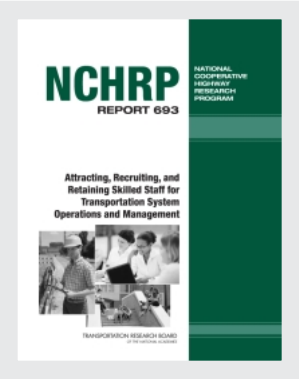

Attracting, Recruiting, and Retaining Skilled Staff for Transportation System Operations and Management

DETAILS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP REPORT 693

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

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The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the National Research Council and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the National Research Council and the Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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Dr. Brian Cronin, Senior Manager in ICF's Applied Organizational Research group, was the Principal Investigator and Project Director. Dr. Lance Anderson, Vice President in ICF's Applied Organizational Research group, served as the project's Administrative Officer. The other authors of this report are Dr. Candace Cronin, Senior Manager; Dr. Mike Lodato, Senior Associate; Ms. Allison Cook, Associate and Ph.D. Candidate at Texas A&M University; Mr. Daniel Fien-Helfman, Analyst; and Ms. Marie Venner, of Venner Consulting, Inc.

FOREWORD

By Christopher J. Hedges
Staff Officer
Transportation Research Board

This report presents guidance to help transportation agencies recruit and retain qualified professional staff in the Systems Operation and Management (SOM) area. It is based on an analysis of SOM career paths, skill requirements, and training needs to identify successful programs, state-of-the-art initiatives, and best industry practices. This report will be useful for all transportation professionals working in the SOM area and the Human Resources staff who address their personnel requirements.

Transportation system operations and management (SOM) draws on the knowledge of many disciplines—including, for example, traffic engineering, intelligent transportation systems, maintenance, emergency response and incident management, performance measurement, and system planning—applied in a comprehensive approach to increase the efficiency and safety of the transportation system. SOM encompasses interactions among transportation modes and between the transportation system and other functions such as emergency management, public safety, and the concerns of the general public.

State departments of transportation, metropolitan planning organizations, corridor coalitions, and other transportation agencies are being called on increasingly to expand their activities beyond the more traditional design and construction functions most closely associated with civil engineering to the broader and more diverse tasks of SOM.

While many transportation agencies view SOM as an increasing priority, they are encountering a shortage of management, professional, and technical staff with appropriate skills and knowledge. Retirement of transportation practitioners will deplete the ranks of qualified transportation professionals. Many students emerging from currently available education programs lack the cross-disciplinary perspective and multi-disciplinary skills needed for SOM. The transportation agencies are coming to recognize the need to support development of the supply of SOM management, professional, and technical staff.

Under NCHRP Project 20-86, a research team led by ICF International identified key workforce challenges for SOM staffing, and developed a series of eight workforce action plans. Each of the action plans addressed SOM workforce issues for various staff positions and career stages. Each of the plans includes a communications strategy, a list of additional resources, and examples of successful programs.

Supplemental information is available on the TRB website. *NCHRP Web-Only Document 182,* which includes a set of tables showing SOM job categories, number of positions, and educational requirements for all 50 states, can be downloaded at http://www.trb.org/Main/Blurbs/166342.aspx. An *Executive Workbook* provides a summary of the project results and recommendations for senior management personnel and is also available at http://www.trb.org/Main/Blurbs/166342.aspx.

CONTENTS

Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

1. OVERVIEW OF PROJECT

The purpose of this project was to provide transportation agencies with strategies and resources to meet their needs for attracting, recruiting, and retaining transportation system operations and management (SOM) staff. The research described herein considers the potential supply and demand for SOM skills and staffing; the actions transportation agencies may take to attract, recruit, develop, and retain skilled staff with SOM capabilities; and the tools that are available or may be developed to assist agencies in attracting and recruiting skilled staff in this area.

SOM draws on the knowledge of many disciplines—including, for example, traffic engineering, intelligent transportation systems, maintenance, emergency response, traffic operations, traffic safety, incident management, performance measurement, and system planning—applied in a comprehensive approach to increase the efficiency and safety of the transportation system. SOM encompasses interactions among transportation modes and between the transportation system and other functions such as emergency management, public safety, and outreach.

In this report, we provide information regarding the methodology, results, recommended action plans, and potential future research directions in relation to this project.

2. PROJECT METHODOLOGY

The purpose of this research is to provide transportation agencies with strategies and resources to address their needs for attracting, retaining, and enhancing the skills of SOM staff. To execute this project, we completed the following nine tasks:

1. Conducted literature review, engaged leadership, and determined SOM staffing estimates.
2. Identified the principal pools of potential workers to meet forecasted SOM needs.
3. Described SOM careers, career paths, and attributes and training needed for successful performance of SOM jobs.
4. Prepared Technical Memorandum 1.
5. Described and evaluated current practices in transportation agencies.
6. Identified resources available to facilitate attracting, recruiting, developing, and retaining SOM staff.
7. Developed action plan and strategic marketing plan.
8. Presented key findings and recommendations.
9. Submitted final report.

Project results—in the form of example successful programs, state-of-the-art initiatives, and industry best practices to attract, recruit, develop, and retain SOM staff—provide much-needed workforce guidance to transportation SOM programs across the United States.

An overview of the method for each of the nine tasks is provided in this section. This is followed by the full project results and the final strategic workforce recommendations and action plans.

Task 1: Conduct Literature Review, Engage Leadership, and Determine SOM Staffing Estimates

Task 1 involved four major subcomponents. First, the research team built on the preliminary literature review by further investigating the results of NCHRP Project 20-77 and other current materials to more clearly understand the workforce trends impacting SOM occupations. Second, we engaged transportation leadership across the United States to describe current and anticipated future SOM employment needs and the technical knowledge requirements for SOM careers. Third, we reviewed U.S. Department of Labor (DOL) and Department of Transportation (DOT) information to determine if SOM staff positions are adequately addressed in employment statistics. This involved developing estimates of national and regional (e.g., by state) needs for SOM staff, for the years 2005, 2010, 2015, and 2020. Finally, we determined whether staffing needs represent new employment or reclassification of existing positions. Each of these four subtasks is described in this section.

Subtask 1.1—Conducting the Literature Review. To fully understand SOM occupations, our team conducted a literature review to identify and assemble information from United States and international published research, technical reports, conference presentations, and case studies on SOM employment trends. An overview of the documents we reviewed is provided in Exhibit 1.

Exhibit 1
Literature Review Sources

Previous TRB projects including the following NCHRP Projects: 20-77, Transportation Operations Training Framework; 20-24(40), Analysis and Benchmarking of State DOT Recruitment and Hiring Practices; 20-24(48), Analysis and Benchmarking of State DOT Human Resource Activities; 20-24(50), In-Service Training Needs for State DOTs; 20-72, Tools to Aid State DOTs in Responding to Workforce Challenges; and *TRB Special Report 275: The Workforce Challenge*.	**ICF's Transportation Recruitment, Development and Retention Practices Database,** which extensively cataloged over 150 'Best-Practice' recruitment, development, and retention programs for NCHRP (created for NCHRP Project 20-81).
ICF's Related Industry and Private Sector Benchmarking Database that includes data ICF has collected on recruitment and retention practices during similar studies with Fortune 500 companies, related federal and state agencies, and local and national member associations.	**Database of Best Practices in Recruitment and Workforce Management of DOT Contractors** identified during a project for the Florida Department of Transportation.
Surveys and research conducted by AASHTO, Association of Metropolitan Planning Organizations (AMPO), International City/County Management Association (ICMA), and state leagues of municipalities.	**Professional Human Resources (HR) organizations,** which provide publications and published surveys by organizations with specific expertise in recruitment, retention, and workforce development issues such as the Society for Human Resource Management (SHRM), the Society for Industrial/Organizational Psychologists (SIOP), the International Public Management Association for Human Resources (IPMA-HR), and the John J. Heldrich Center for Workforce Development at Rutgers University.
NCHRP Research Results Digest 327: Transportation Implications of Emerging Economic Development Trends, published by the Transportation Research Board in August 2008.	**Technical reports and relevant studies conducted by private- and public-sector organizations** such as the Department of Defense, the Department of Education, Federal Transit Administration, and other federal agencies and state and local organizations.

Exhibit 1 (Continued) Literature Review Sources	
Journals devoted to applied problems in organizations, such as *Personnel Psychology, Academy of Management Journal, Public Personnel Management, Journal of Applied Psychology,* and *Journal of Organizational Behavior*.	**Position description and skills databases,** such as the Occupational Information Network (O*NET) and the National Transportation Training Resource. **Industry journals,** such as *Transportation* and *Transportation Quarterly*.

The primary outcome of the Task 1 literature review was to establish a preliminary definition of past, current, and future SOM employment trends. This understanding informed subsequent project activities.

Subtask 1.2—Interviewing Subject Matter Experts (SMEs). To further develop an understanding of the SOM workforce, specifically concerning the current and anticipated future SOM employment needs and the technical knowledge requirements for SOM careers, our team conducted interviews with a representative group of SOM subject matter experts (SMEs). These SMEs had at least 5 years' experience in various SOM careers and were identified through their involvement in one of the following: NCHRP Project Panel 20-86, AASHTO Highway Subcommittee on Systems Operation and Management, and/or NCHRP Project Panel 20-77. SMEs were also selected across diverse and geographically dispersed transportation agencies that further varied in size and community distinction (such as urban versus rural).

All experts participated in a 1- to 2-hour telephone interview to discuss opportunities and obstacles they saw in careers in the SOM field. Using the preliminary literature review findings, we developed a protocol comprised of open-ended questions and probes that allowed for investigation of the factors that facilitate and challenge career growth, as well as the specific career paths that incumbents have followed to pursue an SOM career. For example, the protocol included questions regarding the types of jobs, work responsibilities, education, and training which helped SMEs progress toward their current SOM career.

In total, we interviewed 24 SOM experts. Exhibit 2 provides the positions and represented agencies of the SOM experts who participated in these interviews.

Exhibit 2 SOM Interview Participants	
Position Title	**Representative Agency**
Program Manager for Transportation Engineering Operations	AASHTO
Transportation Staff Consultant	Bergmann Associates
Deputy District Director of Operations	California DOT
Chief, Division of Research and Innovation	California DOT
ITS Branch Director	Colorado DOT
TMC Operations Manager	Delaware DOT
Systems Preservation Engineer	FHA
Assistant Chief Engineer (Operations)	Idaho DOT
Branch Manager for System Operations	Kentucky Transportation Cabinet
Director of Transportation	Maine DOT

Exhibit 2 (Continued) SOM Interview Participants	
Position Title	**Representative Agency**
Deputy Director, Office of Highway Development	Maryland State Highway Administration
Chief, Recruitment and Examination Division	Maryland State Highway Administration
Director of ITS Programs	Massachusetts DOT
Systems Operations and Management Engineer	Michigan DOT
Director of System Management	Missouri DOT
Deputy Director/Chief Engineer	Nevada DOT
Executive Director, Statewide Traffic Operations	New Jersey DOT
Manager of ITS Operations	New Mexico DOT
Special Assistant to the Chief Operating Officer	New York State DOT
Director for Systems Operations, Office of Traffic Safety and Mobility	New York State DOT
Director, Workforce Development	Appalachian Transportation Institute
State Traffic Engineer, Transportation Mobility and Safety	North Carolina DOT
Operations Director	Utah DOT
Chief of Operations	Virginia DOT

Subtask 1.3—Determining SOM Staffing Estimates. To generate staffing estimates for SOM occupations, our team mapped SOM-related work functions to standardized occupational codes (SOCs or O*NET-SOC Code) developed by the Employment and Training Administration of the Department of Labor (DOL). This mapping exercise allowed our team to identify DOL standard occupations that include the knowledge, skills, and abilities (KSAs) characteristic of SOM occupations. KSAs are often designated as mandatory or desirable and are defined in the following manner:

- **Knowledge statements** refer to an organized body of information usually of a factual or procedural nature which, if applied, makes adequate performance on the job possible. A body of information is applied directly to the performance of a function.
- **Skill statements** refer to the proficient manual, verbal, or mental manipulation of data or things. Skills can be readily measured by a performance test or proficient manipulation of things where quantity and quality of performance are tested, usually within an established time limit.
- **Ability statements** refer to the power to perform an observable activity at the present time. This means that abilities have been evidenced through activities or behaviors that are similar to those required on the job.

Next, our team generated and analyzed current and future occupational estimates for SOM occupations through the use of SOC codes. We conducted this analysis at the national, regional (i.e., Northeast, South, Midwest, and West), and state levels. Our historical estimates provide information on the change in SOM-related occupations during the time period between 2005 and 2010. Our future occupational reports provide information on projected changes for SOM-related occupations between 2010 and 2015, as well as 2010 and 2020.

Subtask 1.4—Estimating Whether Needs Represent New Employment or Reclassification of Existing Positions. Using results of Task 1, we assessed and identified employment trends to determine if new employment classifications are needed or if existing positions should be reclassified. This involved determining if a completely new SOM classification is needed, determining if collapsing two old classifications into one new class was necessary, or if dividing the responsibilities of an existing class into two new classes would more accurately represent DOT needs and make the work more manageable. As part of this process, we relied on our literature review results, data collected during our SME interviews, and our analysis of SOM occupations. In addition, we assessed new technologies and agency demands on SOM staff.

Our findings indicate that while the demand for SOM staff will continue to increase universally, there is no overarching, national need for SOM positions to be reclassified or combined. The use of SOM staff varies greatly across agencies, to meet individual organizational needs. Thus, classification decisions are most appropriately made within agencies.

Task 2: Identify Principal Pools of Potential Workers to Meet Forecasted SOM Needs

Our team worked to identify pools of potential workers who may be available to meet SOM workforce needs by assessing two essential components of the skills pipeline framework:

- **Renewal Systems:** This component represents opportunities to recruit new talent to the SOM field through the retraining of workers employed in related transportation occupations as well as the retraining of workers migrating from downsizing industries.
- **Advancement Systems:** This component of the skills pipeline is the educational system. It represents opportunities to attract new talent to the SOM field from post-secondary programs. Additionally, post-secondary education provided by community and technical colleges is included.

Our assessment of renewal systems consists of two analytical components. First, we identified transportation and other related occupations that involve KSAs common to SOM occupations. We identified SOC codes related to the core groups of SOM occupations to generate an expanded list of SOCs from which future applicants can be drawn into the SOM domain. The expanded list of SOC codes contains occupations that are similar in nature to traditional SOM occupations in terms of KSAs. These professionals are suitable training candidates who may be able to be prepared for SOM positions in a cost-effective manner and within a relatively short time.

Second, in our assessment of renewal systems, our team identified industry sectors that are shrinking (or are projected to shrink) in terms of employment. These industry sectors were identified so that future recruitment efforts at the local, regional, state, and federal levels can be informed and guided toward expanded potential applicant pools. By virtue of working in industry sectors that require professionals with similar KSAs and competencies that are also common to SOM occupations, these workers are ideal candidates for retraining and transitioning.

As part of our advancement systems evaluation, we employed a “skill investigation” to identify KSAs associated with current/future SOM occupations. Awareness of occupational KSAs helped us to target workforce development efforts by focusing on issues such as skill obsolescence, skill

abundance, and the skills pipeline. In addition, we used data analytics to estimate rates of graduation and assess the skill-rendering capacity of training and educational infrastructure that prepares students in competencies crucial to satisfying future SOM occupational needs. Results of Task 2 linked core work functions to training and education courses and allowed our team to determine the existing skills pipeline that augments SOM workforce needs.

Task 3: Describe SOM Careers, Career Paths, and Attributes and Training Needed for Successful Performance of SOM Jobs

This task sought to describe SOM careers, career paths, and attributes and training needed for successful performance of SOM jobs. We conducted a comprehensive analysis of available literature, SOM job information, and employment practices used by transportation systems to recruit, develop, and retain SOM staff. Our analysis included a thorough investigation of SOM careers, the challenges and opportunities associated with the career, the future direction of SOM careers, and the different career paths that feed into successful, long-term SOM careers. In addition, one of the primary goals of our Task 3 analysis was to capture a comprehensive set of effective practices that will help organizations prepare current employees as well as potential future talent for successful and satisfying SOM careers. Task 3 was conducted according to the following three subtasks.

Subtask 3.1—Analyzing Literature Review Findings. We utilized the information collected in the literature review to create a broad framework to describe the SOM career and the traditional career paths that feed into SOM jobs. This framework describes the opportunities, rewards, challenges, and impediments associated with pursuit of a SOM career. Projections made in Task 1 regarding future work requirements and SOM employment needs were also reviewed to identify emerging workforce challenges.

Subtask 3.2—Interviewing Subject Matter Experts (SMEs). Once we developed a broad framework of the SOM career and jobs that compose SOM career paths, we moved into Subtask 3.2 to identify personal experiences of SOM staff and the career paths which have and will lead to SOM careers. To conduct this subtask, we leveraged our interview data from Task 1. The SME interviews allowed us to further define the career paths which feed into SOM careers and helped to further articulate the rewards, challenges, and barriers experienced in SOM careers. As part of this review, we also identified factors such as work responsibilities, education, and training that facilitate and challenge career growth.

Subtask 3.3—Collecting SOM Job Descriptions. To begin Subtask 3.3, we analyzed the job descriptions (JDs) received through the literature review and interviews. We utilized JDs to identify the core work requirements for SOM jobs. We also used O*NET's comprehensive list of generalized work activities and duties for standardizing the job information across JDs. In addition, O*NET was used to identify knowledge, skills, abilities, and other attributes (KSAOs) needed to perform the duties outlined in the JDs.

Next, we identified groupings of similar job duties that are presented across the JDs within a job title cluster to consolidate duties as necessary. The result was an outline of possible duties conducted within each of the SOM jobs of interest. Once the work requirements of the SOM

careers were identified, a similar approach of identifying patterns across the JDs was used to create an exhaustive list of viable KSAOs for each of the job titles. In addition, we utilized the principles of Future-Oriented Job Analysis to identify KSAOs which will be needed to perform the duties of transportation managers in the future (Landis, Fogli, and Goldberg, 1998).[1] To verify that the identified KSAOs link back to the fundamental requirements of the SOM jobs, we convened our project team to provide linkage ratings between the KSAOs and job duties identified for each of the SOM jobs of interest to determine which KSAOs are critical to the job. As a final step in this subtask, we clustered the KSAOs into broader competencies which will allow for comparison across SOM jobs and between jobs that feed into the SOM career.

Task 4: Prepare Technical Memorandum 1

To fulfill the requirements of Task 4, we provided the NCHRP project panel with a comprehensive Technical Memorandum describing our methodology and results from Tasks 1 through 3. Based on panel feedback, we refined the memorandum and planned for the second phase of the project. The revised report served as the foundation for the research conducted in project Tasks 5 through 7.

Task 5: Describe and Evaluate Current Practices in Transportation Agencies

In this key task, we conducted a thorough assessment of current human resource (HR) practices used by transportation agencies to attract, recruit, develop, and retain SOM staff. Specifically, we collected data on practices such as strategic recruitment, professional development and training, compensation and benefits programs, outsourcing policies, and other programs that directly impact key organizational outcomes (e.g., satisfaction, turnover for SOM). Results of this task informed our SOM workforce recommendations and related action plans.

Task 6: Identify Resources Available to Facilitate Attracting, Recruiting, Developing, and Retaining SOM Staff

Our research team captured a comprehensive set of effective practices and resources related to the recruitment, development, and retention of SOM jobs. Results of this task allowed our team

[1] Job analysis is often described as the cornerstone of successful employee selection efforts and performance management initiatives. A job analysis involves the systematic collection of information about a job. Job-analytic methods are often described as belonging to one of two approaches. One approach, the task-oriented job analysis, involves an examination of the duties, tasks, and/or competencies required by a job. The second approach, a worker-oriented job analysis, involves an examination of the knowledge, skills, abilities, and other characteristics (KSAOs) required to successfully perform the work. Various adaptations of job-analytic methods include competency modeling, which examines large groups of duties and tasks related to a common goal or process; and practice analysis, which examines the way work is performed in an occupation across jobs. Future-oriented job analysis, (also known as strategic job analysis) involves analysis of jobs that will exist in the future or that will be changed drastically as a result of reorganization or other change efforts. The approach for analyzing jobs of the future can briefly be summarized in the following steps: (1) Analyze the current job to identify current tasks and KSAs. (2) Assemble SMEs who are knowledgeable about the future job to discuss how future issues are likely to affect the job. Collect information from these individuals concerning expected job changes. (3) Identify differences between the job as it currently exists and the job of the future. Isolate those tasks and KSAs where the greatest change is expected.

to document available resources used to attract, recruit, develop, and retain SOM professionals while also determining which resources may be developed or adapted from other sectors beyond transportation. Results of this task were used to develop the SOM strategic workforce recommendations and action plans provided.

Task 7: Develop Action Plan and Strategic Marketing Plan

The purpose of this task was to develop strategic SOM workforce recommendations that will assist transportation agencies in attracting, recruiting, and retaining SOM personnel. To address this requirement, workforce recommendations and alternatives were developed for each of the eight critical career stages across the SOM workforce pipeline. In addition, a comprehensive action plan was created for each career stage and specifically designed to guide SOM stakeholders and hiring personnel or supervisors, in particular, in the implementation of key workforce recommendations.

Based on feedback received during the NCHRP project panel meeting on February 10, 2011, we refined and finalized the strategic SOM workforce recommendations and related action plans. These materials are included in this report.

Task 8: Present Key Findings and Recommendations

Following the recommendations received during the NCHRP project panel meeting, the key findings and recommendations from this project will be presented in a webinar that will be delivered using the TRB webinar program and will be made available through the TRB website.

Task 9: Submit Final Report and Executive Workbook

Based on panel feedback, we have refined and finalized this report. This document provides the strategic workforce recommendations and action plans. The action plans are provided in a manner that will facilitate extraction from the report and allow for presentation in a stand-alone format. This report summarizes all research conducted throughout the project, and provides all project deliverables described in the tasks. Additionally, based on panel feedback, a second deliverable has been created. This additional resource is an *Executive Workbook*, which serves as a summary of the project that may be more accessible to DOT employees than the full report. The *Executive Workbook* is available on the TRB website at http://www.trb.org/Main/Blurbs/166342.aspx.

3. FULL PROJECT RESULTS

The findings reported here are based on results from the data collection and analyses conducted in Tasks 1 through 7. Because of overlap in content across tasks, results are not reported task-by-task but instead are integrated. These results are intended to describe the SOM career field and workforce based on the latest available research. Specifically, this report provides the following:

- Key workforce challenges and trends
- Overview of SOM career field
- Profile of the existing SOM workforce

- Estimates of future SOM workforce needs
- Generalized SOM career paths
- Overview of SOM career lattice or pipeline
- Strategic SOM workforce recommendations
- Action plan for implementing workforce recommendations at each career stage.

Understanding the key issues, trends, and the strategic recommendations provided in this report will help enable decision makers and program managers to identify and implement cost-effective workforce solutions. These proposed workforce practices will assist SOM departments in attracting, recruiting, retaining, and developing individuals who have the knowledge, skills, and abilities to operate and manage highway systems in a manner that will maximize their operational capacity and meet the nation's growing transportation needs.

3.1 KEY WORKFORCE CHALLENGES AND TRENDS

Researchers and transportation leaders alike agree that the transportation industry is experiencing a growing number of challenges related to workforce attraction, recruitment, training, and retention (Cronin et al., 2011, Cronin, Heinen, and Youman, 2007, Warne, 2003, Warne, 2005, Skinner, 2000, TRB, 2003). For example, *TRB Special Report 275* (2003) indicates that the transportation workforce requires a broader range of skills than in the past because agency missions are changing and expanding and new technologies continue to emerge. This is particularly true for SOM-specific positions in transportation systems. Five critical issues affecting SOM workforce attraction, recruitment, training, and retention are listed below; detailed descriptions follow.

- Demographic changes in the workforce, including Baby Boomer retirement
- Availability of training
- New technologies
- Demand on transportation agencies

Demographic Changes in the Workforce. "Baby Boomer" retirements are one of the major challenges facing SOM and transportation systems (Warne, 2005). Although departures have slowed due to the economy, studies indicate that 50% of the transportation workforce will be eligible to retire in the next 10 years, which is double the retirement rate of the nation's entire workforce (New Mexico State Highway and Transportation Department, 1999, TRB, 2003). In many cases, retirees are the only ones who possess specialized knowledge and unique experiences, as well as historical perspective, critical for efficient operation of the organization (Rothwell and Poduch, 2004). According to the American Public Transportation Association (APTA), Baby Boomers compose such a large portion of the total population that the age 65+ group is predicted to grow at a rate that is four times that of the entire population; one out of five people will be in this group by the year 2030. Thus, while customer bases will be soaring, personnel losses for many organizations will be significant. Adding further complexity, the loss of these highly skilled personnel is likely to result in skill gaps needed to perform mission-critical tasks.

The retirement of Baby Boomers will result in many new opportunities for the next generation of SOM workers in the long term; however, in the short term, the economic recession has resulted in the retention of many retirement-eligible employees for several more years. Additionally, interview participants suggested that the recession and lack of employment opportunities has led students to stay in school longer and delay their entrance into the workforce. As a result, DOTs have benefited by obtaining additional time to address critical issues concerning knowledge management systems and succession planning programs, which are essential to help junior employees learn and adopt best practices in the field. This additional time is priceless, because several participants acknowledged their transportation agency lacked these components completely.

As the Baby Boomers do retire, the new workforce is becoming more diverse than ever. In the past, seniority has defined the placement of many SOM managers, professionals, and technicians, thereby resulting in the majority of this management workforce being older Caucasian males. However, the potential applicant pool for SOM positions is much younger with greater ethnic and gender diversity. While expanding the applicant pool helps alleviate challenges associated with maintaining a sustainable workforce, cross-cultural differences can also give rise to new challenges for management. For example, one participant indicated that in his region, communication issues may arise as a result of language barriers.

Lastly, the impending influx of younger workers into leadership positions presents another set of challenges. For example, younger workers typically expect more support from their employers in terms of work-life balance and flexible work arrangements (Zemke, Raines, and Filipczak, 2000). Participants also commented on the younger generation's need to see how they can advance throughout their career, which is sometimes difficult to illustrate in SOM since the field currently lacks a standardized career path. These types of benefits may need to be added to recruitment packages to attract, recruit, and retain a viable workforce. Furthermore, participants indicated that motivational factors vary across generations, specifically citing the younger generation's need to be stimulated and challenged in their work, perhaps as a result of growing up with an emphasis on multi-tasking and greater feedback from their environment. These differences may result in the need for new management approaches in order to keep younger employees engaged and to retain them in the workforce.

***Availability of Training*.** Training that focuses on transportation-related issues can help address the demographic changes, technology advances, and greater demands that this industry faces. Much attention has been paid to the need for training within transportation as a whole, as well as available training resources for the industry (Warne, 2003, Warne, 2005, Shiplett, 2007, Spy Pond Partners et al., 2009; and TRB, 2003). Recently, NCHRP Project 20-77 (2008) was conducted in order to determine what training is needed, what training is available for SOM staff, what training gaps exist, and what is the most effective way to deliver missing training. The resulting gap analysis identified several SOM competencies for which training tends to be nonexistent or significantly lacking (e.g., comprehensive-level special event management, overview-level electronic payment systems) and many other SOM competencies for which there is very little or inadequate training (e.g., intermediate-level arterial operations, all levels of automated safety enforcement). Therefore, there is a critical need for SOM training, particularly given Baby Boomer retirements, increasing expectations for transportation capacity

enhancements via implementation of new and evolving SOM technologies and practices, a potential workforce with insufficient skills, and the ever increasing demand for SOM services. The need for formal SOM training programs—specifically in terms of communicating with the public, understanding the policy side, and understanding and operating new technologies—was accentuated throughout our interviews, as these expert practitioners and managers have observed gaps among the desirable experiences and skill levels of SOM personnel and the existing knowledge and skills of those employees entering the field.

Interview participants indicated that SOM personnel do learn about opportunities in transportation SOM while enrolled in school. Civil and electrical engineering courses in community colleges and universities that focus on or discuss transportation can be the gateway to SOM careers (Agrawal and Dill, 2009). However, interview participants reported that the training students receive from colleges and universities is often insufficient to prepare for a career in SOM. SOM is a special branch of engineering, communications, technology, and systems management that frequently requires background in multiple fields to perform well. Participants remarked on the value of a diverse background in the transportation organization that would then help the SOM staff person "see how all the pieces fit together" and then operate better, through SOM. Others commented on the importance of communication and collaboration skills for employees within SOM and indicated that finding engineering applicants with these skills is a challenge; these skills are primarily developed through experiences and cross-training in diverse fields. Furthermore, some participants suggested that the training offered to students is too broad and that entry-level applicants frequently lack key, specialized SOM skills. Interviewees indicated that the curricula used at some universities and colleges apparently do not engage SOM skills at all. Alarmingly, these participants have observed a parallel trend in students making decisions about which field of transportation they will specialize in, before they have a chance to hear about or get to know SOM, so they are neither considering nor preparing for SOM careers.

Given the near pre-requisite of cross-training in multiple areas of the DOT before assuming a leadership role in SOM and the value of transportation experience for all SOM staff, participants almost unanimously agreed that more formal training is needed once an employee enters an organization, regardless of the training students obtain in college. Almost every interview participant representing a DOT on the West Coast indicated a need to create an operations training academy, similar to the University of Maryland Operations Academy, in their region of the country or alternatively, a web-based SOM training academy program. Additionally, participants discussed a shared need for DOT-level training, since it is critical that SOM personnel understand the infrastructure, operations, and stakeholders at the agency level. By and large, participants felt such training could be developed or would be in existence and already available, were funding sufficient. They did comment that there has been an increase in the amount of webinars conducted for training and outreach with their DOTs, especially welcome given the difficulty of funding out-of-state travel for staff development.

New Technologies. Technological innovations have played an important role in how transportation agencies accomplish their mission and in the evolution of SOM careers. The most recent examples of technological innovation in transportation agencies have emerged from Intelligent Transportation Systems (ITS). ITS technologies, which involve the convergence of

communication, computing sensing, and control technologies, focus on achieving operational improvements through services such as freeway and incident management, traveler information, and road weather information (TRB, 2003). The emergence of ITS technologies has influenced not only what transportation agencies do but how they plan and conduct projects, as "the use of ITS to operate and manage transportation systems creates a whole new operating environment for transportation agencies and increases the demand for people who understand and operate these technologies" (TRB, 2003, p. 39).

Initiatives at the Pennsylvania Department of Transportation (PennDOT) highlight the increased reliance on technology to operate more effectively, as their ITS program adopted a formal communications procedure. The regional architecture system PennDOT developed allows transportation system managers, operators, emergency services providers, local officials, and information service providers to communicate more efficiently with one another and respond more quickly and appropriately to congestion or emergency situations (PennDOT, 2007). Similarly, transportation agencies are increasing their reliance on the media and technology to communicate incident information to the public.

Increased reliance on technology affects recruitment, development, and retention of SOM personnel in multiple and sometimes contradictory ways. For example, although technology can improve efficiency, interview participants suggested the use of these devices may push some experienced staff out of key positions as job functions become more technologically oriented. Conversely, utilizing state-of-the-art tools to streamline work processes may help to retain other employees as certain work tasks become easier. Cutting-edge technologies may also help to improve SOM's attractiveness as a field and can be used as a recruitment tool. Yet, as more complex operating systems gain momentum in the transportation industry, more technologically savvy systems operators and managers are needed. This is particularly evident within the SOM workforce where new technology and the complex relationships for personnel working across different modes, disciplines, and with differing stakeholder groups require a unique set of skills (Martin and Glenn, 2002). In any case, new employee recruitment and retention techniques should be considered as job functions and procedures continue to evolve.

Interview participants in this study indicated that there is a greater need for employees knowledgeable in ITS, with skills in Geographic Information Systems (GIS), critical thinking, document management, and especially systems management, because participants anticipated the greatest gaps among SOM skill sets to be computer-related. An increase in computer literacy is imperative for SOM employees as the ability to use and manage the DOT's computerized systems becomes more important. Innovation and creativity were additional skills that participants suggested would be valuable to the workforce.

The unique demands of the jobs and the lack of available, tailored training led many participants to believe that DOTs will begin cultivating and using more in-house capabilities. Participants forecast diminishing reliance on contractors in some cases and more reliance on hiring and training new employees, both to improve internal capacity and to reduce the vulnerability to transportation operations of not having the ability to perform certain key job functions. It is critical that DOTs address these needs to create a talent pipeline full of qualified applicants ready to move into SOM positions, because SOM experts will be increasingly in demand.

Several interview participants also indicated that their transportation agencies were identifying ways to utilize new technologies in an effort to make information more manageable and available. The distribution of these messages is through radio and television outlets, dynamic message signs along the roadways, traveler information internet sites, pager and broadcast fax alerts, and traveler information telephone numbers (FHWA, 2010). Furthermore, the installation of cameras and other traffic monitoring equipment helps supplement information provided to travelers. The emergence of complex equipment using new technology, specifically ITS and advanced electronics, requires a parallel investment in training personnel to ensure that the equipment is safely and effectively operated and maintained. The need for this type of training was commonly expressed throughout our interviews, as participants described the criticality for employees to understand the technology they use to perform their job. Without understanding the technology, employees are less able to interpret the data or understand the design of system components or other potential inter-relationships.

Transportation personnel, specifically those employed in SOM, have acknowledged that keeping pace with advanced electronic-based technologies solely through traditional on-the-job training is not sufficient (McGlothin Davis and Corporate Strategies, 2002). To address this need, many traditional classroom-based activities have moved to web-based versions, which can make it easier for more personnel to take the training courses. Furthermore, the advent of sophisticated simulators allows for realistic job previews and training for complex positions, such as those in transportation SOM.

Demand on Transportation Agencies. The demand on transportation agencies has been dramatically increasing over the past few decades, highlighting the need for successful attraction, recruitment, development, and retention practices in SOM. Although it has slowed recently, vehicle miles traveled (VMT) has grown by over 80% in the past 20 years. In addition, although transportation agencies have worked hard to keep up, the capacity of the current highway system is still not adequate to address this growth (AASHTO, 2002). Furthermore, transportation agencies are being called to broaden their focus from construction to finding and creating capacity improvements through more diverse SOM activities, which require a sophisticated understanding of the transportation system and traffic behavior, along with many other inter-related disciplines.

Data from our interviews with SOM experts provide insight to the current demand on transportation agencies, because the majority of our participants indicated a paradigm shift in progress as state DOTs are changing their focus from building and adding new roads to maintaining, operating, and managing the system more efficiently. Their changing mission and broader responsibilities require a workforce capable of addressing a variety of issues other than construction and civil engineering; electrical engineering, IT, and communications systems are newer areas for DOTs. Thus, it is critical for transportation agencies to recruit and retain a workforce with a wider range of technical disciplines such as SOM (TRB, 2003). In addition, the majority of participants interviewed accentuated a need to define SOM because it often varies from DOT to DOT based on whatever their current needs are. For example, to help DOTs and the public better understand the value of SOM, participants indicated a need to create separate job descriptions and position titles, since the majority of the DOTs use regular civil and electrical engineering job descriptions. This would also help to attract appropriate applicants.

Unfortunately, participants indicated that SOM resources are spread thin, especially in the recent economic crisis, and it is often difficult to meet demand across all facets of a DOT. One participant cited that $50 million originally allocated to SOM out of a $20 billion bond was in fact used entirely to increase capacity. Participants suggested that a lack of SOM funding is often related to the general unawareness of the field. Thus, it is essential that SOM receives greater buy-in from senior management and the public in order to be effective and successful in operating and managing the system.

Participants also agreed that there needs to be a greater emphasis on SOM, specifically aspects of it that will have a bigger impact for the public. Despite the buzz different DOTs receive from message signs that inform commuters on the expected travel time or other new technological advancements, participants shared the belief that the public is primarily unaware of SOM and its contributions, much less its potential. DOT interviewees primarily looked to university transportation centers to increase awareness; however, a DOT's own communication and outreach may be equally important, as well as communication at even higher levels such as the governor's office. Public awareness is critical because the public is the ultimate source to be convinced of the worth of the investment. Participants hoped that increasing outreach with the public would result in greater buy-in, leading to more efficient use of transportation funds for the benefit received and leading to greater funding and resources as awareness increases. TRB's Strategic Highway Research Program (SHRP2) on Reliability may also produce resources.

3.2 OVERVIEW OF SOM CAREER FIELD

Transportation SOM interfaces with many disciplines and transportation modes, both internal and external to the organization, as well as with functions such as emergency management and public safety, and the concerns of the general public (Michigan DOT, 2008; Victoria Transport Policy Institute, 2010). As the emphasis on transportation management and operations increases, the demand for personnel with skills in these areas is also increasing. Transportation agencies are experiencing a shortage of SOM professionals with the suitable skills and knowledge to move beyond more traditional civil engineering functions to the broader and more diverse SOM activities. According to interview participants, the desired skill set and knowledge base cannot be acquired simply from college or university courses, but rather is obtained through on-the-job experiences. Currently, the SOM workforce is being depleted due to retirement of transportation practitioners and a shortage of graduates from education programs with the cross-disciplinary perspective and skills needed to meet the functional requirements of SOM tasks.

A meeting of the AASHTO Subcommittee on Human Resources in 2005 sought to identify the competencies needed to carry out work in the modern-day state DOT. Although no worker is expected to possess the skills necessary to carry out all facets of a state DOT's mission, failure of an agency to staff for the different responsibilities with which it has been tasked can lead to reductions in efficiency and effectiveness with regards to operating the system. As a result, NCHRP Project 20-77 was initiated to identify the core functions and employment positions that characterize SOM activities, as well as many currently available SOM education and training

resources for transportation professionals. The result of this identification between SOM core functions and positions produced a matrix that matched a total of five core functions, including:

- Policy and strategic considerations
- Program planning
- Systems development
- Project management
- Real-time operations

These core functions are related to all job levels and job titles presented below. Exhibit 3 provides a snapshot of these relationships.

Exhibit 3
Snapshot of Core SOM Job Functions by Position Level

Core Functions	Senior Management	Mid-Level or Project Related (HQ or Regional)	Transportation Management Center Technician/Field Personnel
Policy and Strategic Considerations	✓	✓	
Program Planning	✓	✓	
Systems Development		✓	✓
Project Management	✓	✓	✓
Real-Time Operations	✓	✓	✓

To better support the development and supply of SOM staff at the management, professional, and technical levels, it is important to understand how the career field is organized. According to the literature, the transportation SOM workforce is a group of professionals with a variety of backgrounds who are involved in the operations and management of U.S. highways. This finding is similar to the insights participants shared during interviews, but it is important to note that the organization and structure of SOM varies greatly across DOTs. As a result, participants agreed that domain issues are one of the biggest challenges of SOM, as there is no single agency that has total control over operations.

To further complicate this issue, there were several participants who were not completely sure how to describe the organization of SOM even within their respective agencies (e.g., whether maintenance should be included in SOM or on its own). Participants suggested a need to develop a better understanding of SOM at the policy-making level in order to realize its importance to the DOTs' business structure.

The aim of the current study was to better define SOM occupations and their relationships within DOT organizations. At a general level, Chief Engineers and/or District Engineers usually direct SOM programs within the state DOT and are supported by a variety of personnel in job categories such as:

- Transportation and traffic engineers

- Operations engineers
- Operations managers
- Safety specialists
- Traffic operators and technicians
- Intelligent transportation systems technicians
- Emergency response and incident management personnel

Exhibit 4 provides an overview of the typical position/job titles that exist within SOM departments across DOTs with respect to their primary job function. The job titles presented resulted from data collected from the literature review and SOM experts who were interviewed. Primary job functions for the job titles listed were determined using the results of the NCHRP Project 20-77 study, which included a matrix of core functions and competencies.

Exhibit 4
Typical SOM Positions by Level and Job Category Across DOTs

Senior Management	Mid-Level or Project Related	Transportation Management Center Technician/Field Personnel
Policy and Strategic Considerations		
Assistant Chief (Transportation) Engineer Chief (Transportation) Engineer ITS Branch Manager Senior Transportation Engineer Transportation Director	Section Head TMC/Field Operations	
Program Planning		
	Transportation Technical Engineer Transportation Specialist	Traffic Data Analyst Transportation Data Analyst
Systems Development		
Director of Traffic and Safety	Engineering Technician 3, 4, and 5 Implementation Support Technician Project Development Engineer Safety Specialist	Electrical Mechanic Electronics Supervisor Engineering Technician 1 and 2 Traffic Systems Technician 1 and 2

Exhibit 4 (Continued) Typical SOM Positions by Level and Job Category Across DOTs		
Senior Management	**Mid-Level or Project Related**	**Transportation Management Center Technician/Field Personnel**
Project Management		
Senior Transportation Project Manager	ITS Project Manager Operations Manager Transportation Engineer Transportation Engineer Supervisor/Manager	
Real-Time Operations		
Assistant Director Maintenance Engineer Assistant Director Traffic Engineer State Maintenance Engineer State Traffic Engineer	Assistant Engineer Communications Officer ITS Technical Manager Maintenance Supervisor Regional Supervisor Emergency Service Patrol Traffic Incident Manager Traffic Operations Engineer Work Zone Managers	Communications Operator Communications Operator Trainee Communications Systems Technician Emergency Response Technician Emergency Service Patrol Apprentice Emergency Service Patrol Operator Highway Maintenance Worker ITS Technician 1 and 2 Junior Engineer Transportation Maintenance Technician

Within each of the job functions listed, SOM personnel typically perform duties in many specialty areas and seasonally focus on different activities and responsibilities. Since the positions and activities associated with the SOM career field are so diverse and vary geographically, SOM managers and their subordinates need a broad set of skills, as well as overarching knowledge of how each activity operates and impacts other functions. Thus, while some of the job functions appear to contain more positions, it is common for SOM employees to work across each of the five functions.

3.3 PROFILE OF THE EXISTING SOM WORKFORCE

Systems operations and management requires the knowledge of multiple disciplines, primarily including, but not limited to, intelligent transportation systems (ITS), traffic engineering, maintenance, emergency response and incident management, performance measurement, and system planning (Spy Pond Partners et al., 2009). An understanding of the interactions among transportation modes and between the transportation system and other functions, such as emergency management, public safety, and the concerns of the general public is critical for a job within SOM, as was determined from NCHRP Project 20-77. Thus, extensive knowledge of statistics and experience in data management and analysis lay the foundation for the skill set necessary for an occupation in SOM. Skills needed to improve productivity and quality of operations, such as quality assurance, forecasting, planning and scheduling, staffing, design and control of operations systems, creating value for the customer, project management, and supply chain and inventory management, continue to build the skill set needed for an SOM.

Opinions on the skill sets necessary to carry out some of the SOM's most widespread and critical occupations vary, depending on the combination of core function and position. One important distinction being investigated by many employers is the difference between core and complementary skills for staff. Core skills can be defined as those abilities which are necessary for an individual to carry out the technical responsibilities of a position; one would be unable to qualify for a position without possessing the necessary core skills required. As determined by NCHRP Project 20-24(48), complementary skills such as communication and problem solving, on the other hand, are not a requisite for obtaining a position, although they are valuable and useful in their own right. For example, in a typical SOM position, an individual may primarily serve as a Traffic Technician responsible for overseeing a variety of activities designed to enhance highway safety and user efficiency. This responsibility is often performed through the collection, analysis, and application of traffic and highway safety data and principles to specific traffic control, signing, and marking situations. The Traffic Technician may be the only certified technician specialist with a degree in civil or electrical technology in the work unit (core skills necessary to qualify for the position), but he/she must also possess leadership and project management skills (complementary skills) to direct work and carry it out effectively. Many employers are making great strides in defining core and complementary skills for a number of SOM positions, and using the information to set appropriate staffing levels and chart training programs.

The interface and collaboration with various disciplines and the nature of SOM work itself distinguishes the competencies required of the engineers and other employees who hold SOM positions from the competencies used by other engineers and transportation workers. Several participants indicated challenges in recruiting for SOM positions because the typical applicant is specialized in one area while SOM jobs require someone with broad knowledge, capable of performing a variety of roles. As a result, participants said their DOTs sometimes rely on contracted staff to address SOM skill gaps.

The amount of work that gets contracted out varies among DOTs and primarily depends on the agency's budget. Due to funding limitations, DOTs are able to justify an increase in the number of contractors hired to perform the work that would otherwise require a full-time employee.

According to participants, DOTs opt to contract out work, especially short-term projects, because agencies are facing full-time employee (FTE) caps in many cases and it is a lot easier to hire and terminate consultants when they are no longer needed, compared to a full-time government employee. However, DOTs expressed concerns about the contracting out of work and knowledge the DOT needs, to manage the larger system and/or when contractor turnover occurs or services are not available in their region. The DOT's responsibilities and the increasing demand for SOM knowledge and maintenance remains. The majority of work contracted out occurs in the more specialized positions, including ITS Maintenance, Control Room Managers and Operators, Incident Response, Traffic Control, and Electronic Technicians, where participants indicated their DOT often lacked employees with the technical skills. Participants reported the demand for these positions is greater because there is a challenge in recruiting for these positions, as DOTs typically struggle to find applicants with these specific skills willing to work at the associated pay grade.

Regardless of whether the work is contracted out or performed in-house, the core competencies related to each of the core functions remain the same. Exhibit 5 provides an overview of the core competencies related to each of the core functions previously identified.

Exhibit 5
Core Job Function by Related Competencies

Core Job Functions	Related Competencies
Policy and Strategic Considerations	▪ **Policy Development –** The development of principles or rules to guide decisions within departments with which to achieve reasonable outcomes. ▪ **Public Outreach –** The effort to connect the ideas or practices of the department to the efforts of other organizations or agencies as well as the general public. ▪ **Strategy Development –** The development of strategies to help the department achieve its mission, or the establishment of a framework for guiding the direction of department decision making. ▪ **Organizational Change Management –** Using a structured, pre-defined strategy, model, or framework to transition organizations from a current state to a desired future state.
Program Planning	▪ **Business Process Management –** The alignment of all aspects of an organization with the wants and needs of customers while promoting department effectiveness and efficiency and striving for innovation, flexibility, and integration with technology. ▪ **Organization and Staffing –** Staffing is the process of finding the right people, with the right knowledge, skills, abilities, and fit, who may be hired, who already work for the department, or who may be trained or developed to acquire the right knowledge or skills. ▪ **Link Between Operations and Planning –** The knowledge of both transportation operations and program planning that allows for understanding the connections between them.

Exhibit 5 (Continued) Core Job Function by Related Competencies	
Core Job Functions	**Related Competencies**
Systems Development	▪ **Systems Development Process/Methods –** Awareness and understanding of the process or methods used to develop and implement a transportation system. ▪ **Systems Architecture –** The process or art of defining the hardware and software architecture, components, modules, interfaces, and data for a transportation/ITS system to satisfy specified requirements. ▪ **Database Management for Operations –** Awareness and understanding of how centralized collections of transportation operations data are stored, manipulated, accessed, and secured. ▪ **Program Languages and Technology –** Familiarity with the vocabulary and rules for instructing a computer to perform specific tasks and understanding of the computers or technologies that require these languages. ▪ **Visualization –** The creation of images, diagrams, or animations to communicate a message. ▪ **Network Security –** The development and use of policies and provisions in a computer network infrastructure to protect the network and network-accessible resources from unauthorized access, as well as monitoring and measuring the effectiveness of these policies and provisions.
Project Management	▪ **Project/Contract Management –** The management of a project/contract for goods, services, or works, which includes monitoring performance, commercial aspects, delivery, improvement, complaints, and customer satisfaction. ▪ **Outsourcing Contract Management –** Utilization of a contractor to manage a contract for goods, services, or works, which includes monitoring performance, commercial aspects, delivery, improvement, complaints, and customer satisfaction. ▪ **Procurement –** The purchase of goods and/or services at the best possible total cost of ownership, in the right quantity and quality, at the right time, in the right place for the direct benefit or use of the department, generally via a contract. ▪ **In-House Procurement –** Utilizing the goods and/or services currently offered by the department in the right quantity and quality, at the right time, in the right place for the direct benefit or use of the department. ▪ **Risk Management –** The identification, assessment, and prioritization of risks within projects followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of adverse events.

Exhibit 5 (Continued) Core Job Function by Related Competencies	
Core Job Functions	**Related Competencies**
Real-Time Operations	▪ **Operations Strategies** – Maintenance of the capacity and safety of highways by controlling traffic, responding to incidents, clearing snow and other obstructions, and providing information to users on highway conditions and alternatives. ▪ **Systems and Technology –** Knowledge and understanding of the department's operating systems as well as the technology required to carry out real-time operations. ▪ **Safety –** Focus on crash avoidance by enhancing driver performance, including advanced collision avoidance systems and the automated highway system. ▪ **Security –** Precautions taken to guard against the danger, risk, or safety threats of major highways**.** ▪ **Management of Real-Time Operations Systems** – The integration of key activities to ensure real-time monitoring of the traffic and travel conditions of major highways and sharing that information to improve transportation system security; address congestion; improve response to emergencies, weather events, and surface transportation incidents; and facilitate national and regional highway traveler information.

The competencies highlighted represent the underlying KSA requirement for the positions previously described in Exhibit 4. All information presented was assembled from position descriptions and data collected during our literature review as well as from our SOM experts interviewed.

3.4 ESTIMATING FUTURE SOM WORKFORCE NEEDS

Using the defined core function areas and related competency information associated with the SOM jobs titles identified (see Exhibit 4), our team mapped the job titles to a standard listing of Department of Labor (DOL) occupations to conduct the historical and future staffing estimates. The mapping exercise accomplished two goals. First, converting the DOT titles revealed through our data collection to Standard Occupation Classification (SOC) codes allowed our team to conduct these analyses using existing DOL labor market data and through a propriety workforce analysis tool developed by EMSI, Inc. EMSI's labor market research and forecasting tool compiles data from over 90 state and federal government sources, including data sets published by the Bureau of Economic Analysis, Bureau of Labor Statistics, and the U.S. Census Bureau. Second, this mapping exercise allowed our team to ensure that the specific occupational knowledge, skill, and ability needs of SOM jobs were represented in our staffing analysis.

The DOL SOC codes that were identified through the mapping exercise are presented in Exhibit 6. The first column in the table represents the SOC codes of each occupation and the second column lists the title of each SOC code. Subsequent columns represent each of the five Work Function categories associated with SOM occupations. A "✓" mark represents an association between SOC codes and SOM-related Work Functions. As illustrated in Exhibit 6, the list of

SOC codes identified broadly captures the entirety of functional characteristics existing within SOM occupations. This mapping exercise also revealed that the SOC codes found sufficiently cover the KSAs and work functions needed in SOM occupations.

Exhibit 6
Standard Occupation Classification (SOC) Codes and Titles Mapped to SOM-Related Work Functions

Dept. of Labor (DOL) SOC Code	DOL Standard Occupation Title	Policy and Strategic	Program Planning	Systems Dvlpmnt	Project Mngmnt	Real-Time Ops
11-3021	Computer and Information Systems Managers	✓	✓	✓	✓	✓
15-1081	Network Systems and Data Communications Analysts			✓	✓	✓
15-1099	Information Technology Project Managers		✓	✓	✓	
17-2051	Civil Engineers	✓	✓	✓	✓	✓
17-2071	Electrical Engineers	✓		✓		✓
17-3022	Civil Engineering Technicians			✓	✓	✓
17-3023	Electronics Engineering Technicians			✓		✓
17-3029	Engineering Technicians, Except Drafters, All Other			✓	✓	✓
43-5031	Dispatchers					✓
47-2111	Electricians			✓		✓
47-4051	Highway Maintenance Workers					✓

Exhibit 6 (Continued) SOC Codes and Titles Mapped to SOM-Related Work Functions						
DOL SOC Code	DOL Standard Occupation Title	Policy and Strategic	Program Planning	Systems Dvlpmnt	Project Mngmnt	Real-Time Ops
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment			✓		✓
49-9042	Maintenance and Repair Workers, General					✓
49-9097	Signal and Track Switch Repairers					✓
53-6041	Traffic Technicians	✓	✓	✓	✓	✓

It is important to point out that the SOC codes and the data associated with them do contain jobs that would not fall under this report's definition of the "SOM" and they include jobs from other related industries. For instance, "Dispatchers" includes jobs that might fall under police and fire. Similarly, the data reported for civil engineers includes civil engineers employed within other transportation modes as well as other industries. Nevertheless, this is the best national data available for these occupations, and at a macro level, it is apparent that each of these occupations serves an important indicator for the SOM workforce. By analyzing SOC data, we are able to determine if and how demand for these jobs will continue to increase over the next decade. This will assist the SOM community in planning for projected increases in staffing levels and assist in avoiding future workforce skill gaps due to amplified competition from other fields.

Once the relevant SOC codes were identified, our team generated and analyzed historic, current, and future occupational estimates for SOM occupations. Our historical estimates provide information on the change in SOM-related occupations during the time period between 2005 and 2010. Our future occupational reports provide information on projected changes for SOM-related occupations between 2010 and 2015 as well as between 2010 and 2020. For all time periods, we conducted the occupational analysis at the national, regional (Northeast, South, Midwest, and West), and state levels. The regional distinctions used correspond with the U.S. Census Bureau's definitions. Exhibit 7 provides an overview of the specific states represented in each regional area.

Exhibit 7 States Included in Each Regional Area Used to Conduct Occupational Analysis	
Regions	**State Areas**
Northeast	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont
Midwest	Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin
West	Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming
South	Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia

Historic SOM Staffing Estimates (2005–2010). This section presents our historical analysis of SOM staffing estimates across the representative SOC codes at the national levels. Region- and state-level historical analyses are provided in Appendix A of *NCHRP Web-Only Document 182*, which is available at http://www.trb.org/Main/Blurbs/166342.aspx. In each table, the full list of SOM-related SOC codes is provided with their corresponding DOL standard occupational titles. Then, for each SOC code, we provide the total number of jobs in 2005, the total number of jobs in 2010, and the corresponding change. In addition, we provide the occupation's corresponding entry education level. All tables are sorted by '% Change' to highlight the occupations with the greatest job growth over the last 5 years. Exhibit 8 provides the national occupational change summary from 2005–2010.

Exhibit 8 National—Historical Occupational Change Summary 2005–2010						
SOC Code	**DOL Standard Occupation Title**	**# of 2005 Jobs**	**# of 2010 Jobs**	**Change**	**% Change**	**Education Level**
15-1081	Network systems and data communications analysts	303,364	356,088	52,724	17%	Bachelor's degree
43-5031	Dispatchers	90,202	98,005	7,803	9%	Moderate-term on-the-job training
49-9097	Signal and track switch repairers	31,704	34,549	2,845	9%	Moderate-term on-the-job training
15-1099	Computer specialists, all other	224,950	237,783	12,833	6%	Associate's degree
11-3021	Computer and information systems managers	297,123	306,710	9,587	3%	Degree plus work experience
17-2051	Civil engineers	296,138	302,371	6,233	2%	Bachelor's degree
17-3022	Civil engineering technicians	80,463	82,333	1,870	2%	Associate's degree
47-4051	Highway maintenance workers	138,028	140,876	2,848	2%	Moderate-term on-the-job training

Exhibit 8 (Continued) National—Historical Occupational Change Summary 2005–2010						
SOC Code	DOL Standard Occupation Title	# of 2005 Jobs	# of 2010 Jobs	Change	% Change	Education Level
53-6041	Traffic technicians	6,799	6,893	94	1%	Short-term on-the-job training
49-9042	Maintenance and repair workers, general	1,368,025	1,355,676	(12,349)*	(1%)	Moderate-term on-the-job training
17-3029	Engineering technicians, except drafters, all other	71,603	70,019	(1,584)	(2%)	Associate's degree
11-3071	Transportation, storage, and distribution managers	106,034	101,736	(4,298)	(4%)	Work experience in a related field
49-2093	Electrical and electronics installers and repairers, transportation equipment	14,144	13,612	(532)	(4%)	Postsecondary vocational award
17-2071	Electrical engineers	159,420	152,126	(7,294)	(5%)	Bachelor's degree
17-3023	Electrical and electronic engineering technicians	161,272	151,788	(9,484)	(6%)	Associate's degree
47-2111	Electricians	759,065	664,009	(95,056)	(13%)	Long-term on-the-job training

*Change and % Change numbers that appear in parentheses and in red indicate negative change.

There are several observations that can be derived from the national occupational change data provided in Exhibit 8, in conjunction with the regional occupational change data provided in Exhibits A-1 through A-4 included in Appendix A of *NCHRP Web-Only Document 182*. First, it is clear that the demand for the following three key SOM occupations has greatly increased over the last 5 years: *Network systems and data communications analysts, Dispatchers*, and *Signal and track switch repairers*. This finding was supported by our interview results as well. The majority of participants suggested that these three jobs are increasing in their organizations. Second, it is interesting to note that the demand for Civil Engineers has remained relatively constant over the last 5 years, between 0% and 4% across the regions, despite the downturn in the economy. This suggests that these jobs will remain a vital part of transportation organizations going forward. Lastly, on a national labor category level, demand has been steadily decreasing for the following three important SOM occupations over the last 5 years: *Electrical engineers, Electrical and electronic engineering technician,* and *Electricians.* This finding underscores the evolution of SOM occupations. It also represents potential cross-training opportunities of employees skilled in the area of *Electronics* over to *Network systems and data communications analyst* positions.

Forecasted SOM Staffing Estimates (2010–2015 and 2015–2020). In this section, we present our analysis of SOM staffing estimates over the next 5-year (2010–2015) and 10-year (2010–2020) periods. As in the previous section, staffing estimates were derived using representative SOC codes and are provided at the national level. Region- and state-level future staffing analyses are provided as Appendix B in *NCHRP Web-Only Document 182*. In each table, the full list of SOM-related SOC codes is provided with their corresponding DOL standard occupational titles. Then, for each SOC code, we provide the total number of jobs in 2010, the total estimated number of jobs in 2015, and the total projected number of jobs in 2020. The resultant change is calculated for the period between 2010 and 2020. In addition, we provide the occupation's corresponding entry education level. All tables are sorted by '% Change' to highlight the occupations with the greatest job growth over the next 10 years. Exhibit 9 provides the national forecasted occupational change summary from 2010–2015 and 2010–2020.

Exhibit 9
National—Forecasted Occupational Change Summary
2010, 2015, and 2020

SOC Code	DOL Standard Occupation Title	# of 2010 Jobs	# of 2015 Jobs	# of 2020 Jobs	Change (2010-2020)	% Change (2010-2020)	Education Level
15-1081	Network systems and data communications analysts	356,088	432,635	500,975	144,887	41%	Bachelor's degree
17-2051	Civil engineers	302,371	343,268	368,168	65,797	22%	Bachelor's degree
49-9097	Signal and track switch repairers	34,549	39,286	41,398	6,849	20%	Moderate-term on-the-job training
11-3021	Computer and information systems managers	306,710	335,784	357,383	50,673	17%	Degree plus work experience
17-3022	Civil engineering technicians	82,333	91,627	96,525	14,192	17%	Associate's degree
43-5031	Dispatchers	98,005	107,604	113,239	15,234	16%	Moderate-term on-the-job training
47-2111	Electricians	664,009	726,463	752,438	88,429	13%	Long-term on-the-job training
15-1099	Computer specialists, all other	237,783	256,543	268,962	31,179	13%	Associate's degree
49-9042	Maintenance and repair workers, general	1,355,676	1,450,082	1,513,467	157,791	12%	Moderate-term on-the-job training
17-3029	Engineering technicians, except drafters	70,019	72,173	74,006	3,987	6%	Associate's degree

Exhibit 9 (Continued) National—Forecasted Occupational Change Summary 2010, 2015, and 2020							
SOC Code	DOL Standard Occupation Title	# of 2010 Jobs	# of 2015 Jobs	# of 2020 Jobs	Change (2010-2020)	% Change (2010-2020)	Education Level
53-6041	Traffic technicians	6,893	7,230	7,285	392	6%	Short-term on-the-job training
47-4051	Highway maintenance workers	140,876	146,743	147,888	7,012	5%	Moderate-term on-the-job training
49-2093	Electrical and electronics installers and repairers, transportation equipment	13,612	13,969	14,149	537	4%	Postsecondary vocational award
17-2071	Electrical engineers	152,126	154,331	155,772	3,646	2%	Bachelor's degree
11-3071	Transportation, storage, and distribution managers	101,736	103,425	101,644	(92)*	0%	Work experience in a related field
17-3023	Electrical and electronic engineering technicians	151,788	150,130	149,249	(2,539)	(2%)	Associate's degree

*Change and % Change numbers that appear in parentheses and in red indicate negative change.

In reviewing the national and regional forecasted occupation change data (see Exhibits B-1 through B-4 included in Appendix B of *NCHRP Web-Only Document 182*), widespread growth is expected in the SOM field. Numerous SOM-related occupations are likely to experience substantial demand increases between 2010 and 2020, including *Network systems and data communications analysts, Civil engineers, Signal and track switch repairers, Computer and information systems managers, Civil engineering technicians, Computer specialists, Maintenance workers,* and *Dispatchers*. Even among the few occupations where the growth is expected to be negative or modest between 2010 and 2020 such as *Electrical engineering, Electrical and electronic engineering technicians,* and *Engineering technicians,* staffing projections indicate that there will be no major SOM staffing declines.

This nearly unilateral growth was also supported by our interview data. The majority of SOM experts we interviewed believe SOM workforce needs would change and increase dramatically over the next 5 to 10 years. Experts were in agreement, speculating that DOTs will increase their focus on asset management as they begin to shift from an emphasis on capacity building and adding to the system to an emphasis on "taking care of what is already in place" and maximizing the operational capacity of the existing system. In other words, this could lead to an increased focus on systems becoming better managed, including higher levels of efficiency and effectiveness, as well as traffic throughput. Every participant stated that they believe SOM will have an increasingly important role in this shift. As a result, participants reiterated the need to

emphasize the importance of SOM to senior executives. They indicated this would help to achieve greater buy-in while fostering a culture that understands and is capable of implementing new SOM technologies.

3.5 PRINCIPAL POOLS OF POTENTIAL WORKERS TO MEET FORECASTED SOM NEEDS

In this section, principal pools of potential workers who may be available to meet forecast needs for SOM staff are identified. Considering demographic and economic trends, estimates of the likely numbers of people that might be attracted to SOM positions were developed. To conduct this analysis, our team assessed two essential components of the skills pipeline framework:

- **Renewal Systems:** This component represents opportunities to recruit new talent to the SOM field through the retraining of workers employed in related transportation occupations as well as the retraining of workers migrating from downsizing industries.
- **Advancement Systems:** This component of the skills pipeline comprises the educational system. It represents opportunities to attract new talent to the SOM field from four-year undergraduate and graduate programs. Additionally, post-secondary education provided by community and technical colleges is included.

Each of these systems and their related analyses are described in detail below.

Renewal Systems—Related Occupations

There are many occupations directly related to SOM jobs that exist in other industries. The related jobs require core knowledge, skills, and abilities (KSAs) that are similar to SOM jobs. Thus, people who hold these related jobs represent potential new, relatively qualified applicants for SOM positions. To establish related occupations and to conduct the renewal analyses, we identified occupations that are similar in nature to traditional SOM occupations using standard DOL occupational codes (i.e., SOCs). To begin, we started with the core list of SOC codes used to conduct the SOM historical and forecasted staffing estimates (see Exhibit 6 for core SOC list) and then added SOCs determined to require the same or similar KSAs. The 'related' and 'core' SOC codes were then combined into one 'expanded' list of SOC codes.

Specifically, the process of SOC association was based on assessing the KSA composition of core SOM occupations. For each core SOM occupation, our team identified similar occupations using the DOL occupational data. For example, a *Traffic technician* is a core SOM occupation. To conduct SOC association, we deconstructed *Traffic technicians* to examine its core knowledge, skills, and abilities. Next, using DOL data we found similar, linked occupations. Each linked occupation identified included KSAs associated with the original elements identified for *Traffic technicians*. By doing this, we were able to find occupations such as *Emergency management specialists* that require a KSA composition similar to the original SOM occupation. Once the initial expanded list was created, our internal transportation subject matter experts (SMEs) and occupational experts reviewed the expanded list of SOM occupations. The process of reviewing allowed us to eliminate certain SOCs that appeared to be related through KSAs but did not qualify on the basis of work activities performed at DOTs. Finally, we had an expanded list of SOCs that could potentially assist in creating the pipeline for SOM occupations.

The final expanded list is presented in Exhibit 10. This list was used to conduct analyses of the SOM renewal system.

Exhibit 10
Expanded List of SOC Codes Based on KSA Association

SOC Code	Description	Core	Expanded
11-1011	Chief executives		✓
11-1021	General and operations managers		✓
11-3011	Administrative services managers		✓
11-3021	Computer and information systems managers	✓	✓
11-3071	Transportation, storage, and distribution managers	✓	✓
11-9021	Construction managers		✓
11-9041	Engineering managers		✓
13-1051	Cost estimators		✓
13-1061	Emergency management specialists		✓
15-1011	Computer and information scientists, research		✓
15-1081	Network systems and data communications analysts	✓	✓
15-1099	Computer specialists, all other	✓	✓
15-2031	Operations research analysts		✓
17-1012	Landscape architects		✓
17-1022	Surveyors		✓
17-2051	Civil engineers	✓	✓
17-2071	Electrical engineers	✓	✓
17-2072	Electronics engineers, except computer		✓
17-3011	Architectural and civil drafters		✓
17-3022	Civil engineering technicians	✓	✓
17-3023	Electrical and electronic engineering technicians	✓	✓
17-3029	Engineering technicians, except drafters, all other	✓	✓
29-9011	Occupational health and safety specialists		✓
33-3051	Police and sheriff's patrol officers		✓
43-2099	Communications equipment operators, all other		✓
43-5031	Police, fire, and ambulance dispatchers	✓	✓
47-1011	First-line supervisors/managers of construction trades and extraction workers		✓
47-2111	Electricians	✓	✓
47-4011	Construction and building inspectors		✓
47-4051	Highway maintenance workers	✓	✓
49-2093	Electrical and electronics installers and repairers, transportation equipment	✓	✓
49-9042	Maintenance and repair workers, general	✓	✓
49-9097	Signal and track switch repairers	✓	✓
53-6041	Traffic technicians	✓	✓

After finalizing the expanded list of SOC codes associated with the SOM field, our team generated occupational reports to investigate the occupational growth/decline over the next 10 years (2010 to 2020). The results of the national analysis are presented below in Exhibit 11. The results of the region- and state-level analyses are provided in Appendix C, *NCHRP Web-Only Document 182*.

Exhibit 11
National—Forecasted Renewal Systems—Related Occupations Summary
2010, 2015, and 2020

SOC Code	DOL Standard Occupation Title	# of 2010 Jobs	# of 2015 Jobs	# of 2020 Jobs	Change (2010-2020)	% Change (2010-2020)	Education Level
15-1081	Network systems and data communications analysts	356,088	432,635	500,975	144,887	41%	Bachelor's degree
13-1051	Cost estimators	207,429	239,169	260,529	53,100	26%	Work experience in a related field
15-2031	Operations research analysts	63,446	71,992	78,281	14,835	23%	Master's degree
17-2051	Civil engineers	302,371	343,268	368,168	65,797	22%	Bachelor's degree
13-1061	Emergency management specialists	16,823	18,993	20,334	3,511	21%	Work experience in a related field
49-9097	Signal and track switch repairers	34,549	39,286	41,398	6,849	20%	Moderate-term on-the-job training
11-1011	Chief executives	1,229,756	1,387,282	1,457,653	227,897	19%	Degree plus work experience
11-9021	Construction managers	704,688	803,582	842,026	137,338	19%	Bachelor's degree
15-1011	Computer and information scientists, research	66,122	73,892	78,970	12,848	19%	Doctoral degree
47-1011	First-line supervisors/managers of construction trades and extraction workers	976,603	1,110,863	1,164,824	188,221	19%	Work experience in a related field
11-3021	Computer and information systems managers	306,710	335,784	357,383	50,673	17%	Degree plus work experience
17-3022	Civil engineering technicians	82,333	91,627	96,525	14,192	17%	Associate's degree

Exhibit 11 (Continued) National—Forecasted Renewal Systems—Related Occupations Summary 2010, 2015, and 2020							
SOC Code	DOL Standard Occupation Title	# of 2010 Jobs	# of 2015 Jobs	# of 2020 Jobs	Change (2010-2020)	% Change (2010-2020)	Education Level
47-4011	Construction and building inspectors	120,623	134,661	141,632	21,009	17%	Work experience in a related field
43-5031	Police, fire, and ambulance dispatchers	98,005	107,604	113,239	15,234	16%	Moderate-term on-the-job training
17-1012	Landscape architects	57,881	63,972	66,412	8,531	15%	Bachelor's degree
17-1022	Surveyors	52,479	58,083	60,105	7,626	15%	Bachelor's degree
15-1099	Computer specialists, all other	237,783	256,543	268,962	31,179	13%	Associate's degree
47-2111	Electricians	664,009	726,463	752,438	88,429	13%	Long-term on-the-job training
11-3011	Administrative services managers	250,736	270,476	281,696	30,960	12%	Degree plus work experience
49-9042	Maintenance and repair workers, general	1,355,676	1,450,082	1,513,467	157,791	12%	Moderate-term on-the-job training
29-9011	Occupational health and safety specialists	52,818	56,449	58,526	5,708	11%	Bachelor's degree
17-3011	Architectural and civil drafters	106,753	116,123	117,399	10,646	10%	Postsecondary vocational award
11-9041	Engineering managers	177,569	183,977	189,743	12,174	7%	Degree plus work experience
33-3051	Police and sheriff's patrol officers	632,770	667,476	678,576	45,806	7%	Long-term on-the-job training
17-3029	Engineering technicians, except drafters, all other	70,019	72,173	74,006	3,987	6%	Associate's degree
53-6041	Traffic technicians	6,893	7,230	7,285	392	6%	Short-term on-the-job training
47-4051	Highway maintenance workers	140,876	146,743	147,888	7,012	5%	Moderate-term on-the-job training

Exhibit 11 (Continued) National—Forecasted Renewal Systems—Related Occupations Summary 2010, 2015, and 2020							
SOC Code	DOL Standard Occupation Title	# of 2010 Jobs	# of 2015 Jobs	# of 2020 Jobs	Change (2010-2020)	% Change (2010-2020)	Education Level
49-2093	Electrical and electronics installers and repairers, transportation equipment	13,612	13,969	14,149	537	4%	Postsecondary vocational award
11-1021	General and operations managers	1,827,263	1,889,851	1,880,297	53,034	3%	Degree plus work experience
17-2071	Electrical engineers	152,126	154,331	155,772	3,646	2%	Bachelor's degree
17-2072	Electronics engineers, except computer	138,246	137,982	139,407	1,161	1%	Bachelor's degree
11-3071	Transportation, storage, and distribution managers	101,736	103,425	101,644	(92)*	0%	Work experience in a related field
17-3023	Electrical and electronic engineering technicians	151,788	150,130	149,249	(2,539)	(2%)	Associate's degree
43-2099	Communications equipment operators, all other	2,748	2,624	2,422	(326)	(12%)	Short-term on-the-job training

*Change and % Change numbers that appear in parentheses and in red indicate negative change.

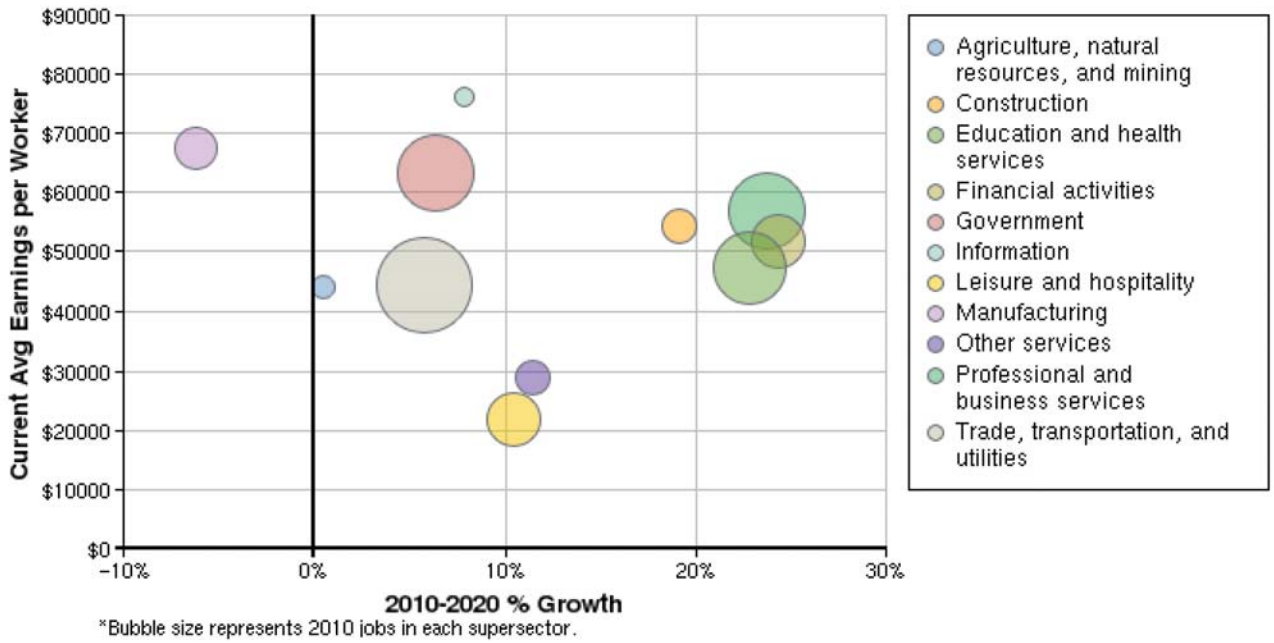
Results of the SOM-related occupations renewal system through the expanded list of SOC codes are encouraging. The data suggest that related occupations will also be experiencing rapid job growth over the next 5 to 10 years, which indicates that the potential pool of applicants that might transfer or retrain into an SOM job from a related industry is increasing. These related occupations include *Cost estimators, Operations research analysts, Emergency management specialists, Construction managers, First-line supervisors/managers of construction trades and extraction workers, Construction and building inspectors,* and *Police, fire, and ambulance dispatchers.* Of course, the data also suggest that competition for premium talent may also increase as related industries increasingly desire the skills necessary in SOM fields.

Renewal System Findings—Shrinking Industry Sectors

Potential pools of new workers also exist within related industries that are expected to experience downsizing over the next 5 to 10 years. Many employees in these sectors will likely be seeking new job opportunities as their field shrinks. In cases where the migrating employees possess KSAs similar to those needed in SOM, they can be retrained to meet SOM demand at DOTs.

In this section, industry sectors that are forecasted to shrink between 2010 and 2020 are identified. Results are presented at the national and regional levels. For each, a bubble chart presents the size and relative growth/shrinkage of prominent industry sectors in terms of occupational growth/decline percentages between 2010 and 2020. The bubble chart is followed by a tabular representation of the same information with 2010 and 2020 occupational numbers. Exhibit 12 provides the national industry growth data. The exhibits that provide the regional data are included in Appendix D, *NCHRP Web-Only Document 182*.

Exhibit 12
National—Industry Size and Growth Estimates
2010–2020



Description	2010 Jobs	2020 Jobs	Growth	% Growth	Current EPW*
Agriculture, natural resources, and mining	4,531,569	4,553,584	22,015	0%	$44,088
Construction	9,443,666	11,248,682	1,805,016	19%	$54,357
Education and health services	22,987,292	28,224,915	5,237,623	23%	$47,197
Financial activities	16,649,492	20,691,874	4,042,382	24%	$51,643
Government	23,747,888	25,265,528	1,517,640	6%	$63,216
Information	3,296,015	3,553,998	257,983	8%	$76,101
Leisure and hospitality	15,582,276	17,205,411	1,623,135	10%	$21,736
Manufacturing	12,518,401	11,739,347	-779,054	-6%	$67,354
Other services	9,187,746	10,242,448	1,054,702	11%	$28,799
Professional and business services	24,187,428	29,925,136	5,737,708	24%	$56,755
Trade, transportation, and utilities	30,979,855	32,770,376	1,790,521	6%	$44,468

*EPW=Earnings Per Worker
Source: EMSI Complete Employment—2nd Quarter 2010.

In reviewing the industry size and growth estimate data, it is clear that opportunities exist for the retraining of workers from downsizing industries. For example, the *Manufacturing*; *Agriculture, natural resources, and mining*; and *Government* sectors are forecasted to experience shrinkage or minimal growth over the next 10 years. The *Manufacturing* sector alone is projected to experience a decrease of about 779,000 jobs nationwide while the *Agriculture, natural resources, and mining* industry is estimated to lose more that 46,000 jobs in the Midwest and almost 20,000 jobs in the South. This indicates that migrating workers from these industries could be prime candidates for targeted SOM recruitment and development programs, if training is provided.

Advancement Systems

As described, the SOM advancement system is the portion of the skills pipeline that comprises the educational system. It represents opportunities to attract new talent to the SOM field from post-secondary programs. Additionally, it represents post-secondary education provided by community and technical colleges.

To more fully understand SOM skill 'supply,' a detailed analysis of the SOM advancement system was conducted. To begin, we utilized the National Center for Education Statistics (NCES) crosswalk between DOL SOC codes and Department of Education (DOE) Classification of Instructional Programs (CIP) codes. The crosswalk allowed our team to derive a mapping of the expanded SOC list to existing educational programs across the United States (see Exhibit 6). This mapping exercise was undertaken to establish the link between SOM-related occupations and existing programs of study that render young professionals with post-secondary degrees in relevant educational fields. The resultant list of CIP codes is presented in Exhibit 13.

Exhibit 13
CIP Codes—Department of Education (DOE) Standard Educational Programs Related to SOM Occupations

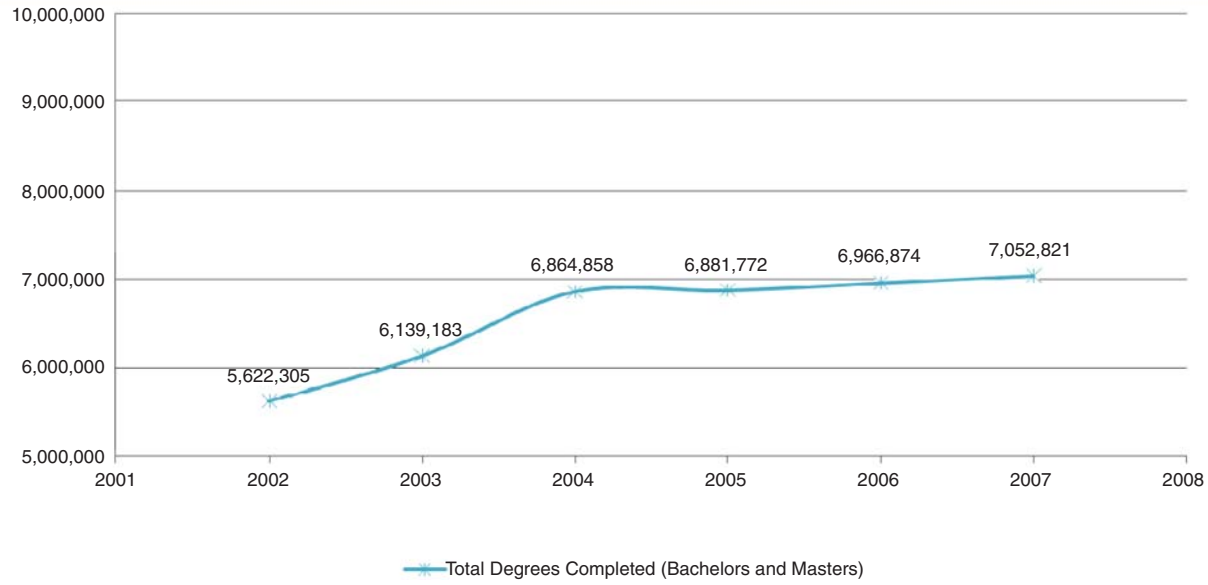
CIP Code	Standard Education Program Description
04.02	Architecture
04.03	City/Urban, Community and Regional Planning
04.04	Environmental Design
04.06	Landscape Architecture
04.09	Architectural Technology/Technician
11.01	Computer and Information Sciences, General
11.03	Data Processing
11.04	Information Science/Studies
11.05	Computer Systems Analysis
11.07	Computer Science
11.09	Computer Systems Networking and Telecommunications
11.99	Computer and Information Sciences and Support Services, Other
14.01	Engineering, General
14.04	Architectural Engineering

Exhibit 13 (Continued) CIP Codes—DOE Standard Educational Programs Related to SOM Occupations	
CIP Code	**Standard Education Program Description**
14.08	Civil Engineering
14.09	Computer Engineering, General
14.10	Electrical, Electronics, and Communications Engineering
14.11	Engineering Mechanics
14.19	Mechanical Engineering
14.27	Systems Engineering
14.33	Construction Engineering
14.37	Operations Research
14.38	Surveying Engineering
14.99	Engineering, Other
15.01	Architectural Engineering Technologies/Technicians
15.02	Civil Engineering Technologies/Technicians
15.03	Electrical Engineering Technologies/Technicians
15.05	Environmental Control Technologies/Technicians
15.07	Quality Control and Safety Technologies/Technicians
15.10	Construction Engineering Technologies
15.11	Engineering-Related Technologies
15.12	Computer Engineering Technologies/Technicians
15.13	Drafting/Design Engineering Technologies/Technicians
30.17	Behavioral Sciences
43.01	Criminal Justice and Corrections
44.02	Community Organization and Advocacy
44.04	Public Administration
44.05	Public Policy Analysis
44.99	Public Administration and Social Service Professions, Other
45.01	Social Sciences, General
45.99	Social Sciences, Other
46.03	Electrical and Power Transmission Installers
46.04	Building/Construction Finishing, Management, and Inspection
47.01	Electrical/Electronics Maintenance and Repair Technology
51.22	Public Health
52.01	Business/Commerce, General
52.02	Business Administration, Management and Operations
52.12	Management Information Systems and Services
52.13	Management Sciences and Quantitative Methods

It is important to note that not all educational programs presented currently advance graduates towards SOM occupations. On one hand, educational programs such as Civil Engineering (14.08) and Systems Engineering (14.27) are common feeders into the existing SOM workforce. On the other hand, educational programs such as Computer Science (11.07), Computer Systems Analysis (11.05), Public Administration (44.04), and Management Information Systems and Services (52.12) are less common educational profiles of the existing SOM workforce but have strong potential to prepare the next generation of SOM professionals. Thus, graduates from these programs should be targeted in recruitment efforts.

On an aggregate level (including all CIP four-digit series that are mapped to SOM-related occupations), the number of post-secondary degree completions experienced a growth of about 25% between 2002 and 2007. Most of this growth was between 2002 and 2004 (22%) and declined to only 3% growth between 2004 and 2007. Overall, the growth in graduates is healthy, especially considering the larger numbers returning to graduate school in the recent recession, and will likely meet SOM workforce demand in the coming years, provided that recruitment and development efforts are properly designed. Exhibit 14, on the following page, provides an overview of the growth.

Exhibit 14
Estimated Number of Graduates from SOM-Related Programs
(All SOM-Related CIPs Combined)
2002–2007



Using the SOC to CIP mapping, it is also possible to analyze the skill pipeline supply within specific educational fields related to SOM careers. In Exhibits 15 through 18, the results of our related analyses for key educational program areas are presented. Specifically, we provide detailed data for:

- Computer and Information Sciences and Support Services Programs
- Engineering Programs
- Engineering Technologies/Technicians Programs
- Architectural and Related Services Educational Programs

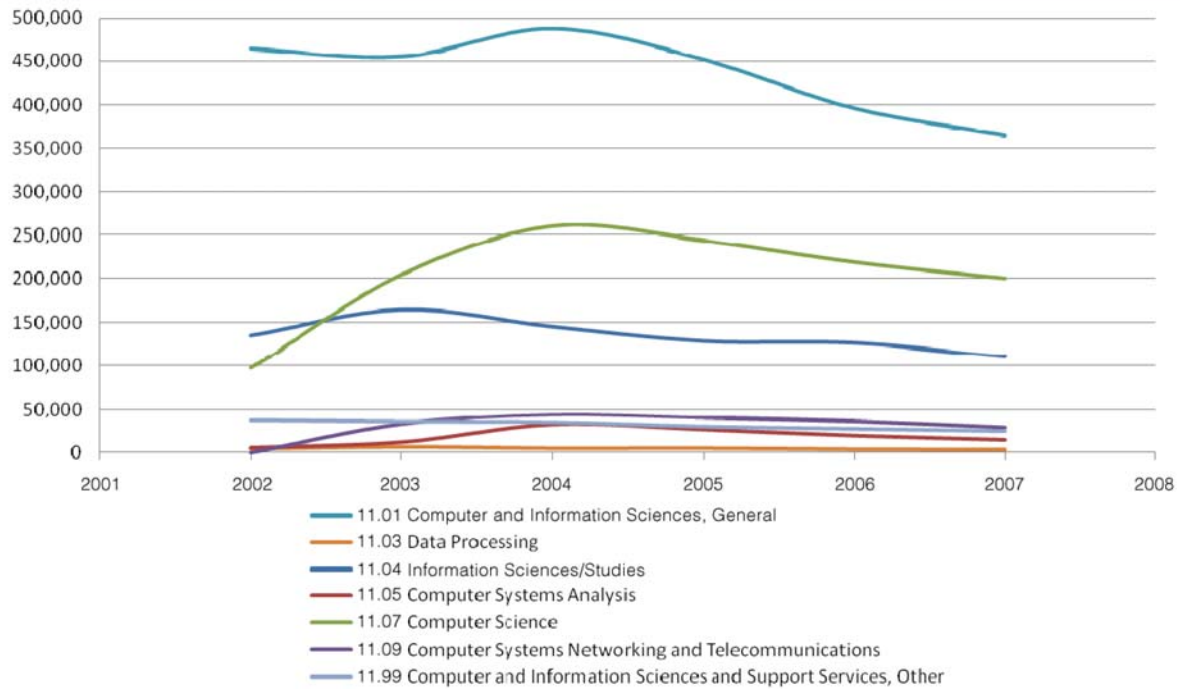
Data for this analysis was generated using the NCES Data Analysis System (DAS).[2] The timeframe of analysis includes the years 2002 through 2007. This timeframe was used based on the availability of the latest Integrated Postsecondary Education Data System (IPEDS)[3] data.

[2] The DAS is a software application that allows you to produce tables and to estimate covariance analyses from NCES data sets. There is a separate DAS for each data set, but all have a consistent interface and command structure. In the Tables mode, the DAS will create a table of estimates; corresponding standard errors are calculated by taking into account the complex sampling designs used in NCES surveys and weighted sample sizes for the estimates.

[3] The IPEDS, established as the core postsecondary education data collection program for NCES, is a system of surveys designed to collect data from all primary providers of postsecondary education. IPEDS is a single, comprehensive system designed to encompass all institutions and educational organizations whose primary purpose is to provide postsecondary education. The IPEDS system is built around a series of interrelated surveys to collect institution-level data in such areas as enrollments, program completions, faculty, staff, finances, and academic libraries.

Computer and Information Sciences and Support Services Programs. Exhibit 15 provides a summary of Computer and Information Sciences and Support Services educational programs. As shown in the exhibit, programs in *Computer Science* and *Computer Systems Analysis* experienced substantial growth between 2002 and 2007. The programs will likely be an important component of the SOM skills pipeline over the next decade as well and should be targeted in recruitment efforts. Conversely, several other programs have experienced a decline in the number of degree completions, such as *Information Science/Studies,* in the same time period. The decline indicates that recruitment programs targeted at students leaving these programs should be reevaluated and possibly redirected toward higher growth programs.

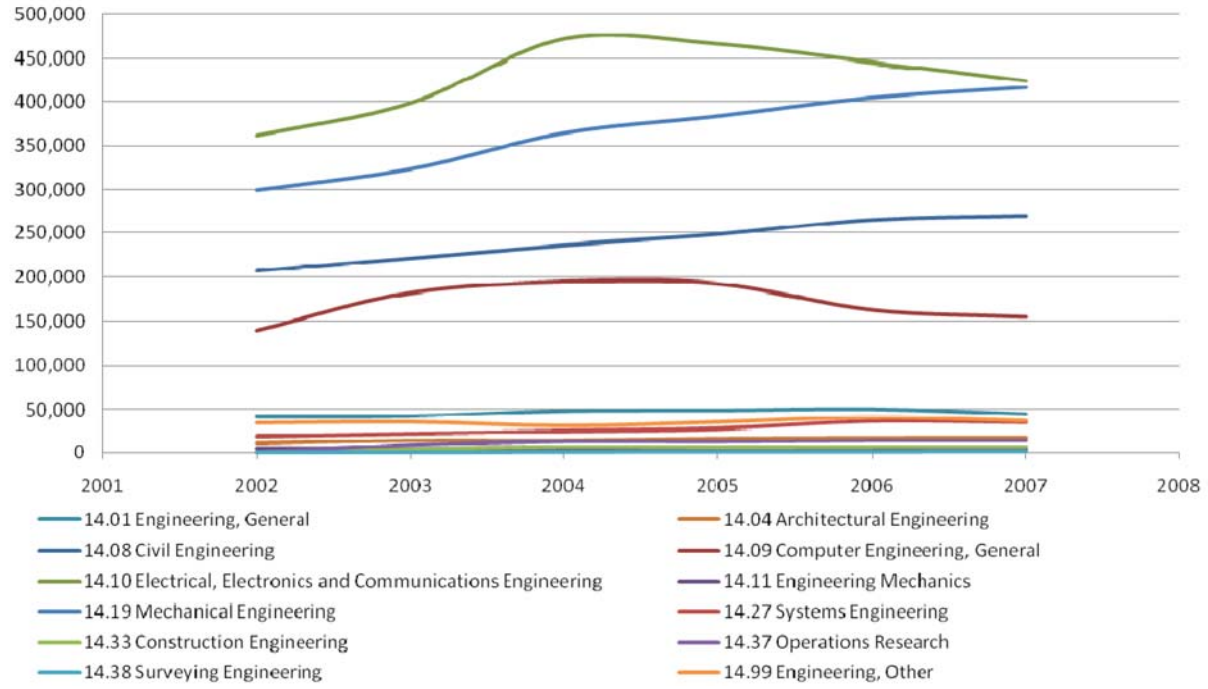
Exhibit 15
Computer and Information Sciences and Support Services Educational Program Trends 2002–2007



CIP Code	Education Program Description	2002 Grads	2003 Grads	2004 Grads	2005 Grads	2006 Grads	2007 Grads
11.01	Computer and Information Sciences, General	463,946	455,151	486,933	451,603	395,642	365,174
11.03	Data Processing	4,140	6,761	4,895	5,055	3,521	2,913
11.04	Information Science/Studies	134,898	164,944	145,316	128,592	126,509	110,530
11.05	Computer Systems Analysis	5,364	11,832	32,332	26,433	19,410	14,512
11.07	Computer Science	97,631	204,515	260,059	243,988	218,714	200,088
11.09	Computer Systems Networking and Telecommunications	0	32,739	43,521	39,985	35,808	28,771
11.99	Computer and Information Sciences and Support Services, Other	37,138	35,654	34,717	29,763	27,223	24,511

Engineering Programs. As indicated in Exhibit 16, several programs in Engineering have experienced significant growth (>17%) between 2002 and 2007 including *Computer Engineering* and *Mechanical Engineering* (or between 2003 and 2007 in case of *Construction Engineering* and *Operations Research*). These programs will likely continue to produce top talent for SOM jobs over the next decade as well.

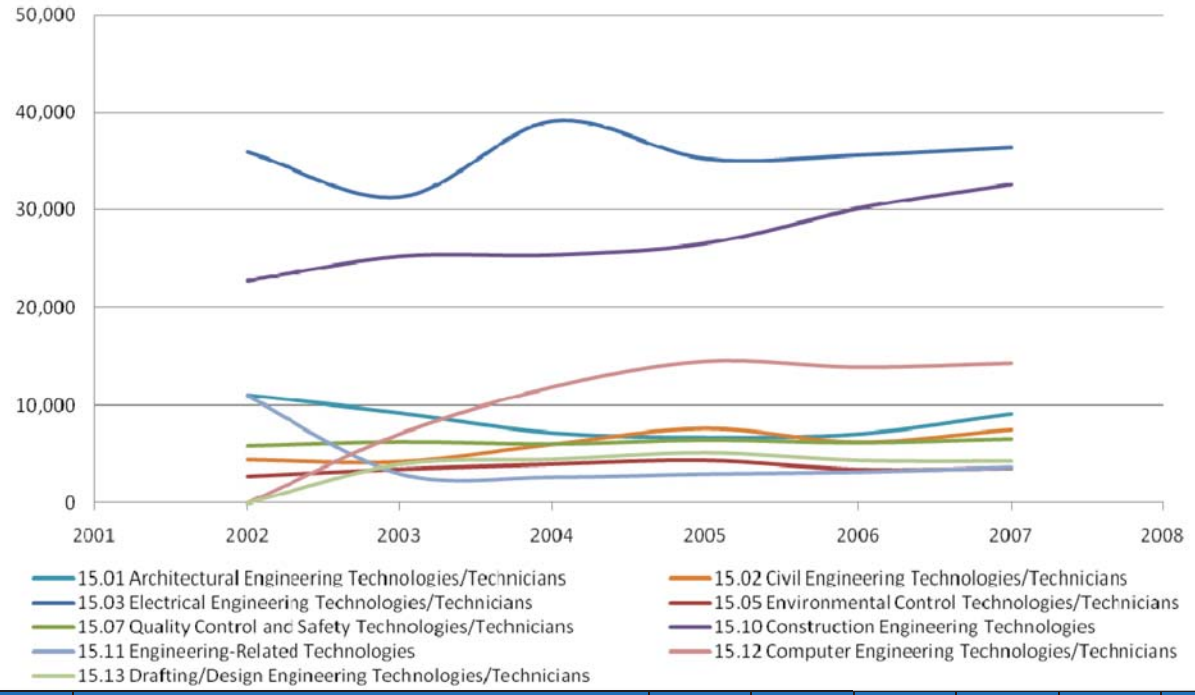
Exhibit 16
Engineering Educational Program Trends
2002–2007



CIP Code	Education Program Description	2002 Grads	2003 Grads	2004 Grads	2005 Grads	2006 Grads	2007 Grads
14.01	Engineering, General	41,013	41,801	48,276	49,052	50,501	44,348
14.04	Architectural Engineering	11,571	14,581	14,710	16,655	17,414	17,726
14.08	Civil Engineering	207,365	222,071	237,029	248,942	265,981	270,665
14.09	Computer Engineering, General	139,500	182,917	195,394	193,281	163,077	155,181
14.10	Electrical, Electronics and Communications Engineering	361,441	398,427	472,764	466,878	446,256	424,149
14.11	Engineering Mechanics	4,992	4,285	4,900	3,341	4,349	3,404
14.19	Mechanical Engineering	299,659	323,594	364,507	383,678	404,830	416,749
14.27	Systems Engineering	19,243	22,441	24,974	27,494	35,695	34,214
14.33	Construction Engineering	0	3,356	6,397	5,810	6,301	6,462
14.37	Operations Research	0	9,000	13,500	13,463	14,721	14,644
14.38	Surveying Engineering	0	0	300	621	519	806
14.99	Engineering, Other	34,402	35,543	31,116	35,297	40,502	36,636

Engineering Technologies/Technicians Programs. As shown in Exhibit 17, *Civil Engineering Technologies/Technicians, Environmental Control Technologies/Technicians,* and *Construction Engineering Technologies* programs in Engineering have experienced significant growth (>29%) between 2002 and 2007 (or between 2003 and 2007 in the case of *Computer Engineering Technologies/Technicians*). Over the next decade, these programs will almost certainly continue to be important components of the SOM skills pipeline and should be targeted in DOT recruitment campaigns.

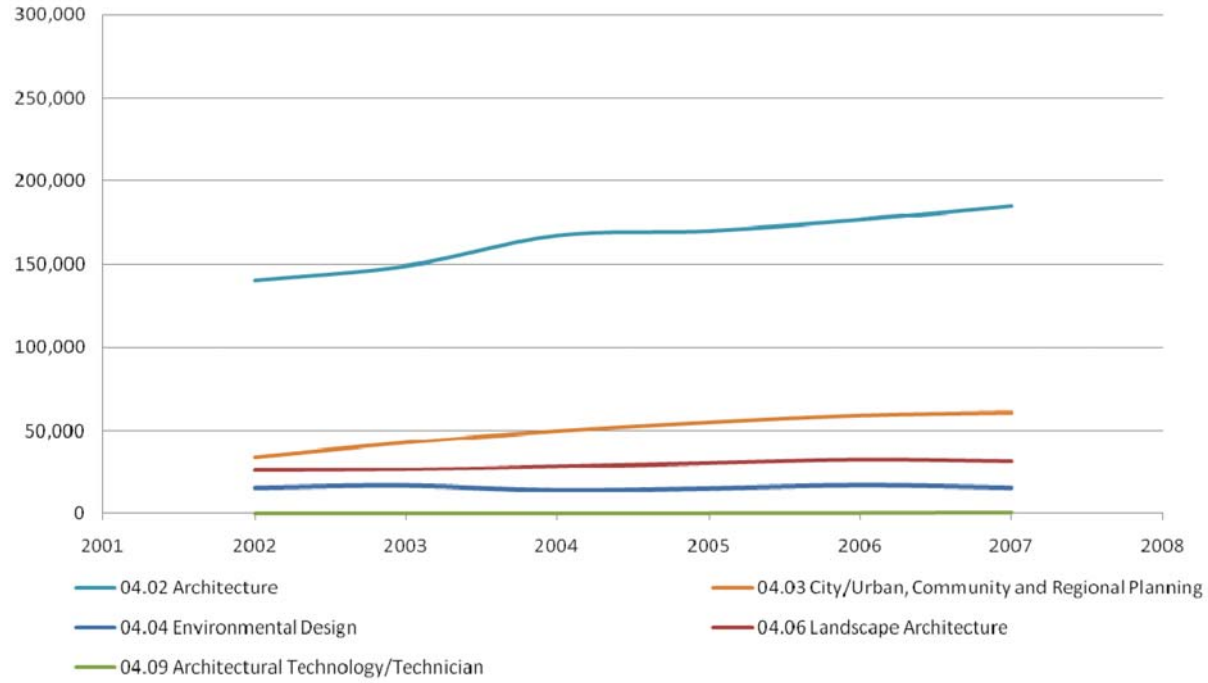
Exhibit 17
Engineering Technologies/Technicians Program Trends
2002–2007



CIP Code	Education Program Description	2002 Grads	2003 Grads	2004 Grads	2005 Grads	2006 Grads	2007 Grads
15.01	Architectural Engineering Technologies/Technicians	11,091	9,310	7,291	6,836	7,179	9,207
15.02	Civil Engineering Technologies/Technicians	4,492	4,274	6,090	7,714	6,314	7,579
15.03	Electrical Engineering Technologies/Technicians	35,991	31,291	39,145	35,302	35,669	36,453
15.05	Environmental Control Technologies/Technicians	2,833	3,561	4,048	4,434	3,518	3,648
15.07	Quality Control and Safety Technologies/Technicians	5,888	6,295	6,074	6,489	6,216	6,588
15.10	Construction Engineering Technologies	22,734	25,244	25,379	26,550	30,097	32,582
15.11	Engineering-Related Technologies	10,938	3,014	2,673	2,996	3,194	3,653
15.12	Computer Engineering Technologies/Technicians	0	7,188	11,931	14,623	14,010	14,422
15.13	Drafting/Design Engineering Technologies/Technicians	0	4,029	4,518	5,202	4,418	4,343

Architectural and Related Services Educational Programs. Exhibit 18 provides an overview of educational program trends in Architecture and Related Services. As depicted, *Architecture* and *City/Urban, Community and Regional Planning,* and *Landscape Architecture* programs have experienced substantial growth (>20%) between 2002 and 2007. This indicates that these programs will likely continue to produce graduates that can be recruited into SOM fields over the next decade.

Exhibit 18
Architectural and Related Services Educational Program Trends
2002–2007



CIP Code	Education Program Description	2002 Grads	2003 Grads	2004 Grads	2005 Grads	2006 Grads	2007 Grads
04.02	Architecture	140,393	149,045	167,381	170,106	176,617	184,934
04.03	City/Urban, Community and Regional Planning	34,487	43,152	49,853	55,157	59,306	60,911
04.04	Environmental Design/Architecture	15,773	17,043	14,106	15,431	17,241	15,850
04.06	Landscape Architecture	26,675	27,274	28,865	30,917	32,920	31,965
04.09	Architectural Technology/Technician (New)	0	115	101	144	294	539

3.6 ESTABLISHING SOM CAREER PATHS

Results of our data collections indicate that there is uncertainty in the transportation industry about how individuals should advance in a SOM career. This can inhibit DOT staff from cross-training to enter the field and deter potential new, skilled employees from entering SOM jobs. We discovered that the biggest challenge or impediment to pursuing a career in SOM is that there are few clear or standard career paths for personnel. It is difficult for potential and existing staff to navigate the array of job titles within and across DOTs. Yet, because SOM personnel often have knowledge of multiple disciplines and an understanding of how SOM interacts with transportation modes, the public, and other transportation functions (e.g., emergency

management, public safety), their skills are highly transferable across core functions so advancement within and across core functions is certainly attainable.

To assist DOTs in creating standard SOM career paths for their agencies, we developed several generalized SOM career paths by analyzing the literature review findings, interview data, our compiled list of SOM job titles, and the staffing estimate data. Because of the lack of standardization across DOTs in terms of SOM department structures, we defined generalized SOM career paths that outline how individuals might progress through their SOM career in general. However, when implemented, each career path should and likely will be tailored to the individual needs of the host agency by internal staff.

Generalized SOM Career Paths

Exhibit 19, adapted from materials from NCHRP Project 20-77, provides a generalized summary of how individuals might advance in SOM careers within and across each of the five core functions of SOM. The horizontal arrows (i.e., Policy and Strategic Considerations Career Path, Program Planning Career Path, etc.) represent typical career growth for employees as they advance to higher organizational levels within one of the five core functions. In addition, since SOM personnel often advance across core functions, the double arrows indicate career movement between core functions. For example, employees working within the Real-Time Operations core function may advance their career by moving within Real-Time Operations or by moving up into the Project Management, Systems Development, or Program Planning components of SOM. Movement across core functions is more common when additional training is provided.

The grey shaded cells indicate that the core function typically does not have personnel working at the indicated organization level. As a result, the exhibit suggests that SOM applicants with minimal prior working experience, interested in beginning their career at the entry-level, are most likely going to start as a Transportation Management Center Technician or Field Technician within Real-Time Operations, and work their way up. On the other hand, applicants with graduate degrees, or who are more tenured employees with knowledge of the industry and experience in SOM are most likely to start at the mid- or project-related level.

The exhibits that follow Exhibit 19 provide generalized career paths within each of the five core functional areas and indicate specific job titles that may be associated with each core function. (See Exhibits 20 through 24.) The career paths for each SOM core function are represented separately because the positions included within SOM are diverse and the typical career paths vary for each position, even within the specific core function. Thus, the exhibits provide a visual representation of the general movement between jobs for SOM personnel. Please note that although many of the SOM positions included in these exhibits require more than one (or all) of the core functions, we display them based on each position's primary core function. Additionally, it is important to be aware that these career paths only represent the generalized path we identified based on our analysis of data collected in Tasks 1 through 3. Thus, the career paths do not reflect all the possible ways for an employee to advance. Furthermore, since agencies range in size (i.e., number of employees) and have different demands, the path provided may not be consistent across all DOTs.

Exhibit 19
Career Paths by Core Function and Organizational Levels

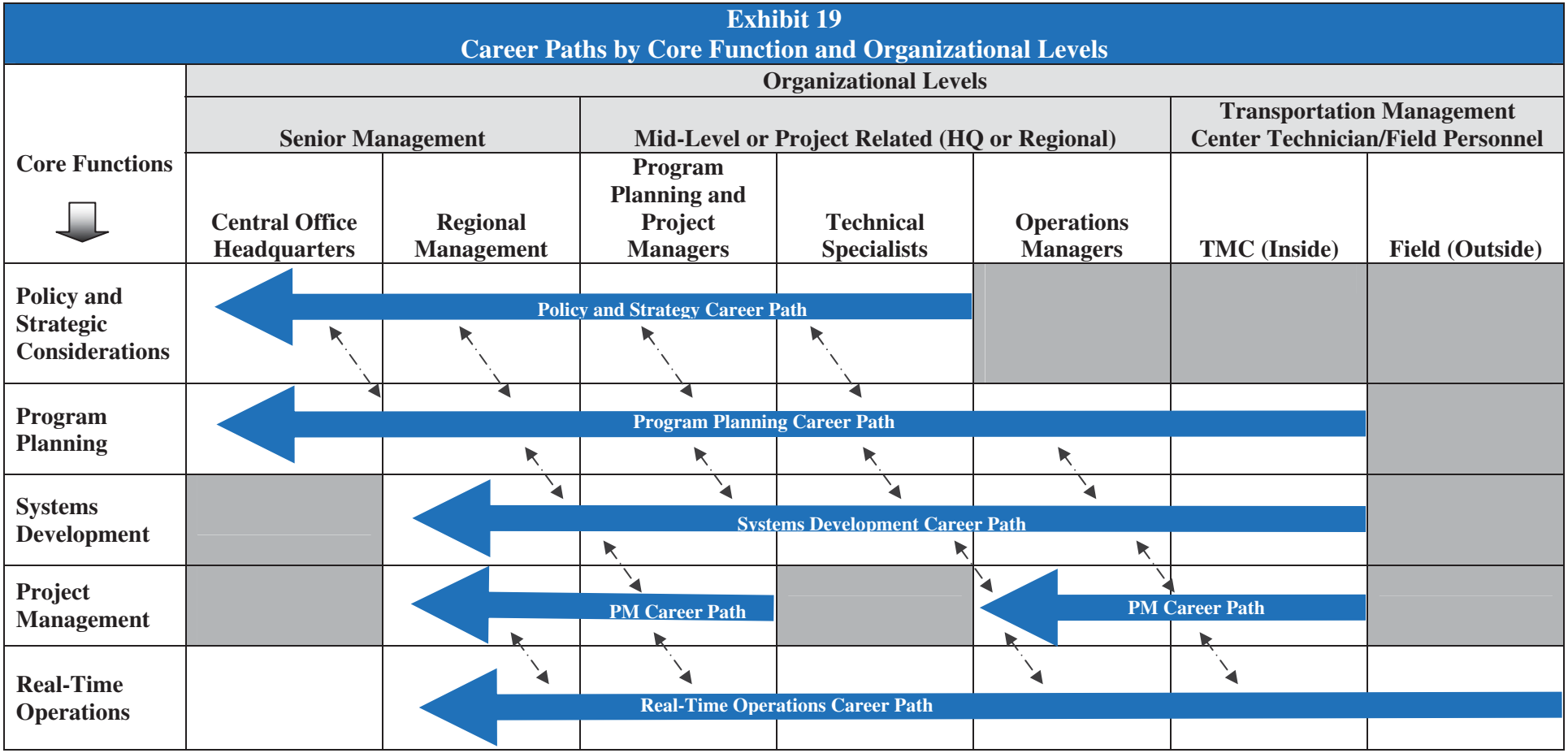


Exhibit 20 represents the various common career paths for an SOM employee within the Policy and Strategic Considerations core function. The positions presented in this exhibit start at the mid-career level, suggesting that most employees probably have degrees or job experience when they enter the core function. Nevertheless, the arrows displayed in the exhibit indicate that there are numerous options for an employee to reach the higher senior management levels within Policy and Strategic Considerations.

Exhibit 20
Policy and Strategic Considerations Core Function: Career Paths

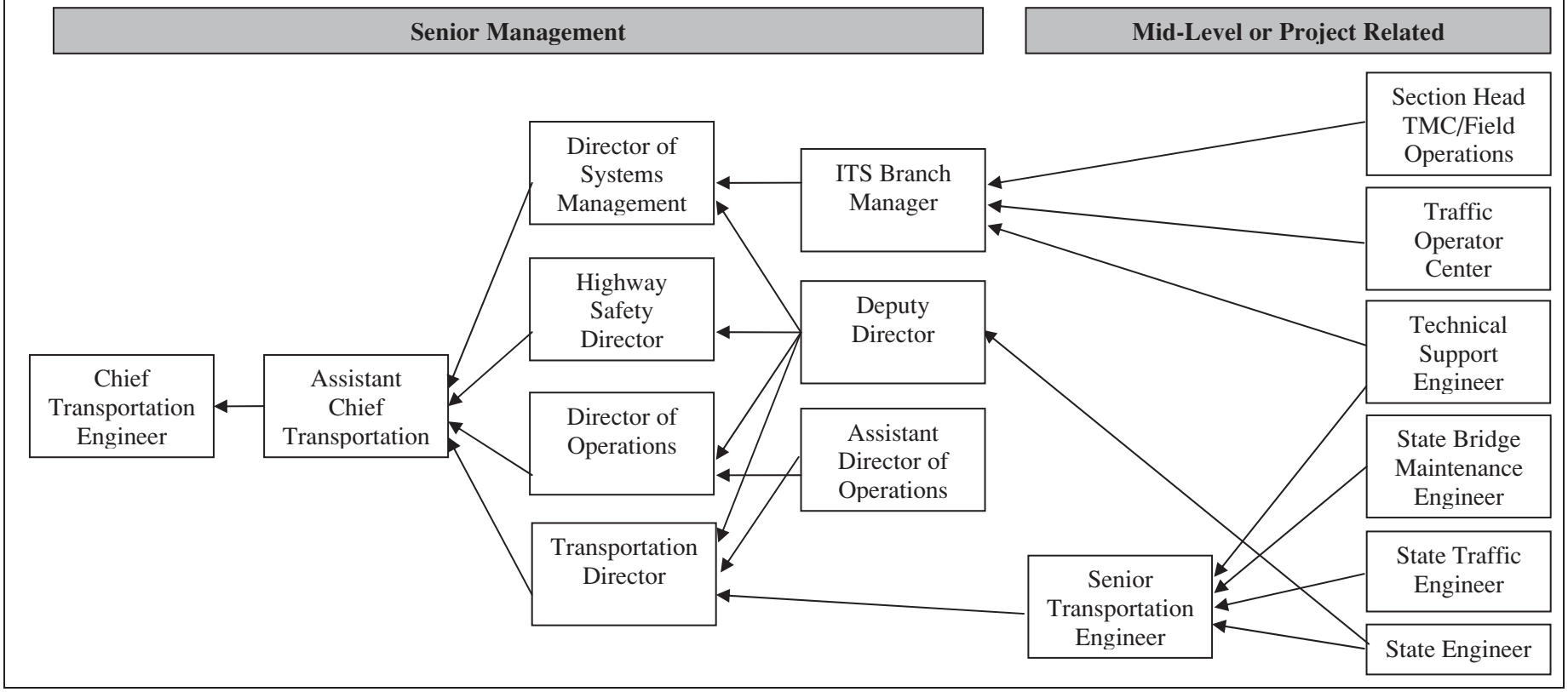


Exhibit 21 presents the generalized career paths for an SOM employee within the Program Planning core function. The positions presented in this exhibit start at the level of Technician and Field Personnel and end with positions in senior management. This suggests that an advanced degree is not required to start, but that training and years of experience can lead into a specialist position at the mid-career level, and Chief Planner at the senior level. On the other hand, employees with an engineering degree are likely to enter as a Technical Engineer or State Engineer, and can advance to Division Chief of Operations and Management or Assistant Engineer at the senior level.

Exhibit 21
Program Planning Core Function: Career Paths

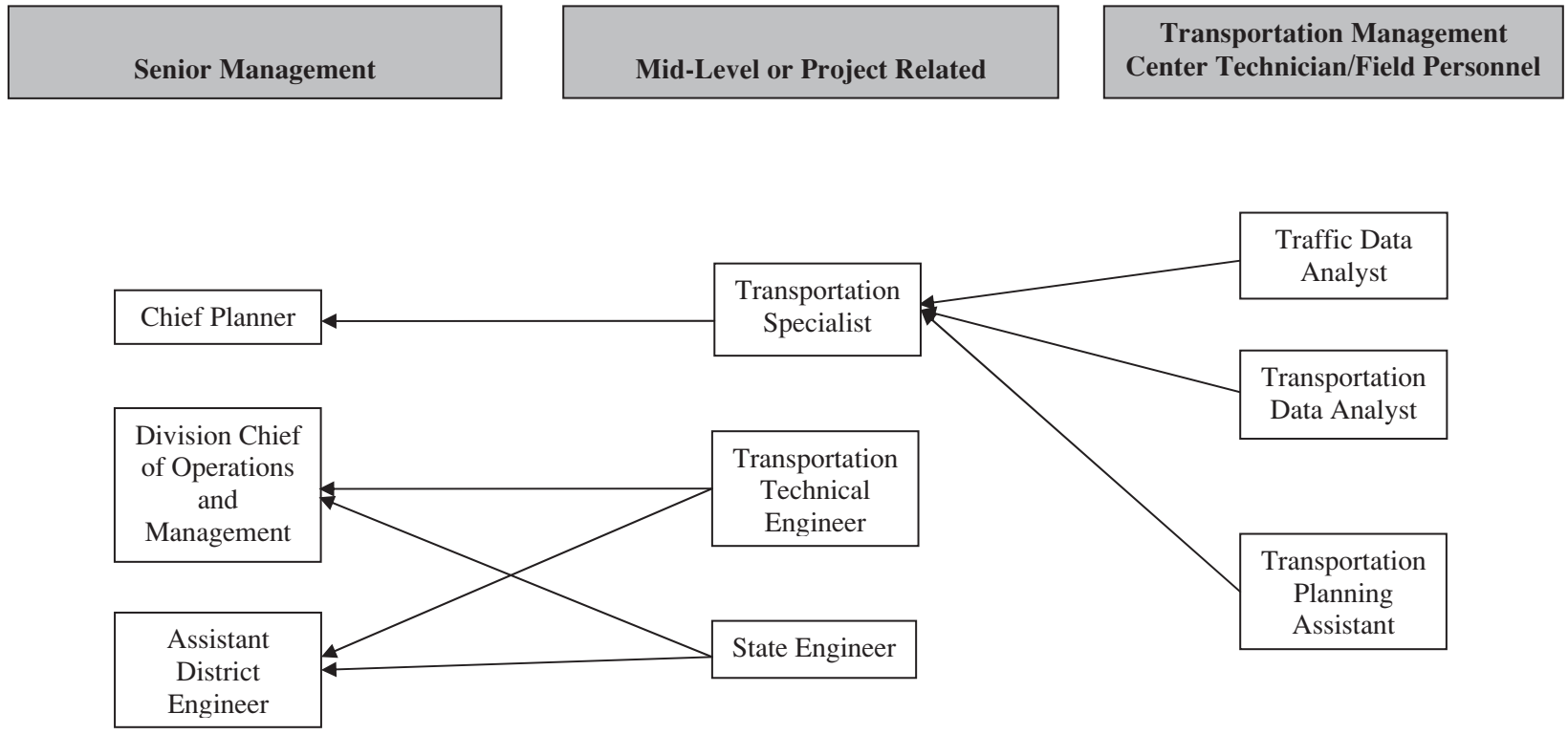


Exhibit 22 represents the generalized career paths for an SOM employee within the Systems Development core function. Employees beginning their career at the entry level in Systems Development typically start as an Electrical Mechanic, Traffic Systems Technician 1, or Engineering Technician 1. While the Engineering Technician has a clearly defined career path to the senior level, the career path shown for the Electrical Mechanic and Traffic Systems Technician ends at the mid-level. As a result, once an employee reaches Implementation Support or IT Section Leader he/she probably needs to retrain to one of the other core functions to advance their career within SOM.

Exhibit 22
Systems Development Core Function: Career Paths

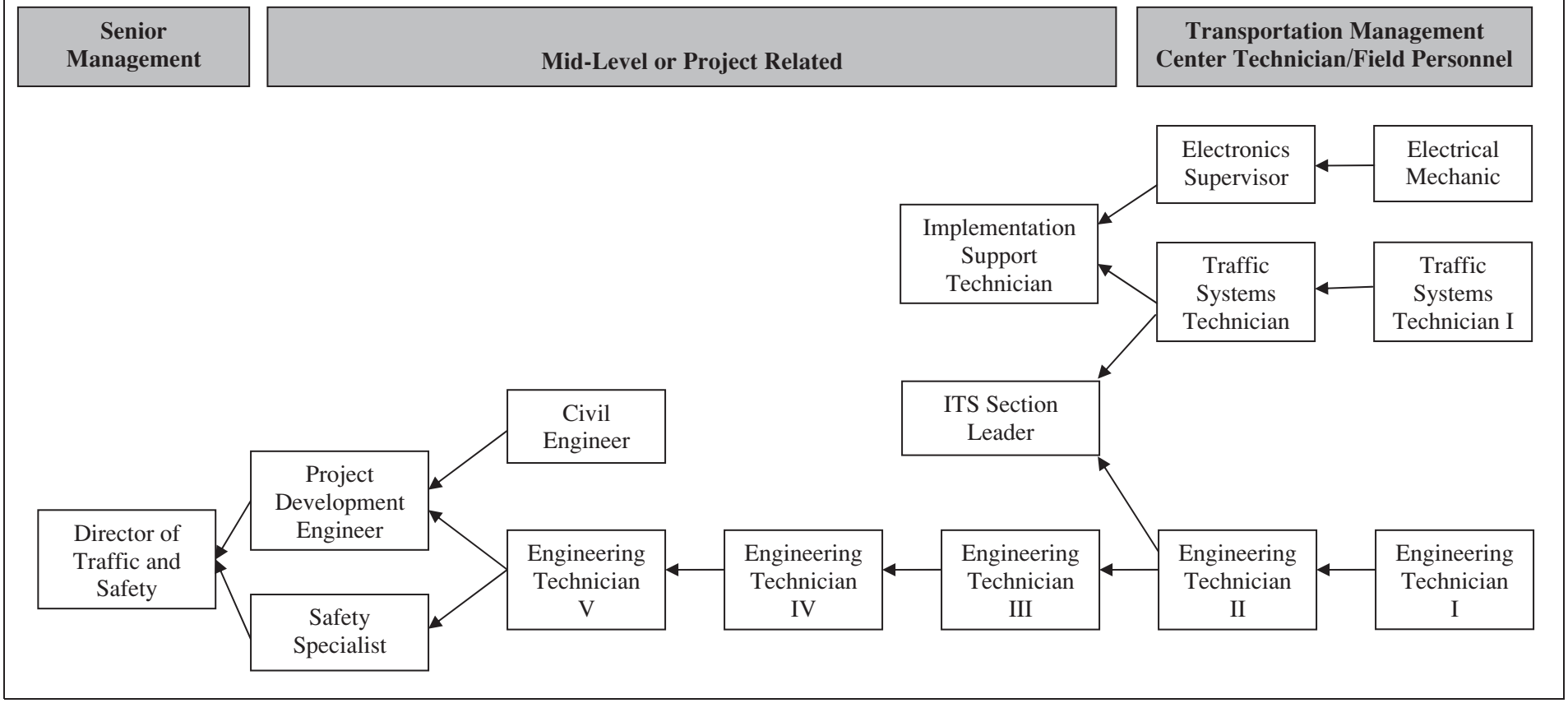


Exhibit 23 represents a general career path for an SOM employee within the Project Management core function. The positions presented in this exhibit start at the mid-career level, suggesting that employment in Project Management, SOM, requires an advanced degree, or certificate. Employees beginning their career in Project Management typically start as a Traffic Operations Engineer or Transportation Engineer. Employees with a certificate in Project Management, in addition to the advanced degree, may be eligible to start as an ITS Project Manager.

Exhibit 23
Project Management Core Function: Career Paths

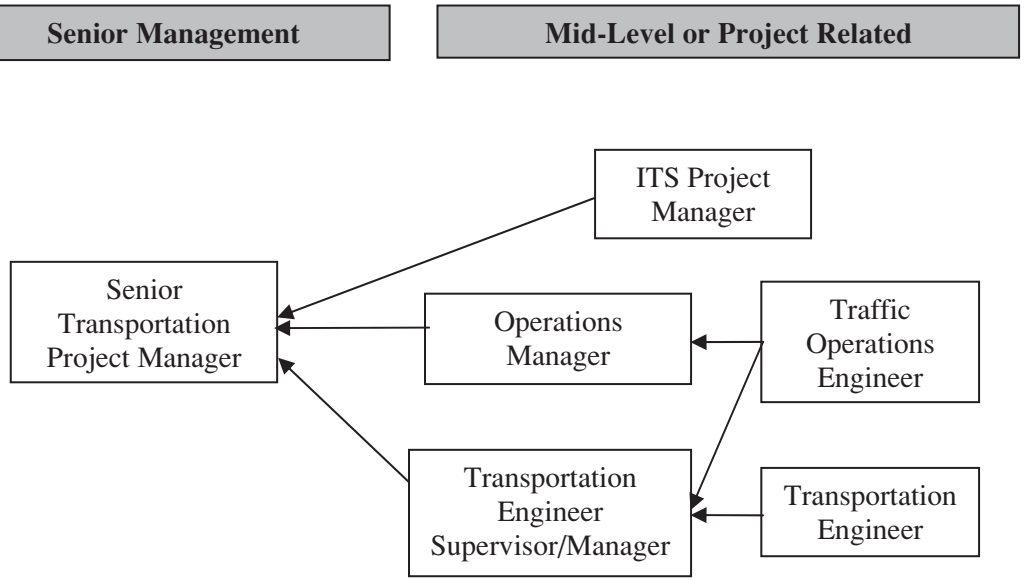
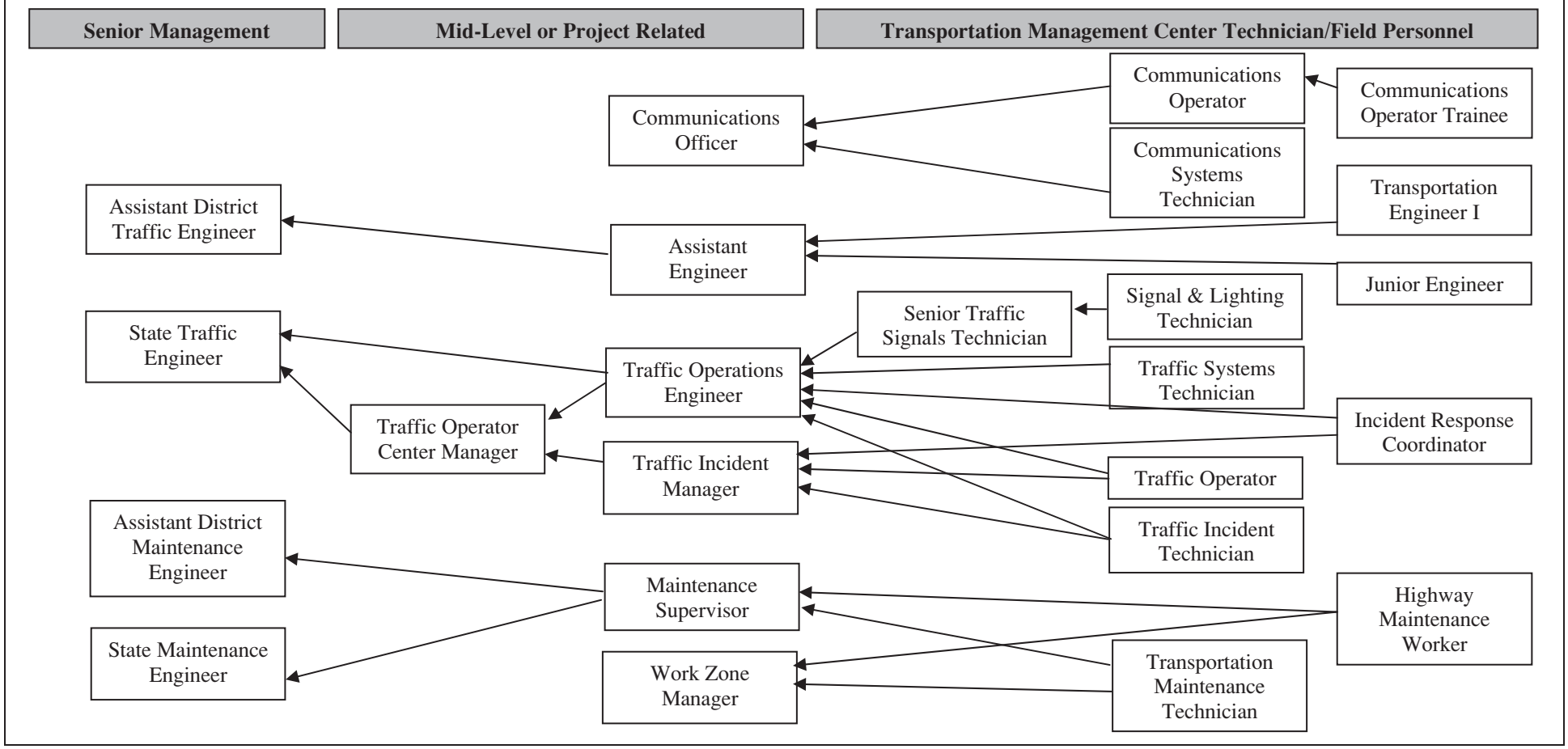


Exhibit 24 represents the common positions included in, and the typical career paths for an SOM employee within, the Real-Time Operations core function. The majority of the positions presented in this exhibit are at the entry level (i.e., Technical and Field). This suggests that employees entering this core function in the Technical or Field positions generally do not need an advanced degree, and may not need a Bachelor's. Nevertheless, the arrows displayed in the exhibit indicate that there are numerous options for an employee to reach the mid-level or project related positions, and continue their career advancement to the senior level.

Exhibit 24
Real-Time Operations Core Function: Career Paths



4. FULL INTRODUCTION AND OVERVIEW OF PROJECT RECOMMENDATIONS

The ultimate goal of this project was to develop strategic recommendations and guidance that can be implemented by transportation agencies to recruit SOM staff and enhance SOM staff capabilities. To achieve this objective, the ICF project team incorporated results of Tasks 1 through 6 to develop strategic action plans related to the career stages of the transportation workforce pipeline as identified in *NCHRP Report 685: Strategies to Attract and Retain a Capable Transportation Workforce* (Cronin et al., 2011). Each action plan describes the information, recruitment, and retention resources needed to implement the workforce recommendation; the costs and schedule for development; and outreach activities. In order to provide stakeholders with a comprehensive understanding of the recommendations provided, we present the following here:

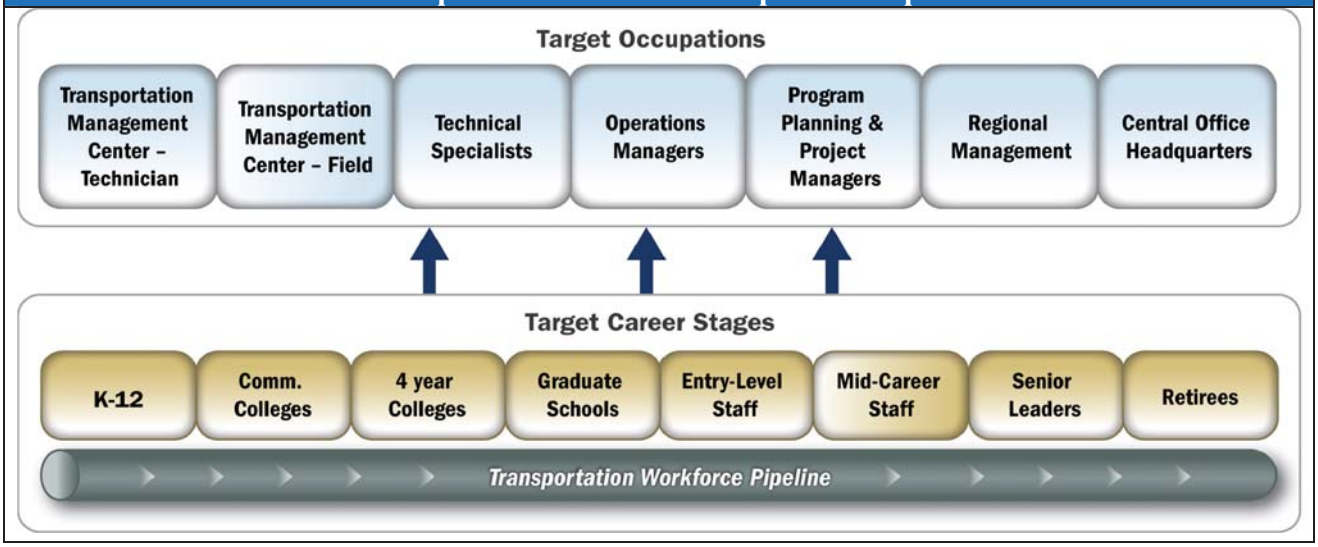
- Overview of transportation pipeline
- Summary of the materials reviewed to create strategic guidance
- Introduction to the strategic action plans
- Recommendations and Strategic Action Plans for each SOM career stage

In the subsequent sections, we provide more detail related to each of these topics.

4.1 OVERVIEW OF TRANSPORTATION PIPELINE

The transportation workforce pipeline consists of the major career stages through which an SOM employee might progress before, during, and after their employment at a transportation agency. The graphic in Exhibit 25 highlights these career stages and demonstrates that the seven target SOM occupations introduced earlier in this report are directly impacted by each stage of the pipeline.

Exhibit 25
Transportation Workforce Pipeline Graphic



In each strategic action plan, this graphic is presented again, highlighting only the career stages under consideration and the occupations directly influenced. The intention is to indicate the relationship between the strategic recommendation and specific job categories. It should be noted, however, that many of the action plans could be expanded or adapted to meet the needs of additional career stages and occupations. Further, many of the action plans would undoubtedly have indirect positive effects on other career stages and occupations.

4.2 SUMMARY OF THE MATERIALS REVIEWED TO CREATE STRATEGIC GUIDANCE

To form the foundation of the strategic recommendations and related action plans, we conducted a thorough assessment of the data collected during the first six tasks of this study. This data included results from the SOM leadership interviews, the described SOM staffing analysis, and a review of current human resource practices used to attract, recruit, develop, and retain SOM staff. This assessment included an analysis of practices related to strategic recruitment, professional development and training, compensation and benefits programs, outsourcing policies, and other programs that directly impact key organization outcomes (e.g., satisfaction, turnover) for SOM. Exhibit 26 provides an overview of the sources we consulted to fully understand programs and practices used to attract and retain SOM staff across DOTs.

Exhibit 26
Sources Consulted in Development of Strategic Action Plans

- **ICF's FHWA Workforce Database** detailing nearly 100 workforce programs including:
  - AASHTO's Transportation and Civil Engineering (TRAC) Program,
  - West Point Bridge Design Contest,
  - FIRST© Robotics Competition,
  - ACT WorkKeys® job skills system, and
  - Summer Transportation Institutes.
- **ICF's Related Industry and Private Sector Benchmarking Database** that includes data ICF collected on recruitment and retention practices during similar studies with Fortune 500 companies, related federal and state agencies, and local/national associations.
- **Additional TRB projects**, including results from the following NCHRP projects: 20-77, "Transportation Operations Training Framework"; 20-24(40), "Analysis and Benchmarking of State DOT Recruitment and Hiring Practices"; 20-24(48), "Analysis and Benchmarking of State DOT Human Resource Activities"; 20-24(50), "In-Service Training Needs for State DOTs"; 20-72, "Tools to Aid DOTs in Responding to Workforce Challenges"; and *TRB Special Report 275.*
- **Industry source documents that describe:**
  - Gridlock Buster traffic control game,
  - FIRST© Robotics Competition,
  - Dowling College School of Aviation FIRSTplus air traffic control (ATC) simulator, and
  - Two videos provided in subject RFP.
- **ICF's Transportation Recruitment, Development and Retention Practices Database,** which extensively catalogs over 150 'Best-Practice' recruitment, development, and retention programs for NCHRP (created for NCHRP Project 20-81).
- **Database of Best Practices in Recruitment and Workforce Management of DOT Contractors** identified during a Florida Department of Transportation project.
- **Technical reports and relevant studies conducted by private and public sector organizations**, such as the Department of Defense, the Department of Education, Federal Transit Administration, and other federal agencies, and state and local organizations.

Exhibit 26 (Continued)
Sources Consulted in Development of Strategic Action Plans

- **Surveys and research conducted by AASHTO**, Association of Metropolitan Planning Organizations (AMPO), International City/County Management Association (ICMA), and state leagues of municipalities.
- ***NCHRP Research Results Digest 327: Transportation Implications of Emerging Economic Development Trends***, published by the Transportation Research Board in August 2008.
- **Journals devoted to applied problems in organizations**, such as *Personnel Psychology, Academy of Management Journal, Public Personnel Management*, *Journal of Applied Psychology,* and *Journal of Organizational Behavior*.
- **Professional Human Resource (HR) organizations,** which provide publications and published surveys by organizations with specific expertise in recruitment, retention and workforce development issues such as the Society for Human Resource Management (SHRM), the Society for Industrial/Organizational Psychologists (SIOP), the International Public Management Association for Human Resources (IPMA-HR), and the John J. Heldrich Center for Workforce Development at Rutgers University.
- **Industry journals,** such as *Transportation* and *Transportation Quarterly*.

4.3 INTRODUCTION TO THE STRATEGIC ACTION PLANS

As described, strategic recommendations and action plans were developed to address the SOM recruitment or attraction challenges associated with each career stage in the transportation pipeline. Separate action plans were created to ensure that the strategic guidance was focused enough to make implementation realistic and to ensure that the plans, when used together, were comprehensive enough to impact all major aspects of the SOM workforce pipeline.

In this section, an overview of the general action plan categories is presented to facilitate SOM decision-maker use of the strategic guidance provided. Exhibit 27 identifies the major sections and specific categories used across all of the action plans. This exhibit also defines the type of information provided in the category.

Exhibit 27 Overview of Data Fields Used in Each Strategic Action Plan	
Data Field Name	**Description**
Section 1 Overview of Strategic Recommendation	
Recommendation Title	▪ Short descriptive label for strategic recommendation.
Recommendation Highlights	▪ Bulleted overview of key points of interest from full strategic action plan.
Description	▪ Provides broad overview of proposed recommendation.
Rationale for Recommendation	▪ Provides rationale for the recommendation based on available literature, SOM needs, and study findings.
Section 2 Target Audiences	
Relevant Position	▪ Graphic depiction of the anticipated target occupations impacted as a result of proposed recommendation and target career stages.
Source of Initiation	▪ Indicates whether the recommendation should be initiated by the individual agency or at the industry level.
Primary Human Resource Focus	▪ Indicates if the recommendation is an attraction, recruitment, retention, or development effort.
Implementation Level	▪ Describes the level at which the recommendation should be implemented.
Estimated Time to Implement	▪ Provides an estimate of how long it will take to develop and implement the recommendation.
Return on Investment	▪ Identifies the approximate time required for the practice to pay off.
Section 3 Implementation Plan	
Action Lead(s)	▪ Identifies the key person(s) within the agency who are accountable for developing and managing the appropriate action plan, including carrying out the specific implementation steps.
Targeted Audience(s)	▪ Identifies the key person(s) who should be contacted in order to implement the practice and the stakeholders with whom to coordinate.
Steps to Implement	▪ Presents the key steps that should be followed, in order to successfully implement the practice.
Graphic Depiction	▪ When applicable, this section provides a graphic to help the reader understand the implementation process.

Exhibit 27 (Continued) Overview of Data Fields Used in Each Strategic Action Plan	
Data Field Name	**Description**
Section 4 Communication Plan	
Communication/Outreach Strategies	▪ Describes communication and outreach strategies that will help ensure successful implementation.
Process for Obtaining Buy-In	▪ Describes the critical steps and processes that will assist the agency in getting senior leadership to champion the practice.
Section 5 Useful Internal and External Resources	
To Implement Practice	▪ Identifies the internal and external resources that will assist in implementing the practice including groups or stakeholders that will need to be involved in implementation.
To Sustain Practice	▪ Identifies the internal and external resources that will assist in successfully sustaining the practice.
Section 6 Example(s) of Effective Programs	
Example(s) of Real-World Effective Programs	▪ Provides bulleted examples of effective programs that have been successfully implemented and practiced at various state DOTs or in other industries. ▪ Where possible, contact information for each of the examples is provided.
Section 7 Alternative Approaches	
Alternative Approaches	▪ Alternative approaches that may be less optimal, yet effective solutions for organizations with limited resources to consider.
Section 8 Impact	
Positive Outcomes of the Practice	▪ Describes anticipated results of the practice with full adherence to the implementation steps. The impact information may include findings from research studies and/or anecdotal evidence from other agencies/groups who have implemented the practice.
Section 9 Cautionary Considerations	
Negative Outcomes of the Practice	▪ Provides bulleted list of potential challenges, cons, or residual effects of the implementation that should be considered. ▪ Each Cautionary Consideration includes ideas for how the challenge might be overcome.

The major sections and specific categories included in the action plans were designed to provide users with all the information needed to successfully implement the recommendations proposed.

4.4 RECOMMENDATIONS AND STRATEGIC ACTION PLANS FOR EACH SOM CAREER STAGE

In this section, eight strategic SOM workforce recommendations are presented. The recommendations are designed to provide transportation agencies with strategies and resources to meet their needs for SOM staff. The recommendations will allow agencies to expand the pool of workers with SOM expertise by reaching out to students at all levels who are preparing to enter the workforce, to older workers seeking to extend their careers past traditional retirement ages, and to workers of all ages seeking to change their career paths.

To make optimal use of this report, an agency's Human Resource (HR) director should thoroughly evaluate the current and projected SOM workforce needs they have with respect to the external labor market and then map those needs to the "Primary Human Resource Focus" for the recommendations that have "Agency" identified as the "Source of Initiation." It is suggested that HR directors initiate the majority of these recommendations due to their unique expertise and training in personnel management. However, in some cases the recommendations indicate that SOM managers could be appropriate to serve as the action lead when an HR director is either not available or the director requires additional support, or the manager may have unique knowledge about the specific workforce challenge and he/she desires to initiate changes at a divisional level and drive them up to the greater agency level. It would be optimal if the industry-level recommendation were initiated by a national association as indicated because it requires an orchestrated effort across numerous agencies. For each of the eight recommendations included in the report, a comprehensive action plan was created. Exhibit 28 defines each of the recommendations and identifies relevant career stages. Please note that the recommendation titles are hyperlinked to their respective action plan.

Exhibit 28
Overview of Strategic SOM Workforce Recommendations by Career Stage

Target Career Stage	SOM Workforce Recommendation
K-12 Community Colleges Four-Year Colleges Graduate Schools Entry-Level Staff Mid-Career Staff Senior Leaders Retirees	**1. Implement Annual or Semi-Annual SOM Career Days.** The K-12 target career stage is broken into two age groups so that agencies can create programs and materials that are tailored to better match how the age groups become interested and learn about SOM. The first age group includes students in grades K-8, while high school students are the second age group targeted. In order to expose elementary and middle school students to the SOM-related fields in the transportation industry, agencies could partner with after school programs to create a 3- to 5-day program that explores different components of SOM. Part of this learning program could include classroom time where students have the opportunity to learn about the transportation industry from a variety of sources (e.g., books, movies, video games), with the goal of piquing the students' interest. An emphasis on safety issues should be included in the materials. The second part of the learning program could include a field trip to the local transportation agency, which would allow students to see how the concepts they learned are applied in everyday work. Students could try the equipment onsite and experience an SOM job. In order to expose high school students to the SOM-related fields in the transportation industry, agencies could reach out to vocational technical schools and Science, Technology, Engineering and Mathematics (STEM) schools about developing an SOM Career Day. Students enrolled in these types of schools are taught the skills they need to succeed in today's challenging world. Many of these skills and abilities are sought after for positions within SOM, including the ability to think critically, solve complex problems, and drive advancements in technology. In addition, these types of schools are more flexible in designating a couple of hours or even a day for guests to speak to students about their careers. This opportunity gives employees at DOTs and operation agencies a chance to connect with a young audience and share experiences from their job at a time when these students are expanding their interests and beginning to think about which careers take advantage of their skill sets. SOM employees are able to answer questions and provide detailed examples of their daily work activities and projects.

Exhibit 28 (Continued)
Overview of Strategic SOM Workforce Recommendations by Career Stage

Target Career Stage	SOM Workforce Recommendation
K-12 Community Colleges Four-Year Colleges Graduate Schools Entry-Level Staff Mid-Career Staff Senior Leaders Retirees	2. **Develop SOM Curriculum Content for Related Higher Education Courses and Training Programs.** Associations (AASHTO, ACEC, ASCE, etc.), university transportation centers (UTCs), and other stakeholder organizations should work with higher education and training providers to develop curriculum content that can be added to existing courses and programs. Target providers might include community colleges, four-year colleges, Local Transportation Assistance Programs (LTAPs), and the National Highway Institute. This process will help address the technical needs of the SOM discipline. In addition, since educators influence job decisions (e.g., teachers and school counselors), SOM stakeholders should also consider ways to support students through grants for night school, scholarships for degrees, and certification classes during off-peak times.
K-12 Community Colleges Four-Year Colleges Graduate Schools Entry-Level Staff Mid-Career Staff Senior Leaders Retirees	3. **Implement Student-Worker Internship Program with a Job Rotational Component.** Agencies should implement student-worker internship programs that allow for the option to rotate jobs. Such programs allow DOTs to target universities with students in specific programs and offer them paid positions while in school at lower rates than typical employees. Rotational job programs provide students with the opportunity to work in more than one job over the course of their involvement in the program. This gives them the opportunity to experience different jobs, learn about different functions, experience SOM-related duties from multiple perspectives, and work on a variety of different projects. Within each rotation, students should be assigned a mentor who is responsible for supervising the student and serving as a point of contact for any issues that may arise. These programs are attractive to students who are looking for real world experience as well as income, and provide agencies with a means to have a presence on college campuses and develop a pipeline for talent. The job rotation component provides students with an opportunity to try different kinds of work, increasing the chances they will find a job they like at the agency and also increasing the chances they will stay if hired, given their previous exposure to the actual job duties.
K-12 Community Colleges Four-Year Colleges Graduate Schools Entry-Level Staff Mid-Career Staff Senior Leaders Retirees	4. **Implement Virtual Pre-Employment Realistic Job Preview.** Agencies develop a virtual pre-employment realistic job preview (RJP) that interested candidates can complete before applying for a job or in the process of learning new skills. Such tools are web-based and interactive, providing candidates with a candid preview of what the job entails by allowing them the opportunity to see what the job is like and participate in simulated job tasks. A virtual job preview can present various SOM-related positions in a way candidates find interesting and impressive. The RJP is like a virtual day in the life of an SOM employee. Using an RJP, such as a video or a virtual job tryout, can show potential employees work conditions or activities experienced on the job, which may encourage applicants to pursue a career within the agency. An RJP can also help frame job expectations so that new employees are not surprised or potentially disappointed by unknown requirements experienced on the job. Virtual presentations can be very high-tech, which can also help to attract potential applicants and bring new employees to the SOM field.

Exhibit 28 (Continued)
Overview of Strategic SOM Workforce Recommendations by Career Stage

Target Career Stage	SOM Workforce Recommendation
K-12 Community Colleges Four-Year Colleges Graduate Schools Entry-Level Staff Mid-Career Staff Senior Leaders Retirees	**5. Institute Mentoring Program.** In order to quickly develop and onboard entry-level staff or other employees new to the SOM field, mentoring programs (both formal and informal) are effective. Mentoring programs typically involve pairing someone more junior with an individual in a similar field of work but who has more experience in the organization (e.g., 5+ years) and a successful performance record. Mentoring programs have also shown success for encouraging and engaging minority workers by partnering the worker with someone who is more advanced in his/her career, who may share similar demographic characteristics and therefore may have experienced certain challenges or perceived barriers the junior person may encounter during the early stages of his/her career.
K-12 Community Colleges Four-Year Colleges Graduate Schools Entry Level Staff Mid-Career Staff Senior Leaders Retirees	**6. Develop Employees and Maintain Employee Career Pathways.** DOTs should consider making in-house recruiting a priority to promote from within and ensure that growth opportunities are available to employees (KFH Group, Inc., 2008). Results of a recent study indicate that career pathways improve job satisfaction, employee motivation, and employee commitment (Griffin, Kalnbach, Lantz, and Rodriguez, 2000). Furthermore, results from analyses of 21 turnover studies indicate that receiving promotions is directly related to less employee turnover (Carson et al., 1994). To prepare employees for advancement, agencies need to implement structured employee development practices. A career lattice demonstrates the possible ways that a career can progress and the different jobs an employee might consider as his/her career develops. The pathway is usually represented as a diagram showing the relationships between various roles in an industry and the possible paths for moving between them, both linearly and laterally. A career pathway serves as a strategic planning tool as the employee identifies long-term goals for his/her professional life.

Exhibit 28 (Continued) Overview of Strategic SOM Workforce Recommendations by Career Stage	
Target Career Stage	**SOM Workforce Recommendation**
K-12 **Community Colleges** **Four-Year Colleges** **Graduate Schools** **Entry-Level Staff** **Mid-Career Staff** **Senior Leaders** **Retirees**	**7. Implement SOM Succession Plans.** Organizations could identify senior leader positions that will be vacated in the near future due to retirements, transfers, and other means of attrition. In order to fill these vacated positions, the organization could offer the opportunity for entry-level to mid-career employees to participate in training programs that focus on management and leadership issues. This type of training would help employees who are interested in becoming leaders of the organization acquire the skills necessary for advancement and continued success. Employees with strong performance records, who demonstrate both the skills to succeed at the senior level and interest in a future leadership position, may then be matched with a senior leader who serves as a mentor. Mentoring and on-the-job training is particularly important when filling senior leadership positions because many of the incumbents have long tenures and there is a need to have them pass on the industry and agency knowledge they have accumulated over the years, before they retire. In addition to the type of knowledge transfer that comes from mentoring, agencies could create people-focused knowledge management systems that promote knowledge sharing among employees. One possible technique to capture this critical knowledge involves staff working in HR departments interviewing senior leaders about their position and work functions. This includes collecting information on the cognitive processes that may go into making decisions as well as the rationale behind specific procedures and task performance. These interviews will help ensure that institutional memory and expertise is not lost when senior staff retire.
K-12 **Community Colleges** **Four-Year Colleges** **Graduate Schools** **Entry-Level Staff** **Mid-Career Staff** **Senior Leaders** **Retirees**	**8. Recruit from Non-Traditional Sources.** Create recruitment strategies that seek out candidates from non-traditional sources to build a deep and diverse applicant pool. Non-traditional applicants, such as retired military personnel, engineers from the public sector, stay-at-home parents, minority group members, ex-prisoners, retirees, and/or DOT employees from other agencies could prove to be an excellent source for talent. These applicants often have a wealth of knowledge and a desire to return to the workforce in some fashion. In fact, some unemployed individuals may be stay-at-home parents who left work because they did not want a full-time job commitment or older individuals, not yet of retirement age, who went through a company downsizing and have difficulty finding subsequent work. Additionally, some retirees include individuals who leave their jobs due to early buy-outs or government pension plans but still prefer to be working. Knowing what prompted candidates to initially leave the workforce can inform recruitment and offer solutions or arrangements that work for non-traditional employees who might be brought in part-time or benefit from flexible work arrangements. DOTs should consider how to leverage the experience and expertise of non-traditional applicants while keeping in mind that they might not want to maintain a traditional work schedule. When considering non-traditional sources, it is important to note that retired military personnel often show exemplary leadership skills based on the discipline and training they gained in the military.

A summary of the eight action plans is presented in Exhibit 29. This table can serve as a quick reference to all of the recommended action plans as well as a way to compare the action plans on multiple relevant criteria.

5. FULL SOM WORKFORCE ACTION PLANS

For each of the recommendations included in the present report, a comprehensive action plan was created. All eight action plans are presented following the action plan summary table.

Exhibit 29
Summary of Recommended Action Plans

Recommended Action Plan	Source of Initiation	Primary Human Resource Focus	Implementation Level	Return on Investment	Estimated Time to Implement	Action Lead(s)
1. Implement Annual or Semi-Annual SOM Career Days	Agency	Attraction Recruitment	State	6+ years	0-3 months	Agency HR Director
2. Develop SOM Curriculum Content for Related Higher Education Courses and Training Programs	Industry	Attraction Recruitment	National Regional State	3-5 years	More than 1 year	AASHTO Highway Subcommittee on Systems Operations and Management, Regional SOM Associations, or State SOM Manager.
3. Implement Student-Worker Internship Program with a Job Rotational Component	Agency	Attraction Recruitment Retention Development	State	0-2 years	7 months - 1 year	Agency HR Director/Manager
4. Implement Virtual Pre-Employment Realistic Job Preview	Agency	Attraction Recruitment Retention	State	0-2 years	3-6 months	Agency HR Director/Manager
5. Institute Mentoring Program	Agency	Attraction Recruitment Retention Development	State	0-2 years	7 months - 1 year	HR Manager (Designated Mentoring Program Coordinator)
6. Develop Employees and Maintain Employee Career Pathways	Agency	Retention Development	State	0-2 years	3-6 months	Agency HR Director/Personnel Manager
7. Implement SOM Succession Plans	Agency	Retention Development	State	3-5 years	3-6 months	Agency HR Director
8. Recruit from Non-Traditional Sources	Agency	Attraction Recruitment	State	0-2 years	3-6 months	Agency HR Director

Action Plan for Recommendation #1

Implement Annual or Semi-Annual SOM Career Days

Hyperlink to Exhibit 28: Overview of Strategic SOM Workforce Recommendations by Career Stage

RECOMMENDATION #1
Implement Annual or Semi-Annual SOM Career Days

Description: The K-12 target career stage is broken into two age groups so that agencies can create programs and materials that are tailored to better match how the age groups become interested and learn about SOM. The first age group includes students in grades K-8, while high school students are the second age group targeted.

Recommendation Highlights

- Target Career Stage: K-12
- Will help with Attraction and Recruitment
- Estimated Time to Implement: 0–3 months
- Exciting, hands-on approach to introduce students to SOM-related careers at a young age
- Will increase understanding in the community of agency's services, mission, and value to the region

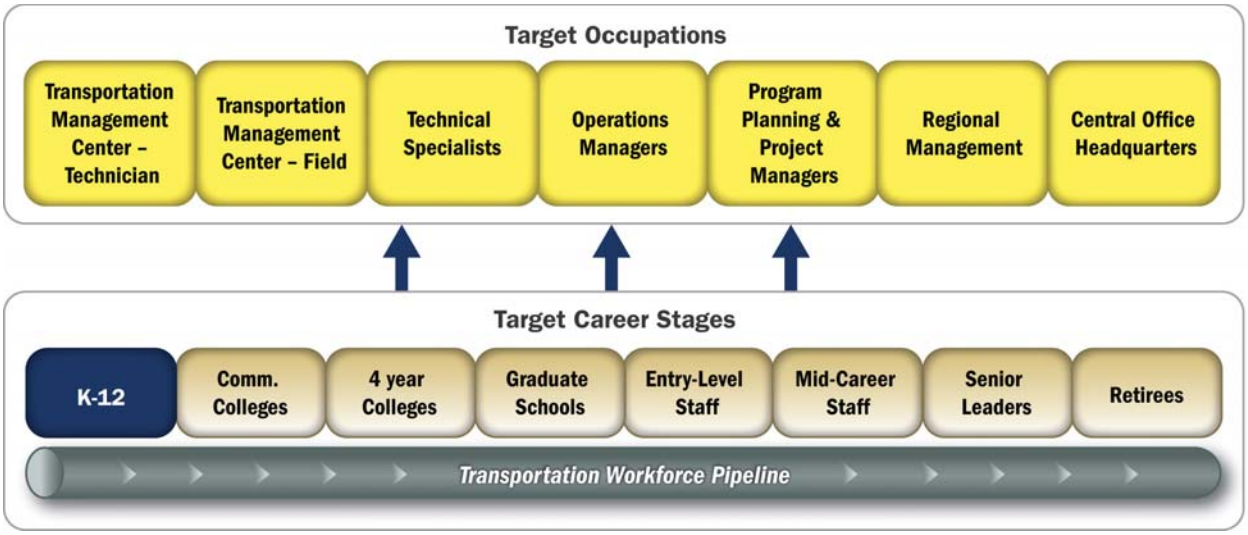
In order to expose elementary and middle school students to the SOM-related fields in the transportation industry, agencies could partner with after school programs to create a 3- to 5-day program that explores different components of SOM. Part of this learning program could include classroom time where students have the opportunity to learn about the transportation industry from a variety of sources (e.g., books, movies, video games), with the goal of piquing the students' interest. It is critical that an emphasis on safety issues is included in the materials. The second part of the learning program could include a field trip to the local transportation agency, which would allow students to see how the concepts they learned are applied in everyday work. Students could try the equipment onsite and experience an SOM job.

In order to expose high school students to the SOM-related fields in the transportation industry, agencies could reach out to vocational technical schools and Science, Technology, Engineering and Mathematics (STEM) schools about developing an SOM Career Day. Students enrolled in these types of schools are taught the skills they need to succeed in today's challenging world. Many of these skills and abilities are sought for in positions within SOM, including the ability to think critically, solve complex problems, and drive advancements in technology. In addition, these types of schools are more flexible in designating a couple of hours or even a day for guests to speak to students about their careers. This opportunity gives employees at DOTs and operation agencies a chance to connect with a young audience and share experiences from their job at a time when these students are expanding their interests and beginning to think about which careers take advantage of their skill sets. SOM employees are able to answer questions and provide detailed examples of their daily work activities and projects.

Rationale for Recommendation: Our interviews with various SOM subject matter experts (SMEs) revealed that SOM job functions and tasks varied greatly among different DOTs depending on their size and resources. As a result, few understand what SOM jobs entail; interview participants indicated that there is ambiguity regarding what a DOT SOM position is and the duties of these jobs. With limited exposure to SOM and a lack of knowledge about its importance, students are less likely to pursue SOM-related careers, and qualified job candidates may not apply to SOM position openings that would otherwise be a good fit for their skill set and interests. In addition, our SOM interview participants indicated that by the junior or senior year of high school, students have begun to identify the subjects they enjoy studying and are already

forming ideas about their career directions. As a result, these two targeted programs can be effective ways for DOT staff to introduce students to transportation careers at a young age, from the time they are just beginning to think about what they want to be when they grow up (Kindergarten), to the point when they are actually beginning to make decisions about their future career (late high school). The DOT and transportation recruiting initiatives receive benefit on a larger scale as well, with more awareness of the DOT's work in the community and potential transportation careers and special emphasis on the DOT's evolving role: maximizing the efficient use of our current transportation infrastructure through increasingly effective operations and management.

RELEVANT POSITIONS



TARGET AUDIENCES

Source of Initiation
- ○ Industry
- ● Agency

Primary Human Resource Focus
- ● Attraction
- ● Recruitment
- ○ Retention
- ○ Development

Implementation Level
- ○ National
- ○ Regional
- ● State

Return on Investment
- ○ 0-2 years
- ○ 3-5 years
- ● 6+ years

Estimated Time to Implement
- ● 0-3 months
- ○ 3-6 months
- ○ 7 months-1 year
- ○ More than 1 year

Action Lead(s)
Agency HR Director

Targeted Audience(s)
After School Program (K-8)

Primary: Program directors and students

Secondary: Parents for further reinforcement.

SOM Career Day (9-12)

Primary: Principals, teachers, counselors, and students at high schools.

Secondary: Parents for further reinforcement.

Components of both programs may also be applicable to community colleges, four-year colleges, and graduate schools.

IMPLEMENTATION PLAN

Steps to Implement

1. **Assemble Agency Project Team.** Create team to lead program development and organization.
2. **Identify and Network with Partners.** Identify and network with either local after school programs or vocational technical/STEM schools and discuss the mutual benefits of developing a joint program for their students.
3. **Hold Planning Meetings with Partners.** Meet with after school program directors or school administrators to schedule an annual or semi-annual day for the career day to occur, and any standards/requirements. This meeting involves establishing expectations, event structure and organization (i.e., location for the event to occur, duration of the event, and schedule for the event), and discussing a plan for marketing and outreach.
4. **Develop Marketing Materials.** Develop marketing materials that provide an overview of the agency, including its mission and goals, with a specific focus on SOM. One month prior to the event, HR personnel send these materials to the after school program director or school administrator who then distributes to teachers. If partnering with a vocational technical/STEM school, ask teachers to inform students of the upcoming career day and have students prepare questions in advance to ask the employees who will be participating (i.e., 1 to 2 weeks prior).

5. **Recruit DOT Participants and Develop Content for After School SOM Learning Program/Career Day.** Identify agency employees in SOM-related jobs at various levels and in different functions who are willing and skilled in sharing their work experiences. These employees can range from field technicians to call center employees, to project managers. HR personnel and other agency employees should collaborate to decide what types of equipment they want to bring with them to create a hands-on experience for the students.
6. **SOM Employees Engage Students.** SOM employees either attend the career day or visit the after school program in work clothes to provide a brief overview of the transportation industry, their experiences and accomplishments working for a state DOT, and any interesting stories about their careers in the DOT. These work experience stories could include visual supplements (i.e., interactive PowerPoint presentations, pictures, short videos). Before the event ends, employees should reserve 20 to 30 minutes to field any questions. Materials should also be developed that students can take home with them, like magazines, pencils, and stickers.
7. **Follow-Up with Partner.** A week after the program/career day, follow-up with the program director or school administrator and discuss the possibility of a class field trip to the agency. This field trip would provide students with the opportunity to apply the information they received during the career day to practice; students could tour the control room, see the traffic cameras, and observe the internal/external operations at the agency.

COMMUNICATIONS PLAN

Communication/Outreach Strategies

- Identify key information resources used by the target audiences (school principals, teachers and counselors, PTAs) to market the idea of including SOM-related careers in existing fairs. These resources can include:
  - Trade associations (i.e., American School Counselor Association, Maryland Association of Secondary School Principals)
  - Specific magazines and publications (i.e., Teacher Magazine, American Educator, School Counselors)
  - Blogs/Websites
  - Conferences

  Informal class presentations or "career days" may be initiated or conducted without these.
- Develop marketing materials to promote the SOM-related career fair to the primary target audiences through the identified information channels for the career days or fairs. Outreach may include web banners, articles for trade publications and magazines, and an email/announcement for bi-weekly e-newsletters.
- Develop materials such as a flyer to provide an overview of the agency, including its mission and goals, with a specific focus on SOM, in order to inform students and parents of the upcoming career day. Some schools will also include a brief write-up in the school's monthly bulletin to parents.

- Develop materials for the actual career fair or career day such as:
  - Brochure to define SOM jobs and to promote the agency/industry in general, including its mission and goals, and career opportunities.
  - Exciting video-vignette testimonials from employees describing the value of their daily jobs and the agency's work.
  - Hands-on activities for students to experience what "a day in transportation operations and management" is like.
  - Take-aways for the students like stickers, posters, backpacks, pins, with a message like "I will be a future engineer" or "Be cool, become a transportation operations technician."

Process for Obtaining Buy-In

- Provide data that highlight the impact of being represented at a career fair, and tie them to specific strategic goals the agency has regarding recruitment and retention targets or cultivating community understanding of the DOT's work.
- Develop a list of other agencies in the region that have participated in school career days.
- Gather materials (data, pictures, videos) that show the impact and critical importance of systems operations and management jobs in the community.
- Identify media contacts (newspapers, radio, magazines) who cover education news and who would be interested in writing a story on the industry's/agency's efforts to educate kids and parents on reputable jobs and careers within the SOM field.

USEFUL INTERNAL AND EXTERNAL RESOURCES

To Implement Practice

- Ensure support from leaders at the industry level.
- Develop materials that can be brought to career days to show students about SOM-related jobs. If possible, provide them with the opportunity to touch and interact with SOM equipment or "tools of the trade." A hands-on experience is more memorable.
- Utilize current employees who are not only high performers, but are also passionate about their job and skilled at working with children and discussing their work experiences in an interesting and exciting way.
- Maintain data on which positions and anecdotes are most appealing to students, at different ages, so that participating employees can tailor their stories to engage students and attract them to a potential career in SOM.

To Sustain Practice

- Ensure support from senior management and school administrators in order to continue to appear at the after school program or career day each year.
- Incorporate feedback from last year's after school program or career day into the upcoming program or career day by making additions where there is interest. This may include introducing students to new technology and letting them experiment with it, or something even simpler such as presenting a video before sharing experiences.
- Demonstrate that the agency's presence in an after school program or at a career day is providing a return on the investment. For example, the agency may calculate: awareness before and after participating at career days, increases in applications received from students looking for a summer job, increases in the number of high school students that continue their education at a trade school.

EXAMPLES OF EFFECTIVE PROGRAMS

- **DOT Construction Career Days.** Construction career day events are workforce development tools that introduce high school students to the transportation construction industry and support the pipeline that will provide the professionals of tomorrow. It's a long-term investment, so future-oriented that some DOTs perceive it as akin to community service; however, the shows can have a memorable, lifelong effect on participants on both sides of the table.

  Construction career day events have successfully promoted the transportation construction industry and the careers it offers since highway agency staff first started to present in local schools. Since 1999, 293,696 students have participated in construction career day events. Since then, more than 250 events have been held nationwide.

As the success and popularity of construction career days have increased, FHWA recognized the need for a centralized source of information and technical assistance to new and existing Construction Career Days host sites. In partnership with Rhode Island DOT (RIDOT), the University of Rhode Island Transportation Center (URITC) was named the National Construction Career Days Center by the FHWA.

In cooperation with FHWA's Rhode Island Division office and RIDOT, the new partnership helps state and local committees effectively reach an expanding target population of students capable of entering the transportation construction industry.

- Contact Information: Jeff Cathcart, Director, Rhode Island T2 Center, 401-874-7075, jcjci@cox.net

- **P.J. Keating Participation in Construction Career Days.** P.J. Keating, a construction materials supplier, sends equipment and volunteers to high school-focused construction career days in order to spark an interest in a construction career. For example, in 2008, over 1,800 students from across the region experienced the world of construction at the Sixth Annual Massachusetts Construction Career Days (MassCCD) in 2008. The event is held at the New England Laborer's Training Academy in Hopkinton. At the event, students learn how to operate backhoes, excavators, jackhammers, pavers, and other construction equipment and participate in concrete finishing, welding, cutting and burning, electrical work, carpentry, laying brick and block, surveying, field engineering, and other hands-on activities. There is also a series of design challenges, including: Design, Construction, and a Universal component (completed by student volunteers prior to the event). Three monetary prizes are awarded to the schools achieving the most points per student. Volunteers from exhibitor companies and the operators that staff the exhibits can talk to the students about the skills, training, and professionalism they have used to succeed. Students also receive information on colleges, trade schools, and certification programs that serve the construction industry. The event gives students the opportunity to learn about the careers in the industry that interest them the most and the scholarships available to help them achieve their goals. This event is geared to give students information on job and educational opportunities in construction, engineering, and environmental fields in both union and open-shop companies. Since the event's inception, P.J. Keating Company of Lunenburg has sent several pieces of heavy equipment and employees to the event, allowing students to experience first hand what the industry is all about. There are typically 200 volunteers on hand at the site each day making sure students and their chaperones are given as much information as possible.

  - Contact Information: Joanne Pagnotta, 978-582-5200 ext: 205, info@pjkeating.com

SOM staff may want to consider how they can add to or leverage existing outreach efforts, to see SOM components included. See the alternative approaches discussed in the next section.

ALTERNATIVE APPROACHES

Alternative Approach 1

It may be difficult for companies to contribute equipment and volunteer time during times of economic instability. Thus, instead of hosting a specific SOM career day, the agency may find it more feasible to simply participate in a career day supported by multiple agencies or other parts of the DOT. Shorter is better, also, to reduce effort and cost. This option allows students the opportunity to learn about a variety of careers from different professionals and still creates an environment where students can get excited to speak to active professionals in their field of interest.

Alternative Approach 2

Since it might be difficult to include a hands-on component at the school-site, the agency could establish a field trip for students in high school. This approach provides a real view of the agency's various departments and activities and can require much less DOT or operations agency staff time. No equipment needs to be brought to a school either.

A field trip to the DOT could also include an opportunity for students to get hands-on experience with the machinery and equipment that is more difficult to offer at a school's career day. A drawback is the difficulty of allowing any large group to interact with machinery or equipment at once, outside of a training facility. Safety is also a consideration, especially in the field and with younger students.

IMPACT

Positive Outcomes of the Practice

- Increase awareness of SOM-related careers. Occupations and tasks can be presented in an interesting and hands-on way that can help to create an exciting perception of transportation jobs in today's youth. Greater awareness and enhanced perceptions of SOM are likely to result in a larger pool of talented applicants in the future.
- Facilitate greater understanding in the community of the agency's services and mission, and awareness of the value the agency brings to the region.

CAUTIONARY CONSIDERATIONS

- There is a necessary time and labor commitment from HR and employees who will need to organize the program, develop and prepare materials, and spend a day away from their regular job.
- The return on investment from these types of programs may not be seen for some time, especially when targeted to younger students, and it can be harder to rationalize the time, from the recruitment and retention perspective. As a result, the agencies should collect feedback from the students and the program's director or school administrator on the program. It is important for the agency to identify specific areas that interest young students so that the subsequent programs can be tailored to generate more interest.

Action Plan for Recommendation #2

Develop SOM Curriculum Content for Related Higher Education Courses and Training Programs

Hyperlink to Exhibit 28: Overview of Strategic SOM Workforce Recommendations by Career Stage

RECOMMENDATION #2
Develop SOM Curriculum Content for Related Higher Education Courses and Training Programs

Description: Associations, university transportation centers (UTCs), and other stakeholder organizations could work with higher education and training providers to develop curriculum content that can be added to existing courses and programs. Target providers might include community colleges, four-year schools, Local Transportation Assistance Programs (LTAPs), and the National Highway Institute. This process will help address the technical needs of the SOM discipline. In addition, since educators influence job decisions (e.g., teachers, school counselors), SOM stakeholders should also consider ways to support students through grants for night school, scholarships for degrees, and certification classes during off-peak times.

Recommendation Highlights

- Target Career Stage: Community colleges and four-year colleges
- Will help with Attraction and Recruitment
- Estimated Time to Implement: More than 1 year
- Critical for creating awareness for SOM occupations and to ensure students have the opportunity to learn and develop skills needed for these jobs
- Developing SOM course content in schools could help to increase numbers of applications, reduce attrition of new hires, and reduce turnover and training expenses

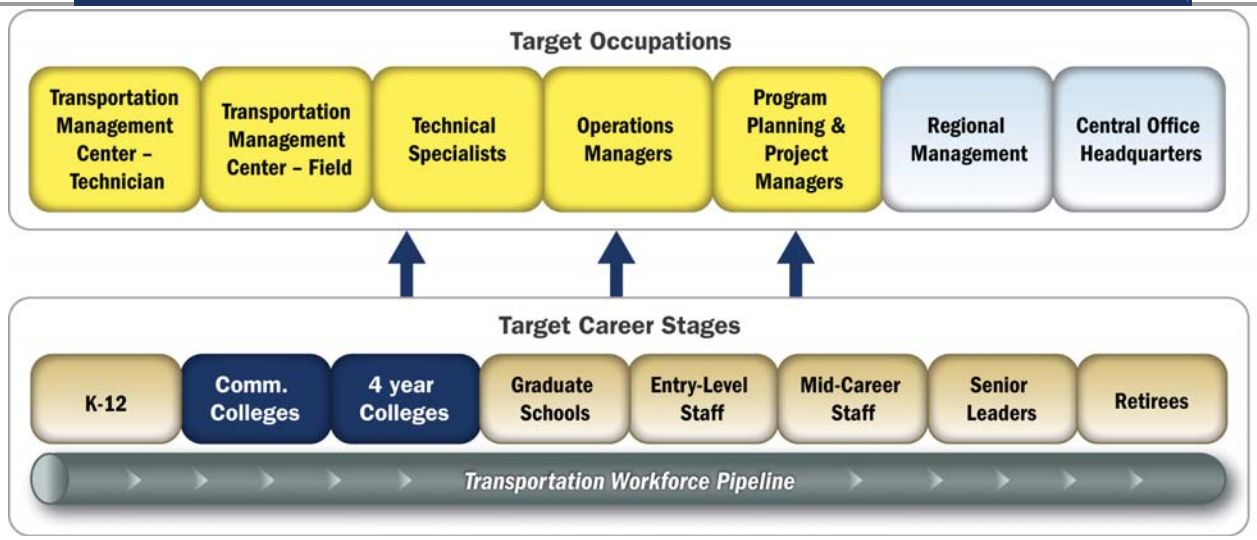
Rationale for Recommendation: These collaborations can help ensure that trained SOM personnel are ready for hire, when a transportation agency needs them. Phase 1 results indicated that the development of SOM curriculum will serve a critical need in developing the SOM pipeline. For example, interview participants indicated that SOM personnel learn about opportunities in transportation SOM while enrolled in school. Civil engineering courses in community colleges and universities that focus on transportation or even just begin discussions of transportation applications can be the gateway to SOM careers (Agrawal and Dill, 2009).

Interview participants also reported that, like many other areas of transportation, but particularly in a cross-cutting transportation field like SOM, the training students receive from colleges and universities is often insufficient to prepare for a career in SOM. SOM represents a unique combination of engineering, communications, technology, and systems management that frequently requires backgrounds in multiple fields to perform well. An advantage is that this mix of topic areas can be very attractive to young applicants; however, awareness of the opportunity for employment and the development of particular skills in communications, technology, and systems management need to be increased.

More specifically, research participants commented on the importance of communication and collaboration skills for employees within SOM and indicated that finding engineering applicants with these skills is a challenge. More often than not, the communication and collaboration skills that SOM staff need are primarily developed through experiences and cross-training in diverse fields. Furthermore, some noted that the training offered to students is too broad; they have experienced entry-level applicants lacking key, specialized SOM skills. Several participants indicated that the curriculum used at universities and colleges sometimes does not focus on SOM skills at all. These

participants have observed a trend in students already focused on the specific field they want to enter when they join the transportation workforce, without knowing about or ever having heard of SOM. These participants suggested that students from these programs, although relatively qualified as entry-level staff, often do not even consider SOM as a possible field because it is not included in the curriculum. More than ever, DOT involvement would be helpful in working with training providers and colleges to understand and develop SOM skill sets and the transportation system of the future.

RELEVANT POSITIONS



TARGET AUDIENCES

Source of Initiation
- ● Industry
- ○ Agency

Primary Human Resource Focus
- ● Attraction
- ● Recruitment
- ○ Retention
- ○ Development

Implementation Level
- ● National
- ● Regional
- ● State
- ○ Agency

Return on Investment
- ○ 0-2 years
- ● 3-5 years
- ○ 6+ years

Estimated Time to Implement
- ○ 0-3 months
- ○ 3-6 months
- ○ 7 months-1 year
- ● More than 1 year

Action Lead(s)
AASHTO Highway Subcommittee on Systems Operation and Management, regional SOM associations, or state SOM manager.

Targeted Audience(s)
Primary: Education agencies, trainers, college deans, and curriculum developers, as well as state workforce agencies who are charged with updating technical curriculum to meet workforce demands. Local Transportation Assistance Programs (LTAPs) and the National Highway Institute can also be among the target audiences for these programs.

Secondary: Professors, students

IMPLEMENTATION PLAN

Steps to Implement

1. **Assemble Agency Project Team.**
2. **Conduct a Job Analysis.** Once objectives are defined, a detailed job analysis should be conducted around each of the work activities that will be covered in the classroom. The job analysis will define the specific job tasks to be covered as well as their complexity, frequency, importance, and learning difficulty.
3. **Develop General Course Objectives.** Course objectives are the beginning point of any well-organized curriculum. Course objectives will help to define the general work activities that should be taught in the program or course. Objectives can typically be developed through the agency project team as well as industry resources and interested stakeholders.
4. **Partner with Education Agencies, Faculty, and/or Trainers.** Collaborating with external education decision-makers will allow SOM staff to tailor the curriculum development process to the needs of course providers. It will also increase buy-in from these stakeholders.

5. **Develop Performance Objectives.** Performance objectives are statements describing what the learner is able to do after each task has been taught. They include the conditions, expected behavior, and the minimum level of achievement. A performance objective outlines the basics of the lesson; it tells what the student will do, how it will be done, and how the student will be evaluated when the task is completed. Performance objectives are an outgrowth of the goals and expectations of an occupation.

6. **Select the Instructional Strategy.** There are many other ways of delivering informational content than just lecture. Sometimes lecture and demonstration is perfect. Other times, a different approach may work better. With today's student, new and innovative teaching techniques must be considered. Students are more adept at using problem solving and critical thinking skills because of their familiarity with computers and the technology they have grown up with. The method of delivery chosen also depends a great deal on what is being taught. To determine the best method for the materials, seek advice from experienced curriculum developers, experiment, and evaluate. Some delivery options include role plays, peer teaching, cooperative learning, demonstration, interactive video, and independent study, but there are many others.

7. **Write Theory and Demonstration Steps.** Every lesson has theory. This is what is explained to the students about the task. Usually, it is done in the classroom. Most lessons have demonstration; this is where the students are shown how to do the task, in a lab setting. This includes safety, terminology, equipment needed, reasons for performing each step of the task, and review of any previous tasks that are needed as prerequisites.

   Theory steps do not need to cover every conceivable point of information. The purpose of listing theory is to help organize the operation in the instructor's mind. Terminology is important in writing theory steps. Theory only covers what will be conveyed to the student. There is no demonstration in the theory part of the lesson. Theory statements begin with a verb, and as a rule, only a few verbs are used. These include: explain, identify, discuss, review, and describe. Here are some examples:

   a. Explain relevant safety precautions.
   b. Discuss the importance of measuring twice before cutting.
   c. Review color codes.

   In essence, theory statements constitute a lesson plan outline.

   Demonstration includes the step-by-step process necessary to perform the task, beginning with safety precautions and ending with a final step, such as checking for accuracy or cleaning up the work area. Demonstration should have these characteristics:

   a. A logical step of progression toward total task performance.
   b. A sequential set of skills as substeps.
   c. It can be demonstrated, performed, and evaluated as a meaningful task component.
   d. All of the steps should equal the task performance.

   It should be noted that demonstration steps are only used when the task calls for an active performance by the student.

8. **Develop Methods to Measure Student Performance.** The last step in curriculum development is important because in order to evaluate student performance, written and performance tests need to be developed. Performance assessments help determine if the student has reached the desired goal.

9. **Refine Materials Based on Changing Job Requirements and Evaluation Feedback.** A valid and usable curriculum is one that is constantly under revision to keep up-to-date with advances in the field and improve instructional content.

COMMUNICATIONS PLAN

Communication/Outreach Strategies

- Identify information channels that reach out to colleges, education professionals, and potential students, such as grassroots organizations, associations, and non-profits.
- Share instructional materials developed internally, job descriptions, job analyses, etc., and discuss need shortfalls and projected hiring.
- Develop materials to promote the new curriculum through the identified information channels. In class, resources might include a one-page hand-out that instructors of existing courses can use. Other resources may include college websites, publications, and events/fairs (i.e., web banner for website, article for quarterly magazine, web poster for bi-weekly e-newsletter).
- Develop materials for college recruitment fairs such as a flyer to promote the new SOM program, email to registered participants, and advertisement through the fair magazine.
- Develop materials to target students/potential recruits:
  - Radio announcements (on-air and web-streamed)
  - Video vignette with SOM student testimonial to disseminate through social media venues
  - Tweet SOM-related news
- Identify media contacts (newspapers, radio, magazines) who cover education news and who would be interested in writing a story on the new curriculum offerings and the importance of SOM careers.

Process for Obtaining Buy-In

- Provide data that highlight the impact of the new curriculum and tie them to specific strategic goals the industry has regarding recruitment targets. For example, develop a succinct PowerPoint presentation highlighting key data that supports the recommendations.
- Reach out to and partner with workforce investment boards and education agencies that influence the curriculum of colleges and explain that incorporating more SOM-related content into their curriculum can increase enrollments.
- Develop a story on the unique characteristics of the curriculum; its advantages for students, employers, and the workforce in general; and satisfaction of employees in the field.

- Obtain case studies indicating success of other industries and/or transportation fields in similar curriculum development efforts and co-benefits in terms of college enrollment, if possible.

USEFUL INTERNAL AND EXTERNAL RESOURCES

To Implement Practice

- Obtain support from leaders at the industry level.
- Create job descriptions to identify job tasks and knowledge, skills, and abilities needed to perform the job.
- Engage subject matter experts who are invested in the development of the new curriculum, and who can provide useful information about the job and the target candidate pool throughout the development process.
- Compile data on which positions are the most difficult to fill and could benefit the most from a college SOM program.
- Find organizations who work with colleges and/or education professionals who can act as partners/advisors on the project.

To Sustain Practice

- Ensure support for revisions to the curriculum every few years or as needed so that it is tailored to best meet recruitment targets and needs, and the current labor pool and economic conditions.
- Collect evidence that the curriculum is providing a return on the investment. For example, the industry may calculate the following: turnover data before and after implementing the new curriculum, money saved due to reduction in turnover, increases in applications received, retention numbers over specific periods of time, and increases in new hire performance.

EXAMPLES OF EFFECTIVE PROGRAMS

- **LDOTD's Master's of Engineering Program**. The Louisiana Department of Transportation and Development's (LDOTD) Master's of Engineering initiative is a good example of a curriculum development project that is currently underway. LDOTD estimates between 30 and 40 percent of the agency's workforce will be eligible to retire in the next 5 years. As a result, LDOTD recognized a need to build the skills of staff that will remain with the agency. Thus, LDOTD is currently implementing a Master's of Engineering program to improve their workforce development efforts by making higher education more accessible to LDOTD employees. Through educating employees, the agency hopes to be better able to fill those positions, specifically those of middle managers, which will be vacant due to retirement. LDOTD is coordinating with engineering schools in Louisiana to use distance learning technology, which allows courses being taught on one campus to be viewed by participants in a

class/training room at another university or LDOTD facility. The courses, coordinated by LDOTD, will be taught by faculty members at the participating universities who are recruited by the Louisiana Transportation Research Center (LTRC).

LTRC has been spearheading the implementation efforts for LDOTD's Master's of Engineering Program. Currently, LTRC is working to obtain buy-in from potential partner universities. To date, LTRC has showcased the Master's of Engineering Program at the Louisiana Engineering Transportation conference, and publicized the program through the American Society for Civil Engineers, Louisiana Engineering Society, the DOTD's internal intranet and email systems, and several other societies and discussion boards. Because the Master's of Engineering Program is still in the implementation process, only one individual has gone through the whole program and received a degree so far, but the graduate's feedback for LTRC was very positive.

- Contact Information: Louisiana Transportation Research Center, 225-767-9131

- **Massachusetts Partnership Between Green Industries and Community Colleges.** The Environmental Technology program at Cape Cod Community College (CCCC) emerged in 1994 in response to Cape Cod's significant environmental degradation. Since then, this state-funded, green-workforce training program has improved and expanded to include training in new technologies such as renewable energy sources and energy efficiency measures used to combat climate change. Along with two nearby technical vocational high schools, CCCC is preparing students with the knowledge and technical skills needed to join the growing environmental workforce. The program also provides students with valuable real-world learning experience through internships designed to help the student and the organization where they intern. At the same time, the college has become a leader in sustainability by greening its own campus and encouraging other schools to do the same. As a result, CCCC has become a leading voice in the environmental movement among institutes of higher education both regionally and nationally.

  - Contact Information: Valerie Massard, Environmental Technology Program Coordinator, 508-362-2131 ext. 4468, vmassard@capecod.edu

ALTERNATIVE APPROACHES

Alternative Approach 1

Develop in-house SOM training program that provides new hires with proper knowledge-base and skills to perform SOM duties proficiently. This would occur at the agency level and require less coordination of resources across agencies and less outreach to unfamiliar educational institutions. An in-house training program would also require a significant time and monetary investment in each new hire, but SOM may experience other benefits from having the needed knowledge systematized in this fashion.

Alternative Approach 2

Develop a short, optional SOM training event that could be added into an existing college transportation program. This approach would not provide graduates who are fully versed in the SOM field but would at least introduce them to SOM concepts, providing many of the benefits at less cost and effort. It may also be a quicker method for the industry to influence the current education system and may be more readily received by colleges, as it requires lower investment. This approach can also be employed as an interim measure.

IMPACT

Positive Outcomes of the Practice

- Increase in college graduates with SOM skills.
- Increases in applications.
- Reduced attrition in new hires.
- Reduced turnover and training expenses.
- Money saved in training costs due to filtering out hires that are a poor fit.
- Improved performance of new hires.

CAUTIONARY CONSIDERATIONS

- High Cost—Obtaining the funding to develop and implement new curriculum. Developing an SOM program at the college level will certainly lead to more skilled applicants, but it will be expensive and labor intensive to develop. Knowledgeable professionals from the DOT, regional agency, or local governments may need to supply much of this. It is essential that champions work with agency and/or state leadership to secure this funding and time commitment in advance.
- Use of Resources—Time and labor commitment from stakeholders and subject matter experts will be substantial for a 6-month to 1-year period or longer. Again, it is best if project leaders work with agency and/or state leadership to secure resources in advance. This will decrease the chance of delays during the development and implementation process.

Action Plan for Recommendation #3

Implement Student-Worker Internship Program with a Job Rotational Component

Hyperlink to Exhibit 28: Overview of Strategic SOM Workforce Recommendations by Career Stage

RECOMMENDATION #3
Implement Student-Worker Internship Program with a Job Rotational Component

Description: Agencies could implement student-worker internship programs that allow for the option to rotate jobs. Such programs allow DOTs to target universities with students in specific programs and offer them paid positions while in school at lower rates than typical employees. Rotational job programs provide students with the opportunity to work in more than one job over the course of their involvement in the program. This gives them the opportunity to experience different jobs, learn about different functions, experience SOM-related duties from multiple perspectives, and work on a variety of different projects. Within each rotation, students could be assigned a mentor who is responsible for supervising the student and serving as a point of contact for any issues that may arise. These programs are attractive to students who are looking for real-world experience as well as income, and provide agencies with a means to have a presence on college campuses and develop a pipeline for talent. The job rotation component provides students with an opportunity to try different kinds of work, increasing the chances they will find a job they like at the agency and also increasing the chances they will stay if hired, given their previous exposure to the actual job duties.

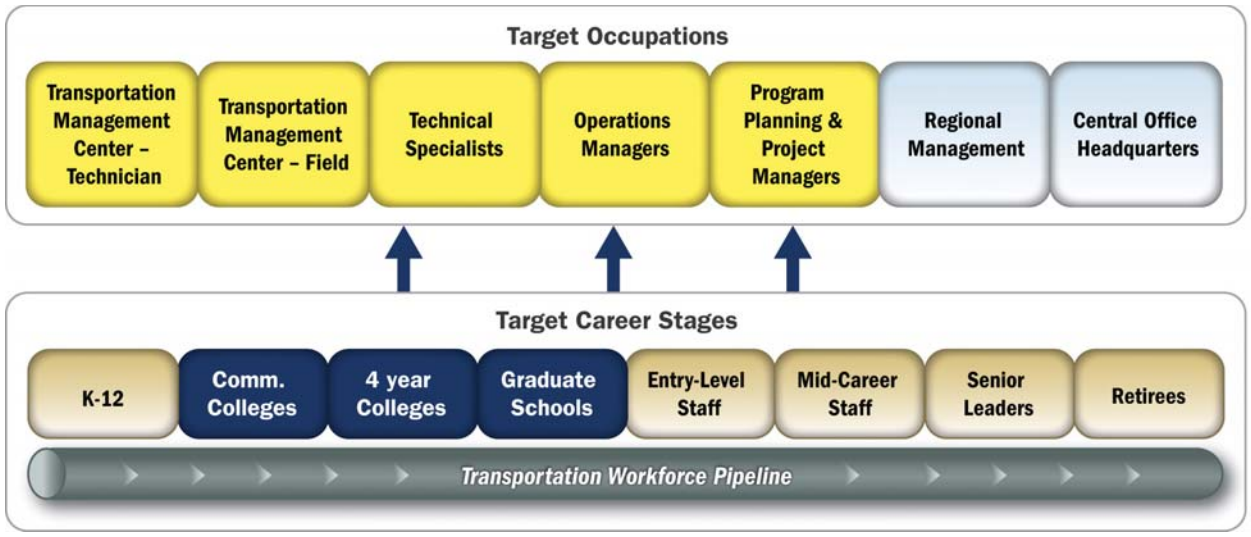
Recommendation Highlights

- Target Career Stage: Community colleges, four-year colleges, graduate programs, and Transportation Research Centers (TRC)
- Will help with Attraction, Recruitment, Retention, and Development
- Estimated Time to Implement: 7 months to 1 year
- Mutually beneficial approach to introduce college students to SOM occupations and variety of different duties and tasks
- Will increase number of college educated applicants to SOM jobs with actual work experience
- Will reduce turnover because new hires will have job experience prior to being hired full-time

Rationale for Recommendation: DOTs perceive these programs as having a high benefit-cost ratio and showing results in an observable time period. Such programs function as a mutually beneficial way to introduce college students to SOM occupations and a variety of different duties and tasks, while providing the training and orientation to make entry-level hires more useful, longstanding employees. Our findings in earlier phases of this project indicated that despite the economic downturn, DOTs remain concerned about a looming shortage of employees and experienced staff to promote as Baby Boomers near retirement. Many interviewees indicated that their agency's workforce is mainly composed of long-tenured employees, most of who are over the age of 40, and nearing their retirement. Interviewees also noted their agency's struggles and in some cases minimal success in recruiting and retaining their desired number of younger employees, especially before the economic downturn. While hiring is down and recruits are staying longer now, this workforce challenge is a concern for state DOTs because it threatens a significant loss of institutional knowledge. As a result, it is critical that DOTs create programs that attract, recruit, and retain qualified workers, ideally those who are already trained and prepared to replace the retiring workers. However, as suggested by interviewees, the training students receive from colleges and universities is often insufficient to prepare for a career in SOM. In addition, our research indicates that SOM is a relatively new focus for DOTs. Given that SOM is a new field to many people and

that colleges and universities do not address many of the important aspects at this time, a rotational job program for students would expose and train them at a pivotal point in their academic studies, and perhaps attract them to the interesting and important work in SOM-related professions within the DOT.

RELEVANT POSITIONS



TARGET AUDIENCES

Source of Initiation

- ○ Industry
- ● Agency

Primary Human Resource Focus

- ● Attraction
- ● Recruitment
- ● Retention
- ● Development

Implementation Level

- ○ National
- ○ Regional
- ● State

Return on Investment

- ● 0-2 years
- ○ 3-5 years
- ○ 6+ years

Estimated Time to Implement

- ○ 0-3 months
- ○ 3-6 months
- ● 7 months-1 year
- ○ More than 1 year

Action Lead(s)

Agency HR Director/Manager

Targeted Audience(s)

Primary: University career centers and faculty who provide career advisement in degree programs related to SOM fields.

Secondary: Students.

May also be applicable to continuing education programs, including community colleges and graduate schools.

IMPLEMENTATION PLAN

Steps to Implement

1. **Assemble Project Team.** Assemble agency project team, including HR personnel and project managers.
2. **Determine Positions for Program and Competencies for Success.** Meet with project managers to identify a variety of positions and work functions to be included in the program. During these meetings, HR personnel should also identify the specific knowledge, skills, and abilities (KSAs) and competencies to look for in applicants.
3. **Determine Number of Openings.** Determine the number of position openings available based on budget and amount of work to be done. Identify employees interested in serving as mentors who are capable of supervising and being a point of contact for the student who rotates through each opening. It may be helpful to develop a mentor training workshop to debrief employees on the responsibilities and expectations of mentors. Also, determine the duration of time students will spend in a position before rotating to another. Make a comparison of full-time equivalent need to student availability and how rotated positions may supplement this need.
4. **Select Incentive Structure.** Select an incentive structure to apply to the program (It might be helpful to review the agency and departments budget). Below are examples of four different incentive structures:
    a. Paid Structure—Agency pays the student while they work, similar to an internship program.

b. Academic Credit Structure—Agency partners with nearby colleges to support the program, which allows students enrolled in specific courses the opportunity to receive academic credit for successful completion and a strong performance evaluation. The agency does not pay the students while they work.

c. Partial Scholarship Structure—Agency does not pay the student while they work, but after completion of the program and a strong performance evaluation the student can apply for a scholarship to help pay for the upcoming college year. The student is capable of having the scholarship available to them for the remainder of their college years, if they return to the program each summer.

d. Full Scholarship Structure—Agency does not pay the student while they work, but after completion of the program and a strong performance evaluation the student can apply for a scholarship to help pay for the upcoming college year.

5. **Develop Job Descriptions.** Develop job descriptions for student-worker positions including requirements, duties, required knowledge, skills, and abilities.

6. **Recruit at Local Colleges and Universities.** Develop relationships with local college and university career centers, and advertise for the positions at these schools. Contact faculty directly for positions that target within a specific discipline, as these faculty members may be able to recommend top-performing students. Agencies might receive better reception from colleges that have already developed Cooperative Education Programs. University Transportation Centers (UTCs) may also be another good source to target for candidates.

7. **Develop Hiring Process.** Develop a process for choosing students if demand exceeds number of available positions. May look at GPA, letters of recommendation, or conduct interviews.

8. **Determine Application Deadlines and Position Start Dates.**

9. **Host an Orientation.** Host an orientation meeting on the first day of the program to introduce students to the program and introduce them to their first mentor/supervisor. An orientation also provides a good opportunity for the student and mentor to discuss their interests, expectations, and goals for their time in the position before they rotate to the next position. This meeting is important because it allows the mentor to learn about the student's experience so he/she can be placed on projects and be responsible for tasks that meet their knowledge, skills, and abilities.

10. **Gather Feedback.** Collect feedback from students after the program end date about which experiences they found most beneficial and interesting. Also, provide students with constructive feedback on their performance.

COMMUNICATIONS PLAN

Communication/Outreach Strategies

- Identify four-year colleges nearby that are willing to partner with the agency.
- Develop marketing materials such as:
  - Brochure with a synopsis of the program, along with some of its accomplishments and statistics on students who enrolled and began their career. Included in this synopsis should also be job descriptions based on the type of work students should expect to be exposed to and specific competencies applicable to the position.
  - Webpage with detailed information on the agency and the program.
  - Short video-vignettes with student testimonials to be placed on the website and disseminated through other social media sites targeting students.
  - Information card/flyer with program's name and website.
  - Radio spots.
  - Web banner/poster to disseminate through colleges/career centers' websites, Facebook, and other websites targeted to the students.
  - Newspaper/magazine advertisements.
  - Career day participation of current student workers.
- Attend college career/recruitment fairs and have the printed material to disseminate as well as a video screen displaying vignettes showing examples of students performing different types of SOM-related work in a DOT. Gather e-mail addresses to follow-up with students and send additional information.

Process for Obtaining Buy-In

- Provide data that highlight the impact of program, and tie them to specific strategic goals the agency has regarding recruitment and retention targets.
- Develop a story on the unique characteristics of the program and its advantages for students, employers, universities, and the workforce in general. Identify media contacts interested in covering the story.
- Obtain case studies from other agencies that have implemented similar programs (i.e., internship programs, apprentice programs, job rotational programs). Emphasize benefits such as a stronger presence in the community, increased employee satisfaction, and better employee job fit.
- Set-up meetings at career centers and do presentations at local universities to talk about the benefits for universities to participate in a student-worker program with a DOT.
- Develop and describe specific goals and anticipated results for the program.
- If implemented, monitor success of moving student workers into full-time positions post-graduation to demonstrate success or identify program weaknesses.

USEFUL INTERNAL AND EXTERNAL RESOURCES

To Implement Practice

- Compile metrics indicating success for similar programs at DOTs, such as increases in applications and the number of positions filled with employees with a college degree.
- Use job descriptions and input from managers on the positions and work functions that would be best for student workers.
- Collect feedback from students on which positions and job functions they found most beneficial to their career and which experiences they enjoyed most in general.
- Develop contacts at local universities particularly at career centers.

To Sustain Practice

- Constantly look to improve the program over time based on feedback from students and career centers.
- Collect feedback upon the students' completion of the program. This feedback may be collected in a meeting between HR personnel and the student, similar to that of an exit interview, or it may be conducted via paper or e-mail survey. It is important that the feedback be reviewed and incorporated into next year's program. A common weakness is that information is collected, but additional time is not taken to review and absorb what has been provided.
- Compile evidence the program is providing a return on the investment (ROI). For example, the agency may calculate: increases in program applicants from year to year, length of tenure for employees who began as student-workers vs. employees recruited in other ways, money saved due to reduction in turnover, increases in qualified applications received, retention numbers over specific periods of time, and increases in new hire performance. These measures to calculate ROI are further described below.
    - Annual Increase in Program Applicants—shows an increase in student awareness and interest of SOM positions. Successful efforts to use the program to reach out to college students and to market the program to colleges will have a significant impact on the program's ability to increase applicants from year to year.
    - Length of Tenure for Employees (Student-Workers vs. Others)—shows the program's success in recruiting and retaining qualified SOM employees, compared to other recruitment efforts. Students who participate in the program as a resource to explore SOM as a career may feel an extra commitment to the agency because of the value they received from the program.
    - Money Saved from Decreased Turnover—shows the monetary value of the program in retaining SOM employees. Again, students who participate in the program as a resource to explore SOM as a career may feel an extra commitment to the agency because of the value they received from the program.
    - Increase in Qualified Applicants—shows the program's ability to raise awareness of SOM while promoting SOM as a viable career and attracting qualified students interested in

pursuing a job within SOM. Again, successful efforts to use the program to reach out to college students and to market the program to colleges will have a significant impact on the program's ability to increase qualified applicants.

- Increase in New-Hire Performance—shows the program's ability in preparing students for a successful career in SOM. The program's ability to provide students with valuable hands-on experiences and exposure to working on a team and better understanding of the work processes (i.e., operations) that occur in SOM are essential to the program's success in increasing new-hire performance.

EXAMPLES OF EFFECTIVE PROGRAMS

- **Mn/DOT Seeds Program**. Minnesota Department of Transportation's (Mn/DOT) program, called Seeds, is an approach to growing talent in-state, as an alternative to out-of state recruiting. The program began with the intent to find good students, connect them with on-the-job learning opportunities, and build them into well-qualified potential job candidates. The program has a special focus on increasing ethnic, gender, and economic diversity among the job classes in which Mn/DOT is hiring. The Seeds program has a 72% placement rate, which Mn/DOT considers a worthwhile investment.

  Mn/DOT has expanded from potential engineers to other employment classes, including the technicians that compose 50% of the agency's workforce. Mn/DOT has tried to make sure they have a Seeds presence, such as Seeds students, in every part of the department; leaders have found that to be the best way to get the word out about the program. Mn/DOT has also supported program implementation through use of its community liaison program, supervisor training, mentoring support, and an annual workshop for Seeds participants and managers. Mn/DOT has developed Seeds program guidelines and presentations, which can be shared with other state DOTs.

  Mn/DOT has measured success in the number of permanent hires the agency has made out of the Seeds program. The agency also credits a percent of its total diversity, now at 25%, to the achievements of the Seeds program. Mn/DOT has devoted 1.5 full-time equivalent (FTE) staff and about $500,000 annually to implementing Seeds, which accommodated 70 students this past year and trains about 50 students in an average year. The program manager handles the mentoring program and helps with performance reviews for the students. Part of the success of the program is the investment in the students throughout their careers, such as mentoring and shepherding to help the student navigate the DOT and prepare for a DOT career. Five disabled candidates have been hired in the past year as an outgrowth of the program. Finally, in addition, the program boasts an outstanding placement rate and higher Grade Point Averages (GPAs) and levels of supervisor satisfaction than standard hiring methods and hires.

  - Contact Information: Denise Hals, Seeds Program Manager, 651-366-3379, denise.hals@state.mn.us

- **ODOT College Internship Program.** Oregon Department of Transportation's (ODOT) College Internship Program is one of the largest in Oregon. ODOT's internship program was initially designed to introduce interested engineering students to the agency and enable them to get hands-on experience on actual projects, which in turn helps interns determine what aspects of engineering they like most and want to pursue. ODOT invested in marketing of the program and advertised the opportunity as one where interns could work on real projects with incredibly smart and creative people.

  Each year, the initial step in implementing the internship program is the collection of internship projects and positions from various managers around the state within the highway division. These managers complete a summary of the project and intended outcomes, and identify measurable activities and goals. Available internships and locations are posted online. Then the ODOT HR personnel and interested managers and specialists perform a nationwide, in-person recruiting effort at colleges and work fairs in the West, South, and Midwest.

  ODOT traditionally offers between 65 and 70 internship opportunities each summer, with over 200 highly qualified engineering students applying each year. The requirements are rigorous, so quality stays high. Interns must maintain a GPA of over 3.5, present references from two professors, and answer essay questions on their reasons for interning and what they expect to gain from their internship. ODOT HR implements an interview process with those applicants who qualify after the first hurdle. Based on these conversations and submittal records, HR works with the managers to understand what type of candidate and qualifications they are seeking. HR then chooses four to five candidates and presents these candidates to the managers.

  This program has expanded to include not only recruitment of interested engineers, but also recruiting heavy equipment operators and mechanics and potential candidates with backgrounds in Information Systems. ODOT is now also doing some recruiting for Right-of-Way (ROW) and geotechnical positions and is continuing to expand its internship program to cover other areas, such as accounting and finance.

  ODOT sees student interns as their greatest marketing tool, especially when these students return to their schools and talk with other students about the agency. ODOT further supports the program with an offsite orientation and mid-summer engineering conference for networking and the sharing of projects and lessons learned. The program also feeds ODOT's Graduate Engineer program, a rotation program available to both internal staff and recent graduates.

  In addition to paying the salaries of 1.5 full time employees, ODOT spends money each year to sustain the internship program's success. The agency budgets around $150,000 to $200,000 per year for the program's marketing and national outreach efforts. The agency also hosts "engineering days" which cost $20,000 to $30,000 per day and draw the community of interns and agency staff together in joint learning. This includes the costs associated with renting a center to host the event in an offsite location.

  The internship program provides students with the opportunity to obtain valuable hands-on experience and training as they work with other employees on large, real-world projects. Through students' word-of-mouth and communication about the program, ODOT has been able to successfully brand itself as one of the leading DOTs and places to work.

  - Contact Information: Daniel Killam, HR Manager, 503-378-6796, daniel.killam@odot.state.or.us

- **PennDOT Civil Engineer Training (CET) Program.** PennDOT has created the Civil Engineer Training (CET) program to identify, recruit, and retain civil engineers by allowing program participants to gain 1 year of work experience rotating through the phases of civil engineering (CE) work at PennDOT. CET participants, or CETs, are inducted into a class of 25-35 trainees; each trainee must pass department tests and go through orientation and training programs to become acclimated to their work with PennDOT before they begin their year-long rotation. After they complete all the requirements associated with their 12 months of training and job rotations, the candidate becomes eligible for full-time permanent status as a Civil Engineer with PennDOT.

  The CET program equips candidates with a supervisor, training coordinator, and a mentor to familiarize them with PennDOT and guide their career development. PennDOT created a manual for the CET program discussing the roles and responsibilities of the CET, the work phases CETs will experience (e.g., the planning and programming phase, design phase), the training courses CETs will take and activities in which they will participate, and evaluation forms for CETs to track their own progress and evaluate the CET program. Additionally, PennDOT requires CETs to maintain a daily log of activities in the form of a journal, which serves as a record for PennDOT and for the trainee to track his or her progress.

  The CET program was implemented by the Workforce Division of PennDOT. The Workforce Division brought subject matter experts (SMEs) together from various DOT disciplines to help create the CET manual, which gets distributed to all trainees. PennDOT's Workforce Division also partnered with the Civil Service Commission to streamline the CET application process, which can otherwise be cumbersome, and to ensure the validity of the CET entrance exam. PennDOT communicates the practice to employees and to college students, the target audience of the CET program, through learning institutions; the PennDOT website; and internally through PennDOT's intranet site, job fairs, and the Civil Service Office in the Commonwealth of Pennsylvania. All steps of implementing the CET program have been performed internally, and thus the only cost to PennDOT has been in employee time and resources.

  To assess the success of the CET program, PennDOT uses a number of measures:

  1. Survey CETs and their supervisors for feedback;
  2. Examine trainees' performance reviews at the end of each trainee job rotation;
  3. Read CETs' journals; and
  4. Examine CET completion rates of various markers in the CET program.

  Based on the feedback from the aforementioned methods, and on the increasing applicant pool and rising retention rates, PennDOT considers the CET program a success and credits the program with improving organizational performance.

  - Contact Information: Pennsylvania Department of Transportation, Bureau of Human Resources, 717-787-3803

ALTERNATIVE APPROACHES

Alternative Approach 1

Rather than developing and organizing a student-worker program, DOTs may offer summer internships or allow students to shadow employees performing SOM-related duties. Although internships would also provide students with the opportunity to learn about SOM-related jobs, the students may have less time to learn about a variety of different jobs and would have less of an opportunity to earn income/incentives. The DOT also gains less familiarity with the students and potential hires than the more comprehensive programs outlined above.

IMPACT

Positive Outcomes of the Practice

- Increased numbers of college-educated, qualified applicants with actual job experience.
- Reduced attrition in new hires.
- Enhanced perception of the industry. More likely to attract stronger applicants, who then are more likely to recommend to friends and colleagues that they apply.
- Reduced turnover and training expenses.
- Saved money in training costs due to filtering out hires that are a poor fit.
- Improved performance of new hires.
- Greater awareness in the community and specifically at local colleges and universities of the different types of SOM work performed at DOTs, as well as the agency's services and mission.

CAUTIONARY CONSIDERATIONS

- There is a significant time and labor commitment from HR and employees involved in every element of this effort—the program would need to be developed, partnerships would need to be formed with local universities and colleges, and employees would need to take extra time to train and mentor the student-workers. Significant internal recruiting needs to occur and some supervisors need to see data/outcomes showing that supervisors tend to be more satisfied with recruits identified by HR through this process, than through other contacts they receive.
- There is a risk that student workers will view the program as an opportunity to earn income and experience while in school, but then look to work in another sector or industry after the DOT provides their training. If this occurs, agencies would still have benefited from employing the educated workers at lower wages than a full-time employee while they were in the program. Agencies could consider developing a contractual agreement with the students that provides additional incentive, but requires students to return to the agency upon obtaining their degree.
- There could be generational differences between younger and older interns, specifically concerning their level of experience. Agencies should consider age and experience when identifying the positions to be included in the rotational program. Mentors should also meet with their student worker at the beginning of the rotation to better understand their interests, expectations, and goals.

Action Plan for Recommendation #4

Implement Virtual Pre-Employment Realistic Job Preview

Hyperlink to Exhibit 28: Overview of Strategic SOM Workforce Recommendations by Career Stage

RECOMMENDATION #4
Implement Virtual Pre-Employment Realistic Job Preview

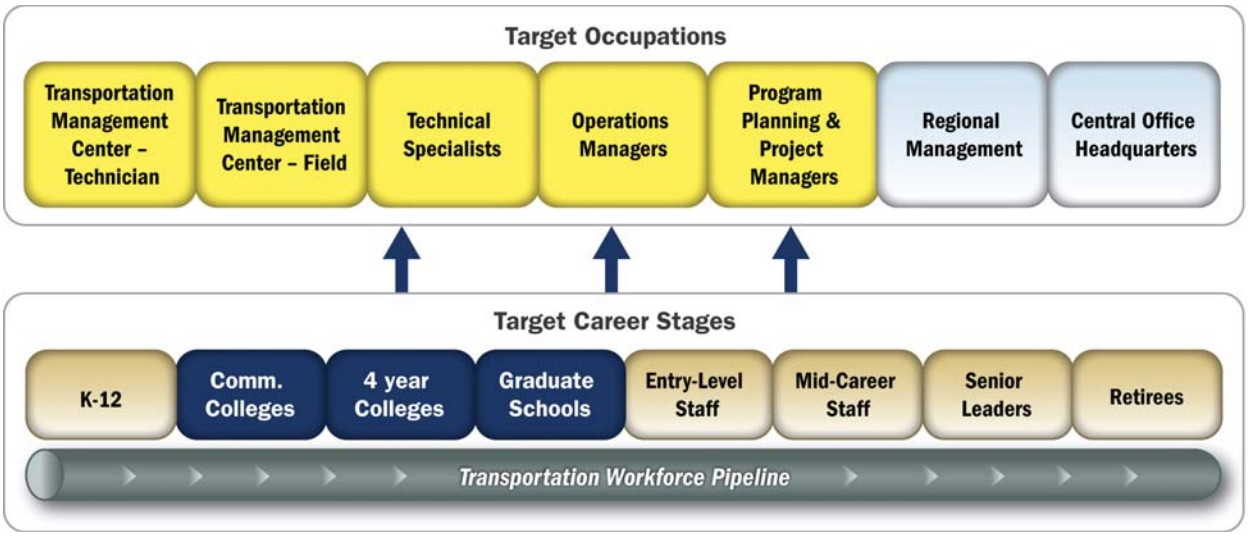
Description: Agencies develop a virtual pre-employment realistic job preview (RJP) that interested candidates can complete before applying for a job. Such tools are web-based and interactive, providing candidates with a candid preview of what the job entails by allowing them the opportunity to see what the job is like and participate in simulated job tasks. A virtual job preview can present various SOM-related positions in a way that candidates find interesting and impressive. The RJP is like a virtual day in the life of an SOM employee. Using an RJP, such as a video or a virtual job tryout, can show potential employees work conditions or exciting situations or activities experienced on the job, which may encourage applicants to pursue a career within the agency. An RJP can also help frame job expectations so new employees are not surprised or potentially disappointed by unknown requirements experienced on the job. Virtual presentations can be very high-tech, which can also help to attract potential applicants and bring new employees to the SOM field.

Recommendation Highlights

- Target Career Stage: Community colleges, four-year colleges, and graduate schools
- Will help with Attraction, Recruitment, and Retention
- Estimated Time to Implement: 3–6 months
- Provides opportunity for applicants to determine if they will be a good fit for the position
- Can provide a "wow" factor to applicants, given the interactive web-based technology
- An RJP can help to increase numbers of applications, reduce attrition of new hires, and reduce turnover and training expenses

Rationale for Recommendation: Technological innovations have played a large role in the evolution of SOM careers. Innovations, such as Intelligent Transportation Systems (ITS), which involve the convergence of communication, computing sensing, and control technologies, require technologically savvy systems operators and managers. Cutting-edge recruitment technologies, like a virtual, interactive RJP, are not only more likely to attract a larger, more diverse candidate pool in general, but they will also attract a more educated, technology savvy applicant pool, in an efficient manner. Appealing to this applicant pool will be critical when attempting to fill openings in the top growing SOM occupations over the next 10 years such as Network System and Data Communication Analyst, Signal and Track Switch Repairer, and Computer Specialist. Furthermore, the existing skill gaps associated with SOM occupations, such as ITS knowledge, Geographic Information Systems (GIS), critical thinking, document management, and systems management, can be reduced by focusing the tool on these areas.

RELEVANT POSITIONS



TARGET AUDIENCES

Source of Initiation
- ○ Industry
- ● Agency

Primary Human Resource Focus
- ● Attraction
- ● Recruitment
- ● Retention
- ○ Development

Implementation Level
- ○ National
- ○ Regional
- ● State

Return on Investment
- ● 0-2 years
- ○ 3-5 years
- ○ 6+ years

Estimated Time to Implement
- ○ 0-3 months
- ● 3-6 months
- ○ 7 months-1 year
- ○ More than 1 year

Action Lead(s)
Agency HR Director/Manager

Targeted Audience(s)
Primary: University Career Centers and Department Faculty providing career advice/mentoring to students at community colleges and four-year colleges, as well as to graduate students.

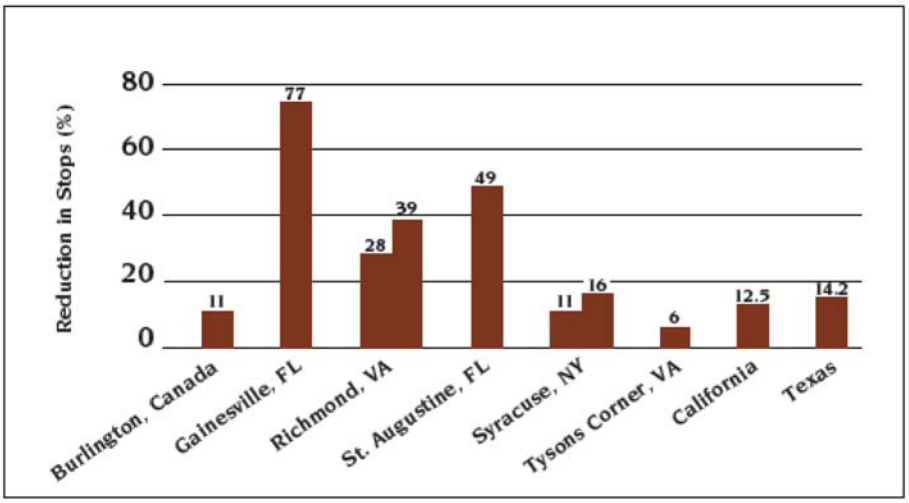
IMPLEMENTATION PLAN

Steps to Implement

1. **Assemble Project Team.**
2. **Identify Vendors and Compare Prices and Services Offered.**
3. **Identify Subject Matter Experts (SMEs).** These are typically employees who supervise candidates for the target position.
4. **Meet with Vendor to Finalize Requirements for the Development of the Tool.** This meeting involves establishing expectations and team roles; determining how the tool will fit into the current process; and defining the project scope, communication, and change management plan.
5. **Job Analysis.** Vendor conducts performance modeling and job analysis with participation from SMEs. The vendor would typically review job descriptions; conduct site visits, focus groups and SME interviews; and administer a job analysis questionnaire. This can provide information about the job to be presented in the RJP.
6. **Determine Format of Output.** Agency works with vendor to determine format of the output from the administrations. Vendor should provide training on administering the RJP.
7. **Quarterly Reports.** Vendor produces quarterly reports demonstrating applicant activity and ROI. Agency should monitor the RJP over time to ensure that the content remains representative of the job.

Graphic Depiction

Below, we have provided a sample graphic that may be part of an RJP. This graph, depicting Reduction in Number of Stops with Traffic Signal Coordination,[4] may be used to show a candidate the type of data and outputs that would be a part of their job. The candidate could also see how this graph is interpreted or what can be inferred from its contents.



COMMUNICATIONS PLAN

Communication/Outreach Strategies

- Develop materials to promote the tool through university and employer/professional association websites, publications, and events/fairs (i.e., web banner for website, article for quarterly magazine, web poster for bi-weekly e-newsletter).
- Identify top career fairs where the tool can be administered and onsite interviews can take place.
  - Develop materials for career fair such as flyer to promote virtual tool experience, email to career fair registered participants, advertisement through career fair magazine, etc.
- Identify top universities offering SOM specific careers and provide them with information on the tool (flyer, cover email, article).
- Partner with top job search engines to promote SOM careers through the RJP experience through methods such as web banners on websites, emails to members/registrants according to career/interests, and e-newsletters.
- Target students/potential recruits directly through social media venues.

[4] Figure adapted from *Intelligent Transportation Systems Benefits, Costs, Deployment, and Lessons Learned: 2008 Update.* U.S. Department of Transportation Research and Innovative Technology Administration, September 2008.

- Develop introductory home page where potential SOM applicants can launch the tool.
- Promote the interactivity feature of the tool through LinkedIn, YouTube, and SOM Facebook group/targeted ads.

- Attend college career/recruitment fairs and have the printed material to disseminate as well as a video screen displaying vignettes showing examples of students performing different types of SOM-related work in a DOT. Gather e-mail addresses to follow-up with students and send additional information.

Process for Obtaining Buy-In

- Provide data that highlight the impact of the tool and tie them to specific strategic goals the agency has regarding recruitment and retention targets.
- Develop a story on the unique characteristics of the tool and its advantages for students, employers, universities, and the workforce in general.
- Obtain case studies from the vendor indicating success of previously developed tools, demonstrated ROI, and other benefits of RJPs such as positive applicant perceptions.
- Provide a sample to leaders to try out the assessments to gain buy-in.

USEFUL INTERNAL AND EXTERNAL RESOURCES

To Implement Practice

- Establish support from leaders at the industry level.
- Develop job descriptions—to identify job tasks and knowledge, skills, and abilities needed to perform the job.
- Engage SMEs who are invested in the development of the tool, and who can provide useful information about the job and the target candidate pool throughout the development process.
- Compile data on which positions are most difficult to fill and could benefit the most from a virtual pre-employment RJP.
- Create specific recruitment and retention goals—based on these goals, a vendor may be able to project return on investment (ROI).

To Sustain Practice

- Ensure support for revisions to the tool every few years or as needed so that it is tailored to best meet recruitment and retention targets and needs, and the current labor pool and economic conditions.
- Provide evidence the tool is providing an ROI. For example, the agency may calculate:
  - Turnover data before and after implementing the tool.
  - Money saved due to reduction in turnover.

- Increases in applications received.
- Retention numbers over specific periods of time.
- Increases in new hire performance.

EXAMPLES OF EFFECTIVE PROGRAMS

- **Washington State DOT's Use of Social Media.** Washington State Department of Transportation (WSDOT) decided to enhance their recruitment efforts through the use of a variety of social media applications, including Twitter, Facebook, MySpace, and YouTube. Their Human Resources Department decided to interview several employees, asking them about their experience working for the DOT, their favorite parts of their jobs, and some of the challenges they deal with on a day-to-day basis. These employee interviews were recorded on video and uploaded to YouTube when a similar position to the one described became open. Their use of Web 2.0 and other media outlets allowed them to reach different audiences, at a minimal cost. Furthermore, it significantly improved their recruitment rates.
  - Contact Information: Erica Mulherin, Social Media Manager, 360-705-7733, mulhere@wsdot.wa.gov
- **Shaker Consulting's Virtual Job Tryout for Starbucks.** Shaker Consulting developed an interactive tool for Starbucks called a Virtual Job Tryout (VJT). The VJT is a highly engaging, interactive, customized assessment tool that allows candidates to learn about Starbucks and virtually try out the job, while collecting data that predicts job performance. In the VJT this is all done through an online platform that delivers interactive simulations that are highly representative of the actual job. The results of the assessment provide valuable data to Starbucks on how likely the candidate is to perform successfully in the job, and candidates have indicated that the VJT has helped them gain a better understanding of the job and determine if it was a good fit for them. The VJT has helped Starbucks to optimize talent selection and reduce turnover.
- **Shaker Consulting's Virtual Job Tryout for CVS Caremark Pharmacy Supervisor.** Shaker Consulting created a VJT for CVS Caremark, specifically for the pharmacy supervisor position. CVS Caremark was experiencing a high level of turnover in this position. The pharmacy supervisor position is always filled internally, by promoting a current pharmacist into the pharmacy supervisor position. However, pharmacist and pharmacy supervisor are two distinct roles, each with separate requirements. Additionally, pharmacists are not taught the duties that a pharmacy supervisor is required to perform. As such, this VJT was created in order to provide insights regarding the opportunities and challenges of the pharmacy supervisor position to pharmacists. It is an engaging way that the pharmacists can see a true "day in the life" picture of the position. Because pharmacists who may be interested in the pharmacy supervisor position are now able to see what it truly entails through the VJT, turnover in the pharmacy supervision position has decreased.
  - Contact Information: Shaker Consulting, 888-485-7633, info@shakercg.com

- **Sheetz Realistic Job Preview.** Sheetz, Inc., a family owned convenience store, contracted with Five Star Development in 2008 to build a Web-Based Realistic Job Preview and Compatibility Test. The online tutorial is very attractive with its bright, interesting, and interactive module that allows job seekers to choose the realistic job preview that best matches their skills. Additionally, Sheetz advanced their RJPs by personalizing them with the information they initially collected from the job seeker. Sheetz developed multiple pathways for job seekers to experience the tutorial, RJP, and test that best reflected the position of interest. Also included were a set of job standards and expectations associated with the position, as well as information about the company's culture.
  - Contact Information: Sheetz, Inc., 800-487-5444

ALTERNATIVE APPROACHES

Alternative Approach 1

Develop paper-based RJPs or provide tours of the workplace where participants can see first-hand what the job is like. Although these alternatives may be less costly to the agency, they do not provide the same "wow" factor as a virtual, interactive tool.

Alternative Approach 2

Similar to Washington State DOT, a less expensive approach could involve using social media outlets in order to reach larger audiences and enhance the brand of the agency. Agencies may, for example, videotape employees performing their job or interview them about their job, and post them on Facebook.

Alternative Approach 3

When the economy is poor and DOTs have a choice of many applicants, filtering through those applicants, finding the best fit, and saving time are all factors for the agency. The visual-interactive aspect and opportunity to present the agency and the job all have the potential to boost recruiting. An additional segment could be recorded that emphasizes "fit" and encourages more self-filtering and thus time-savings for the DOT, that could be used during times when applicants are plentiful.

IMPACT

Positive Outcomes of the Practice

- Improves the image applicants form of the agency when applying. Stronger applicants are more likely to accept offers and are more likely to recommend to friends and colleagues that they apply.
- Produces increases in applications.
- Ensures a better "fit" between applicants and job needs.
- Decreases attrition in new hires.
- Reduces turnover and training expenses.
- Improves performance of new hires.

CAUTIONARY CONSIDERATIONS

- Cost—Obtaining the funding to develop and implement a virtual pre-employment RJP and assessment can be a challenge. Use of the latest technology and increased realism will help make the tool a success, but it may be more expensive and labor intensive to develop. When considering the implementation of a new RJP, it is important to plan for the costs that will be incurred.
- Requires a substantial time and labor commitment from HR and SMEs, as well as incumbents, to develop a tool that is realistic, fair, and predictive of actual performance on the job. Again, it is necessary to plan for these labor costs when considering the creation of a new RJP.
- Success relies upon identification of and accessibility to the appropriate candidate pool, which may take additional resources. This could be minimized by ensuring that appropriate candidate pools are established and means of accessing these candidates are set up before trying to use the RJP.

Action Plan for Recommendation #5

Institute Mentoring Program

Hyperlink to Exhibit 28: Overview of Strategic SOM Workforce Recommendations by Career Stage

RECOMMENDATION #5
Institute Mentoring Program

Description: In order to quickly develop and onboard entry-level staff or other employees new to the SOM field, mentoring programs (both formal and informal) are effective. Mentoring programs typically involve pairing someone more junior with an individual in a similar field of work who has more experience in the organization (e.g., 5+ years) and a successful performance record. Mentoring programs have also shown success for encouraging and engaging minority workers by partnering the worker with someone who is more advanced in his/her career, who may share similar demographic characteristics and therefore may have experienced certain challenges or perceived barriers that the junior person may encounter during early stages of his/her career.

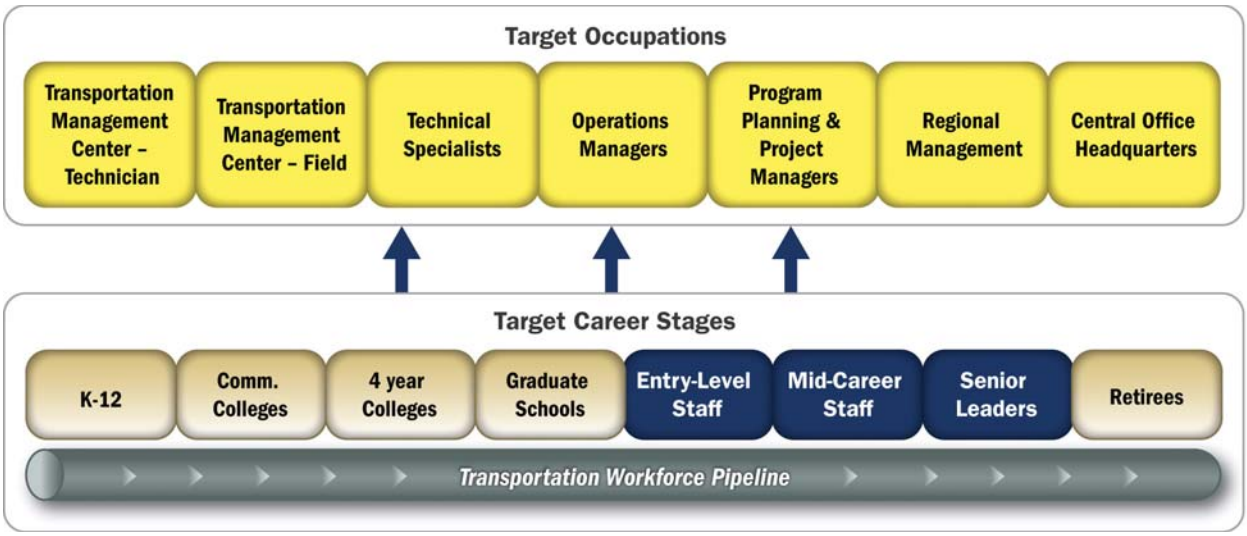
Recommendation Highlights

- Target Career Stage: Entry-level staff, mid-career staff, senior leaders
- Will help with Attraction, Recruitment, Retention, and Development
- Estimated Time to Implement: 7 months to 1 year
- Provide opportunity for new employees to learn about their job and the agency from an experienced staff member
- Can lead to workers who are more satisfied and more likely to succeed in their jobs

Rationale for Recommendation: As the Baby Boomers retire, the marketplace faces the most diverse workforce ever encountered. Whereas many SOM managers, professionals, and technicians are older white males, the potential applicant pool for SOM positions is much more diverse in almost every state and metro area. These changes in the demographics of the applicant pool have already impacted the demographics of the current SOM workforce. For example, the majority of participants interviewed indicated their respective agency has begun to reach out to populations often overlooked (e.g., minorities, veterans, ex-prisoners). As a result, these interviewees reported an increase of younger employees, minorities, and women employed at all levels of the SOM field. While tapping into minority populations to expand the applicant pool helps alleviate challenges associated with maintaining a sustainable workforce, it may also give rise to new challenges for management. For example, one participant indicated that communication issues may arise as a result of cultural and/or language barriers.

Lastly, the impending influx of younger workers into leadership positions presents another set of challenges. For example, younger workers typically expect more support from their employers in terms of work-life balance and flexible work arrangements (Zemke, Raines, and Filipczak, 2000). Participants also commented on the younger generation's need to see how they can advance throughout their career, which is sometimes difficult to illustrate in SOM since the field currently lacks a standardized career path. These types of benefits may need to be added to recruitment packages to attract, recruit, and retain a viable workforce. Furthermore, participants indicated that motivational factors vary across generations, specifically citing the younger generation's need to be stimulated and challenged in their work, perhaps as a result of growing up with an emphasis on multi-tasking. These differences result in the need for new management approaches in order to keep younger employees engaged and sometimes to retain them in the workforce. These changes in the demographic composition of the workforce and the influx of so many new workers argue for increased focus on mentoring and other programs that support efficient development and inclusion into the workplace culture.

RELEVANT POSITIONS



TARGET AUDIENCES

Source of Initiation
- ○ Industry
- ● Agency

Primary Human Resource Focus
- ● Attraction
- ● Recruitment
- ● Retention
- ● Development

Implementation Level
- ○ National
- ○ Regional
- ● State

Return on Investment
- ● 0-2 years
- ○ 3-5 years
- ○ 6+ years

Estimated Time to Implement
- ○ 0-3 months
- ○ 3-6 months
- ● 7 months-1 year
- ○ More than 1 year

Action Lead(s)
HR Manager (Designated Mentoring Program Coordinator)

Targeted Audience(s)
Primary: New hires within the organization and those identified as strong performers with a predetermined amount of experience. The new hires should be assigned mentoring relationships within their first month of hire.

IMPLEMENTATION PLAN

Steps to Implement

1. **Assemble Committee**. Assemble committee including HR Manager, recruitment staff, and senior leadership, which will be led by the mentoring program coordinator.
2. **Design Mentoring Program**. Design the mentoring program by laying out the program objectives, coordinators, size, and scope of program.
3. **Determine Mentorship Match Criteria**. Determine match criteria that will designate how mentees/protégés and mentors are placed into relationships. A formal mentoring program, as recommended, includes mentees being assigned a specific mentor based on predetermined criteria. Example criteria for matching include:
   - Competency Matching—Mentees are matched based on their weak areas. Mentors are selected based on their strengths or level of proficiency on competencies such that mentors can help a mentee "fill in competency gaps."
   - Job Type Matching—Mentees are matched with mentors who have at least 5 years of experience in the same job type and who have demonstrated excellent performance of the job tasks.
   - Demographic Characteristics—Mentees may be matched with mentors across jobs or lines of business based on sharing common characteristics with the mentor such as age, race or gender.
   - Combination Approach—Matches occur based on a combination of factors. Typically the factors are prioritized so that the first "cut" for matching occurs along the most important dimension and then within that dimension, and additional factors are considered prior to making a match.
   - Allow input on specific matching by mentors. The senior-level staff often see relationships that would be most conducive to mentoring based on criteria that are very qualitative or "soft."
4. **Market the Mentoring Program**. Conduct briefing sessions where employees learn about the program, including its benefits and how the restructured program differs from past mentor programs.
5. **Recruit Mentors through Various Media Channels**. Information should include benefits for the mentor, program expectations, and time commitments. Interested employees should be asked to complete an application. Mentors should be "pre-screened" to ensure they have good working relationships with their colleagues and have no indiscretions on their performance record that might result in a mentee being put at risk should the behavior re-emerge.
6. **Invite Mentees to Participate**. This should occur at the same time as mentor recruitment. However, it is recommended that once a mentoring program is established, mentees are assigned a mentor within 1 month of employment to help with the onboarding process. The mentee should also be informed of the benefits and expectations.

7. **Administer Self-Assessments**. At this point, mentor applications should be screened by the program coordinator. Mentors who display a lack of interest or time or who may have ulterior motives for applying should not be selected. Mentors as well as all mentees who apply should be asked to complete a self inventory that is based on the match criteria.
    - For example, the inventory may include a competency self-assessment. This brief survey should ask the participants to rate themselves on how proficient they believe they are on each of the competencies. Responses will be made on a four-point scale with their perceived level of proficiency ranging from 'expert' to 'limited" or low proficiency in an area.
8. **Match Mentor and Mentee**. Based on the criteria selected in Step 3, the mentor and mentee should be matched and provided with the appropriate contact information to initiate the relationship. Two important considerations in matching include:
    - Mentor should not be in the mentee's chain of command (e.g., the mentee's direct supervisor).
    - For entry-level mentees, the mentor should be two levels above the mentee. This can assist the new employee in learning the technical skills that are necessary for the position.
    - For senior-level employees who are hired mid-career, the mentor should be someone at the same level as the mentee because this new employee will already have the technical skills required for the job, but will benefit from a mentor who can help teach the role the new employee will fill in the organization.
9. **Train Mentors on Their Role as a Mentor.** Optimally, before meeting with their mentees, mentors should receive training. This training should be formalized, with all mentors being required to participate. Required potential topics could include what it means to be a mentor, how to be a successful mentor, personal benefits associated with being a mentor (e.g., respect, developing a new relationship), and a place where mentors can go to ask questions or seek advice about the mentoring program.
10. **Conduct Orientation and Training**. The orientation session provided to program participants should meet the following objectives:
    - Outline the program's structure, roles, and responsibilities for mentees and mentors as well as program staff, and clearly delineate the expectations and limitations of the program.
    - Identify additional resources available to the mentee/mentor pairs, including career counseling services and quarterly conferences designed to encourage and assist the mentoring pairs.
    - Provide activities and a structured environment in which the mentees and their mentors can begin to develop their mentoring relationship.
11. **Build Camaraderie among Mentee-Mentor Pairs**. Plan and offer activities to build camaraderie and support among mentee-mentor pairs such as guest speakers on career development, group lunches, trainings, job-related conferences, and end-of-year mentoring celebrations.

12. **Monitor and Evaluate the Program at Regular Intervals** . It is recommended that formal evaluation of the mentoring program take place on a quarterly basis. This includes collecting feedback from mentees and mentors on the effectiveness of the program. Structured evaluation forms should be developed and used each time data is collected in order to make comparisons across evaluations. It is also essential to get feedback from both participants before and after.

COMMUNICATIONS PLAN

Communication/Outreach Strategies

- As part of Implementation Steps 4 and 5, it is important that the incentives and expectations for participating in a mentoring relationship are clearly defined. Mentoring relationships often fail due to unmet expectations (e.g., the mentee expects the mentor to be accessible every day but the mentor is rarely available; the mentor sees little value in continuing as a mentor).
- With respect to Step 7 under Implementation, results of any assessments or personal information collected as part of the matching process should be treated with strict confidentiality. For the mentoring relationship to be successful, participants' supervisors should not be involved in the selection of mentors or in review of any information regarding the mentee. For success, it is important to inform participants that the assessment process is for matching and program evaluation purposes only and will not be used to influence the participants' performance appraisal process.
- For Steps 9, 10, and 11 under Implementation, the program coordinator should distribute inter-office mail memos and post information clearly on the agency intranet regarding upcoming trainings and activities. These postings should occur at least 2 months in advance of the sessions, require RSVPs, and be paired with reminder notices 1 week in advance to ensure all mentees and mentors are aware of events and have the opportunity to participate.
- The mentoring program can be used as a hook to recruit new staff at career fairs and transportation-related conferences/events. Marketing materials describing the program such as a brochure or flyer should be developed to distribute at these events.
- In the effort to recruit minorities, the agency should identify organizations committed to the professional advancement of different groups and try partnering with them or identifying events/conferences they could attend with recruitment purposes (e.g., Women's Transportation Seminar – WTS, Society of Hispanic Professional Engineers).

Process for Obtaining Buy-In

- As part of the first implementation step, agencies are encouraged to engage senior leaders in articulating the program objectives and scope of the mentoring program. Allowing the senior leaders a voice helps to gain top management support, which is critical to ensuring that the initiative is adopted throughout the organization.
- The program coordinator should be responsible for identifying the ROI of the mentoring program and should hold regular meetings with the senior leadership team and initial mentoring committee to discuss program evaluation results and ways to make continuous improvements.

USEFUL INTERNAL AND EXTERNAL RESOURCES

To Implement Practice

- It is essential that the agency has a staff member who is dedicated to implementing, sustaining, and evaluating the mentoring program.
- The agency needs access to individuals with expertise in training design and delivery to develop the mentee and mentor training/orientation sessions.

  Example topics that could be covered in a *mentee training session* include:

  - Review of program expectations and activities.
  - Identifying personal mentee goals.
  - How diversity affects mentoring relationships.
  - Situations where seeking assistance from a mentor would be appropriate.
  - Situations where seeking assistance from a mentor would not be appropriate.
  - Tools for building a relationship with mentor.
  - How to be a productive mentee.

  The *mentor training session* could include the following topics:

  - Review of program expectations and activities.
  - Basic mentoring skills.
  - How diversity affects mentoring relationships.
  - Effective interpersonal and communication skills related to coaching and providing feedback.
  - The mentor's role in helping the mentee set and achieve developmental goals.
  - How to be an effective mentor.
  - Tools for building a relationship with mentee.
  - Suggestions and ideas for future meeting topics.

To Sustain Practice

- The mentoring program needs to be highly integrated with other leadership, knowledge capture, and training initiatives. Mentoring should be tailored to provide mentees with specific guidance and activities that are appropriate for where the participant is in his/her career.
- The agency needs to designate a program coordinator who is responsible for continuous communication about the mentoring program to ensure that its value is recognized throughout the organization. Top management support is also integral to keeping mentors and mentees engaged and making sure the pairs prioritize time spent on mentoring.

- Record evidence of where and how the mentoring program provides a return on investment. For example, the agency may calculate: turnover data before and after implementing the mentoring program, money saved due to reduction in turnover among mentees, any increases that may be discerned in applications received, retention numbers over specific periods of time, and increases in new hire performance.

EXAMPLES OF EFFECTIVE PROGRAMS

- **Idaho EIT Mentoring Program.** The Idaho Transportation Department employs a successful, formal mentoring program as part of the Engineer in Training (EIT) program. The mentoring program is required while participating in the training program. For the program, an experienced engineer mentor is paired with a new trainee protégé. These matches are made purposefully by a selection committee based on the interests, goals, and areas of expertise of the mentor and the protégé. In making these matches, the program stipulates that mentors cannot be in the direct supervisory line of protégés. Both the mentor and protégé must sign a contract that sets out clearly defined expectations between the mentor and protégé and they must work together to ensure that the mentoring relationship is successful. Participants in the program are provided with a handbook that gives advice for both mentors and protégés, which covers communication, each person's role in the mentoring relationship, how to deal with conflict, necessary worksheets, and further resources regarding how to be an effective mentor or protégé. The program stipulates that each mentor-protégé pair must meet for at least 1 hour each month. This program successfully exposes new employees to the organizational culture, the technical requirements of the job, and provides managerial and organizational information. It is also used as a means to help develop future leaders. While protégés benefit from the support, encouragement, and information that they receive, mentors benefit by the positive impact they are making, earning admiration and respect, and by improving and refining interpersonal skills. In order to ensure that the mentoring program is successful and all mentor-protégé pairs are benefiting, semi-annual evaluations are conducted by mentors and protégés regarding each other as well as the program as a whole.
  - Contact Information: Matt Farrar, EIT Coordinator, 208-334-8538, matt.farrar@itd.idaho.gov
- **New Jersey DOT Succession Planning Mentoring Program**. As a part of succession planning at the New Jersey DOT, experienced leaders are paired with less experienced employees in a mentoring program. The purpose of this mentoring relationship is to provide the mentee with career guidance, encouragement, knowledge, and a role model in order to assist in meeting individual goals as well as becoming future leaders. For this program, mentees are given the option to choose a mentor who can either be inside or outside of the NJDOT. Because this mentoring program is a part of NJDOT's succession planning, all participants are expected to be future leaders and are thus required to take initiative in driving the mentoring relationship. Therefore, the goal of the program is to help mentees in becoming future leaders.

Mentor-mentee pairs are expected to meet for at least 2 hours each month, focusing on areas the mentee wants to improve in and on assessments of the mentee. The mentoring program is 1 year in length, and includes both formal training sessions and individual meetings with the mentor. After a year is completed in the mentoring program, mentees can choose to stay with their mentor or choose a new mentor, but they are encouraged to remain in the program.

- Contact Information: New Jersey Department of Transportation Succession Planning program, sp@dot.state.nj.us

- **Charleston County Government Mentor Network Program**. The government of Charleston County, South Carolina, recently implemented a pilot mentoring program called the "mentor network program" to help workers at all levels of the organization develop into leaders. It is a leadership tool. Mentees chose their mentors. Similar to a speed-dating approach, protégé bios are distributed. The pilot program started with five pairs. The potential pairs were given a certain amount of time to meet each other as done in speed dating. The matched pairs then worked together for a year. The program is a structured and formal program. Once a month, the pair is required to submit information to their human resource division. The mentoring pairs are provided with mentor toolkits, articles on mentoring, and forms to help with dialogue. Self-assessments (Meyers-Briggs Personality Tests) were conducted to ensure those chosen for the pilot had the appropriate focus. People in mentoring relationships were not restricted to the same functional areas.

  - Contact Information: Evelyn DeLaine-Hart, Director of the Office of Organizational Development, 843-202-6917, edelaine-hart@charlestoncounty.org

- **Joint Workforce Investment (JWI) New Operator/Mentor Pilot Project.** The Joint Workforce Investment (JWI), established in 2006, is a joint labor management partnership between the Santa Clara Valley Transportation Authority (VTA) and the Amalgamated Transit Union Local 265 (ATU). Both organizations operate together as one "JWI" team. The JWI sponsored several projects including the "new operator/mentor pilot project." This one-year pilot project, now complete, paired 26 new operators who graduated in January 2008 with 17 veteran exemplary operators who acted as mentors. Prior to working with new operators, mentors were trained via a course offered by a local university partner. The program provided best practice customer service and job stress coping skills through on-the-job mentoring and classroom training. The mentoring and classroom training followed a coordinated curriculum, the content of which was driven by the experiences of veteran operators. With the support of the JWI team, a third-party consultant was used to collect job-relevant data, collective work experiences, and lessons learned and then form that information into several training modules. New operators and veterans have indicated that the curriculum was more "real and relevant" because of this inclusive development process. Seeing their contributions reflected in the curriculum also developed a sense of professional pride among many employees. At the beginning of the mentoring relationship, the new operators would spend 8-hour days on the veteran's bus and then later the veteran would spend a similar amount of time on the new operator's bus. New operators were brought back for classroom sessions with mentors at three critical junctures in their year-long apprenticeship. The collective bargaining agreement between ATU and VTA created the apprentice designation in 2008. This early intervention prevents new operators from developing bad habits and attitudes that amplify stress. Eventually, when the new operators began to drive on their own, they were encouraged to call their mentor at any time to discuss problems. The mentoring program is supported by a Job Development Initiative

Fund (JDIF) grant from the Chancellor's Office of the California Community College system.

- Contact Information: Santa Clara Valley Transportation Authority, 408-321-2300 or 800-894-9908

ALTERNATIVE APPROACHES

Alternative Approach 1

Agencies facing constraints in their human resources function or limitations in funding may choose to implement an informal mentoring program where mentees select their own mentors. In some cases, the agency may choose to partner potential mentees-mentors upon hire of a new employee (the mentee) but the length of the relationship is not defined by the agency. These programs often have established no-cost activities that are not required but that encourage mentees and mentors to interact such as "brown bag lunches" and networking sessions. Challenges with an informal program include difficulty in assessing the quality of the mentoring relationship and unmet expectations, and lack of accountability to ensure that each person upholds his/her role. Risks include potential backfire if an employee is persuaded to leave based on his/her impression of the organization through the lens of the mentor who lacks a positive attitude. Last, but not least, there often tends to be little opportunity for evaluation with an informal program.

Alternative Approach 2

An agency that is not able to dedicate one person solely to the role of program coordinator may request volunteer coordinators from different divisions to provide oversight to the program for a specified amount of time (e.g., 6 months to 1 year). Furthermore, if enough mentors are not available to match with new hires, networks of mentors can be used where a mentee has a list of individuals they can approach for different needs and the mentors are shared across mentees.

Alternative Approach 3

A mentoring program could be considered by the TRB and AASHTO committees covering SOM activities. Because committee activities can differ quite significantly from typical SOM activities, it can be difficult for new committee members to adapt to their newly acquired responsibilities. As such, instituting a mentoring program for new committee members would make the transition onto the committee easier because they would be paired with a mentor who has experience on the committee. This would decrease the time that is needed to learn about one's role on the committee and would make joining a committee less intimidating for potential new members.

IMPACT

Positive Outcomes of the Practice

- Research has found that mentoring programs can lead to a number of positive outcomes for the mentee such as salary increases, promotional opportunities, job and career satisfaction, perceptions of organizational justice, organizational commitment, career mobility/opportunities, recognition, organizational socialization, and reduced turnover intentions (Viator and Scandura, 1991, Koberg et al., 1998).
- Mentored individuals reported having more satisfaction, career mobility/opportunity, recognition, and higher promotion rate than non-mentored individuals, regardless of gender or level (Fagenson, 1989).
- Protégés in informal mentorships reported more favorable outcomes (like organizational socialization, satisfaction, and salary) than non-mentored individuals, which suggests that some form of mentoring program is better than none (Chao, Walz, and Gardner, 1992).
- While results from the JWI program cannot be credited solely to the mentoring pilot due to four different programs serving as part of the JWI initiative, the overall results of the JWI have been positive. A Program Performance Statistics Summary used by VTA benchmarked quarterly data comparing JWI participants and non-JWI participants on four categories: absenteeism, retention, number of grievances, and complaints. According to the data collected each quarter, this initiative helped the agency alleviate several workforce issues. For example, the data collected from April 1, 2009, to June 30, 2009, show the following for bus operators:
    - Less absenteeism in JWI vs. non-JWI (3.5% vs. 8.5%)
    - Higher retention rate in JWI vs. non-JWI (100% vs. 84.3%)
    - Slightly less grievances per employee in JWI vs. non-JWI (.5 vs. 1.7)
    - Slightly less complaints per employee in JWI vs. non-JWI (.5 vs. 2)
- One study regarding mentoring of minority individuals found that those who had multiple mentors who served different roles in their development had the most successful mentoring experiences. The article is titled "Mentoring Across Differences: A Guide to Cross-Race and Cross-Gender Mentoring," published by the Minority Corporate Counsel Association, and written by Ida Abbott, Esq., and Rita S. Boggs, Ph.D. (Abbott and Boggs, 2007).

CAUTIONARY CONSIDERATIONS

- To create an effective mentoring program, there must be an agency commitment to continuous evaluation and improvement. Without this commitment, the program can begin to lose momentum, leaving a divergence in the expectations for mentees and mentors about how the relationship should be maintained. In order to gain continued commitment to the mentoring program, it is important to make sure that individuals within the agency are aware of the mentoring program and the positive outcomes that it brings to the agency.
- Without a valid approach to assess potential mentors prior to partnership and a system of accountability that includes requirements for periodic "check ins," the mentoring relationship may backfire. An ineffective mentor can actually become the catalyst for low job satisfaction and even possible turnover intentions if the mentee perceives he/she is "stuck" with the mentor or that the mentor represents the larger agency. Agencies should institute an automatic reassignment period so mentees can have more than one mentor within their first 2 years of employment. The agency should also have a grievance reporting process for mentees that is confidential so that it is perceived as a safe avenue for expressing concerns.
- Mentors should be outside the chain-of-command of a mentee to avoid disruption of the trust needed for a successful relationship based on fears of the mentee that performance decisions will be made by the mentor. To ensure that this does not happen, it is necessary to have a full list of supervisors when matching mentees to their new mentors.

Action Plan for Recommendation #6

Develop Employees and Maintain Employee Career Pathways

Hyperlink to Exhibit 28: Overview of Strategic SOM Workforce Recommendations by Career Stage

RECOMMENDATION #6
Develop Employees and Maintain Employee Career Pathways

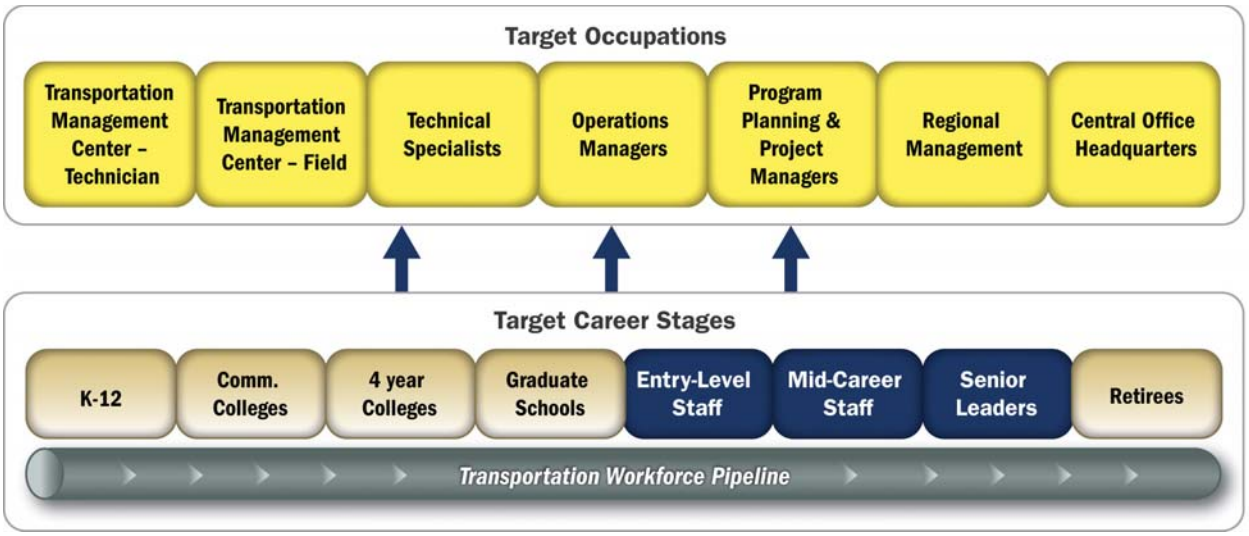
Description: DOTs should consider making in-house recruiting a priority to promote from within and ensure that growth opportunities are available to employees (KFH Group, Inc., 2008). Results of a recent study indicate that career pathways improve job satisfaction, employee motivation, and employee commitment (Griffin, Kalnbach, Lantz, and Rodriguez, 2000). Furthermore, results from analyses of 21 turnover studies indicate that receiving promotions is directly related to less employee turnover (Carson et al., 1994). To prepare employees for advancement, agencies need to implement structured employee development practices. Career lattices demonstrate the possible ways that a career can progress and the different jobs an employee might consider as their career develops. The pathway is usually represented as a diagram showing the relationships between various roles in an industry and the possible paths for moving between them, both linearly and laterally. A career pathway serves as a strategic planning tool as the employee identifies long-term goals for his/her professional life.

Recommendation Highlights

- Target Career Stage: Entry-level, mid-career staff, and senior leaders
- Will help with Retention and Development
- Estimated Time to Implement: 3–6 months
- Provides guidance to employees to help them to plan for future and advance within the agency
- Career pathways may increase job satisfaction, employee motivation, and commitment to the agency

Rationale for Recommendation: Our research results indicated that there is uncertainty in the transportation industry about how individuals should advance in an SOM career. This can inhibit DOT staff from cross-training to enter the field and can deter potential new, skilled employees from entering SOM jobs. We discovered that the biggest challenge or impediment to pursuing a career in SOM is that there are no clear or standard career paths for personnel. Thus, it is difficult for potential and existing staff to navigate the array of jobs. Further, each of SOM's five core functions does not represent all levels of SOM positions. For example, the Policy and Strategic Considerations function has no Transportation Management Center (TMC) technicians or field personnel and few mid-level or project-related personnel because of the high level of the work. On the other hand, the Real-Time Operations function has many TMC technicians and field personnel, but few senior managers. This also makes it difficult to describe where junior- or mid-level employees might progress across SOM functions. Yet, because SOM personnel often have knowledge of multiple disciplines and an understanding of how SOM interacts with transportation modes, the public, and other transportation functions (e.g., emergency management, public safety), their skills are highly transferable across core functions so advancement within and across core functions is certainly attainable. Thus, DOTs should work to develop and maintain clear career pathways for SOM employees that communicate when and how employees may be or become qualified to advance.

RELEVANT POSITIONS



TARGET AUDIENCES

Source of Initiation
- ○ Industry
- ● Agency

Primary Human Resource Focus
- ○ Attraction
- ○ Recruitment
- ● Retention
- ● Development

Implementation Level
- ○ National
- ○ Regional
- ● State

Return on Investment
- ● 0-2 years
- ○ 3-5 years
- ○ 6+ years

Estimated Time to Implement
- ○ 0-3 months
- ● 3-6 months
- ○ 7 months-1 year
- ○ More than 1 year

Action Lead(s)
Agency HR Director/Personnel Manager

Targeted Audience(s)
Primary: Staff who are seeking career guidance. Career paths will assist them in making training and skill development decisions and allow these staff to plan for likely future jobs.

IMPLEMENTATION PLAN

Steps to Implement

1. **Assemble Project Team.**
2. **Define the Job Group.** Define the purpose the job group performs within the organization, key tasks, products, and objectives.
3. **Consult with Stakeholders.** Consult with stakeholders by collecting input from managers and workers, subject matter experts (SMEs), and professional and educational organizations in the field to create a competency model that identifies the knowledge, skills, and abilities that are needed to successfully perform the job and its purposes previously described. This will become the basis of your job pathway. (Career OneStop, provided by the U.S. Department of Labor, offers a tool for building competency models as well as pre-defined model frameworks for various industries.)
4. **Divide the Competencies into Tiers from Entry to Management Level.** The lower tiers will include applicable foundational skills, abilities, and behaviors. Middle and upper tiers will build on the competencies for the tiers below, adding specialized knowledge and technical competencies as well as leadership skills and behaviors.
5. **Create and Refine Specific Job Titles and Descriptions for Each Level**. Descriptions will include the tasks and responsibilities of the position, reporting relationships, competencies, and educational and experience requirements. Consider differences between responsibilities and qualifications for each tier and how an employee might move between jobs.
6. **Create a Visual.** Create a visual representation that describes your structure, showing each job and possible paths to and from it.
7. **Assign Salary Ranges and Obtain Final Approval from Management.**
8. **Communicate with Users.** Communicate with users by publishing the job pathway information along with guidelines for employees about the critical development experiences needed to progress to the next tier.
9. **Validate and Refine.** Collect data on the paths via which staff are promoted to various positions. Improve the job pathway over time by observing how effectively employees are able to progress from one tier to the next by acquiring and demonstrating the competencies you have included in the pathway.

Graphic Depiction

These exhibits provide a summary of how individuals might advance in SOM careers within and across each of the five core functions of SOM. These are example pathways for each core function; however, they can be tailored for individual agency needs.

Exhibit 1
Policy and Strategic Considerations Core Function: Career Paths

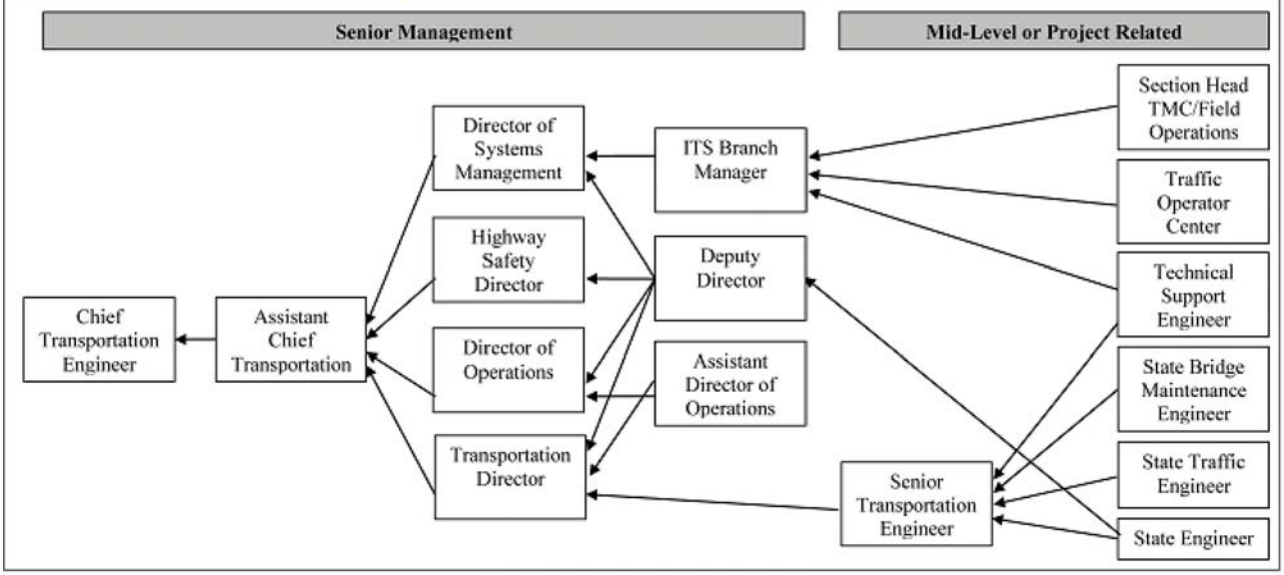


Exhibit 2
Program Planning Core Function: Career Paths

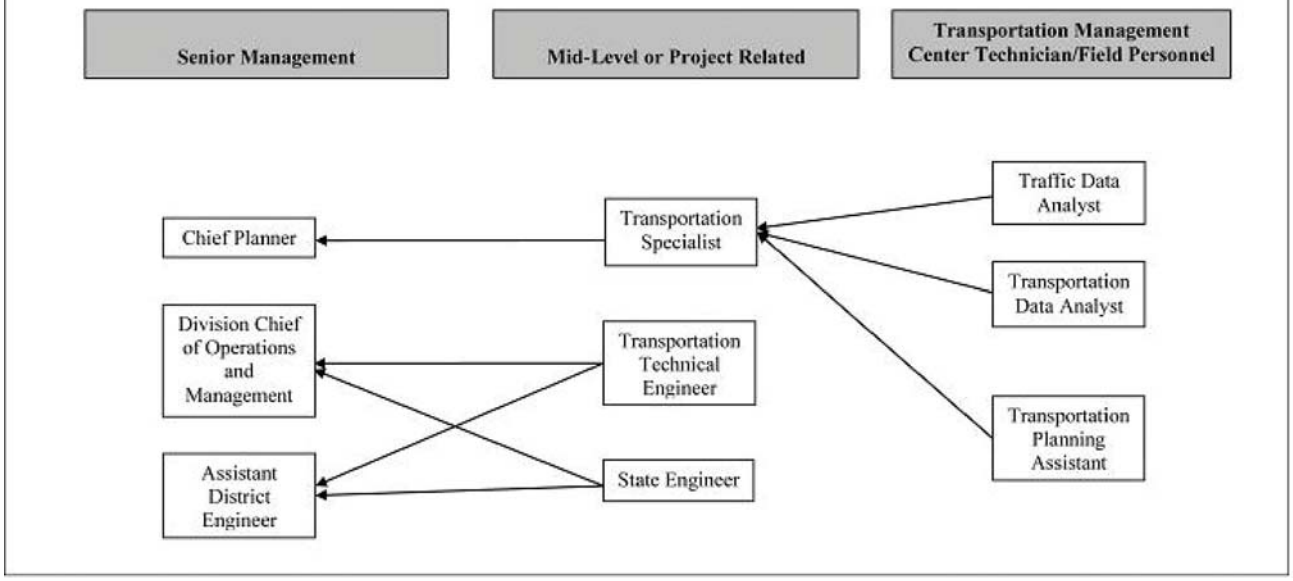


Exhibit 3
Systems Development Core Function: Career Paths

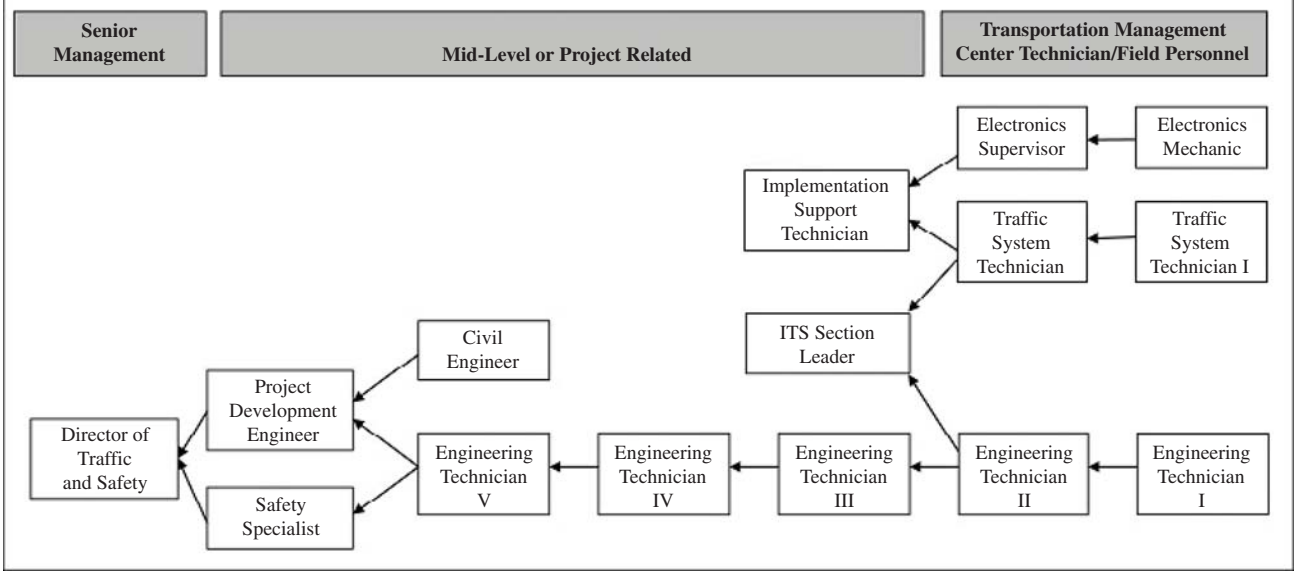


Exhibit 4
Project Management Core Function: Career Paths

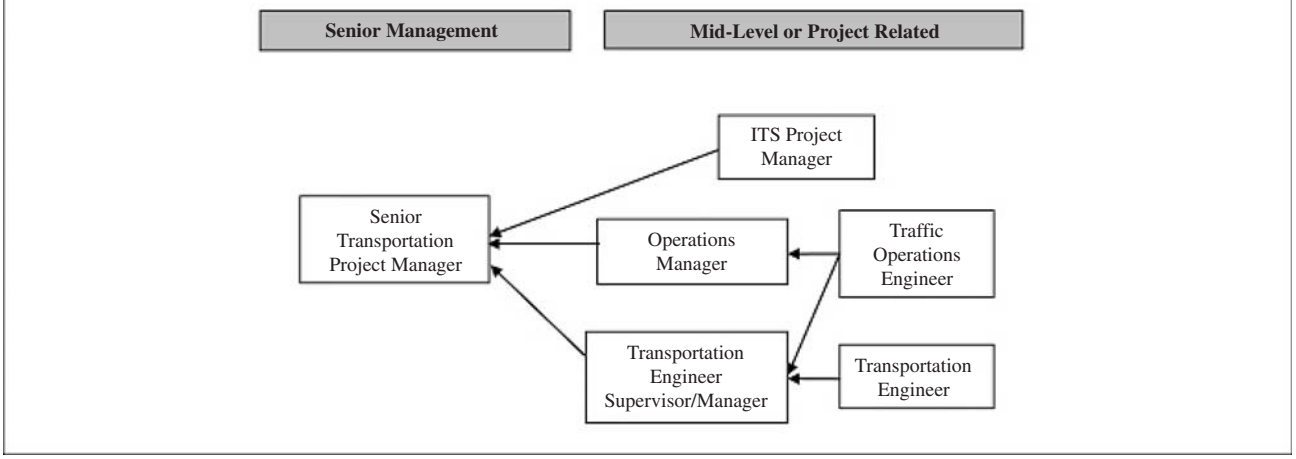
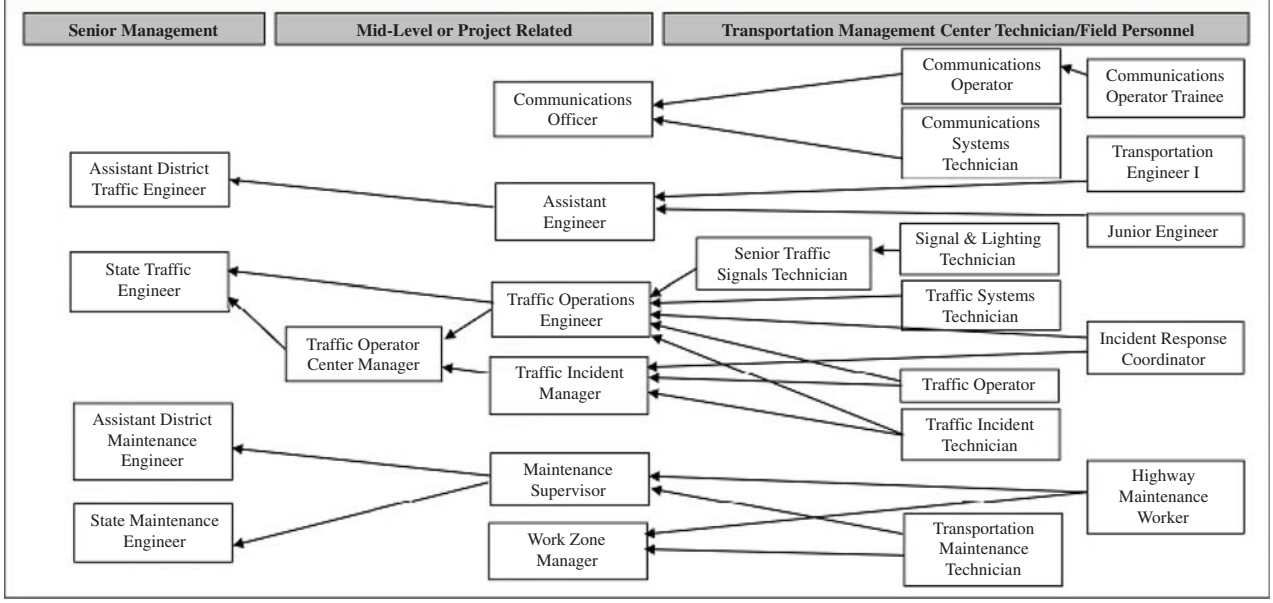


Exhibit 5
Real-Time Operations Core Function: Career Paths



COMMUNICATIONS PLAN

Communication/Outreach Strategies

- Develop orientation training to provide employees with overview of career pathways and benefits.
- Utilize all internal communication channels to inform about HR's efforts in defining career paths:
  - Send inter-office mail memos.
  - Post information clearly on the agency intranet regarding the different tracks and upcoming orientation sessions.
- Develop a career pathway chart where employees can track their progress and remind employees and supervisors to review the career pathway chart during mid-year and annual evaluations.

Process for Obtaining Buy-In

- Provide data that highlight the impact of career pathways and tie them to specific strategic goals the industry has regarding development targets.
  - Show projected results on attrition reduction and savings on recruitment efforts.
- Obtain case studies indicating success of other industries and/or transportation fields in similar career pathway efforts.

USEFUL INTERNAL AND EXTERNAL RESOURCES

To Implement Practice

- Develop support from agency leadership.
- Create job descriptions to identify job tasks and knowledge, skills, and abilities needed to perform the job.
- Involve HR managers and personnel managers who are engaged and invested in the development of the new career pathways.

To Sustain Practice

- Enlist commitment from personnel managers and HR managers to assist employees in progressing up career pathways.
- Ensure support for revisions to the tool every few years or as needed so that it is tailored to best meet development and retention targets and needs, as well as the current labor pool and economic conditions.
- Record evidence where and how the career pathway is providing a return on investment. For example, the agency may calculate: turnover data before and after implementing the career pathways, money saved due to reduction in turnover, any increases that may be discerned in applications received, retention numbers over specific periods of time, and increases in new hire performance.

EXAMPLES OF EFFECTIVE PROGRAMS

- **Santa Clara Valley Transportation Authority (VTA) Joint Workforce Investment (JWI) Program**. Santa Clara Valley Transportation Authority's (VTA's) Joint Workforce Investment (JWI) program, established in 2006, is a joint labor-management partnership between the VTA and the Amalgamated Transit Union Local 265 (ATU). Both organizations operate together as one "JWI" team. The three primary programs that were brought together under the JWI initiative are described in detail below.

  The first program is called the Maintenance Career Pathways Training Project (MCPTP). This 1-year project ended in 2008. During that time, it established the Mechanic Helper program. The Maintenance division has three positions: (1) service worker, (2) service mechanic, and (3) full transit mechanic. First, the program involved utilizing funding that was meant to support the salaries of vacant full transit mechanic positions and reallocating that funding to create vacancies at the mechanic helper (mechanic trainee) level. The program then provided training to mechanic trainees to allow them to be eligible for promotional opportunities. The external Mechanic Helper training involved enrolling employees in an 18-month Associate's Degree program at local community colleges. Once employees at the Mechanic Helper level had completed the required training, they were promoted into the service mechanic positions. In doing this, VTA addressed

the bus mechanic shortages and provided members of the community with living-wage-level employment.

The second program is the New Operator/Mentor Pilot Project. This one-year pilot project, now complete, paired 26 new operators who graduated in January 2008 with 17 veteran exemplary operators who acted as mentors. The program provided best practice customer service and job stress coping skills through on-the-job mentoring and classroom training. At the beginning of the mentoring relationship, the new operators would spend 8-hour days on the veteran's bus and then later the veteran would spend a similar amount of time on the new operator's bus. This early intervention prevents new operators from developing bad habits and attitudes that amplify stress.

The third program is the Health and Wellness Project. This mentor-led, "operator to operator" project conducts various informal activities at the three bus operating divisions to promote the JWI approach to health, wellness, and professional development. Activities emphasize mastering the "human element" of driving a bus and applying stress management/health and wellness techniques. During the project, new operators are brought into a classroom to debrief after completing some initial driving time. They discuss their experiences and whether or not they were able to release the stress that some situations may have caused them.

As a result of JWI, the level of skill and organizational commitment across the VTA increased. Specifically, ten mechanic helpers graduated from their training programs and were promoted into the ten service mechanic vacancies. Retention of new bus drivers rose from 80% to 100% for participants of the program. Anecdotal conversations between the management team and employees have indicated that employee morale has also increased due to the program.

- Contact Information: Santa Clara Valley Transportation Authority, 408-321-2300 or 800-894-9908

- **PennDOT's Position Analysis Workbooks Program.** The Pennsylvania Department of Transportation (PennDOT) once implemented a practice called Position Analysis Workbooks (PAWs) to address recruitment and retention efforts and support career paths and succession planning. A PAW described the roles, responsibilities, and tasks that are performed in a given position in PennDOT and the competencies and training necessary for an individual to be successful in the position. To develop a PAW for a position, PennDOT convened a focus group consisting of exemplary employees currently serving in the position or those supervising employees in the position. The focus groups were moderated by someone who served as a Subject Matter Expert (SME) and helped the group to devise a strategy or a series of steps for PennDOT employees to succeed in the position described in the PAW. PennDOT works to assign a PAW to each major position in the organization.
  - Contact Information: PA Department of Transportation, 717-787-7894
- **San Francisco Transit Career Ladder Partnership.** Rapidly changing transit technologies, related skills shortages, and job vacancies pose critical challenges to public transportation systems across the country and in San Francisco in particular. The San Francisco Transit Career Ladder Partnership resolves these skills shortages by means of a collaborative approach to training for incumbent workers to move up industry career ladders targeted to areas of skills shortage. The goal of these programs is to strengthen promotional opportunities for incumbent San Francisco Municipal Railway (Muni) employees, fill chronic vacancies, prepare incumbent workers for jobs that will require new technological and human relations skills, and permit Muni

to more effectively meet new service delivery guidelines. The principal partners are Muni, Transport Workers Local 250-A (TWU), City College of San Francisco (CCSF), and the Community Transportation Development Center, which is funded by the U.S. Department of Transportation to help develop regional skills partnerships in mass transit. The San Francisco Municipal Railway Improvement Fund (MIF), a joint labor-management project established by Muni and TWU in 1996, facilitates this partnership. As the fiscal agent, MIF ensures effective partnership coordination and delivery of the career ladder training.

- Contact Information: San Francisco Transit Career Ladder Partnership, sftclp@ccsf.edu

- **Kentucky Transportation Cabinet Career Pathways.** The Career Pathways to Highways project is a collaborative venture between the Kentucky Transportation Cabinet, Elizabethtown Community and Technical College, and the Lincoln Trail Workforce Investment Board to address workforce shortages identified by the Federal Highway Administration. The Career Pathways to Highways project is designed to meet the needs for qualified individuals to work in the transportation career cluster. The scope of the project is to train eligible participants to varying skill levels within the transportation industry within a 2-year timeframe.
  - Contact Information: Doug Hogan, Executive Director, Office of Public Affairs, 502-564-3419

ALTERNATIVE APPROACHES

Alternative Approach 1

Develop detailed agency job descriptions for all SOM positions. While job descriptions may not detail the relationships between the positions and the development experiences needed to progress within the organization, the job descriptions will provide incumbents with an accurate description of the knowledge, skills, and abilities needed in each job. Thus, the job descriptions will provide a target for incumbents as they are planning career growth.

IMPACT

Positive Outcomes of the Practice

- Decreased turnover.
- Better prepared staff for leadership positions.
- Increased job satisfaction and organizational commitment among mid-career staff.
- Increased organizational ability to properly target training and developmental experience.

CAUTIONARY CONSIDERATIONS

- Significant Dedication of Resources—Time and labor commitment from stakeholders and subject matter experts (SMEs) can be substantial for a 6-month to 1-year period while career pathways are being developed. This has the potential to be expedited through use and modification of more generic career pathways, such as those developed in this project. The latter can serve as a starting point. Project leaders should work with agency and/or state leadership to secure resources in advance. This will decrease the chance of delays during the development and implementation process.
- Long-Term Commitment—To realize the greatest ROI, agencies must commit to the development, implementation, and maintenance of career pathways. Career pathways must be updated and refined as jobs evolve. In addition, the agency must be willing to assist employees in their development so they can achieve career pathway goals.

Action Plan for Recommendation #7

Implement SOM Succession Plans

Hyperlink to Exhibit 28: Overview of Strategic SOM Workforce Recommendations by Career Stage

RECOMMENDATION #7
Implement SOM Succession Plans

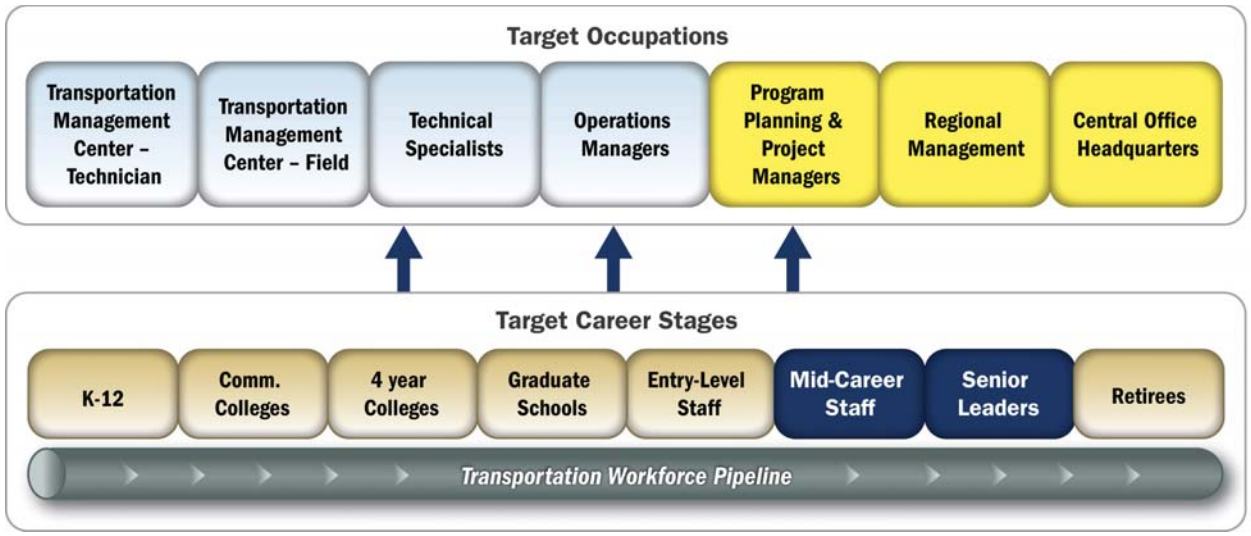
Description: Organizations could identify senior leader positions that will be vacated in the near future due to retirements, transfers, and other means of attrition. In order to fill these vacated positions, the organization could offer the opportunity for entry-level to mid-career employees to participate in training programs that focus on management and leadership issues. This type of training would help employees who are interested in becoming leaders of the organization acquire the skills necessary for advancement and continued success. Employees with strong performance records, who demonstrate both the skills to succeed at the senior level and interest in a future leadership position, may then be matched with a senior leader who serves as a mentor. Mentoring and on-the-job training are particularly important when filling senior leadership positions because many of the incumbents have long tenures and there is a need to have them pass on the industry and agency knowledge they have accumulated over the years, before they retire. In addition to the type of knowledge transfer that comes from mentoring, agencies should create people-focused knowledge management systems that promote knowledge sharing among employees. One possible technique to capture this critical knowledge involves staff working in Human Resource (HR) departments interviewing senior leaders about their position and work functions. This includes collecting information on the cognitive processes that may go into making decisions as well as the rationale behind specific procedures and task performance. These interviews will help ensure that institutional memory and expertise are not lost when senior staff retire.

Recommendation Highlights

- Target Career Stage: Senior leaders
- Will help with Retention and Development
- Estimated Time to Implement: 3–6 months
- Ensures bench strength available within the agency
- Critical for workforce planning, especially with the expected high numbers of retirements in DOTs across the country in coming years
- Will help ensure that institutional knowledge is retained across generations in the agency

Rationale for Recommendation: Although attrition has slowed in recent years due to the economy, studies indicate that 50% of the transportation workforce will be eligible to retire in the next 5 to 10 years, which is double the retirement rate of the nation's entire workforce (e.g., *TRB Special Report 275,* 2003). In addition to filling open positions due to retirements, agencies must also attempt to retain the institutional knowledge retiring employees have accumulated over their periods of employment. Implementing succession plans not only helps to ensure that the senior leader positions vacated by retiring leaders are filled with the top talent within the agency, but also it allows for the future leaders to be identified earlier in their career, trained, and mentored by existing leaders so they gain the institutional knowledge and are ready to step in as soon as senior leaders leave the agency. Succession plans are important not only because many senior leaders will be retiring over the next 10 years, but also because it is critical to have a management pipeline in place regardless of the reason senior leaders choose to leave the agency.

RELEVANT POSITIONS



TARGET AUDIENCES

Source of Initiation
- ○ Industry
- ● Agency

Primary Human Resource Focus
- ○ Attraction
- ○ Recruitment
- ● Retention
- ● Development

Implementation Level
- ○ National
- ○ Regional
- ● State

Return on Investment
- ○ 0-2 years
- ● 3-5 years
- ○ 6+ years

Estimated Time to Implement
- ○ 0-3 months
- ● 3-6 months
- ○ 7 months-1 year
- ○ More than 1 year

Action Lead(s)
Agency HR Director

Targeted Audience(s)
Primary: Agency leaders and talented entry-level and mid-career staff who have been identified as future senior leaders in the agency.

IMPLEMENTATION PLAN

Steps to Implement

1. **Assemble a Project Team.** Assemble a project team composed of HR personnel and agency leaders to spearhead the development of the succession planning model.
2. **Develop a Communication Plan.** Communicate this plan to managers and subordinates throughout the agency.
3. **Identify the Critical Leadership Positions.** Consider positions that are critical to the strategic direction of the organization, influence broad policy, possess unique technical or organizational knowledge, directly interface with legislature or Congress, are highly visible, or have significant involvement with entities outside of the agency.
4. **Review the Job.** Review the competencies, knowledge, and qualifications needed to perform successfully in the critical leadership positions.
5. **Offer Leadership Training.** Offer entry-level and mid-career employees the opportunity to participate in a training program that focuses on management and leadership issues. Participation in this training program should be optional, and up to individual employees, so that those who are not interested in becoming senior managers do not invest extra time and effort beyond their regular job.
6. **Assess Bench Strength.** Assess bench strength by identifying top performers in the entry-level and mid-career positions (administer an interest survey, speak with supervisors, review performance evaluations). Review the competencies, knowledge, and qualifications needed to perform successfully in these entry-level and mid-career positions.
7. **Conduct Gap Analysis.** Identify the gaps in competency, knowledge, and qualifications between the senior leaders and entry-level and mid-career positions and develop and/or identify internal and external training to help close those gaps.
8. **Assign Mentorships.** Assign those who have demonstrated the necessary leadership skills and expressed interest in future leadership positions to a senior leader mentor. Senior leader mentors should teach them about leadership issues in the agency and impart the institutional knowledge they have accumulated over their years in the agency/industry. Several methods to capture this knowledge management component of workforce planning may involve additional trainings, job shadowing, presentations/discussions, interviews, and videos of senior leaders either performing their job or explaining particular aspects of the job.
9. **Identify Positions for External Candidates.** Identify positions that are best filled by an external pool of candidates due to a lack of developmental capabilities.

10. **Establish a Knowledge Management System.** Identify senior leaders in the agency for HR staff to interview as part of the knowledge management so that critical information pertaining to their job and the institution is not lost with turnover. Communities of practice should be developed and participation encouraged, as another aspect of the knowledge management system. Communities of practice allow senior leaders the opportunity to attend workshops and share methods for building knowledge networks to capture tacit knowledge and develop better documentation processes.

COMMUNICATIONS PLAN

Communication/Outreach Strategies

- Write an article for an agency newsletter or website and/or send a mass email to agency employees about the program and its benefits to the employees and the agency. Some employees will want to know what they need to do to be considered for the pipeline into the senior leadership positions.
- As part of the identification process of future leaders, administer a survey to gauge interest from employees. Some employees who seem to be good leaders may not be interested, and others who do not immediately seem to be future leaders may actually have potential with more guidance, training, and mentoring.
- Identify activities that will ease the transfer of knowledge and necessary skills for a specific job such as:
  - Junior staff in leadership pipeline shadow senior leaders.
  - Record key questions/best practices on video or audio formats for future reference.
  - Gather and develop case studies to portray best practices/key projects.
- When the project team begins working on developing the succession plan, this team should be visible and avenues should be opened that allow managers and their subordinates throughout the agency to provide input.

Process for Obtaining Buy-In

- Meet with top leaders who are responsible for managing talent in the agency.
  - Emphasize the resources saved due to less time recruiting and less time with senior leader positions unfilled (i.e., consistency of project management and implementation).
  - Emphasize the opportunity to retain institutional knowledge by identifying future leaders and having them mentored by current senior leaders.

USEFUL INTERNAL AND EXTERNAL RESOURCES

To Implement Practice

- Compile job descriptions and thorough job analyses of existing senior leader positions and future position requirements, and the positions that feed into these leadership positions.
- Develop a database of internal and external training available to the agency/government.
- Create a newsletter (paper or electronic) and/or website to communicate information about the succession planning program.

To Sustain Practice

- Requires an understanding of the senior leadership positions and how responsibilities may change over time. Thorough job analyses must be conducted of senior leadership positions every few years to identify competencies, knowledge, and qualifications needed to be a successful senior leader.
- Requires constant interface between the human resource function and the strategic direction of the organization/agency/business unit.
- Requires a database to track agency's strategies, job qualifications, and employees' skills and competencies.

EXAMPLES OF EFFECTIVE PROGRAMS

- **Minnesota DOT (Mn/DOT) Succession Planning Program.** The Minnesota DOT (Mn/DOT) created its Succession Planning Program in 1994 because they estimated that around 90% of their engineering workforce and key positions would be eligible for retirement or retired by 2010. The agency's succession planning model focused on executive-level leadership and management positions and worked to prepare a roster of next-generation leaders. Mn/DOT's succession plan had a two-fold focus: (1) it identified positions the agency could develop internally, and (2) it identified those positions that the agency would benefit from recruiting externally due to a lack of developmental capabilities.

  Mn/DOT wanted to ensure that they had sufficient strength to maintain their critical leadership positions. Mn/DOT developed the following criteria to determine which leadership positions are critical:

  - Position is critical to the strategic direction of the organization.
  - There is potential for negative consequences to the organization if the position fails to succeed.
  - Influences broad policy.
  - Possesses unique technical or organizational knowledge critical to delivery of programs and services.
  - Provides direct interface with legislature or Congress.

- Requires significant involvement with external client groups (executive level).
- Sustainable new initiatives give the position high visibility.

To ensure that Mn/DOT had sufficient strength to maintain their critical leadership positions, the agency created a task force, composed of managers and HR personnel, to develop a succession planning model based on the workforce needs. The first part of the succession planning process involved a review of the agency's personnel pipeline in order to identify positions with at least three existing employees that could potentially fill the position. Through reviewing these leadership positions and the qualifications needed to prepare interested staff, Mn/DOT began to document the competencies, knowledge, and qualifications needed to succeed at different positions. Mn/DOT conducted a thorough review of core competencies, which ensured validation of the qualifications for each position. They developed profiles for 37 jobs to use in their succession planning model, which included the general purpose of the position and ranked criticality of competencies for each position. After identifying the agency's highest potential employees, Mn/DOT used the identified competencies and qualifications to asses each individual's knowledge and experience and determine if they would need further training to prepare them for the next level. This evaluation led the Succession Planning Program to put a prime focus on leadership development within the department.

- Contact information: Eric Davis, HR Director, 651-366-3402, Eric.Davis@state.Mn.us

- **PennDOT Succession Planning Model.** The Pennsylvania Department of Transportation (PennDOT) has recently revamped and implemented a succession planning model as an agency-wide practice. While elements of succession planning models existed at PennDOT before, the agency found it necessary to implement a department-wide strategy. Previously, PennDOT had the ability to pull up data and track employees' years of service/age, but now that succession planning practice has evolved. The current succession planning practice focuses on specific "at-risk" positions and the people in those positions rather than organizational-level data alone. For example, PennDOT now focuses on who is capable of filling a critical organizational position before the position is vacated. Specifically, PennDOT identifies positions that might need to be filled due to impending retirements, promotions, or transfers as well as the pool of incumbents who are capable of completing the duties associated with the at-risk position. Defining these elements is a key aspect of succession planning.

  The practice also includes retirement projection reports, which are distributed to regional decision-makers. Using HR data, the reports identify at-risk positions and the candidate pool to fill those positions. Once these reports are received locally, managers are asked to define potential candidates for development and promotion. This process includes entering candidates into a mentee/mentor program or job training so they are ready for and understand the roles, responsibilities, and decisions that will have to be made at the next level. This practice is not executed by the central office; it is completed in the districts and counties because local leadership has a greater understanding of their situations and the potential of their staff.

  - Contact information: Paul Kovac, Division Chief, Workforce Development Division, 717-787-4285, pakovac@state.pa.us

- **Virginia DOT Knowledge Management Program.** After experiencing significant losses in critical institutional knowledge during downsizing in the early 1990s and concerns that a similar situation would occur with the retirement of nearly 30% of the workforce in the next 5 years, the Virginia Department of Transportation (VDOT) established a Knowledge Management (KM)

program in 2003. VDOT is able to collect both tacit and explicit knowledge through the KM program and its four primary areas including process mapping, organizational network analysis, lessons learned, and communities of practice. First, process mapping is used within communities of practice, with the objective to develop a standard way of doing process mapping to assess the interaction between different functional areas. Second, the organizational network analysis is performed through a survey that captures information that allows management to produce a visual snapshot of what is happening throughout the organization. Third, one- to two-page documents are created that capture the lessons learned by succinctly stating the lesson, its context, related resources available, and solutions. These documents are dispersed across the agency via the Intranet. Fourth, communities of practice allow for small groups of employees to come together and discuss methods for building knowledge networks to capture tacit knowledge and develop better documentation processes. As a result of the four KM components and the program in general, VDOT is better able to manage the sharing and documentation of institutional and job knowledge within their organization while preventing the loss of key data as individuals leave the agency.

- Contact information: Maureen Hammer, Knowledge Management Director, 434-293-1987, maureen.hammer@vdot.virginia.gov

ALTERNATIVE APPROACHES

Alternative Approach 1

Dedicate more resources to recruitment and selection when positions actually become available, rather than planning, training, and mentoring in advance. Dedicating resources to recruitment and selection may help to identify a larger pool of external candidates, whereas a succession plan focuses on developing staff internally.

IMPACT

Positive Outcomes of the Practice

- Bench strength within the agency to address gaps in talent.
- Fewer senior leader position openings in the future and a shorter amount of time needed to fill these positions with strong, qualified candidates.
- Greater continuity in leadership and seeing-through of the long-term vision of the agency.
- Better agency skill retention and performance, with less risk of institutional knowledge lost due to a high number of retirements.
- Generally, succession planning is perceived positively by top talent and it could help to retain them long-term if they know they have been identified as a future agency leader.

CAUTIONARY CONSIDERATIONS

- Resources (funds and labor) will need to be expended to develop the succession plan and to develop those identified as future leaders in the agency. This is why obtaining buy-in and support from management is so important and critical for the program's success.
- The agency runs the risk of developing leaders who can leave for other opportunities before senior leadership positions open up within the agency.
- Employees may feel the additional training and mentoring provided as part of leadership preparation is unnecessary and extra work for which they are not being compensated; however, generally participation in the leadership program is regarded as a privilege. This is why the additional training should be offered but not become mandatory.

Action Plan for Recommendation #8

Recruit from Non-Traditional Sources

Hyperlink to Exhibit 28: Overview of Strategic SOM Workforce Recommendations by Career Stage

RECOMMENDATION #8
Recruit from Non-Traditional Sources

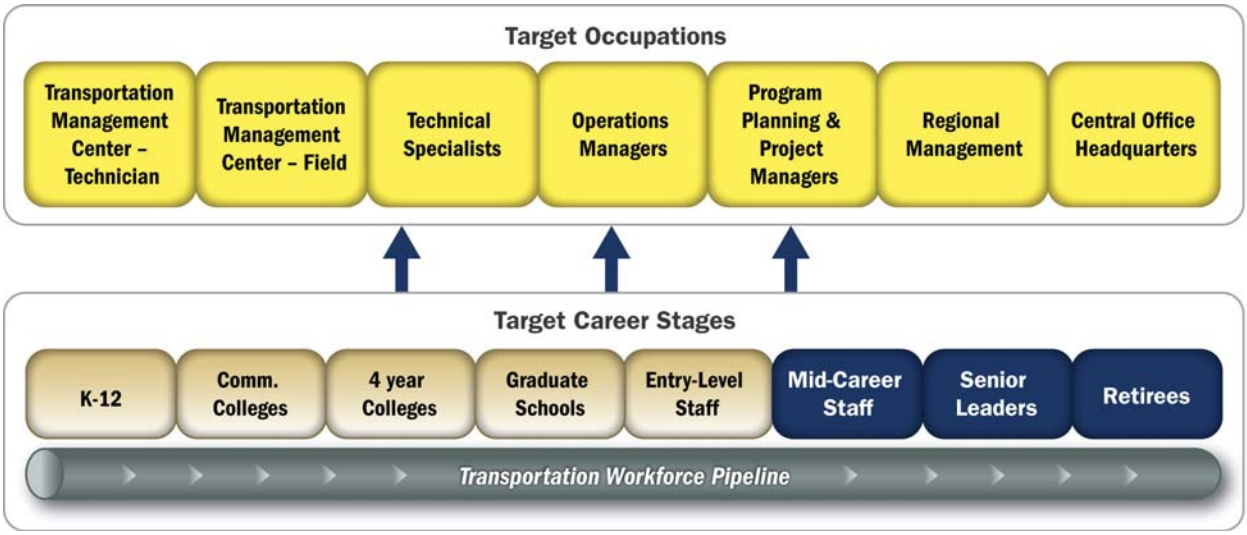
Description: Create recruitment strategies that seek out candidates from non-traditional sources to build a deep and diverse applicant pool. Non-traditional applicants, such as retired military personnel, engineers from the public sector, stay-at-home parents, minority group members, ex-prisoners, retirees, and/or DOT employees from other agencies could prove to be an excellent source for talent. These applicants often have a wealth of knowledge and a desire to return to the workforce in some fashion. In fact, some unemployed individuals may be stay-at-home parents who left work because they did not want a full-time job commitment or older individuals, not yet of retirement age, who went through a company downsizing and have difficulty finding subsequent work. Additionally, some retirees include individuals who leave their jobs due to early buy-outs or government pension plans but still prefer to be working. Knowing what prompted candidates to initially leave the workforce can inform recruitment and offer solutions or arrangements that work for non-traditional employees who might be brought in part-time or benefit from flexible work arrangements. DOTs could consider how to leverage the experience and expertise of non-traditional applicants while keeping in mind that they might not want to maintain a traditional work schedule. When considering non-traditional sources, it is important to keep in mind that retired military personnel often show exemplary leadership skills based on the discipline and training they gained in the military.

Recommendation Highlights

- Target Career Stage: Mid-career staff, senior leaders, retirees
- Will help with Attraction and Recruitment
- Estimated Time to Implement: 0–3 months
- Non-traditional applicants may hold valuable knowledge about the agency or industry in general, and desire to keep working
- Agencies should consider how to leverage the experience and expertise of non-traditional applicants while keeping in mind they might not want to maintain a traditional work schedule

Rationale for Recommendation: In many cases, retirees possess specialized knowledge and unique experiences, as well as a historical perspective that are critical for efficient operation of the organization (Rothwell and Poduch, 2004). Interestingly, retirees often seek to return to the workforce after a short leave of absence. These retirees may be attracted to jobs that afford specific benefits or a desirable scheduling arrangement. Experienced individuals who have left the industry for other reasons may also have valued knowledge and experiences. Costs (i.e., time, monetary) associated with onboarding and training are often reduced when hiring those who have previous experience in the field.

RELEVANT POSITIONS



TARGET AUDIENCES

Source of Initiation
- ○ Industry
- ● Agency

Primary Human Resource Focus
- ● Attraction
- ● Recruitment
- ○ Retention
- ○ Development

Implementation Level
- ○ National
- ○ Regional
- ● State

Return on Investment
- ● 0-2 years
- ○ 3-5 years
- ○ 6+ years

Estimated Time to Implement
- ○ 0-3 months
- ● 3-6 months
- ○ 7 months-1 year
- ○ More than 1 year

Action Lead(s)
Agency HR Director

Targeted Audience(s)
Primary: Depending on the type of job for which recruitment is needed and the knowledge, skills, and abilities required for those jobs (see options under implementation), various audiences may be targeted to identify candidates, such as professional associations for specific fields, community or retiree associations, minority membership organizations, and military groups. The target audience, such as professional associations, may be asked to publish recruitment materials on their websites or in trade journals.

IMPLEMENTATION PLAN

Steps to Implement

1. **Create a Committee.** Create a committee composed of a senior leader from each business unit to discuss the development of a recruitment strategy that targets non-traditional sources of employees. Consider the unique challenges of each line of business prior to deciding whether specific flexible work arrangements or other benefits would work within those lines of business.
    - Consider various flexible work arrangements, such as flextime, job-sharing, and reduced workloads, as options for adding flexibility to jobs in order to attract non-traditional employees.
2. **Identify Knowledge, Skills, and Abilities (KSAs).** Identify the types of KSAs needed upon entry into the job.
    - Review current job description if available.
    - If no job description is available, defining the job is best accomplished by conducting a rigorous job analysis.
3. **Convene a Recruitment Committee.** Convene a recruitment committee including senior leaders from each line of business and the Human Resource (HR) department to identify key jobs and KSAs needed for those jobs.
4. **Design Recruitment Strategy.** Design a targeted recruitment strategy that identifies the candidates with the specific KSAs sought.
5. **Identify Sources for Seeking Candidates Desired.**
    - Different sources can be considered depending on the type of non-traditional employees that have been identified as appropriate for the position. For example, when recruiting minority applicants it would be beneficial to coordinate with or join minority membership groups, such as the Society of Hispanic Professional Engineers. If recruiting stay-at-home parents, it would be valuable to identify daycare centers or parent groups where potential employees can be recruited.
6. **Implement Recruitment Strategy through a Communications and Marketing Campaign.**
7. **Evaluate the Communications and Marketing Campaign's Impact on Recruitment Numbers.**
8. **Identify Rotational Activities.** Identify informal rotational activities that can quickly educate candidates about different activities that may need to be performed. (Note: This is especially valuable for leadership roles where multiple lines of business may be supervised.)

COMMUNICATIONS PLAN

Communication/Outreach Strategies

- Identify sources for reaching specific candidates desired:
  - Adult education centers, temporary agencies, day care centers, company retiree fairs, senior centers, civic groups, realtors with knowledge of people new to the area, minority associations, and even malls and libraries have been used to reach these prospective employees. There are multiple strategies for selecting sources for reaching specific candidates. For example:
    - OPTION A: If the KSAs are rather general such as for an entry-level or non-trade-specific job, design a recruitment strategy to advertise jobs via newsletters, publications, and organizations available to non-traditional applicant sources. For example, trade or professional organizations, local social groups such as church groups or sports leagues, community events, senior centers, and retirement communities could prove to be a valuable source for candidates.
    - OPTION B: Agencies that would like to recruit leadership and mission-oriented individuals may find success in focusing advertisements on military retirees and veterans. Advertisements could be posted in military retiree or veteran publications or newsletters from organizations with strong former military membership (e.g., the Military Officers Association of America's Website [http://www.moaa.org] where employers can post jobs targeting retired officers for free). Agencies may also find it valuable to recruit leadership via general, or non-transit-specific sources (e.g. newspapers, social websites, Chambers of Commerce, local management associations and groups, local business and industry, local or state government entities, and local or regional non-profit agencies).
    - OPTION C: Agencies seeking more SOM-specific experience should design recruitment strategies specific to the desired skills areas, including considering recent retirees or individuals who have left the workforce for other reasons, who have desirable contributing skills and experience.
- Conduct research to identify the key motivators such as work-life benefits and messages that would attract non-traditional employees to come back to a working environment (e.g., extended leave/personal days, flexible work arrangements, job sharing).
  - Ensure that these flexible work arrangements are highlighted when recruiting non-traditional employees. Allowing an employee to work the hours they choose (flextime), to split the job with another employee (job sharing), or to reduce the hours or tasks they are responsible for and be paid less accordingly (reduced workload) are all flexible work arrangements that may entice experienced employees to return to the workforce.
- Tailor marketing and recruitment materials to increase interest among target populations. The messages and photographs used in recruiting materials should incorporate non-traditional employees, such as minorities or older employees. Information about non-traditional employees should also be incorporated into company training literature and promotional literature in order

to create the impression that non-traditional workers are valued employees. Perhaps the most critical consideration in the advertising process is the placement and modality of the advertisement. Examples of materials to be developed include:

- Develop messages about how certain populations fit within the agency. Using retirees and older workers as an example, messages could include:
  - Our agency has retirees/more seasoned employees as managers,
  - Our agency wants retirees to enrich our workforce, and
  - Our agency values the insights and experiences of former retirees.
- Develop 30-second radio spots describing specific KSAs for candidates desired (e.g., use descriptions of example individuals who would do well in the job).
- Provide a realistic job preview of the work to be conducted and include information about the agency's culture (e.g., develop short video vignette testimonials from actual incumbents and disseminate through organization websites and social media venues).
- Create a group on LinkedIn and other professional networks.
- Develop newspaper ads, trade journals, blogs, or website postings for associations; the media type depends on the candidate population targeted.

- Sponsor career orientation activities for individuals from particular populations. This can help individuals understand how they would fit in a transit career.
- Host job fairs that target non-traditional employees. Consider the types of individuals present at career fairs. They should represent the demographic of the candidate being targeted.
  - Partner with military and senior-related organizations, such as Military Officers Association of America, and hold job fairs for retired military personnel. Job fairs targeting seniors and retirees are also common throughout the United States, and are typically held by senior centers or organizations and community groups.
  - Work with local community resources, such as the local Chamber of Commerce, trade or professional organizations, community events, daycare centers, or other local groups to spread the word about job fairs and available positions.
- Identify informal rotational activities that can quickly educate candidates about different activities that may need to be performed. (Note: This is especially valuable for leadership roles where multiple lines of business may be supervised.)

Process for Obtaining Buy-In

- Develop access to communications staff to help prepare marketing materials that are specific to candidates targeted.
- Obtain memberships with associations that maintain directories with information on potential candidates. Provide validation of key messages and sound bites for these associations.

USEFUL INTERNAL AND EXTERNAL RESOURCES

To Implement Practice

- Identify HR staff proficient at designing targeted recruitment strategies.
- Contact individuals who are members of professional transportation associations.
- Solicit referrals from employees who are part of professional associations, community organizations, or retiree groups who may know qualified individuals. (Note: Referrals have been identified as one of the most effective means of recruitment.)
- Compile lists of recently retired staff and employees who left for family or personal reasons, especially those who are interested in further work, along with their expertise and key skill areas.

To Sustain Practice

- Obtain buy-in and assistance from associations or senior groups (e.g., the HR staff from those groups) to help communicate with desired candidates.
- Develop social networking groups within the agency to help encourage and mentor employees according to their personal demographics and job requirements.

EXAMPLES OF EFFECTIVE PROGRAMS

- **California's Boomerang Program.** The State of California's Boomerang program, launched in September of 2006, is a centralized database of retired state employees that have an interest in accepting temporary employment within a state agency as a retired state employee. The database allows retirees to detail their skills and areas of expertise and to determine how long they would like to be a part-time employee. State retirees can work for any state department and state departments can use the Boomerang program to identify potential applicants for retired civil servant employment opportunities.
  - Contact information: California Boomerang Program, webtech@spb.ca.gov
- **The Commonwealth Bank of Australia's Job Sharing Program.** In order to show employees that their home lives and non-work responsibilities are valued, the Commonwealth Bank of Australia implemented a job sharing program. This program allows two employees to voluntarily fill the same position. Employees are asked to fill out an application form that includes the details about how sharing a job would work and who the job could be shared with. There is not a specific method by which the job is shared; it can differ based on what is best for the employees as well as the specific job being shared. Employees can share a job completely, without dividing duties, or there can be a specified set of duties that each employee is required to complete. The job sharing program has been shown to increase applicants and reduce turnover. It can also decrease overhead expenditures for the company because employees share work space but alternate days that they use it. This job sharing program is attractive to non-traditional employees who have important commitments outside of the workplace, such as working parents.

- Contact information: Commonwealth Bank of Australia, 1800-989-696, jobs@cba.com.au

- **HomeBanc's Membership in Minority Community Associations.** HomeBanc wanted to find qualified employees who were fluent in Spanish. In order to accomplish this, they joined minority community associations such as the Latin American Association of Atlanta and the National Society of Hispanic MBAs. By joining these organizations, HomeBanc is able to post job openings in the organization's newsletters and gain diversity in their recruiting efforts. Joining minority organizations is a cost-effective way for HomeBanc to target a specific population for recruitment purposes.
  - Contact information: HomeBanc Human Resources, 813-228-8300, greatplacetowork@homebanc.com
- **Commuter Rail Organization's Recruitment of High Potential Applicants.** One commuter rail organization has developed a relationship with the military and a consulting firm to recruit high-potential applicants. The organization partners with a consulting firm to discover high-potential candidates retiring from the military. They work closely with a transition assistance program at one military base to recruit soldiers and officers who are completing their commitment. Along with the program, the organization provides coaching in basic interview skills and discusses how military experience can be translated to civilian work. In addition, the organization works with West Point, which holds employer panel discussions for its students. They also conduct mock interviews and discuss with the students how their military experience relates to positions in the organization.

ALTERNATIVE APPROACHES

Alternative Approach 1

Agencies that are uncomfortable recruiting and hiring non-traditional applicants could start with short-term hiring commitments. For example, hiring a part-time employee, temporary employee, or student intern with a non-transportation background can give the agency a better idea about how the knowledge, skills, and abilities of hires from non-transportation backgrounds can fit within the agency needs.

Alternative Approach 2

Unemployment agencies are a valuable source for identifying previously employed candidates, who are currently unemployed, but may hold skills valuable to DOTs.

Alternative Approach 3

DOTs may consider hiring recent retirees or unemployed individuals on a contract or part-time basis to access their skills. In some cases, DOTs have developed special programs for bringing retirees back into the fold, or at least capturing more of their knowledge and expertise.

IMPACT

Positive Outcomes of the Practice

- Increases the size and quality of the applicant pool by focusing on individuals who have experience, but do not want to work in a traditional job.
- Brings workers with valuable agency or industry knowledge and experience back into the workplace.
- Helps identify potential managers for transit systems through advertisements at job fairs, employment centers, workforce development programs, community bulletin boards, and local newspapers geared toward special populations (e.g., older individuals, stay-at-home parents) (KFH Group, Inc., 2008, TRB, 2008).
- Provides new solutions through non-traditional means; Wal-Mart has found success recruiting previously retired persons through AARP (Breaugh, 2008).
- Provides ongoing opportunities for mentoring.
- Mitigates the effect of Baby Boomer retirements. DOTs report that the anticipated Baby Boomer retirements have not been hitting them as expected, or with the negative impact previously expected, in part due to DOTs' readiness to re-hire—often part-time or on a contract basis—staff who have otherwise retired.

CAUTIONARY CONSIDERATIONS

- Non-traditional employees may have specific work flexibility needs and not wish to return to full-time employment. This could be overcome by offering flexible work arrangements such as flextime or job-sharing.
- Individuals who have worked within a particular industry for most of their career may find it difficult to suddenly transition to a new industry. Providing comprehensive orientation to the industry or assigning mentors to help individuals learn about the industry could be beneficial for new employees experiencing a career transition.
- Some transportation systems have operated under a corporate culture that makes recruiting and hiring nontraditional employees difficult due to beliefs that managers must have specific experience. To combat this, it may be necessary to communicate with and educate current employees about the benefits that nontraditional employees can bring to the organization.
- Some agencies may have limited resources to train individuals without prior transportation experience. However, it may be possible for multiple agencies to pool resources in order to train new employees regarding general transportation-related issues.

6. SUMMARY AND POTENTIAL FUTURE RESEARCH

A paradigm shift is in progress at state DOTs, as transportation agencies are changing their focus from building and adding new roads to maintaining, operating, and managing the system more efficiently and effectively. As DOTs are being called to broaden their focus from construction to finding and creating capacity improvements through more diverse SOM activities, an increasingly sophisticated understanding of the transportation system, traffic behavior, and supporting technologies is more important than ever. DOTs' changing mission and broader responsibilities require a workforce capable of addressing the newer areas of electrical engineering, IT, and communication systems. For example, the demand for three key SOM occupations has greatly increased over the last 5 years—*Network systems and data communications analysts*, *Dispatchers*, and *Signal and track switch repairers*. As noted in *TRB Special Report 275* (2003), it is critical for transportation agencies to recruit and retain a workforce with a wider range of technical disciplines such as System Operations and Management.

Many participants in this research remarked on the value of a diverse background in the transportation organization that would help the SOM staff person "see how all the pieces fit together" and then operate better, through SOM. Others commented on the importance of communication and collaboration skills for employees within SOM and indicated that finding engineering applicants with these skills is a challenge; these skills are primarily developed through experiences and cross-training in diverse fields. Other participants suggested that the training offered to students is too broad and that entry-level applicants frequently lack key, specialized SOM skills, including intelligent transportation systems (ITS), traffic engineering, maintenance, emergency response and incident management, performance measurement, and system planning (Spy Pond Partners et al., 2009). As learned from NCHRP Project 20-77, an understanding of the interactions among transportation modes and between the transportation system and other functions, such as emergency management, public safety, and the concerns of the general public, is critical for a job within SOM. Extensive knowledge of statistics and experience in data management and analysis lay the foundation for the skill set necessary for an occupation in SOM. Skills needed to improve productivity and quality of operations, such as quality assurance, forecasting, planning and scheduling, staffing, design and control of operations systems, creating value for the customer, project management, and supply chain and inventory management, continue to build the skill set needed of SOM staff.

Initiatives such as those at the Pennsylvania Department of Transportation (PennDOT) highlight the increased reliance on technology to operate more effectively, as their ITS program adopted a formal communications procedure. ITS technologies, which involve the convergence of communication, computing sensing, and control technologies, focus on achieving operational improvements through services such as freeway and incident management, traveler information, and road weather information (TRB, 2003). The emergence of ITS technologies has influenced not only what transportation agencies do but how they plan and conduct projects, as "the use of ITS to operate and manage transportation systems creates a whole new operating environment for transportation agencies and increases the demand for people who understand and operate these technologies" (TRB, 2003, p. 39). The regional architecture system PennDOT developed allows transportation system managers, operators, emergency services providers, local officials, and information service providers to communicate more efficiently with one another and respond

more quickly and appropriately to congestion or emergency situations (PennDOT, 2007). Similarly, transportation agencies are increasing their reliance on the media and technology to communicate incident information to the public. As SOM jobs move away from requiring more traditional engineering expertise to depending more heavily on an array of technical and interpersonal competencies, a deeper understanding of information technology systems, and business communications expertise, it would be wise for DOTs to broaden their scope when defining the SOM workforce pipeline. Specifically, DOTs could conduct a more thorough search of diverse educational programs to fill SOM jobs. In fact, our findings indicate that educational programs such as Computer Science, Computer Systems Analysis, Public Administration, and Management Information Systems and Services produce highly skilled candidates but these programs are widely untapped for SOM employment. In addition to reshaping how DOTs think about recruitment for SOM, these operational shifts require new moving targets for DOT SOM training.

DOTs are particularly in need of support and further research to compile and develop the resources to support ongoing staff education; interviewees indicated that the curricula used at many universities and colleges do not address or engage SOM skills at all. To better support SOM capacity and staff development at DOTs and regional agencies, research is needed in a number of areas:

- **Brand SOM through research in the cost effectiveness of investments in SOM compared to traditional capacity construction**. Garnering support for personnel development within SOM is often linked to understanding the value of SOM for the organization and maximal efficiency of the transportation network. Participants shared the belief that the public is grossly unaware of SOM and its contributions, much less its potential. DOTs are looking to others, such as universities and researchers, to generate this information, even as DOTs realize they need to boost their own communication and outreach at the state (legislature and governor) level. Public awareness is critical because the public is the ultimate consumer of transportation and source for the future workforce. Thus, it is critical that the worth of the investment in SOM and the branding of SOM be a central focus for DOTs especially as the industry faces increasing changes.
- **Identify how DOTs can nurture and invest in operations and traffic management skills in-house**. DOTs expressed concerns about the contracting out of work and knowledge that the DOT needs to manage the larger system. When contractor turnover occurs or services are not available in their region, the DOT's responsibilities and the increasing demand for SOM knowledge and maintenance remains. The majority of work contracted out occurs in the more specialized positions, including ITS Maintenance, Control Room Managers and Operators, Incident Response, Traffic Control, and Electronic Technicians, where NCHRP 20-86 research participants indicated their DOT often lacked employees with the necessary technical skills.

  DOTs need to extend themselves and creatively leverage the technological abilities of their employees more than ever before. To do this work and maintain and expand this creativity, DOTs will need to nurture and more heavily invest in operations and traffic management skills in-house. Furthermore, successful maximum utilization of private sector resources requires investment in knowledgeable staff to oversee, manage, and call for private sector work. The unique demands of the jobs and the lack of available, tailored training led many participants to believe that DOTs will begin cultivating and using more in-house capabilities.

Participants forecast diminishing reliance on contractors in some cases and more reliance on hiring and training new employees, both to improve internal capacity and to reduce the vulnerability to transportation operations of not having the ability to perform certain key job functions. It is critical that DOTs address these needs in order to create a talent pipeline full of qualified applicants ready to move into SOM positions because SOM experts will be increasingly in demand.

Interview participants in this study indicated that, as a result of new technologies, there is a greater need for employees knowledgeable in ITS with skills in GIS, critical thinking, document management, and systems management. In fact, participants anticipated the greatest gaps among SOM skill sets to be computer-related. An increase in computer literacy is imperative for SOM employees as the ability to use and manage the DOT's computerized systems becomes more important. Innovation and creativity were additional skills that participants suggested would be valuable to the workforce.

- **Increase innovation and align incentives to support advancement at DOTs.** DOTs will also need to partner with others, increase innovation, and align incentives to support advancement and manage Intellectual Property (IP). As more complex operating systems gain momentum in the transportation industry, more technologically savvy systems operators and managers are needed. This is particularly evident within the SOM workforce where new technology and the complex relationships for personnel working across different modes, disciplines, and with differing stakeholder groups require a unique set of skills.

Caltrans-based research shows that seven major actions can help the process of innovation: (1) establish clear direction and procedures for the innovation process, (2) improve communications, (3) secure executive sponsorship and management support, (4) empower employees and find champions for each innovation, (5) create incentives for innovators, (6) demonstrate the benefits of innovation, and (7) manage risk and change. Finally, the research showed that "resistance to change" and "lack of political will" are among the most serious barriers to innovation. Managing risk and change is critical for the success of innovation; in the public sector, most failures are highly publicized and criticized. Therefore, creating the ability to take calculated, reasonable risks is required at public agencies. In another study conducted by Minnesota DOT, success factors found to encourage a culture of innovation were maintaining customer orientation, implementing internal communications, establishing criteria to evaluate innovations, identifying champions of innovation, conducting regular self-evaluations and performance measurement, and balancing risk and change (Minnesota DOT, 2010). This Mn/DOT study also identified a subset of programs within state DOTs that supported innovation such as Arizona DOT's Partnering Office and Louisiana DOTD's Quality and Continuous Improvement Program teams. DOT SOM would benefit from further investigation into how innovation is being fostered and supported in other transportation agencies, including research on lessons learned from existing DOT Operations Innovation Programs.

It would also serve DOT SOM well to conduct research into specific tools and techniques used by transportation agencies to facilitate innovation such as performance metrics, ROI instruments, and workforce development programs.

- **Protect Intellectual Property (IP) relating to SOM.** Information and knowledge are the driving force behind today's economy and, increasingly, transportation systems as well, yet

most DOT research programs are not evaluating the IP value or realizing the full potential of their investments.

Both the private and public sectors are seeking more innovative solutions to transportation and transportation-related issues. With creativity and innovation becoming more paramount in the evolution, so too is the industry's responsibility for managing IP in creative ways, and properly identifying, protecting, and commercializing it. This creates many new challenges to entities and individuals who are not fully prepared or equipped to tackle such challenges. Addressing these challenges would improve the industry's ability to become more nimble and innovative and to modernize its commercialization strategies, methods, and techniques by creating more efficient methods to identify, protect, productize, and commercialize innovative products and services. One of the biggest challenges that DOTs must overcome to improve the management of IP is creating organizational awareness of what IP is, what qualifies for protection under IP law, and how to preserve investments in innovation at third-party institutions.

DOTs and the research they fund generate a tremendous amount of IP through state and federally-based research programs. Technological developments are particularly common in the SOM and ITS fields. This, combined with recent trends—including retirements among DOTs' most knowledgeable staff, increasingly finite economic resources, the push for productivity advancements, and legal staff's limited familiarity with IP issues—suggests that managing and protecting IP rights may be one of the foremost legal challenges of tomorrow in the transportation industry, for which DOTs require research support. The IP management mechanisms and practices set forth by industries successful in managing their property rights could potentially inform, improve, and otherwise transform the IP management practices, strategies, and techniques in transportation. To improve the link between knowledge creation and knowledge application in the industry, state DOTs need to be better equipped to clearly identify their assets and their value, and be able to protect and transfer that innovation to the marketplace in a manner that one can measure the ROI by economic terms or mission terms, such as safety. IP rights need to be addressed and considered throughout the entire innovation process—from initiation and inception of research to the marketplace.

- **Sustain/record institutional memory in SOM task areas**. Ensuring that institutional memory and expertise are not lost when staff retire is an important part of succession planning. DOTs need assistance identifying practical, affordable, and effective management practices used by other transportation systems that contribute to knowledge retention. This includes identifying/developing mechanisms by which to engage staff in those workforce development practices to retain valuable intellectual capital. Celebrating careers and sharing key stories are just a few of the mechanisms to explore in greater detail. Systems for organizing, sharing, and accessing retained knowledge also need investigation.
- **Develop training on public communication mechanisms and skills for transportation system operations.** Several interview participants also indicated their transportation agencies were identifying ways to utilize new technologies in an effort to make information more manageable and available. The distribution of these messages is through radio and television outlets, dynamic message signs along the roadways, traveler information Internet sites, pager and broadcast fax alerts, and traveler information telephone numbers (FHWA, 2010). Furthermore, the installation of cameras and other traffic monitoring equipment helps

supplement information provided to travelers. The emergence of complex equipment using new technology, specifically ITS and advanced electronics, requires a parallel investment in training personnel to ensure they are safely and effectively operated and maintained. The need for this type of training was commonly expressed throughout our interviews, as participants described the criticality for employees to understand the technology they use to perform their job. Without understanding the technology, employees are less able to interpret the data or understand the design of system components or other potential inter-relationships. Consequently, DOTs would benefit from research to develop a compendium of communication mechanisms and skills for transportation system operations.

- **Develop electronic training courses particularly to help DOTs keep pace with electronic-based technologies.** Transportation personnel, specifically those employed in SOM, have acknowledged that keeping pace with advanced electronic-based technologies solely through traditional on-the-job training is not sufficient (McGlothin Davis and Corporate Strategies, 2002). To address this need, many traditional classroom-based activities have moved to web-based versions, which can make it easier for more personnel to take the training courses. Further, the advent of sophisticated simulators allows for presentation of realistic job previews and training through interactive online media for complex positions, such as those in transportation SOM. With economic pressures, DOTs are likely to need to increasingly rely on these methods, but DOTs need to know how to expeditiously find what is available. Thus, DOTs could use supporting research to compile this information.
- **Identify existing SOM training resources that DOTs have developed and further develop resources for "virtual exposure" to working conditions in various SOM positions as well as basic training for core SOM positions.** Given today's budget environment, research focused on cost-efficient and easily implementable steps that DOTs can take to increase operational capacity and preparation for the future is probably highly desirable. Research should involve collection of existing resources that DOTs have developed, further interviews with DOT SOM managers and practice leaders in particular position/skill areas, and if possible, collection of training resources developed by community and four-year colleges. In particular, research is needed on how coordination, networking, and joint research with other agencies, organizations, and even the private sector, can be increased.
- **Identify the necessary components and resources that could be tapped to develop an Operations and Management Training Academy**. There are several SOM competencies for which training tends to be completely lacking (e.g., comprehensive-level special event management, overview-level electronic payment systems) and many other SOM competencies for which there is very little or inadequate training (e.g., intermediate-level arterial operations, all levels of automated safety enforcement). Therefore, there is a critical need for SOM training, particularly given Baby Boomer retirements, increasing expectations for transportation capacity enhancements via implementation of new and evolving SOM technologies and practices, a potential workforce with insufficient skills, and the ever-increasing demand for SOM services. The need for formal SOM training programs—specifically in terms of communicating with the public, understanding the policy side, and understanding and operating new technologies—was accentuated throughout our NCHRP 20-86 interviews, because leading practitioners and managers observed gaps among the

desirable experiences and skill levels of SOM personnel and the existing knowledge and skills of those employees entering the field.

Given the near pre-requisite of cross-training in multiple areas of the DOT before assuming a leadership role in SOM and the value of transportation experience for all SOM staff, participants almost unanimously agreed that more formal training is needed once an employee enters an organization, regardless of the training students obtain in college. Almost every interview participant representing a DOT on the West Coast indicated a need to create an operations training academy, similar to the University of Maryland Operations Academy, in their region of the country or, alternatively, a web-based SOM training academy program. Additionally, participants discussed a shared need for DOT-level training, since it is critical that SOM personnel understand the infrastructure, operations, and stakeholders at the agency level. By and large, participants felt that such training could be developed or would be in existence and already available, were funding sufficient. They did comment that there has been an increase in the amount of webinars conducted for training and outreach with their DOTs, especially welcome given the difficulty of funding out-of-state travel for staff development.

- **Develop a compendium of resources and exchange mechanisms to share further mentoring resources among state DOTs**. Mentoring programs are a valuable way to support and educate new employees on the expectations and requirements of SOM jobs. DOTs could benefit from research that explores the types of mentoring programs maintained across transportation agencies. For example, California, Idaho, and New Jersey all have strong mentoring programs. Information that could be collected and shared includes reviews of program expectations and activities for mentees, resources identifying situations where seeking assistance from a mentor would be appropriate, resources identifying situations where seeking assistance from a mentor would not be appropriate, tools for building a relationship with a mentor, and other general advice for mentees. Also needed are mentor training and organization resources, including how to set up training and skill development, basic mentoring skills, effective interpersonal and communication skills related to coaching and providing feedback, the mentor's role in helping the mentee set and achieve developmental goals, and how to be an effective mentor.
- **Create knowledge management research and resources for DOTs**. In addition to the type of knowledge transfer that comes from mentoring, agencies should create people-focused knowledge management systems that promote knowledge sharing among employees. One possible technique to capture this critical knowledge involves interviewing senior leaders about their position and work functions. This includes collecting information on the cognitive processes that may go into making decisions as well as the rationale behind specific procedures and task performance. These interviews will help ensure that institutional memory and expertise are not lost when senior staff retire. It would also gather and develop case studies to portray best practices/key projects. Communities of practice could also be developed and participation encouraged, as another aspect of the knowledge management system, to foster methods for building knowledge networks to capture tacit knowledge and develop better documentation processes.
- **Make Realistic Job Previews a practical option for DOTs**. Realistic Job Previews (RJPs) are an effective tool for ensuring that agencies are cost effective in their hiring. In a challenging economy, DOTs can greatly benefit from low-cost tools that help filter through

those applicants, find the best fit, and save time for the agency. RJPs help filter employees who would not be a good "fit" for the job requirements and organizational culture by presenting candidates with an accurate picture of the perks and challenges of the job. More information is needed to make RJPs practical for DOTs. Research is needed on costs and obtaining the funding to develop and implement a virtual pre-employment RJP and assessment. Research is also needed on the time and labor commitment from HR and subject matter experts (SMEs), as well as incumbents, to develop a tool that is realistic, fair, and predictive of actual performance on the job. DOTs could use an array of sample prices and services to evaluate the practicality of this approach and pre-development of requirements DOTs would need to have outlined in order to contract for such tools. Research could help with identifying and interviewing SMEs, assembling job analyses and performance modeling, reviewing job descriptions, and conducting site visits and focus groups. All of this can provide information about the job to be presented in the RJP and help determine the format of the desired output.

- **Conduct research on DOTs' use of social media**. Some DOTs are starting to use social media but most may not know where to begin in implementing this tool into their recruitment activities and daily workforce management approach. Thus, it would be helpful for these DOTs to have an overview of what other DOTs are doing with regards to social media and case studies that address how and why they are doing it, lessons learned, and explicit instructions. One possible case example is the Washington State Department of Transportation (WSDOT), which decided to enhance their recruitment efforts through the use of a variety of social media applications, including Twitter, Facebook, MySpace, and YouTube. Their HR department decided to interview several employees, asking them about their experience working for the DOT, their favorite parts of their job, and some of the challenges they deal with on a day-to-day basis. These employee interviews were recorded on video and uploaded to YouTube when a similar position to the one described became open. Their use of Web 2.0 and other media outlets allowed them to reach different audiences, at a minimal cost. Furthermore, it significantly improved their recruitment rates. Agencies may, for example, videotape employees performing their job or interview them about their job, and post them on Facebook.

  The visual-interactive aspect and opportunity to present the agency and the job all have the potential to boost recruiting. An additional segment could be recorded that emphasizes "fit" and encourages more self-filtering and thus time-savings for the DOT, and could be used during times when applicants are plentiful.

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Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation