highway Infrastructure (anticipated 2019)*, will produce guidance for state and local transportation agencies in evaluating and adapting their standards and practices for roadway and intelligent transportation system designs (including traffic control devices) and related maintenance and operations to reflect the deployment of connected and automated vehicle technologies.
- *NCHRP 14-42, Determining the Impact of Connected and Automated Vehicle Technology on State DOT Maintenance Programs (active)*: The effects on transportation agency maintenance programs need to be examined to ensure that they are prepared for the challenges of CAV implementation while maintaining the existing roadway system assets such as traffic control signs, markings, signals, guardrail and that other ancillary devices can be designed or enhanced to facilitate CAV operations at an acceptable level of service.
- *NCHRP 20-102(21), Infrastructure Modifications to improve the Operational Domain of Automated Vehicles (anticipated)*. Infrastructure modifications may include infrastructure-to-vehicle communication systems, signage, and infrastructure such as curbs and barriers to provide different levels of segregation between the CAVs and other road users. Uniform and well-maintained traffic control devices, such as lane markings and traffic signs, may improve the extent of AV Operational Domains.

As technology rapidly advances, keeping such systems reliably functioning and updated will require substantially more training. Additionally, M&O personnel will have an important

role in asset management as they are continually observing, inspecting, maintaining, repairing and rehabilitating the infrastructure. This committee will collaborate with other TRB committees, such as Intelligent Transportation Systems, Traffic Signal Systems, Vehicle-Highway Automation, Traffic Control Devices, Work Zone Traffic Control and Traffic Asset Management, in promoting research and discussion as to the role of M&O in this area.

### **Resilience and Security**

*“Extreme weather and other natural disasters pose huge and costly threats to the transportation infrastructure. Public officials face the challenge of making vulnerable highways... more resilient to climate change and other threats.”*

Roadway maintenance personnel rarely get the recognition that they are often first responders to major emergency incidents. In the immediate aftermath of floods, hurricanes, tornadoes, earthquakes, landslides, wildfires and other disasters they clear the roadways so that police, fire, emergency medical and utilities can access the stricken areas and provide egress for evacuees. These vital functions are noted in *NCHRP Synthesis 392 (2007) Transportation’s Role in Emergency Evacuation and Reentry*:

Transportation personnel are involved before, during, and after evacuations by managing and maintaining transportation systems, including traffic control, monitoring, planning, and management...Most important, transportation professionals bring expert knowledge and a situational awareness of transportation systems into an emergency response. In states with large rural areas and populations, DOTs are often one of the few, if not only, state agencies with staff, equipment, and communication assets in remote areas that can be used to evacuate people to safety.

During the recovery phase, local and state maintenance workforces repair damaged roadways and bridges, restore traffic signal operations, clear stormwater drainage systems, remove huge amounts of debris from public right-of-way and assist with perimeter access and temporary traffic control. The Department of Homeland Security officially designated “Public Works” as a component of its Emergency Service Sector along with police, fire and EMS. Because of its vital role in emergency management, the M&O workforce must acquire the same free training offered by the Federal Emergency Management Agency (FEMA) to be recognized and accepted by other responders as an equal partner in planning, preparation and response. The following research projects are relevant to the role of M&O personnel:

- *NCHRP Synthesis 468 Interactive Training for All-Hazards Emergency Planning, Preparation and Response (2015)* identifies interactive emergency training for DOT/PWD maintenance and operations field personnel.
- *NCHRP 20-59(30) Incident Command System (ICS) Training for Field Level Transportation Supervisors and Staff (2015)* developed specialized Incident Command System training and toolkits for field supervisors and staff.
- *NCHRP Report 781: A Debris Management Handbook for State and Local DOTs and Departments of Public Works (2014)*. In the aftermath of an incident, it is essential to quickly restore the transportation system. The maintenance workforce is responsible for clearing debris and repairing, replacing, or restoring critical infrastructure.
- *NCHRP Synthesis 454: Response to Extreme Weather Impacts on Transportation Systems (2012)* examined eight cases of extreme weather in the U.S. from perspectives including transportation operations and maintenance.

The AHD15 committee recognizes that the long-range climate change impact on the roadway infrastructure will significantly affect M&O personnel as they expend more time and

resources on mitigation, response and recovery. Additionally, M&O personnel are increasingly needed for traffic incident management (TIM). This committee will collaborate with other TRB committees, such as Emergency Evacuation, Joint Subcommittee on Emergency Response, Operations Resilience subcommittee of Regional Transportation Systems Management and Operations, Winter Maintenance, and Surface Transportation Weather, to ensure the inclusion of the M&O workforce in practice-ready research, workshops, seminars and other venues.

### **System Performance and Management**

*“In the face of tight budgets, transportation officials must also figure out how to maintain the condition of roads, bridges and other assets for as long as possible.”*

As noted earlier, the backlog of repairs and rehabilitation to U.S. roads is enormous forcing agencies to maximize the limited funding for routine maintenance. It is strikingly clear that deferred maintenance actually costs more in the long run, as noted in *NCHRP Report 742: Communicating the Value of Preservation* (2012). The following are other research projects relevant to the roadway maintenance workforce:

- *NCHRP Synthesis 426: Performance-Based Highway Maintenance and Operations Management* explored performance-based management practices by DOTs in highway maintenance and operations.
- *NCHRP 20-83(03)A: Long-Range Strategic Issues Affecting Preservation, Maintenance, and Renewal of Highway Infrastructure* (2018). Transportation agencies continually face challenges that influence priorities and needs for preservation, maintenance, and renewal of the highway infrastructure. However, affordability and cost-effectiveness of innovations will depend on future economic, social, political, and technology trends.
- *Domestic Scan 10-03, Best Practices in Performance Measurement for Highway Maintenance and Preservation* (2012). Successful agencies support the use of performance data to drive maintenance and preservation decisions. Agencies used training programs to build understanding and buy-in among field personnel.

The Maintenance and Operations Personnel (Workforce) committee will collaborate with other TRB committees, such as Pavement Maintenance, Maintenance and Operations Management, Structures Maintenance, Roadway Maintenance Operations and Maintenance Equipment, to ensure considerations of this workforce in preservation research activities.

### **Institutional and Workforce Capacity: Providing a Capable and Diverse Workforce**

*“Government transportation agencies face huge challenges and tight budgets [and] depend on having capable workers with the tools they need to do their jobs. These agencies have difficulty competing for and keeping talented workers. They simply cannot pay as much as private industry. Also, the changing nature of transportation is creating different requirements for the workforce; transportation organizations struggle to keep workers up to date in the skills they need. This problem is especially acute at the local government level.*

*With a growing, changing, and aging population, transportation organizations will need to hire new and diverse employees. How can managers attract more members of underrepresented racial and ethnic groups into the transportation field? How can they minimize the loss of expertise and experience when Baby Boomers retire?”*

This is of principal importance to AHD15 and other committees as well. At the 2019 Annual Meeting, the chairs of AHD15, AHD50 Roadside Maintenance, AFH40 Construction

Management and ABG20 Education and Training informally discussed the potential need and justification for a Joint Subcommittee on Workforce Development. Other committees will be invited to participate as the purpose and scope is further defined. In addition to training and development, transportation agencies need to aggressively attract women and minorities to the M&O workforce. Military veterans, “second-careerists” and even retirees are also good candidates. As sophisticated machinery now supplants much of the strenuous physical tasks, the stereotypical “strong back and weak mind” worker is becoming obsolete. The following research projects focus on these issues:

- *NCHRP Synthesis 362: Training Programs, Processes, Policies, and Practices (2006)* examines program components required to have a sound set of policies, processes, and procedures for planning, developing, implementing, funding, and evaluating DOT training, development, and education programs.
- *NCHRP Synthesis 20-05/Topic 49-10 Transportation Workforce Planning and Development Strategies (2018)* examined the current state of practice for the implementation of surface transportation workforce planning and identified strategies to help build career pathways in this field including but not limited to young adults, second career professionals, veterans, and encore careerists.
- *NCHRP report 636 (20-72) Tools to Aid State DOTs in Responding to Workforce Challenges (2009)*. DOTs face ongoing, evolving challenges: budgetary pressures, policy mandates, changes in the workforce, introduction of new technology, and other factors require leadership to reassess and reshape their organizations' mission and structure. DOTs seeking to recruit, train, and retain competent, qualified, and high-performing workforces need time, skills, money, and other resources that often are in short supply. This produced a guide and a toolkit to address workforce challenges.
- *NCHRP 20-07/Task 340 National Training: Challenges and Opportunities (2013)* identified issues and challenges faced by highway agencies related to training of the workforce, and ideas and action items to improve national training opportunities.
- *NCHRP 20-07/Task 163A Innovative Practices in Workforce Development for State Departments of Transportation (2004)*: State DOTs face challenges in recruiting, retaining and training their workforces. Sharing information about innovative practices will help states more effectively address workforce issues and contribute to the development of a knowledgeable, skilled and motivated workforce.
- *NCHRP report 685: 20-81 Guide to Implementing Strategies to Attract and Retain a Capable Transportation Workforce (2011)*. Many transportation agencies have difficulty in attracting and retaining capable employees. Competition with other industries and fields, as well as current economic and demographic trends, is making it difficult to sustain an adequate and competent workforce. A growing number of employees are becoming eligible for retirement, and constraints on public sector financing limit the ability to match salary and benefit levels of the private sector.
- *NCHRP 14-11(2): Enhancement to Program for Effective Motivation of Highway Maintenance Personnel (2000)*. Synopsis NCHRP Research Results Digest 257. Highway maintenance organizations are expected to provide rapid, high-quality service for an aging, expanding roadway system that requires substantial maintenance. However, the personnel and financial resources available to these organizations are in short supply and have not been increased to keep pace with demand; it is critical that employees at all levels be productive; strive for high-quality



- workmanship; and demonstrate increased commitment, dependability, and adaptability. A course for motivating highway maintenance personnel was developed.
- *Domestic Scan 11-01, Leading Practices in Large-Scale Outsourcing and Privatization of Maintenance Functions (2014)*. Maintenance outsourcing is practiced to a limited extent by many agencies, but typically on a small scale. When outsourcing becomes large-scale, complex management problems can arise. Large-scale outsourcing implemented by eliminating an agency unit then engaging private enterprise to perform the maintenance functions is usually termed privatization. A variety of economic and political factors determines whether outsourcing of some or all maintenance activities is likely to yield benefits.
  - *Domestic Scan 13-01, Advances in Developing a Cross-Trained Workforce (2016)*. This investigated cross-training (CT) for enhancing agency efficiency and agility in adapting to changing missions, priorities, and budget, and the conditions under which CT strategies are applicable and appropriate. Transportation agencies face increased pressures of new demands, shrinking revenues, wave of retirements, and struggle to attract and retain employees with critical skills and experience. CT can improve performance, enable innovation, reduce workforce transition disruptions, promote career development; aid cross-utilization; foster better leaders; instill succession planning; and provide trained backups.
  - *Workforce 2030--Attracting, Retaining, and Developing the Transportation Workforce: Design, Construction, and Maintenance (Proposed NCHRP 2018)* Agencies are increasingly challenged by the availability and preparedness of the design, construction, and maintenance workforce. DOTs will likely be working with a significantly smaller workforce due to budget constraints. Retirements also puts additional demands on staffing as many new workers will require significant training. DOTs recognize that significant changes in workforce recruitment and training practices are needed. Workforce 2030 is a first step on the pathway for sustaining a qualified workforce. DOTs are unable to offer employees the same pay scales and benefits as private companies. Many struggle to maintain technical career paths that reward and support the development and retention of staff with valuable specific skills as the demand for transportation construction, reconstruction, and maintenance work is increasing.
  - *Recruiting, Retaining, and Promoting for Construction Careers at Transportation Agencies, Transportation Consortium of South-Central States (2018)*. To meet construction and maintenance demands with a shrinking and changing workforce, DOTs need workforce management strategies and guidance to effectively attract, train, and retain engineers, technicians, and workers needed to construct and maintain the U.S. highway infrastructure well into the 21st century. These strategies can be used to gain and sustain valuable human resources from current as well as future generations of workers, including minority and underrepresented individuals.

- *NCHRP 20-07/Task 408 Transportation System Management and Operations (TSMO) Workforce: Skills, Positions, Recruitment, Retention, and Career Development [Active 2019]*. The objective is guidance for DOTs and others for development of TSMO capabilities considering likely technology, workforce, and transportation policy developments within the next 15 years. Agencies face growing needs for a fully competent workforce; recruiting and developing expertise is complicated by generational shifts, the rapid pace of technological innovation and a competitive labor market.
- *NCHRP (20-86) Report 693: Attracting, Recruiting, and Retaining Skilled Staff for Transportation System Operations and Management (2012)*. This provides guidance for transportation agencies to recruit and retain qualified professional staff in the systems operation and management area. The report explores career paths, skill requirements, training needs and identifies successful programs,
- *NCHRP 20-07/Task 380: Proposed AASHTO Manual for the Maintenance of Roadways and Bridges (active 2018)*. Due to changes in maintenance practices, reduced budgets and work forces and recent research, there is a need to produce a new edition of the 2007 manual.

### **Going Forward**

Creating a diverse, highly proficient and productive M&O workforce will continue to be a major focus of the AHD15 committee. Specifically, the committee will examine changes to position descriptions, job requirements, classifications, pay scales, recruiting and hiring, training, advancement policies and institutional culture. At the 2019 TRB Annual Meeting, a panel of state DOT executives discussed successful initiatives to recruit and retain M&O employees.

We recognize that collaboration with other TRB committees is essential to creating a comprehensive approach to guiding research and implementation of practical programs. As noted earlier, many of the same concerns of attracting, recruiting, developing and retaining well-qualified and skilled employees, especially women and minorities, are shared by every segment of the surface transportation industry.

AHD15 will also engage with other organizations including but not limited to: American Association of State Highway and Transportation Officials (AASHTO), American Public Works Association (APWA), American Road and Transportation Builders Association (ARTBA), International Municipal Signal Association (IMSA), National Local Technical Assistance Program (LTAP), Intelligent Transportation System of America (ITSA), American Society of Civil Engineers Transportation and Development Institute (ASCE-TDI), Federal Highway Administration (FHWA), National Highway Institute (NHI), National Network for the Transportation Workforce (NNTW), National Transportation Training Directors (NTTD), University Transportation Centers (UTC), and universities with institutes or extension courses related to roadway maintenance.

Lastly, AHD15 seeks to increase diversity of the committee itself; we are fortunate to have Members and Friends from a range of backgrounds and positions, but we need more participation from under-represented segments such as women, minorities, younger persons and the international community. Much work is needed to plan and prepare for the transformation of the roadway maintenance and operations workforce.

**Author's Note:** The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

**DISCLAIMER**

**This paper is the property of its author(s) and is reprinted by NAS/TRB with permission. All opinions expressed herein are solely those of the respective author(s) and not necessarily the opinions of NAS/TRB. Each author assumes full responsibility for the views and material presented in his/her paper.**