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TRANSPORTATION SAFETY

CAREER PATHWAY REPORT

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West Region
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Integrating Safety Competencies into Transportation Training, Education, and Career Pathway Streams

SECTION 1.0 EXECUTIVE SUMMARY

Past research suggests that, at a minimum, over 100,000 professionals have responsibilities that impact road safety, but there is a noted lack of formal structures in place to ensure that future and incumbent transportation professionals possess road safety competencies. Growing demand to enhance road safety competencies across the transportation sector--including for infrastructure construction and maintenance personnel as well as in transportation engineering, design, and analysis occupations--is evidenced by an increasing level of industry-driven activity toward defining and implementing new professional transportation safety certification programs. These certifications are exam-based and assess critical safety competencies based on applicants' past learning and experience. For those interested in obtaining an industry-recognized safety credential, however, it may be difficult to identify a structured training "road map" or program of study to gain the requisite competencies to be tested. While many professional development training courses may include safety-focused content, the courses are scattered across training providers, organizations, delivery modes, and target audiences, making it difficult for staff to identify easily. Degree-level road safety curriculum is sparse and dependent on individual faculty interest. Further complicating this picture is the difficulty future and incumbent transportation professionals face in gauging the career value of obtaining road safety competencies. Labor market data shows a relatively small number of safety titled occupations, and job posting analysis within the transportation sector reveal an overall focus on occupational health and safety related skillsets, with little attention paid to systemic road safety KSAs.

To address these challenges, the West Region Transportation Workforce Center (WRTWC) proposes to create a nationally replicable structure for obtaining and incentivizing road safety training and competencies attainment. The approach is two-fold. The WRTWC will: 1) deploy a pilot demonstration project of a Local Road Safety Scholars recognition program; and 2) provide support to develop industry-education partnerships at higher education institutions and to disseminate a replicable process for integrating road safety experiential and problem-based learning into the curriculum.

The purpose of the implementation plan is:

- To highlight and disseminate industry-identified safety competencies (NTCPI Year 1 safety discipline research outcomes) to education and training providers to enhance curriculum.
- To provide a structured mechanism for incumbent and future transportation personnel to obtain core safety competencies *and* to achieve employer recognition, a professional credential, or a degree, which will help advance them on a safety career pathway.

- To provide adaptable models for integrating road safety awareness and problem-based learning experiences into existing training and education programs to build interest, knowledge, and technical skills related to road safety.
- To provide a mechanism for transportation employers to ensure staff have core road safety competencies and a way to incentivize and recognize these skillsets in career advancement or other career benefits.

The WRTWC plans to work closely with the National Center for Rural Road Safety, the National Association of County Engineers (NACE), the Montana Local Technical Assistance Program (MT LTAP), and the Educational Partnerships for Innovation in Communities Network (EPIC-N) in implementing a pilot demonstration. Each organization will provide guidance, resources, and time to the successful deployment of the safety career pathway project as described more fully in Section 5.0.

SECTION 2.0 CHARACTERIZING THE WORKFORCE

2.1 The Transportation Safety Workforce

The goal of road safety is for all transportation system users to travel freely without risk of harm or death. Road safety professionals, therefore, must understand the complex interactions between system components –vehicles, system users, infrastructure—and utilize and develop analytical tools and techniques to minimize system risk.[1] Staff representing public health, emergency response, law enforcement, public relations, transportation and other sectors have long held responsibilities that impact road safety. Many day-to-day tasks in these professions relate to reducing motor vehicle crashes, injuries, or fatalities. A TRB Special Report estimates that over 10,000 public sector employees have responsibilities directly related to road safety, and an additional 100,000 professionals from various sectors have responsibilities that impact road safety. The report further predicts an increase in these numbers as focus on data-driven safety outcomes grows at the local, state, and federal levels.[2] MAP-21, for instance, established a perfor-

[1] US Department of Transportation Federal Highway Administration. (2017). Road Safety Fundamentals: Concepts, Strategies, and Practices that Reduce Fatalities and Injuries on the Road. *FHWA Report No. FHWA-SA-18-003.*

[2] *Committee for a Study of Supply & Demand for Highway Safety Professionals in the Public Sector. (2007). Building the Road Safety Profession in the Public Sector: Special Report 289 (Vol. 289). Transportation Research Board.*

mance and outcomes-based highway investment program to include reductions in traffic fatalities and injuries on public roads.[3] Vision Zero has helped push safety as a policy, planning, and budgetary priority down to local levels. Legislative efforts at the national and state levels have mandated improved integration of safety measures and outcomes into transportation planning, design, and operations. The Highway Safety Improvement Program (HSIP) likewise focuses on a data-driven strategic approach to highway safety.

Recognition of safety roles and responsibilities within various occupations is longstanding, but the concept of a "road safety professional" equipped with specific knowledge, skills, and methods to address road safety is relatively recent. Road safety science and road safety occupations are quickly evolving as new analytical, statistical, and technological tools emerge with proven benefits to safety performance. There has also been substantial progress related to the development of textbooks, courses, degree programs and professional certifications dedicated to transportation safety.

As the TRB Special Report points out, the transportation safety workforce "is aptly described as dispersed and diverse."[4] For the purposes of the Transportation Safety Career Pathways, the implementation plan concentrates on two components of this workforce. First, it focuses on the engineering, planning, and data analysis staff that work full-time on road safety, utilizing a data-driven, systems approach to safety management. These "core" occupations are considered to act as the "safety mentors to the larger workforce"[5]. Second, the plan underlines the importance of enhancing road safety competencies and road safety training pathways for on-the-ground front-line road construction and maintenance staff, whose ability to detect safety issues at the local site or systemic levels and to implement appropriate mitigation measures can produce significant safety improvements for both workers and road users.

2.2 Priority Transportation Safety Occupations

The Transportation Safety Career Pathway Implementation Plan focuses on eight critical occupations within two career cluster areas. The **Transportation Safety Planning, Engineering, Design & Analysis** career cluster encompasses occupations responsible for roadway and vehicle design,

[3] https://www.fhwa.dot.gov/map21/factsheets/pm.cfm

[4] *Committee for a Study of Supply & Demand for Highway Safety Professionals in the Public Sector. (2007). Building the Road Safety Profession in the Public Sector: Special Report 289 (Vol. 289). Transportation Research Board.*

[5] Ibid.

traffic engineering and operations, transportation planning, human factors and behavioral research, and safety data analysis. Critical occupations within this cluster include: Civil/Transportation Engineers, Engineering Technicians, Human Factors Engineers, Transportation/Urban and Regional Planners, and Computer and Mathematical Occupations (e.g. statisticians, data analysts, data scientists, computer scientists). The **Infrastructure Construction & Maintenance Safety** cluster includes Construction Managers, First-Line Supervisors of Construction Trades, Civil Engineers, Civil Engineering Technicians, and Highway Maintenance Workers. Data on projected occupational growth and national median wages for each priority transportation safety occupation is provided in the table below.

TABLE 2.2.1: CRITICAL TRANSPORTATION SAFETY OCCUPATIONS

SOC CODE	OCCUPATION TITLE	CURRENT # EMPLOYEES, 2016	PROJECTED # EMPLOYEES, 2026	PERCENT CHANGE	2016 MEDIAN ANNUAL WAGE
11-9021	Construction Managers	403,800	448,600	11.1%	$89,300
15-0000	Computer & Mathematical Occupations	4,419,000	5,026,500	13.7%	$82,830
17-2051	Civil/Transportation Engineers	303,500	335,700	10.6%	$83,540
17-2112	Human Factors Engineers	257,900	283,000	9.7%	$84,310
17-3022	Civil Engineering Technicians	74,500	81,100	8.8%	$49,980
19-3051	Urban and Regional Planners	36,000	40,600	12.8%	$70,020
47-1011	First-Line Supervisors of Construction Trades	602,500	678,300	12.6%	$62,980
47-4051	Highway Maintenance Workers	149,900	160,200	6.9%	$38,130

The conceptual framework for the Transportation Safety Career Pathway career clusters and priority occupations is represented in Figure 1. The occupations and career clusters are overlapping with core competencies based on a data-driven systems approach to transportation safety providing the interconnection between the different occupational purviews. Likewise, the safety career pathways are designed to represent an interdisciplinary and cross-occupational approach to safety education and training.

Figure 1: Conceptual Framework for Safety Occupational Clusters

2.3 Critical Transportation Safety Competencies

Transportation safety as a topic and as a practice is inherently cross-disciplinary. Evidence-based safety improvements are grounded in high-quality data and robust data analysis techniques; and draw from methodological approaches from a variety of disciplines. Research and analysis leads to on-the-ground tools and techniques that can be implemented in transportation safety planning, roadway design, transportation operations, and road construction and maintenance activities. Road safety professionals must possess foundational knowledge of road safety as a distinct field and they must correspondingly apply road safety techniques and tools to their everyday occupational job tasks. Over the past decade, considerable effort has been expended on defining

road safety competencies[6] [7] [8] [9] [10] [11] [12] [13] [14]. To facilitate integration of safety competencies into multi-disciplinary coursework, the pathway plan utilizes these resources to identify critical competencies, and, for clarity, divides them into "core" and "career cluster" competencies.

"Core safety competencies" are industry-wide as opposed to individual, occupation-specific competencies. They represent the fundamental cross-occupational knowledge, skills, and abilities expected of a road safety professional. Attainment of core safety competencies will help new career entrants achieve career flexibility, allowing them to pursue multiple career paths into safety-related careers. They are listed in Table 2.3.1.

[6] Jovanis, P. and F. Gross. (2006) Core Competencies for Highway Safety Professionals. National Cooperative Highway Research Program. Research Results Digest 302. Transportation Research Board, Washington, D.C.

[7] Bahar, G. (2011). Highway Safety Training Synthesis/Roadmap (NCHRP Project 20-07, Task 290), National Cooperative Highway Research Program, Transportation Research Board, Washington, D.C.

[8] National Center for Rural Road Safety (2017). Development Materials for a Local Maintenance Personnel Rural Road Safety Recognition Program. Prepared for FHWA, online: https://ruralsafetycenter.org/resources/list/development-materials-for-a-local-maintenance-personnel-rural-road-safety-recognition-program/

[9] US Department of Labor, Employment & Training Administration, O*NET OnLine: https://www.onetonline.org/

[10] U.S. Department of Transportation, FHWA Safety Program. Guide for State Department of Transportation Safety Data Business Planning. FHWA-SA-17-047. July 2017.

[11] Campbell, J. et. al. (2012). NCHRP Report 600: Human Factors Guidelines for Road Systems. Transportation Research Board. Washington, D.C.

[12] Cambridge Systematics, Inc. (2015). NCHRP Report 811: Institutionalizing Safety in Transportation Planning Processes: Techniques, Tactics, and Strategies. Transportation Research Board. Washington, D.C.

[13] American Road & Transportation Builders Association. Safety Certification for Transportation Project Professionals™ Candidate Handbook. Online: https://www.artba.org/wp-content/uploads/SCTPP/SCTPP_Candidate_Handbook.pdf

[14] Transportation Professional Certification Board. Road Safety Professional Level 1 Domains. Online: http://www.tpcb.org/rsp/FAQs.pdf

TABLE 2.3.1: CORE TRANSPORTATION SAFETY COMPETENCIES

CORE COMPETENCIES FOR TRANSPORTATION SAFETY PROFESSIONALS
Awareness of the importance of safety and ability to communicate importance to a broader audience in a manner that fosters greater organizational, employee, and/or public safety culture.
Understanding of safety management principles and the safety planning process.
Ability to identify and apply regulatory requirements.
Knowledge of, or ability to locate, use, and interpret various data and information sources and analytical tools to: 1. Identify and assess safety risks. 2. Identify appropriate countermeasures to mitigate risks (including prioritization of multiple options using a data-based decision-making process). 3. Assess effectiveness of safety measures.
Ability to effectively develop and/or implement a safety plan.
Ability to communicate and collaborate with multiple stakeholders and to lead and navigate change.
Ability to recognize the capabilities and limitations of different road users in terms of behavior choices, reactions to transportation systems, and the capacity to survive a crash.

The core safety competencies provide the foundation for both career clusters and all priority occupations within the Transportation Safety Career Pathways Implementation Plan. Recognizing differing safety job functions and levels of specialization between the two safety career clusters, competency models were developed for each career cluster. The competency models focus on safety-specific KSAs. Additional competencies specific to individual academic disciplines and occupations (e.g. planning or civil engineering) are clearly required for job seekers and professionals. However, these are well-documented elsewhere. For the purposes of safety career pathway implementation, the competency models focus solely on safety-specific KSAs to facilitate alignment of training and education development efforts and to fill gaps.

Transportation Safety Planning, Engineering, Design & Analysis

A competency model pyramid for the Transportation Safety Planning, Engineering, Design & Analysis career cluster is provided in Figure 2.

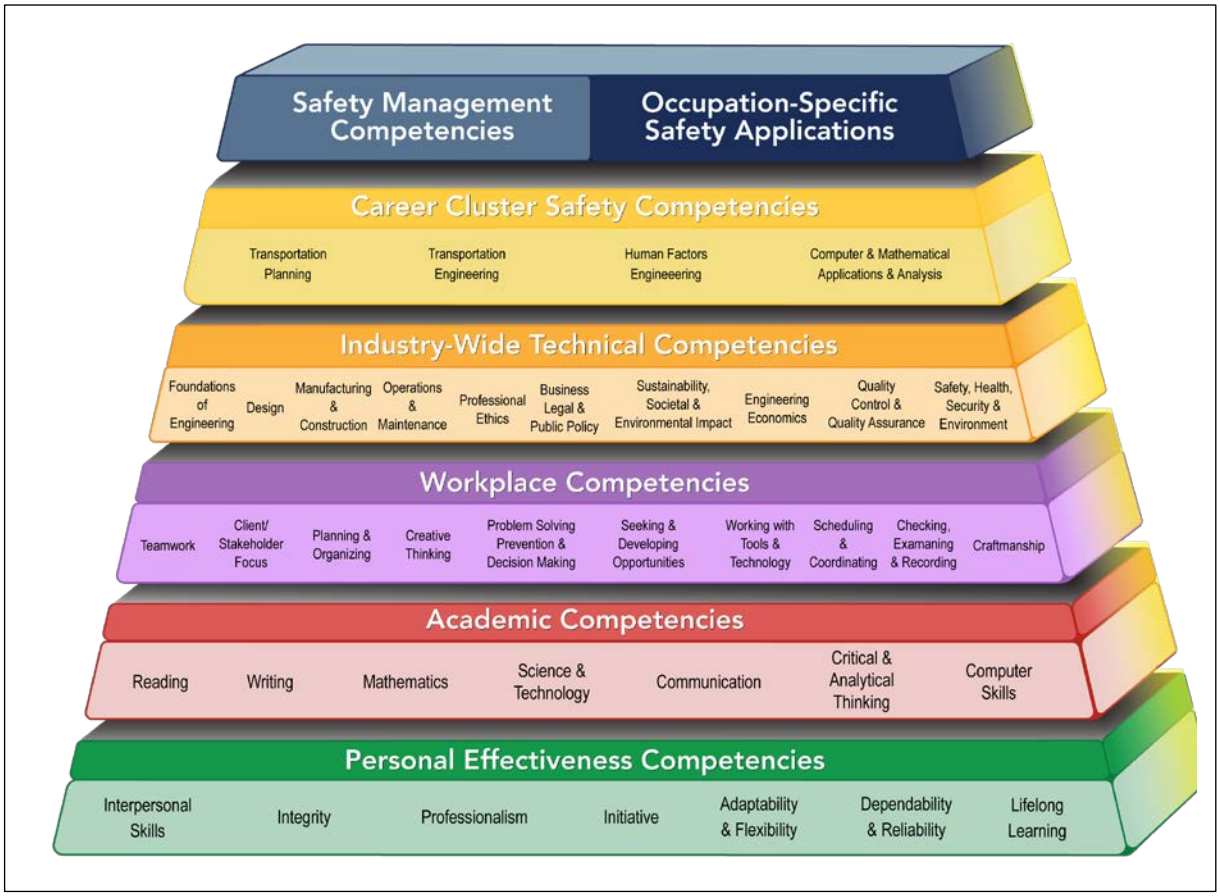


Figure 2: Transportation Planning, Engineering, Design & Analysis Competency Model

The baseline personal effectiveness, academic, workplace, and industry-wide technical competencies are drawn from the Department of Labor's industry model for Engineering.[15] The top

[15] Tiers 1-4 in the Competency Model pyramid graphics are adapted from CareerOneStop's industry competency models for Engineering and Heavy Highway Civil Construction respectively. Toolkit is available online through U.S. Department of Labor, Employment and Training Administration support: https://www.careeronestop.org/CompetencyModel/competency-models/pyramid-home.aspx

three tiers of the pyramid—Career Cluster Safety Competencies, Safety Management Competencies, and Occupation-Specific Safety Applications—are broken down into more detail below.

The Career Cluster Safety Competencies tier focuses on the core knowledge, skills, and abilities, which are common to all priority occupations within the career cluster. These KSAs are based on road safety science principles and techniques. The depth of knowledge, level of competence with specific analytical tools or techniques, and applications of skillsets will vary between the different occupational groupings. However, baseline safety knowledge, skills, and abilities are cross-disciplinary and cross-occupational and are outlined for the career cluster in Table 2.3.2.

TABLE 2.3.2: CORE SAFETY KNOWLEDGE AND SKILLS FOR OCCUPATIONS IN TRANSPORTATION PLANNING, ENGINEERING, DESIGN & ANALYSIS

Core Safety Knowledge	Core Safety Skills
Understand road safety as a complex, interdisciplinary, multimodal discipline devoted to the avoidance and/or mitigation of fatalities, injuries, and crashes.	Know how to identify and access different sources of local and federal data for safety analysis; as well as strengths and deficiencies in different data sets.
Understand the goals, process, and contributors to highway/road safety management.	Be able to interpret crash data and other safety-related data.
Understand and be able to communicate the comprehensive costs of transportation system crashes, injuries, and fatalities to society.	Be able to assess the different factors contributing to highway crashes, injuries, and fatalities and how crash contributing factors interact.
Understand how road user decision making, behaviors, and safety are influenced by the complex interactions of roadway design, transportation planning, traffic control devices and operations,	Be able to assess the appropriateness of different analytical methods used for identifying safety problems and evaluating the effectiveness of safety countermeasures.

Core Safety Knowledge	Core Safety Skills
communications technologies, vehicle design features, and the roadside environment.	
Understand the potential safety impacts of different roadway designs, particularly on vulnerable road users, and how demographic trends impact safety management outcomes.	Be able to use GIS or other spatial data analysis and visualization tools to identify transportation safety issues.
Understand the classification system of roadway elements, highway crash and injury severity factors and their interactions.	Understand and be able to utilize predictive methods for analyzing systemic safety issues.
Be familiar with the transportation safety aspects of major legislation, tort liability and risk management.	Be able to apply modeling and simulation skills as well as appropriate qualitative and quantitative research methodologies to transportation safety problems to develop solutions.
Understand safety research and methods employed to achieve improvements in transportation safety.	Understand the myriad environmental, cultural, and other factors that influence behavior in order to develop an effective plan to promote behavior change and enhanced safety culture.

Attainment of safety leadership positions requires additional development of specific management abilities. Safety management competencies are outlined in Table 2.3.3.

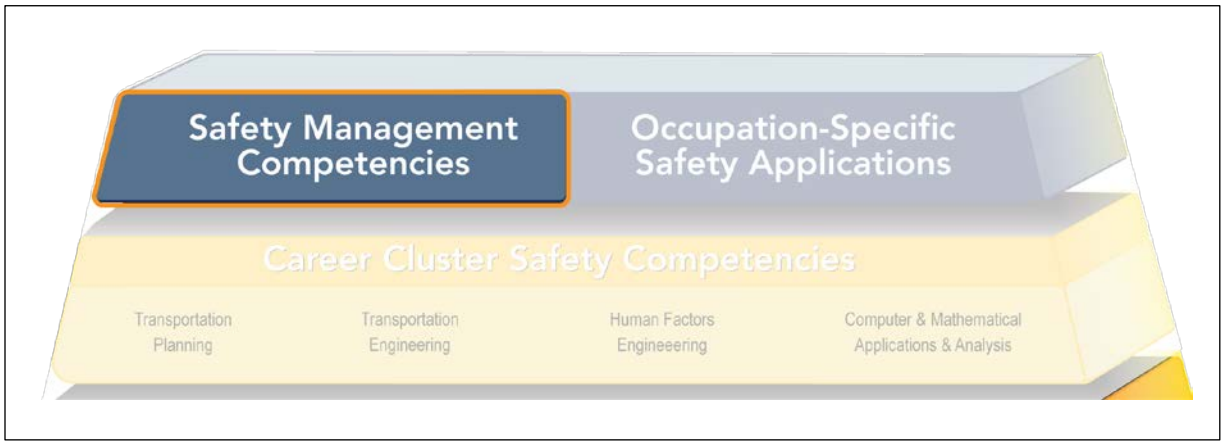


TABLE 2.3.2: CORE SAFETY MANAGEMENT COMPETENCIES IN TRANSPORTATION PLANNING, ENGINEERING, DESIGN & ANALYSIS

CORE SAFETY MANAGEMENT ABILITIES
Utilize scientific management techniques in planning, implementing, and evaluating transportation safety programs.
Assess and implement effective public outreach and marketing strategies and promote stakeholder collaborations and public involvement to successfully implement road safety management programs, decisions, and solutions.
Promote individual, organizational, and public safety culture.
Value and promote science-based safety research and applications to safety.
Utilize effective and strategic communications and provide safety leadership.
Identify opportunities for internal and external coalition-building and strategic communications to implement successful transportation safety initiatives.
Establish the multidisciplinary and cross-sector relationships necessary to support effective transportation safety initiatives.
Understand the importance of analyzing and communicating the expected safety benefit/cost associated with implementing a specific safety countermeasure or planning decision.

The competency models for the Safety Career Pathway implementation plan highlight the safety competency commonalities between occupations within the career cluster. The primary distinction between the different occupations within a career cluster is in the application of these safety KSAs in day-to-day job activities and in the products and outcomes produced (e.g. vehicle safety technologies, highway geometric designs, long range transportation safety improvement plans, etc.). Each occupation will have additional associated KSAs, which are well-documented in career pathway implementation plans for engineering, planning, and elsewhere. For the purposes of the safety career pathways, the competency models focus solely on the additional safety KSAs required to function effectively as a leader in transportation safety.

Occupation-specific safety applications highlight the differences in job tasks and underline safety functions for specific occupations within the cluster (i.e. transportation engineering, transportation planning, human factors engineering, and computer and mathematical occupations). Examples of how transportation safety competencies may specifically be applied within the job specifications for each priority occupation are provided below.

Transportation Safety Planner

Applies safety KSAs to:

- Utilize multiple strategies to explicitly incorporate safety and safety outcome measures into transportation planning and decision-making processes.
- Assess demographic trends and how they impact safety decision-making processes for the purposes of transportation planning.
- Use appropriate traffic safety, public health, and other data systems for identifying and targeting high-risk groups in order to plan effective safety programs at the national, state, and local levels.

Transportation Safety Engineer

Applies safety KSAs to:

- Explicitly incorporate quantitative safety performance measures and outcomes into transportation operations, roadway design processes, and transportation decision-making.
- Utilize tools for road safety analysis and safety improvement design (e.g. Highway Safety Manual, Interactive Highway Safety Design Model; Safety Analyst software tools, etc.).
- Identify, implement, and evaluate effective systemic safety improvements and countermeasures.

Human Factors Engineer

Applies safety KSAs to:

- Integrate human performance or human factors related data and knowledge into transportation systems or vehicle engineering and design activities to improve safety.
- Assess contributing factors to crashes and develop solutions based on user considerations such as factors related to visual and sensory systems, cognitive loads and distractions, situational awareness, decision-making, and information processing.
- Improve understanding of the safety impacts of behavioral decision-making to improve mitigation measures, utilizing psychological and other research methods based on scientific principles related to human behavior and performance; individual differences in ability, personality, and interests; and learning and motivation.
- Improve understanding of user-centered design and analysis methodologies in order to identify effective user-centered interventions.
- Develop behavior change strategies to improve safety culture.

Safety Data Analyst

Applies safety KSAs to:

- Perform data management and analysis tasks to assess transportation safety problems and develop evidence-based solutions. Tasks may include developing or implementing novel computational approaches, statistical methods, simulation models, graphic and spatial data analysis and representation, and developing new software tools or other technologies to support safety research goals.
- Perform validation and testing of models, programs or databases; and review existing or incoming data for currency, accuracy, usefulness, quality, or completeness of documentation. Collaborate with other organizations to support interoperability of systems, and safety data sharing and analysis.
- Manage data systems and implement security measures to safeguard data. Facilitate access and use of safety data for stakeholders.

Transportation Infrastructure Construction and Maintenance Safety

As with the core competencies, there is considerable overlap between safety competencies within each of the two career clusters. The same competency model approach described above is used for the Transportation Infrastructure Construction and Maintenance Safety career cluster, as depicted in Figure 3.

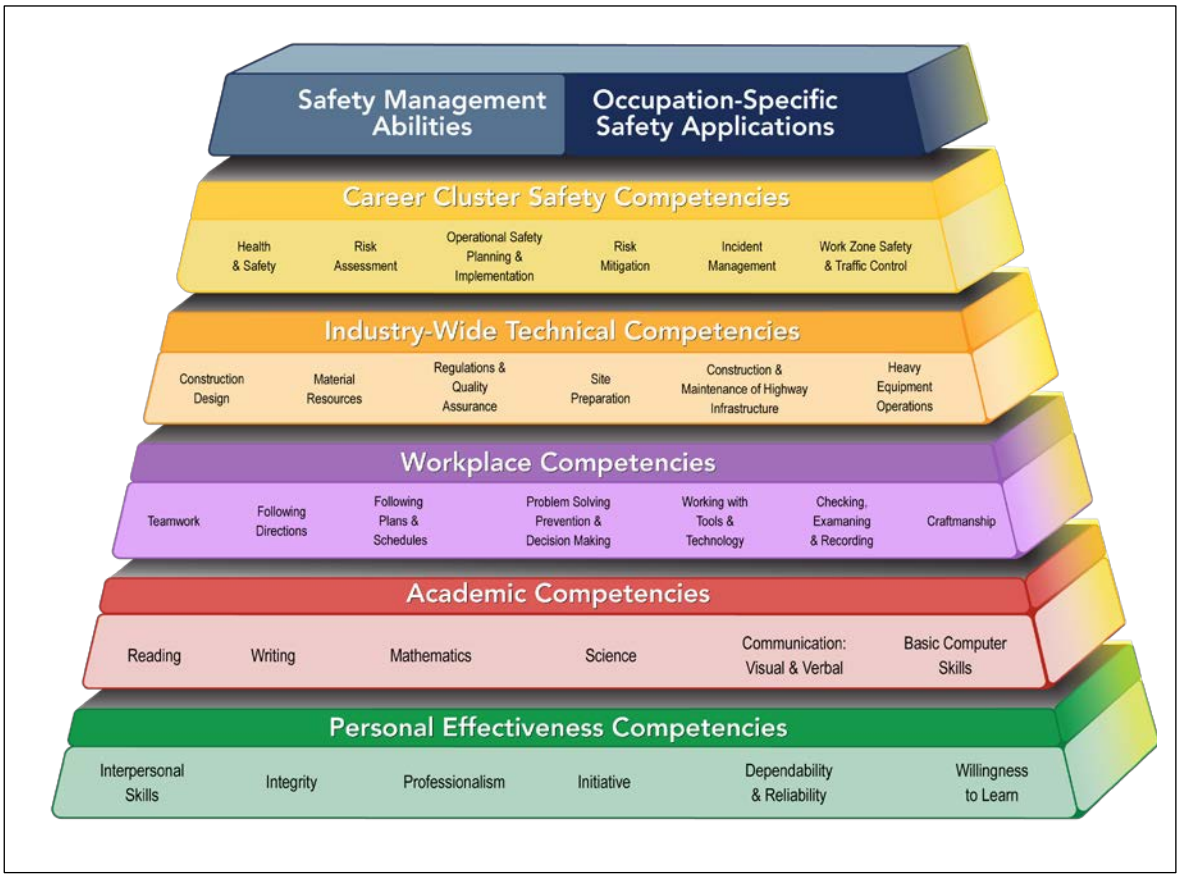


Figure 3: Transportation Infrastructure Construction and Maintenance Safety Competency Model

The baseline personal effectiveness, academic, workplace, and industry-wide technical competencies are drawn from the Department of Labor's industry model for Heavy Highway Civil Construction.[16] The top three tiers of the pyramid—Career Cluster Safety Competencies, Safety Management Competencies, and Occupation-Specific Safety Applications—are broken down into more detail below.

The Career Cluster Safety Competencies tier focuses on the core knowledge, skills, and abilities, which are common to all priority occupations within the career cluster. The depth of knowledge and applications of skillsets will again vary between the different occupational groupings. However, baseline safety knowledge, skills, and abilities are cross-disciplinary and cross-occupational and are outlined for the career cluster in Table 2.3.2.

TABLE 2.3.2: CORE SAFETY KNOWLEDGE AND SKILLS FOR OCCUPATIONS IN TRANSPORTATION INFRASTRUCTURE CONSTRUCTION AND MAINTENANCE SAFETY

Core Safety Knowledge	Core Safety Skills
Understand road safety as a discipline devoted to the avoidance and/or mitigation of fatalities, injuries, and crashes.	Be able to assess contributing factors to highway crashes, injuries, and fatalities and how crash contributing factors interact.
Understand the goals, process, and contributors to highway/road safety management.	Be able to identify, implement, and evaluate roadside and jobsite countermeasures for safety.

[16] Tiers 1-4 in the Competency Model pyramid graphics are adapted from CareerOneStop's industry competency models for Engineering and Heavy Highway Civil Construction respectively. Toolkit is available online through U.S. Department of Labor, Employment and Training Administration support: https://www.careeronestop.org/CompetencyModel/competency-models/pyramid-home.aspx

Core Safety Knowledge	Core Safety Skills
Understand the steps in the safety analysis process and the differences in approaches for systematic, systemic, and individual site concerns.	Be able to assess the safety of different roadway components (e.g. curves, intersections, segments, and roadsides) by observing potential safety issues (i.e. "reading the road").
Understand how road user decision making and safety are influenced by road design, maintenance activities, and traffic control elements (e.g. sight distance, horizontal and vertical alignments, intersection design, signage, speed control, etc.) as well as by the roadside environment and road, weather, and other operational conditions.	Understand the myriad environmental, cultural, and other factors that influence behavior in order to develop an effective plan to promote behavior change and enhanced safety culture.
Understand the potential safety impacts of different roadway designs, signage, and maintenance practices, particularly on vulnerable road users.	Be able to locate, use, and interpret various information sources to assess safety risks and identify appropriate countermeasures.
Understand the classification system of roadway elements and the different safety concerns for each (e.g. low volume roads, etc.).	Be able to use appropriate data and analytical tools to evaluate the effectiveness of safety plans and safety mitigations.
Be familiar with the transportation safety aspects of major legislation, tort liability and risk management; and with safety regulations and policies governing maintenance and construction activities to ensure compliance.	Be able to utilize safety and incident management techniques to identify and remediate risk.
Understand the purpose of the Manual on Uniform Traffic Control Devices (MUTCD) and how its tenants apply to safety.	Be able to implement a wide range of project safety plans, including: confined space, fall prevention, excavation, equipment, incident management, and emergency response plans.
Understand the differences between mobile, short-term, and long-term work zone traffic control requirements and how to implement them.	Be able to use and maintain proper flagging techniques and traffic control devices, and to manage work zone safety.

Attainment of safety leadership positions requires additional development of specific management abilities. Safety management competencies are outlined in Table 2.3.3.

TABLE 2.3.2: CORE SAFETY MANAGEMENT COMPETENCIES IN TRANSPORTATION PLANNING, ENGINEERING, DESIGN & ANALYSIS

CORE SAFETY MANAGEMENT ABILITIES
Utilize scientific management techniques in planning, implementing, and evaluating safety plans and programs.
Communicate importance of safety in a manner that promotes employee, organizational, and public safety culture.
Integrate safety into all organizational and employee performance measures.
Utilize effective and strategic communications and collaborations to provide safety leadership.
Identify opportunities for internal and external coalition-building and strategic communications to promote safety.
Understand and be able to communicate the comprehensive costs of roadway crashes and construction and maintenance personnel injuries and fatalities to society.
Understand and be able to communicate the expected safety benefit associated with implementing a specific safety countermeasure or maintenance decision.

Occupation-specific safety applications highlight the differences in job tasks and underline safety functions for specific occupations within the cluster (i.e. maintenance workers and road construction project managers). Examples of how transportation safety competencies may be applied within maintenance and construction job specifications are provided below.

Highway/Road Maintenance Worker

Applies safety KSAs to:

- Assess safety of different roadway components and the roadway environment, determine appropriate maintenance countermeasures to improve safety as needed, and implement mitigation measures on systemic or individual site basis as appropriate.
- Implement maintenance activities with the aim of improving safety (e.g. vegetation control, signs and supports, guardrails, drainage and other roadside features maintenance, etc.).
- Ensure effective traffic control techniques and jobsite safety measures are in place to ensure safety of workers and those passing through a work zone or temporary maintenance activity site.
- Develop incident management and other safety plans based on risk assessment and knowledge of regulations and compliance measures.

Highway/Road Construction Project Manager

Applies safety KSAs to:

- Ensure road design and construction practices integrate safety best practices for both project site workers and road users based on knowledge of job site safety management techniques, as well as systemic road safety principles and crash reduction factors.
- Identify hazards to develop safety plans and implement effective on-site safety measures based on knowledge of regulations and compliance measures; evaluate deficiencies and implement effective countermeasures.
- Ensure effective traffic control techniques and jobsite safety measures are in place to ensure safety of workers and those passing through a work zone.

Emerging Competencies

Technological changes are having a dramatic impact on the transportation industry. The safety workforce is no different. The development and deployment of vehicle-to-infrastructure and vehicle-to-vehicle systems, autonomous vehicles, automated data collection systems, and other new and emerging technologies are expected to influence the types of knowledge and skillsets that will increasingly be needed by safety professionals. Skillsets projected to be expanding in importance are primarily technology-based, to include: big data and predictive analytics, cybersecurity techniques, computer programming, and algorithm development. Expectations for knowledge in psychology, human-machine/human-computer interactions, systems engineering, and artificial intelligence are likewise expected to grow. Education and training for safety professionals will correspondingly need to be increasingly multidisciplinary; and change management and communication skills, creativity, and the ability to adapt will define leadership qualities in the new environment.[17]

2.4 Transportation Safety Professional Workforce Readiness

One challenge in developing career pathways in transportation safety is the current lack of explicit reference to safety in job titles and in the preferred or required qualifications listed on job postings. This results in a mutually reinforcing disconnect for both employers and job seekers/education providers. On the one hand, job seekers and the education and training institutions responsible for preparing incoming workers do not see any explicit "demand for persons trained in road-safety[18]" within the labor market. As a result, degree-level road safety curriculum remains sparse and dependent on faculty interest.[19] While construction degree programs do tend to offer separate safety courses, primarily as a result of accreditation standards and other influences driving curricular content, few engineering programs offer a separate course on construction safety or safety by design.[20] Research indicates that most construction safety course content is currently

[17] Based on a survey of 95 transportation safety professionals on the expected workforce impacts of transformational technologies; conducted by the WRTWC in December 2017.

[18] Hauer, E. (2007). A case for evidence-based road-safety delivery. Improving Traffic Safety Culture in the United States, 329. AAA Foundation for Traffic Safety, pg. 335.

[19] Gross, F., & Jovanis, P. P. (2008). Current state of highway safety education: Safety course offerings in engineering and public health. Journal of Professional Issues in Engineering Education and Practice, 134(1), 49-58.

[20] Gambatese, J. A. (2003). Safety emphasis in university engineering and construction programs. Construction safety education and training—A global perspective.

related to personal and job site safety (e.g. OSHA related topics), with less class time devoted to risk mitigation, evaluation of safety measures, and safety planning and design.[21]

Lack of evident workforce demand leads to an unproductive cycle characterized by lack of supply of well-trained safety professionals emerging from the education system. Reinforcing the workforce preparatory issue is the reluctance of employers to write specific safety KSAs into job qualification requirements, because there is an assumption that these skills are too difficult to find in typical applicant pools and would prevent successful completion of the hiring process. Safety engineers at state and local agencies expect to have to train new staff on safety-related knowledge and skills because it is rare to find applicants with these skillsets. As a result, an initial period of training is often required for new hires in safety-focused positions to get "up to speed" with fundamental safety competencies.

However, identifying training courses to cover core safety topics and develop the required skillsets for specific positions can be a challenge. A study on safety training utilization by four state departments of transportation found that "training is being addressed on an ad-hoc basis depending on availability and staff needs[22]". A structured transportation safety education and training curricula would benefit both employers and future and incumbent transportation professionals.

Safety career pathways that begin at the pre-career level and build needed safety competencies at the degree level through coursework and experiential learning obtained while students are still in school, have the potential to overcome some of the barriers noted above with respect to meeting increased demand for safety skillsets in the workforce. In addition to providing a skilled pool of potential safety professionals, integration of road safety competency development at the degree-level provides opportunities to target multiple disciplines and to ensure that emerging workers in a variety of entry-level fields (e.g. roadway design, traffic operations, planning, etc.) have foundational safety knowledge and skills. It additionally provides a conduit to cross-discipli-

[21] Gallagher, S., and N. Villwock-Witte. (2018). An Example from Construction Safety: Professional Certifications as Potential Drivers of Degree Program Enhancements. Presentation and paper in proceedings of the American Society for Engineering Education (ASEE) 125th Annual Conference, Salt Lake City, UT, June 24-27, 2018. Paper url: https://peer.asee.org/29784

[22] Otto, J., Finley K., Ward, N. (2016). An Assessment of Traffic Safety Culture Related to Engagement in Efforts to Improve Traffic Safety (FHWA/MT-16-012/8882-309-03; TPF-5(309)). Center for Health and Safety Culture, Western Transportation Institute, Montana State University.

nary learning opportunities for students, allowing them to develop competencies in emerging areas like big data analytics that are expected to be increasingly in demand by transportation employers.

SECTION 3.0 CAREER PATHWAY DESIGN

3.1 Pathway Design Methodology

The design of the safety career pathways is founded on the goal of having safety incorporated into every level of the transportation decision-making process. The pinnacle of each safety career path represents a position that works full-time on road safety – the "safety mentors to the larger workforce," [23] while also incorporating into the pathway the myriad supportive occupations that have responsibilities directly impacting safety, including front-line staff. Pathway implementation therefore focuses on integrating safety competencies into the learning objectives, outcomes, and experiential learning opportunities offered through existing multidisciplinary degree programs and coursework. The pathway design is competency-based, cross-disciplinary, and cross-occupational to avoid academic or workforce silos. In the workplace, the goal is to provide a structured mechanism for incumbent workers to gain safety competencies, and for employers to identify and reward staff for pursuing safety-focused professional development through career advancement opportunities, pay raises, or other staff recognition processes.

"Core" safety occupations for the purposes of the safety career pathway implementation plan were identified in an iterative process involving an extensive literature review, stakeholder interviews, labor market data analysis, and advisement from subject matter experts serving on the Safety Discipline Working Group for the project. Selection of priority occupations was further supported by recent and ongoing efforts to develop professional certification programs in transportation safety, which were likewise based on extensive national outreach and data collection efforts to determine industry demand.

A scan of existing education and training was completed for priority occupations to identify gaps. The safety career pathway models bring safety competencies front and center for each stage of

[23] Committee for a Study of Supply & Demand for Highway Safety Professionals in the Public Sector. (2007). Building the Road Safety Profession in the Public Sector: Special Report 289 (Vol. 289). Transportation Research Board.

the career ladder, highlighting opportunities for safety-focused cross-disciplinary coursework and experiential learning.

3.2 Pathway Learning Strategies

Significant institutional barriers exist that can impede the implementation of new coursework or degree programs at education institutions. Nevertheless, integration of road safety competencies into programs of study can be successfully accomplished through the implementation of experiential or problem-based learning strategies focused on applying technical and problem-solving skills to address transportation safety issues. These strategies can be curricular (i.e. integrated into coursework or classroom projects) or co-curricular (i.e. experiences supplemental to degree work, such as research or internships). Examples that have proven successful in attracting and preparing students for safety careers are highlighted below. Additional examples are provided in career pathway documentation.

Transportation Agency/University Research Partnerships

Research partnerships between university faculty and state DOTs are proven sources for safety workforce development when they: 1) are implemented over the long-term; and 2) actively involve faculty and both undergraduate and graduate multi-disciplinary students in the implementation of safety research and project development. The Utah Department of Transportation (UDOT) provides an excellent example. UDOT contracts with Brigham Young University to develop safety countermeasure improvements, develop and improve safety models (e.g. crash prediction, crash severity, and intersection crash prediction models); analyze up-to-date safety data and identify countermeasures. Project development is done as a collaborative effort between university and DOT, allowing for progressive improvements as partners jointly identify next steps. Since the collaboration began more than 25 students have been involved; and many of these alumni have since entered safety-focused careers, either at the DOT or with private consulting firms.

Safety-Focused Work-Based Learning

Particularly in construction programs, many institutions either require or strongly encourage work-based learning experiences for their students through internships and co-ops. Industry and education institutions can work together to ensure that safety-focused experiences and application of safety skills are an important component of these student development experiences.

Safety-Focused Course-Based Experiential Learning

Integration of safety topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of safety-focused case studies and lab exercises into required coursework; and implementation of assignments that demonstrate understanding of safety principles and processes, through development of safety plans, safety data analysis assignments, or implementation of accident investigations or safety audits. Job site visits and field trips have also been identified as useful tools for promoting student interest in safety. Senior design courses, industry-led challenge projects, or service learning projects offer ample opportunity for employers to engage with educational institutions to help build safety competencies by engaging students on real-world projects.

Engaged Scholarship

Most universities provide mechanisms to incorporate community projects into student coursework, either through senior design, capstone, or service learning courses. Engagement of transportation organizations with universities to provide safety-focused course-based projects can serve as a powerful student exposure and recruitment tool to safety career pathways. For instance, the Idaho Transportation Department (ITD) worked with Boise State University's Executive MBA program to engage students in developing effective outreach tools for young drivers to promote safe driving. The students developed and presented different team ideas on effective outreach and messaging for this population as a course project. In the process, they learned about transportation safety issues and initiatives they otherwise would not have been exposed to during their degree program.

Some universities provide opportunities to scale up these types of engaged scholarship opportunities so that one agency partner can provide multiple projects over the course of an academic year—distributed over multiple departments and colleges across the university.[24] This model provides a powerful tool for gaining access to multidisciplinary students and expertise to solve transportation safety problems.

[24] This model, first spearheaded by the University of Oregon, has since been implemented by universities nationwide, and now constitutes a network of institutions utilizing the Educational Partnerships for Innovation in Communities (EPIC) model (epicn.org).

Competency-Based Curriculum

For incumbent workers, pursuing an academic program of study while a full-time employee can present many challenges. A curriculum organized by competencies required for jobs and cross-walked with industry skill standards can facilitate learning. Academic programs that award credit for prior learning, allowing incumbent workers to obtain academic credit by demonstrating knowledge and skills developed on-the-job, can help workers achieve degrees to advance their credentials. (Colorado DOT and Front Range Community College are currently utilizing this model to implement an Associate's degree in Highway Maintenance Management).

In all cases, the transportation industry can and should play a proactive role in fostering experiential learning opportunities for students to develop safety competencies by offering students exposure to safety topics; and allowing them to develop problem-solving skills and to apply safety techniques and tools to real-world projects. Engagement with education institutions further serves to highlight industry demand for safety skillsets to students as they consider various career options and opportunities.

3.3 Priority Safety Career Pathways

Transportation Safety Career Pathways are presented for each of the priority occupations within the two career clusters. The four **Transportation Safety Planning, Engineering, Design & Analysis** career pathways are as follows:

Career Pathway #1: **Transportation Safety Planning** – The pathway provides guidance for transportation planners to obtain the additional competencies needed to integrate safety into transportation planning documents and processes (to include knowledge of systemic safety issues, demographic and human factors associated with safety risk, and safety data analysis techniques).

Priority Occupations: Transportation Planner, Urban and Regional Planner.

Support Occupation: Planning Aide.

Education/Training: Planning Program (Urban & Regional or Transportation Planning).

Career Pathway #2: **Transportation Safety Engineering** – The pathway provides guidance for transportation engineers to obtain the additional competencies needed to integrate safety into

transportation planning, design, operations, and investment decision-making processes (to include knowledge of systemic safety principles; ability to apply analytical, modeling and simulation skills to identify issues and develop safety solutions; and to identify and evaluate safety countermeasures and performance measures).

Priority Occupations: Transportation Engineer, Highway Safety Engineer, Roadway Design Engineer, Traffic Engineer.

Support Occupation: Engineering/Traffic Technician.

Education/Training: Civil Engineering Program.

Career Pathway #3: **Human Factors Engineering** – The pathway provides guidance for human factors engineers to obtain the additional competencies needed to integrate safety into vehicle and transportation system design (to include knowledge of road user limitations and the impact of behavioral decision-making on safety outcomes; and the ability to incorporate user-centered principles in system design to promote safety).

Priority Occupation: Human Factors Engineer.

Education/Training: Industrial Engineering or Human Factors Engineering Program.

Career Pathway #4: **Transportation Safety Data Analysis** – The pathway provides guidance for those pursuing careers in computer and mathematical occupations to obtain the additional competencies needed to support data-driven transportation system improvements and investment decisions (to include knowledge of road safety science principles, analytical tools and techniques; and the ability to apply analytical, modeling and simulation skills to identify issues and develop safety solutions).

Priority Occupations: Computer and Information Research Scientist, Research Scientist/Mathematician.

Support Occupations: Database Administrator, Computer Systems Analyst, Statistician, GIS Scientist/Technologist.

Education/Training: Program in Computer Science, Data Science, GIS, Mathematics or Statistics.

The two career pathways for the **Transportation Infrastructure Construction and Maintenance Safety** career cluster are as follows:

Career Pathway #1: **Road Construction Safety Management** – The pathway provides guidance for construction managers, supervisors, and project engineers to obtain competencies needed to integrate safety into transportation infrastructure design and construction, to ensure on-site changes do not negatively impact user safety; and to implement effective on-site safety plans and traffic control, identify risks and implement and evaluate safety countermeasures.

Priority Occupations: Construction Manager, Project Engineer.

Support Occupation: Front-line Construction Supervisor, Construction Equipment Operator, Construction Laborer.

Education/Training: Civil or Construction Engineering Program.

Career Pathway #2: **Highway Maintenance Safety Management** – The pathway provides guidance for highway maintenance managers and support staff (maintenance workers, technicians, crew leaders) to obtain competencies needed to integrate road safety considerations into road maintenance activities (to include ability to assess road conditions and the roadway environment to identify safety issues, and to implement maintenance activities with the aim of improving road user safety).

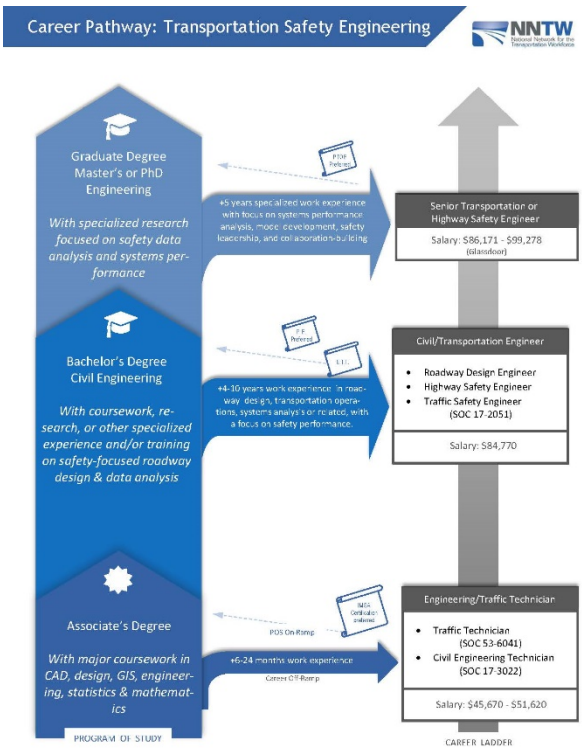
Priority Occupations: Highway Maintenance Manager.

Support Occupation: Highway Maintenance Worker.

Education/Training: On-the-Job training and experience; Civil or Construction Engineering.

3.4 Career Pathway Documentation Overview

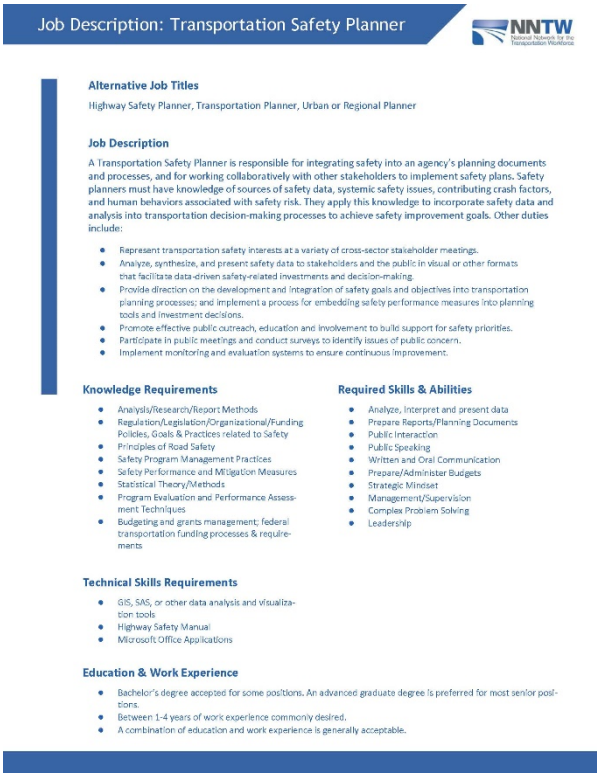
Example 1: **Career Pathway Map**



The career pathway graphic provides entrance and exit points between academic degree coursework and corresponding occupations and pay grades along the career continuum. Examples provided of coursework, research, or other specialized work-based or experiential learning focus specifically on opportunities to develop safety competencies, which in many cases require coursework from disciplines outside of the student's major. Industry credentials are listed as "preferred" or "required" for specific occupations along the career pathway (with additional information on credentials provided in the Program of Study document). For occupations with corresponding Standard Occupational Codes (SOC), median annual national salaries from 2017 Bureau of Labor Statistics data are listed. For occupation titles related to level of seniority (and therefore absent a SOC), data from Glassdoor is utilized, with the exception of various maintenance position levels; in which case the AASHTO salary survey is utilized.

Example 2: **Job Description**

The job description provides information on job titles, general job duties and responsibilities, knowledge, skills, and abilities required for the job, as well as expected education and work experience for job entry. Additional technical skills requirements may include aptitude with specific software programs. For safety pathways, job descriptions focus on the safety-related responsibilities for the occupation, as well as the knowledge, skills, and abilities required to effectively implement the safety functions of the position.



Job Description: Transportation Safety Planner

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Alternative Job Titles

Highway Safety Planner, Transportation Planner, Urban or Regional Planner

Job Description

A Transportation Safety Planner is responsible for integrating safety into an agency's planning documents and processes, and for working collaboratively with other stakeholders to implement safety plans. Safety planners must have knowledge of sources of safety data, systemic safety issues, contributing crash factors, and human behaviors associated with safety risk. They apply this knowledge to incorporate safety data and analysis into transportation decision-making processes to achieve safety improvement goals. Other duties include:

- Represent transportation safety interests at a variety of cross-sector stakeholder meetings.
- Analyze, synthesize, and present safety data to stakeholders and the public in visual or other formats that facilitate data-driven safety-related investments and decision-making.
- Provide direction on the development and integration of safety goals and objectives into transportation planning processes; and implement a process for embedding safety performance measures into planning tools and investment decisions.
- Promote effective public outreach, education and involvement to build support for safety priorities.
- Participate in public meetings and conduct surveys to identify issues of public concern.
- Implement monitoring and evaluation systems to ensure continuous improvement.

Knowledge Requirements

- Analysis/Research/Report Methods
- Regulation/Legislation/Organizational/Funding Policies, Goals & Practices related to Safety
- Principles of Road Safety
- Safety Program Management Practices
- Safety Performance and Mitigation Measures
- Statistical Theory/Methods
- Program Evaluation and Performance Assessment Techniques
- Budgeting and grants management; federal transportation funding processes & requirements

Required Skills & Abilities

- Analyze, interpret and present data
- Prepare Reports/Planning Documents
- Public Interaction
- Public Speaking
- Written and Oral Communication
- Prepare/Administer Budgets
- Strategic Mindset
- Management/Supervision
- Complex Problem Solving
- Leadership

Technical Skills Requirements

- GIS, SAS, or other data analysis and visualization tools
- Highway Safety Manual
- Microsoft Office Applications

Education & Work Experience

- Bachelor's degree accepted for some positions. An advanced graduate degree is preferred for most senior positions.
- Between 1-4 years of work experience commonly desired.
- A combination of education and work experience is generally acceptable.

Example 3: **Program of Study**

The Program of Study provides an example academic path for a corresponding career pathway. Like the career pathway, programs of study offer multiple points of entry and exit. Some individuals may pursue graduate degree completion directly after high school without interruption. Others may choose to leave academics to gain work experience and then return to school at a later date to pursue enhanced academic credentials. Both courses of action can result in positive career experiences and are up to the discretion of individuals. Minimum education requirements for specific occupations will guide appropriate off-ramps from programs of study to careers. The safety programs of study highlight potential academic programs, coursework, and experiential learning opportunities that specifically aid students in obtaining transportation safety competencies. Safety competencies are multi-disciplinary so coursework outside the primary degree program is emphasized.

Example 4: **Experiential Learning**

Examples of key professional associations offering professional development opportunities in safety (training, networking, conferences, scholarships, information resources, etc.) for both pre-career students and incumbent workers are listed. Many institutions either require or strongly encourage work-based learning experiences for degree students through internships and/or co-ops. This is particularly true of programs in construction and the trades. Examples of key organizations that provide these types of co-curricular activities are listed for each career path. Innovative strategies for integrating safety into varied programs of study are also described.

Experiential & Innovative Learning: Safety: Maintenance

NNTW

Experiential Learning & Professional Development Opportunities

Professional associations provide professional development and networking opportunities to students and incumbent workers, bridging education to practice. Many associations provide experiential learning opportunities: professional conferences and other networking opportunities, as well as student scholarships and other support. In addition, many institutions either require or strongly encourage work-based learning experiences for their students through internships and/or co-ops. Industry and education/training providers can work together to ensure that safety-focused experiences and application of safety skills are an important component of these professional development experiences. Relevant maintenance experiential and work-based learning is available through the following sources:

American Society of Safety Professionals (ASSP)

ASSP is a global association of occupational safety professionals that advocates for safer work environments. It supports student chapters and provides scholarships, educational resources, and a student-focused Future Safety Leaders Conference among other professional development and networking opportunities.

National Association of County Engineers (NACE)

NACE provides education and training events to county engineers, road managers, and related professionals across the US. In particular, the NACE Safety and Technology committee hosts annual meetings, which offer safety-specific training opportunities. NACE also leads a pilot program on local road safety planning.

Association of General Contractors (AGC)

Student Chapters exist at accredited two- and four-year schools offering programs in construction management, construction technology, and construction-related engineering. Membership in an AGC Student Chapter provides young professionals with an opportunity to observe and develop their skills with current industry leaders. AGC sponsors contests for student chapters that apply construction knowledge to real-world problems. AGC's Foundation provides scholarships for undergraduates, graduate students, and students pursuing a technical degree or apprenticeship. Opportunities such as job shadowing and career fairs are available through state AGC chapters.

Traffic Safety Scholars (TSS) Program

The TSS Program provides awards of up to $1,000 to undergraduate and graduate students to help defray the cost of attending the Lifesavers Conference on Highway Safety Priorities. This conference provides opportunities to learn about highway safety issues from leading experts and network with the largest gathering of highway safety professionals anywhere in the country.

National Highway Institute (NHI)

NHI provides trainings and education for highway professionals in order to improve the conditions and safety of roads, highways, and bridges.

American Traffic Safety Services Association (ATSSA)

ATSSA represents the road safety, traffic safety, and highway safety industry with effective legislative advocacy, traffic control safety training, and a far-reaching member partnership. ATSSA offers a variety of experiential learning and additional training and networking opportunities through its annual convention and traffic expo, mid-year meetings, and National Work Zone Awareness Week activities.

American Public Works Association (APWA)

APWA student membership connects students to a network of professionals. State chapters provide scholarships as a way to attract students to this field. Public Works conferences or expos often include an Equipment Roadeo—a competition for technicians in a number of maintenance occupations to show their skills troubleshooting mechanical issues or maneuvering equipment in various weather conditions. Local winners advance to regional and national Roadeos. These events showcase the latest in technology and equipment and offer an opportunity for a student to engage with public works staff as well as equipment manufacturers.

American Association of State Highway Transportation Organizations (AASHTO)

AASHTO has a standing committee on highway traffic safety, which administers a Safety Leadership Award, and manages the TCS training program, which offers a variety of safety-focused courses.

State Local Technical Assistance Programs (LTAP)

These FHWA-funded centers offer training and coordination for Local Roads Programs or Road Scholar Programs. Opportunities for students vary by state.

Federal Highway Administration (FHWA) EOT Program

FHWA's Emergency Transportation Operations program provides tools, guidance, capacity building and good practices that aid local and State DOTs and their partners in their efforts to improve transportation network efficiency and public/responder safety when a non-recurring event either interrupts or overwhelms transportation operations.

Federal Highway Administration (FHWA) TIM Program

The Federal Highway Administration has training for safer, faster, stronger, more integrated incident response, through its National Traffic Incident Management Responder Training Program. This program includes web-based training, a communications toolkit, newsletters, and videos that can help to better equip students and professionals in the industry of traffic incident management.

National Traffic Incident Management Coalition (NTIMC)

NTIMC is a multi-disciplinary partnership forum spanning the public safety and transportation communities to coordinate experiences, knowledge, practices, and ideas to improve incident management practices.

Traffic Incident Management Network (TIM)

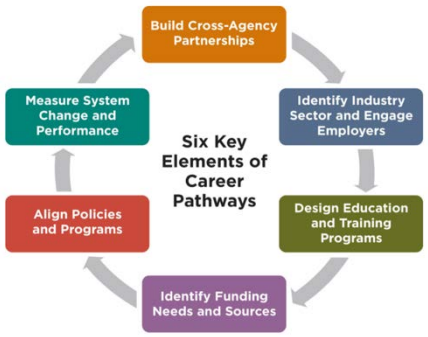
TIM connects traffic incident management professionals from different disciplines. Through the network, students and professionals focused on traffic incident management can have access to the Responder, the monthly newsletter, webinars, podcast, virtual peer exchanges, and more.

SECTION 4.0 THE SIX ELEMENTS OF PATHWAY DEVELOPMENT

The WRTWC implementation plan follows the six key elements of career pathway development, established by the Employment Training Association (ETA) of the Department of Labor (DOL), which are designed to guide state and local workforce development teams through the steps necessary for developing a comprehensive career pathway system.

These six elements are:

1. Build Cross-Agency Partnerships & Clarify Roles
2. Identify Industry Sectors & Engage Employers
3. Design Education & Training Programs
4. Identify Funding Needs & Sources
5. Align Policies & Programs
6. Measure System Change & Performance



In the design of career pathways that are critical to the Safety workforce, and an implementation plan for deploying those pathways into the post-secondary educational continuum, the West Region Transportation Workforce Center team approached this ETA system using the following strategies:

4.1 Build Cross-Agency Partnerships & Clarify Roles

The WRTWC's career pathways implementation plan focuses on two populations within the workforce. First, the plan provides a structured mechanism for employees to develop safety competencies and for employers to reward staff for completing safety training. Second, the WRTWC will provide collaboration-building opportunities, outreach, and technical assistance to foster new industry-education partnerships at the university level that create safety-focused experiential learning opportunities for multidisciplinary pre-career students. For both audiences, the goal is to facilitate connections between industry representatives and education providers for the purpose of integrating safety competencies into the workforce preparatory process.

For incumbent workers, training providers will package and deliver a comprehensive safety curriculum and track training participation. The role of industry/transportation organizations is to disseminate training information to staff and incentivize employee participation through employee recognition programs, career advancement opportunities, etc. The WRTWC will additionally work with the Front Range Community College (FRCC) Highway Maintenance Management program and other potential community college partners to award course credit for safety training completion. This will provide additional incentive to staff pursuing industry and academic credentials.

At the university level, the role of transportation organizations will be to identify safety projects that can be integrated into university courses, set desired outcomes/deliverables, coordinate with faculty, and provide student mentorship, data, and other resources to ensure successful project outcomes. Education providers/faculty will provide access to students, help shape project scopes to match course objectives, mentor student projects, and coordinate with agency partners to ensure project outcomes match their needs.

4.2 Identify Industry Sectors & Engage Employers

Professional associations play an important role in providing connections between incumbent workers and the training resources needed to ensure a qualified workforce. Therefore, the WRTWC will work with the National Association of County Engineers (NACE) to develop a comprehensive training curriculum that covers core safety competencies for local roads personnel and meets its members' safety training goals. NACE will further disseminate information about the

program through its membership. The curriculum will be packaged to facilitate blended delivery either online or in-person by local technical assistance providers (LTAPs) or other local training and education providers. The Montana LTAP will lead the first pilot demonstration of the curriculum focused on construction and maintenance personnel, and work with NLTAPA and other national training associations to help expand the pilot nationally. MT LTAP will serve as the focal point for statewide outreach to transportation staff and organizations during the pilot demonstration.

To integrate safety competencies into existing multidisciplinary university coursework, real world safety projects will be provided by transportation agencies for incorporation into problem-based capstone, service learning, design, or other courses. The WRTWC will again work with professional associations like AASHTO as well as directly with local and state transportation agencies to help match agency projects/needs with university faculty partners. Technical assistance will be provided for universities and public agencies through EPIC-N, which helps support a model for large-scale university-community engagement.

4.3 Design Education & Training Programs

The safety curriculum for local roads personnel will be designed based on the NTCPI's safety competency models, on current and past efforts to identify safety training needs and resources[25] [26] [27] [28], as well as on a scan of existing safety trainings.[29] NACE will implement a member survey to identify additional safety training needs. A training assessment process will be utilized to match safety competencies to existing training courses, providing opportunities for employees to utilize a blended approach in acquiring training--either locally in-person or on-line through national in-

[25] Barnett, T., Herbel, S., Hull, R., Beer, P. (2017). Road Safety Workforce Development in the United States. Presented at the 27th CARSP Conference, Toronto, ON, June 18-21, 2017.

[26] National Center for Rural Road Safety (2017). Development Materials for a Local Maintenance Personnel Rural Road Safety Recognition Program. Prepared for the U.S. Department of Transportation Federal Highway Administration and available online: https://ruralsafetycenter.org/resources/list/development-materials-for-a-local-maintenance-personnel-rural-road-safety-recognition-program/

[27] Bahar, G. (2011). Highway Safety Training Synthesis/Roadmap (NCHRP Project 20-07, Task 290), National Cooperative Highway Research Program, Transportation Research Board.

[28] Cambridge Systematics. (2010). Model Curriculum for Highway Safety Core Competencies NCHRP Report 667, National Cooperative Highway Research Program, Transportation Research Board, Washington, DC.

[29] Training scan completed by the National Center for Rural Road Safety and updated by the WRTWC in 2018.

dustry training providers. Gaps in available safety training will be addressed through the development of new safety training modules, primarily in partnership with the National Center for Rural Road Safety. The WRTWC will work with community colleges like FRCC that award course credit through Prior Learning Assessments to make academic credit available for safety training participants through articulation agreements.

At the university level, the implementation plan focuses on integration of safety experiential and project-based learning experiences into existing coursework, rather than on new curriculum development. The advantage to this approach is in the fact that, because course activities will be driven by current agency projects, student learning outcomes will evolve in step with the safety discipline and practice. This ensures that safety education will not become static but will keep pace with changes in industry as new issues, techniques, and tools emerge. The approach also evades institutional challenges related to approval for new degree course or program development.

4.4 Identify Funding Needs & Sources

Funding to deploy a pilot demonstration safety career pathway project will rely on grant sources to cover time and effort in design, implementation, and assessment of the pilot program. “Start-up” expenses include development of industry outreach, messaging, and program marketing materials; development of participant tracking and learning assessment tools, technical support to help participating transportation organizations and education institutions develop collaboration mechanisms; cross-sector coordination to explore articulation agreements; and program outcomes assessment. Longitudinal program outcomes assessment will require pursuit of additional grant support after the pilot deployment phase ends.

Long-term program sustainability is built into pathway program design. The local roads safety curriculum is designed to facilitate utilization and adaptation by multiple entities (e.g. technical assistance providers, professional associations, community colleges, etc.) to foster national implementation while providing flexibility for both educators and industry to adapt content to local contexts and needs. The plan identifies national professional associations that can take increasing ownership of outreach and resource sharing tasks over time. Agency-university partnership models established to integrate curricular and co-curricular safety experiential learning into degree programs will include development of institutional contracting processes to fund programs.

4.5 Align Policies & Programs

Partners for the safety career pathway pilot demonstration project will adopt a cooperative decision-making model in which each partner maintains its own decision-making processes and responsibilities but agrees to a shared vision and goals; commits to leveraging resources and contributing to project outcomes and tasks; and agrees to share project outcomes data and products with additional partners as the program expands.

The pilot demonstration will address issues with transferability of non-credit bearing training offerings through coordination of efforts with community colleges—to articulate training into credit-bearing programs—and with professional certification programs like the Transportation Professional Certification Board—to provide pathways to industry-recognized credentials.

4.6 Measure System Change & Performance

System change measures will focus on industry engagement with safety career pathways, to include:

- Increased university-agency research and engaged scholarship partnerships focused on safety;
- New hire/promotion practices or employee incentives to reward or recognize staff with safety competencies.

Multidisciplinary university students will gain project-based transportation safety experience through industry engagement. The development of a comprehensive safety training curriculum for local roads personnel will provide incumbent transportation workers with the opportunity for accelerated contextualized safety skillset development. Performance measures will focus on results for participants within the career pathway, to include:

- Increased number of students and workers exposed to road safety topics and tools;
- Increased number of workers with industry recognized safety credentials (certifications, degrees);
- Evidence of career advancement (e.g. job placement, increased wages, promotion) for pathway participants.

SECTION 5.0 CAREER PATHWAY IMPLEMENTATION

As described in the Executive Summary, the Transportation Safety Career Pathway Implementation Plan establishes mechanisms for integrating safety competencies into existing sources for transportation training and education, and established transportation career pathways.

The implementation plan has two main components: 1) to deploy a structured training program of study for incumbent transportation personnel covering core safety competencies identified by the project; and 2) to integrate problem-based road safety projects into existing university coursework and support involvement of students in road safety research through industry-education partnerships. To test methodologies, gather assessment data, and lay the foundation for national implementation, the WRTWC proposes to lead a 3-year pilot demonstration project. The pilot demonstration project is described below as is the proposed process for scaling up from a smaller scale demonstration project to a national implementation of safety career pathways.

1. Local Road Safety Recognition program

The National Association of County Engineers (NACE) is pursuing the development of a comprehensive safety training curriculum and recognition program for local roads personnel, to include road supervisors, engineers, construction, and maintenance personnel. The goal for the initiative is to promote safety through professional development of local road officials. The curriculum will be designed to provide "the core knowledge, skills and abilities to begin functioning effectively in the local road safety field." NACE has partnered with the National Center for Rural Road Safety (Safety Center) to begin laying out the framework of the training program, to include identifying leadership and safety training modules and core safety competencies appropriate for all occupations, as well as specialized training required for specific occupations. The Safety Center has contracted subject matter experts to develop new modules for topics not currently receiving adequate coverage in existing industry training offerings.

The implementation plan leverages these ongoing partnership efforts and will coordinate with both NACE and the Safety Center to deploy a pilot safety demonstration training program focused on frontline construction and maintenance personnel in Montana. The pilot will focus on implementing the core safety training modules identified by NACE, the Safety Center, and the WRTWC (for all career paths) as well as specialized safety training courses targeted specifically to road construction and maintenance personnel. Safety courses will be bundled into a program of study that will be integrated into Montana's Local Technical Assistance Program's Road Scholars program. MT LTAP's implementation of a **Road Safety Scholar** recognition program will facilitate the integration of new road safety trainings into LTAP's existing course offerings, while also enabling MT LTAP to offer training participants additional opportunities to earn certificates between the Road Scholar and the Road Master levels. The Road Scholar program is well-established and well-known by both employers and employees. Implementation of a Road

Safety Scholar program within this existing framework will facilitate program information dissemination and employee and employer buy-in for the safety-focused program.

Montana LTAP will be the in-person training provider for the pilot deployment. The curriculum will also include options for on-line training through the Safety Center or other national training providers, providing training flexibility for full-time professionals. While Montana LTAP offers non-credit course-work, the WRTWC will work to identify community colleges where articulation agreements can be reached to provide college credit to pathway participants for training completed. In particular, the WRTWC will work closely with the Front Range Community College, which is launching an online High-way Maintenance Management Associate's degree in 2019, to align safety training courses with eligible academic credit options for the degree.

Project Partners: Additional information is provided on the role each partner organization will play in the proposed pilot demonstration project. The WRTWC will endeavor throughout the pilot demonstra-tion project to establish resources and processes that will enable the national expansion and long-term viability of the program.

National Center for Rural Road Safety. The National Center for Rural Road Safety will assist in defining learning objectives for core safety training courses, will provide support to develop new training courses to meet these learning objectives and content areas, and will work with training providers to pilot new training courses. The Safety Center will also serve a coordination role with the National Association of County Engineers (NACE). The long-term goal is for the content and process of WRTWC's pilot demon-stration project of a Local Roads Safety Scholar Program in Montana to be integrated into a scaled-up national implementation of a Local Road Safety Certificate Program, which NACE will lead.

National Association of County Engineers (NACE). NACE will provide guidance, through consultation with its membership, in defining core safety content and learning objectives for the Safety Scholars pilot. NACE will work with the WRTWC and National Center for Rural Road Safety to create a cohesive training curriculum that addresses the core safety competencies identified by the Safety Career Pathways Initia-tive, infused with a local roads perspective. NACE will additionally provide outreach support to promote and incentivize participation in the pilot project.

Montana Local Technical Assistance Program. Montana LTAP will coordinate with the WRTWC to adapt existing training courses and to integrate new training courses and course content that meet the tar-geted safety learning objectives, into its on-site and blended training program. Montana LTAP will assist the WRTWC with outreach to employers, employees, and professional associations in Montana to mar-ket the program and encourage participation; and it will lead in-person training, track training participa-tion, assist with program evaluation and assessment, and coordinate recognition awards for participants at program completion. MT LTAP will additionally work with the Front Range Community College in Col-orado to develop articulation agreements. This will provide a pathway for training participants to obtain

college credit for training completion and to advance toward an Associate's degree in Highway Maintenance Management. Finally, MT LTAP will work with the National LTAP Association to facilitate curriculum and process sharing across states.

Project Activities & Timeline: Proposed activities for the pilot demonstration project include:

Year 1:

- Develop program of study for Safety Scholars Recognition Program;
- Develop and disseminate employer outreach and participant recruitment materials;
- Develop participant tracking and course evaluation instruments;
- Development of program assessment tools targeted to participants and employers;
- Begin implementation of Safety Scholars Recognition program of study (through in-person, online, hybrid course offerings);
- Track program participation; evaluate learning outcomes;
- Report on first-year pilot evaluation outcomes; Phase 2 planning meeting with project partners and Safety Discipline Working Group.

Years 2-3:

- Complete an assessment of employer buy-in and the development of effective industry outreach materials based on the assessment;
- Project outcomes evaluation (pilot);
- Funding identification and proposal development to implement long-term longitudinal outcomes assessment;
- Cross-sector coordination to develop articulation agreements between for-credit and non-credit bearing training programs;
- Development of national safety career pathway resources, including professional profiles, case studies, and "next step" opportunities for obtaining degrees or additional industry credentials.
- Coordination with NACE and other professional associations, and with national training/education providers (e.g. NLTAPA) to share pilot project outcomes, outreach materials, and training modules/road map to facilitate adaptation and implementation nationally.
- Establishment of an industry advisory board to identify next steps, assess continuing relevance of training content, and identify emerging topics.

Project Outcomes: Montana LTAP expects to be able to offer 3-5 safety trainings to local roads personnel each year of the program. By the end of the 3-year pilot demonstration project, an estimated 90-375 transportation staff are expected to complete safety training through the pilot project. This will provide adequate data to the WRTWC to be able to evaluate safety learning outcomes (together with its

industry advisory board) and to recommend program revisions as necessary and identify next steps for program expansion.

Additional pilot demonstration project expected outcomes include:

- The project team will develop and assess the effectiveness of recruitment and employer outreach materials about the program.
- The project will track participation in the Safety Scholars program and gather evaluation data on safety competency learning outcomes.
- A long-term plan for assessing training participation impacts on career paths and on-the-job safety performance will be developed.
- Training courses identified/created for the pilot project will be shared with NACE and other national training organizations to facilitate national-level implementation.
- The project team will coordinate with degree-granting institutions to develop articulation agreements to award course credit for training completion.

2. <u>Transportation Agency – University Partnerships for Engaged Scholarship</u>

Critical occupations within the Transportation Safety Planning, Engineering, Design & Analysis career cluster require completion of four-year or graduate-level degrees. Safety job specifications are increasingly interdisciplinary, requiring foundational knowledge of road safety science as well as skillsets drawn from engineering, the behavioral sciences, planning, mathematics, and data analysis fields. Interdisciplinary degree programs are emerging in increasing numbers; however, many challenges exist for education institutions to be able to implement new coursework or degree programs. An underutilized tool for developing in-demand industry skillsets at the university level without relying on new course or program development is through integration of project-based learning into existing courses. Most university degree programs offer an array of opportunities to accomplish this through design courses, capstone courses, service learning courses, and field courses.

Successful implementation relies on industry engagement with education providers. However, agencies may have little or no experience working with educators in this way. The WRTWC will act as a facilitator to identify at least two universities and two transportation organizations and provide them with the support and resources needed to implement productive safety project partnerships. The partnerships will involve multidisciplinary students. Initial deployment will focus on curricular partnerships (project-based learning integrated into undergraduate or graduate degree coursework). Activity during Years 2 and 3 of the implementation plan will focus on "stacking" safety career development experiences through the addition of co-curricular research project partnerships.

Project Partners: The primary project partner for this component of the implementation project will be the Educational Partnerships for Innovation in Communities Network (EPIC-N).

Educational Partnerships for Innovation in Communities Network (EPIC-N). EPIC-N is made up of a consortium of universities utilizing a proven, replicable, and adaptable model for building partnerships between universities and government agencies to integrate project-based learning experiences into university coursework, transforming higher education into an arena where students learn through real-life problem solving. EPIC-N was established to provide insight, resources and tools to universities and public agencies seeking to launch partnerships that bring agency-driven projects into university classrooms at a large scale. The network is made up of universities nationwide who have successfully implemented the model through established community-engagement programs. EPIC-N will provide technical assistance to universities and public agencies to help them organize their partnership projects and agreements effectively. Universities within the network with established programs can also be engaged to partner with transportation agencies on safety-focused projects.

The WRTWC will work with EPIC-N and transportation organizations to foster partnerships that will provide students with exposure to transportation safety problems, projects, and solution-building projects through peer-to-peer networking, collaboration forums, and technical support. The WRTWC has already begun outreach and technical assistance activities. In November 2018, it brought transportation and other public agency representatives together with university representatives from Montana, Wyoming, Oregon, Idaho, and Washington for a workshop on the EPIC-N model. Cross-sector discussions and follow-up technical support have continued since the workshop. The WRTWC will build on these connections to identify and engage specific universities and transportation agencies in the deployment of safety career pathway partnerships. The partnerships will bring problem-based safety learning experiences into multidisciplinary university courses, thereby exposing students to road safety as a discipline and as a career.

Project Activities & Timeline: Proposed activities for the pilot demonstration project include:

Year 1:

- Continue WRTWC-implemented peer networking, collaboration-building, and technical support activities with EPIC-N;
- Identify partners for implementation of course-based road safety project work at two universities;
- Assist universities and transportation organizations to develop MOUs and to identify target courses and faculty for project-based work;
- Support faculty and agencies in defining scopes of work, course learning objectives and activities, and evaluation instruments.

Years 2-3:

- Launch of safety project-based learning in classrooms at two universities in partnership with transportation agencies;
- Development of assessment tools focused on outcomes for students, faculty, and industry partners;
- Evaluation of project outcomes for Year 2 demonstration project;
- Continued outreach and technical support to universities and transportation organizations to identify and assist additional Year 3 partnerships;
- Outreach and coordination with Year 2university-agency partners to develop additional co-curricular student engagement opportunities through the development of university/agency research partnerships;
- Project outcomes evaluation for three-year demonstration project (short-term);
- Funding identification and proposal development to implement long-term longitudinal outcomes assessment;
- Dissemination of project outcomes for the three-year demonstration and development of a guidebook for transportation organizations and universities to promote expansion of program.

Project Outcomes: At the end of the three-year pilot demonstration project, it is expected that over 300 students from various degree programs will be exposed to road safety as a discipline and as a career and will have gained experience applying various tools and techniques to real world transportation safety issues. The goal is for an additional twenty-five students at participating institutions to gain more intensive project experience on agency-sponsored safety research projects. The WRTWC will evaluate the impact these experiences have on students' career choices and the safety skillsets they bring to the workforce, as well as the impact on employers in terms of recruitment and professional development strategies for road safety. Program assessment information will be used to develop a guidebook for universities and agencies nationwide to facilitate national expansion of safety career pathways.

Projected long-term project outcomes for both components of the safety pathway implementation pilot projects, include:

- Career pathway participants will develop core safety competencies, additional professional credentials, and career benefits through program participation.
- Transportation organizations will engage with education institutions to foster safety workforce development efforts.
- The number of prospective hires and incumbent staff possessing road safety competencies will increase.
- Safety performance outcomes for local and state roads will improve through existence of a well-trained safety workforce.

SECTION 6.0 BARRIERS TO DEPLOYMENT

The safety career pathways implementation plan is designed to be employer-driven. Lack of industry investment in the pathway is the primary barrier to pilot deployment and national expansion. Critical industry roles for successful implementation involve elevation of road safety performance outcomes as an organizational priority. Safety prioritization must lead to new policies and practices, which provide evidence of organizational support to prospective and existing employees to include:

- enhanced support for road safety staff training (such as providing staff time and financial support to pursue safety training opportunities);
- investment in employee incentives, such as formal employee recognition programs, pay grade increases, or job advancement opportunities, to staff demonstrating safety competencies;
- investment of staff time and organizational resources to support safety project-based learning experiences, to integrate safety topics and skillset development into education programs while at the same time demonstrating industry demand for safety competencies to both pre-career students and education providers.

There are many institutional barriers that may diminish the ability of transportation organizations to accomplish these tasks. Lack of flexibility in the public sector regarding hiring policies and procedures may restrict an agency's ability to hire or promote individuals with specific skillsets. Some state DOTs, for instance, have promotion policies in place that focus primarily on years of service. Agency leadership may need to review how human resources practices either promote or undermine career pathway development for staff, and how policies in place may impact their overall competitiveness in hiring and retaining qualified staff.

The Safety Career Pathway for local roads personnel is designed to overcome institutional barriers related to lack of resources. By establishing a structured comprehensive safety curriculum for front-line local roads personnel and by providing a low-cost mechanism for employees to participate in safety training and for employers to track staff participation, the implementation plan reduces the burden on limited agency staff time to identify training opportunities on an ad hoc basis; and to track staff training participation over time.

Additional institutional barriers to career pathway deployment at the university level relate to challenges in implementing new degree program coursework. The safety career pathway implementation plan avoids this barrier by working within existing coursework rather than attempting to implement new courses or programs. Course projects identified by transportation agencies will likewise constitute existing project work within the agency's work plan. The benefit to this model is that safety topics can be integrated into a variety of disciplines, allowing agencies to benefit from university capacity, creativity,

and multidisciplinary expertise to develop project deliverables and safety solutions. Students from a variety of academic disciplines will be exposed to transportation safety projects and problems, preparing them for a workforce that increasingly relies on multidisciplinary skillsets.

The success of the transportation safety career pathway implementation plan relies on industry demand for professionals possessing safety competencies. Employer engagement is therefore essential to activating defined pathways into transportation safety careers.

Appendix:

Safety Career Pathway Documentation

A. Transportation Safety Planning, Engineering, Design & Analysis Career Cluster

Career Pathway #1: **Transportation Safety Planning**

Career Pathway #2: **Transportation Safety Engineering**

Career Pathway #3: **Human Factors Engineering**

Career Pathway #4: **Transportation Safety Data Analysis**

B. Transportation Infrastructure Construction and Maintenance Career Cluster

Career Pathway #1: **Road Construction Safety Management**

Career Pathway #2: **Highway Maintenance Safety Management**

Transportation Safety Planning

Career Pathway Documentation

Career Pathway: Transportation Safety Planning

NNTW National Network for the Transportation Workforce

Master's Degree Planning

With specialized research focused on safety data analysis and systems performance

AICP Preferred

+5 years specialized work experience with focus on transportation safety performance analysis, long range safety planning, public outreach, safety leadership, and collaboration-building

Transportation/Highway Safety Planner; Senior Transportation Planner

Salary: $70,956 - $91,827
(Glassdoor)

Bachelor's Degree Urban & Regional Planning

With coursework, research, or other specialized experience and/or training on safety-focused planning, design or analysis

AICP Certificate Preferred

+1-6 years work experience in transportation planning with a focus on safety performance.

Transportation Planner

- Transportation Planner (SOC 19-3099)
- Urban & Regional Planner (SOC 19-3051)

Salary: $71,490 - $79,370

Associate's Degree

With major coursework in CAD, design, GIS, engineering, statistics & mathematics

POS On-Ramp

+6-24 months work experience

Career Off-Ramp

Planning Aide (SOC 19-4061)

Salary: $46,000

PROGRAM OF STUDY

CAREER LADDER

Job Description: Transportation Safety Planner

Alternative Job Titles

Highway Safety Planner, Transportation Planner, Urban or Regional Planner

Job Description

A Transportation Safety Planner is responsible for integrating safety into an agency's planning documents and processes, and for working collaboratively with other stakeholders to implement safety plans. Safety planners must have knowledge of sources of safety data, systemic safety issues, contributing crash factors, and human behaviors associated with safety risk. They apply this knowledge to incorporate safety data and analysis into transportation decision-making processes to achieve safety improvement goals. Other duties include:

- Represent transportation safety interests at a variety of cross-sector stakeholder meetings.
- Analyze, synthesize, and present safety data to stakeholders and the public in visual or other formats that facilitate data-driven safety-related investments and decision-making.
- Provide direction on the development and integration of safety goals and objectives into transportation planning processes; and implement a process for embedding safety performance measures into planning tools and investment decisions.
- Promote effective public outreach, education and involvement to build support for safety priorities.
- Participate in public meetings and conduct surveys to identify issues of public concern.
- Implement monitoring and evaluation systems to ensure continuous improvement.

Knowledge Requirements

- Analysis/Research/Report Methods
- Regulation/Legislation/Organizational/Funding Policies, Goals & Practices related to Safety
- Principles of Road Safety
- Safety Program Management Practices
- Safety Performance and Mitigation Measures
- Statistical Theory/Methods
- Program Evaluation and Performance Assessment Techniques
- Budgeting and grants management; federal transportation funding processes & requirements

Required Skills & Abilities

- Analyze, interpret and present data
- Prepare Reports/Planning Documents
- Public Interaction
- Public Speaking
- Written and Oral Communication
- Prepare/Administer Budgets
- Strategic Mindset
- Management/Supervision
- Complex Problem Solving
- Leadership

Technical Skills Requirements

- GIS, SAS, or other data analysis and visualization tools
- Highway Safety Manual
- Microsoft Office Applications

Education & Work Experience

- Bachelor's degree accepted for some positions. An advanced graduate degree is preferred for most senior positions.
- Between 1-4 years of work experience commonly desired.
- A combination of education and work experience is generally acceptable.

Program of Study: Transportation Safety Planning

NNTW National Network for the Transportation Workforce

Certifications

Transportation Planners can apply for certification from the American Institute of Certified Planners (AICP) after achieving work and education eligibility requirements. Safety Planners can also apply for Road Safety Professional Certification through the Transportation Professional Certification Board (TPCB). Both certifications are exam-based and serve to recognize the attainment of a given level of practice and knowledge.

Year 5-6

Master's Degree in Urban and Regional Planning or Transportation Planning

Year 6: Students complete electives and required research thesis or professional paper requirements for the degree.

Year 5: Students complete core and elective courses within their concentration while selecting specialized independent research activities.

Core Transportation Courses
Methods of Transportation Planning
Transportation Planning Process
Transportation and Land Use
Public Transportation Systems
Alternative Transportation Modes
Transportation Policy
Transportation Demand Analysis
Impact Assessment

Safety Courses
Transportation Safety
Safety Data Analysis Methods
Human Factors
Behavioral Data Analysis
Traffic Engineering

Experiential learning includes planning studios / labs, internship, and fieldwork

Year 3-4

Bachelor's Degree in Urban and Regional Planning or Related

Years 3-4: Students complete major coursework and may select electives in specific areas of interest. Core transportation courses may include transit system planning and transportation planning. Cross-disciplinary elective coursework, internship, fieldwork, or senior capstone requirements should focus on planning applications to transportation safety.

GE Courses
Science, Social Sciences, Humanities, Arts & Foundational Core Courses

Transportation-Related Courses
Transportation Planning
Transportation and Land Use
Transit System Design

Safety-Related Courses
Transportation Safety
Human Factors
Safety Management
Data Analysis Methods
Senior Capstone
Internship

Experiential learning includes planning studios, labs, internships, fieldwork

Year 1-2

Associate's Degree in Geography, GIS, or Related

Year 1 and 2: Course requirements vary by institution. Students will complete institutional requirements for the degree sought. The Associate's degree will provide students with general education requirements as well as basic theoretical knowledge and practical skills in the chosen field. Students wishing to transfer into a 4-year degree program should work with an advisor early on to ensure they take all pre-requisite courses for their intended major.

General Education Courses
Students will develop writing, communication, math, and critical thinking skills.

Core/Transfer Courses
Human Geography
Statistics
Spatial Analysis
GIS Applications
Graphic Communication
Planning Theory
Landforms

Experiential learning includes planning studios, labs, internships, fieldwork

Year 0

High School Diploma or G.E.D.

Transportation CTE coursework if available.

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West Region Transportation Workforce Center

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Experiential & Innovative Learning: Transportation Safety Planning

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging course-work to practice. Many associations provide experiential learning opportunities like design/build or other student competitions; professional conferences and other networking opportunities, as well as student scholarships and other support. In addition, many institutions either require or strongly encourage work-based learning experiences for their students through internships and/or co-ops. Industry and education institutions can work together to ensure that safety-focused experiences and application of safety skills are an important component of these student development experiences. Relevant transportation planning experiential and work-based learning is available through the following sources:

American Planning Association (APA)

Attending an APA-accredited university or obtaining membership connects students to a network of professional planners and an opportunity to obtain an American Institute of Certified Planners (AICP) certification, the only national independent verification of planner qualifications.

Global Planners Network (GPN)

Student APA members are able to connect with GPN's global network of planning associations, through APA regional conferences here in the United States.

Association of Metropolitan Planning Organizations (AMPO)

AMPO provides student members discounted rates to join with an opportunity to attend their annual conference and periodic events.

Association of Pedestrian and Bicycle Professionals (APBP)

APBP provides full time student members with a passion for bicycle and pedestrian transportation with an APBP mentor program and scholarship opportunities for professional meetings.

The Urban Land Institute (ULI)

ULI offers workshop and research competition opportunities hosted across the country, which support the development of member understanding on current urban planning challenges and how to address current trends in industry.

State Departments of Transportation

DOTs offer internships for both community college, university and graduate students. Internships or co-ops are available in a number of occupations relating to asset management: civil engineering, construction, and maintenance. Some DOTs also employ college students to assist in the completion of work related to crash system input and analysis.

Women's Transportation Seminar International (WTS International)

WTS International provides professional development, encouragement, and recognition to support women in their transportation careers. WTS International provides student members with a scholarship program, mentor program, and various professional development opportunities.

Dwight David Eisenhower Transportation Fellowship Program (DDETFP)

The DDETFP awards fellowships to students pursuing master's or doctoral degrees in transportation-related disciplines. As a part of the fellowship program, each year fellows participate in the Transportation Research Board (TRB) Annual Meeting.

Traffic Safety Scholars Program

The Traffic Safety Scholars (TSS) Program provides awards of up to $1,000 to undergraduate and graduate students to help defray the cost of attending the Lifesavers Conference on Highway Safety Priorities. This conference provides opportunities to learn about highway safety issues from leading experts and network with the largest gathering of highway safety professionals anywhere in the country.

National Highway Institute (NHI)

NHI provides trainings and education for highway professionals in order to improve the conditions and safety of roads, highways, and bridges.

Association for Public Policy Analysis & Mgmt (APPAM)

APPAM provides graduate student members with an opportunity to attend regional conferences and participate in a mentor-matching program.

Institute of Transportation Engineers (ITE)

ITE provides transportation professionals with the knowledge, practices, and skills needed to help shape the future of transportation. Student membership is free and grants access to ITE trainings and events as well as networking opportunities.

Innovative Strategies for Integrating Safety Competencies into Varied Programs of Study

A safety career pathway involves attaining specialized safety competencies within various traditional transportation programs of study. In addition to acquiring academic and technical preparedness within a broader field (e.g. Planning or Construction), students and incumbent workers on a safety career pathway will pursue research, experiential learning, on-the-job training and other work-based or real-world learning experiences focused on transportation safety. Examples of effective safety integration models are listed that provide curricular and co-curricular value to student safety career preparedness:

Co-Curricular

Transportation Agency/University Research Partnerships

Research partnerships between university faculty and state DOTs are proven sources for safety workforce development when they: 1) are implemented over the long-term; and 2) actively involve faculty and both undergraduate and graduate multi-disciplinary students in the implementation of safety research and project development.

On-Campus DOT Design Units

Many campuses partner with transportation agencies to provide on-campus internship experiences to undergraduate students in roadway design or traffic operations projects. These programs provide students with hands-on design experience and exposure to state DOT standards and practices while building a pipeline into transportation engineering careers.

Safety-Focused Work-Based Learning

Particularly in construction programs, many institutions either require or strongly encourage work-based learning experiences, which can be utilized to attain safety-focused experiences and to apply safety skills in the workplace.

Curricular

Engaged Scholarship

Most universities provide mechanisms to incorporate community projects into student coursework, either through senior design, capstone, or service learning courses. Engagement of transportation organizations with universities to provide safety-focused course-based projects can serve as a powerful student exposure and recruitment tool to safety career pathways. Some universities provide opportunities to scale up these types of engaged scholarship opportunities so that one agency partner can provide multiple projects over the course of an academic year.

Safety-Focused Course-Based Learning

Integration of safety topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of safety-focused case studies and lab exercises into required coursework; and implementation of assignments that demonstrate understanding of safety principles and processes, through development of safety plans, safety data analysis assignments, or implementation of accident investigations or safety audits. Job site visits and field trips have also been identified useful tools for promoting student interest in safety.

Students can design their own externship experience.

Competency-Based Curriculum

A curriculum that meets academic and quality standards, designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, can be designed for safety. Job profiling and the use of "SMEs" should be considered to meet the competency needs of employers. The proliferation of industry-driven professional safety certifications can be used to facilitate this process. Programs of this kind may award credit for prior learning, allowing incumbent workers to achieve credentials by demonstrating knowledge and skills developed on-the-job.

Asynchronous Learning

Provide education and training for students and incumbent workers at times and locations convenient to students and employers, rather than instructors or institutions. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Problem-based learning provides students with opportunities to solve real life problems, often in environments that replicate the workplace (e.g. design within constraints, working on multidisciplinary teams, etc.). Industry engagement with educators to provide real world problem examples and guidance on project constraints enhances student experience.

Work-Based and Experiential Learning

Incorporate opportunities for "learning-by-doing", including internships, co-op work experience, simulations, and team class projects that are assignments from local employers.

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Transportation Safety Engineering Career Pathway Documentation

Career Pathway: Transportation Safety Engineering

NNTW National Network for the Transportation Workforce

Graduate Degree
Master's or PhD
Engineering

With specialized research focused on safety data analysis and systems performance

PTOE Preferred

+5 years specialized work experience with focus on systems performance analysis, model development, safety leadership, and collaboration-building

Senior Transportation or Highway Safety Engineer

Salary: $86,171 - $99,278
(Glassdoor)

Bachelor's Degree
Civil Engineering

With coursework, research, or other specialized experience and/or training on safety-focused roadway design & data analysis

P.E. Preferred

E.I.T.

+4-10 years work experience in roadway design, transportation operations, systems analysis or related, with a focus on safety performance.

Civil/Transportation Engineer

- Roadway Design Engineer
- Highway Safety Engineer
- Traffic Safety Engineer
  (SOC 17-2051)

Salary: $84,770

Associate's Degree

With major coursework in CAD, design, GIS, engineering, statistics & mathematics

IMSA Certification preferred

POS On-Ramp

+6-24 months work experience

Career Off-Ramp

Engineering/Traffic Technician

- Traffic Technician
  (SOC 53-6041)
- Civil Engineering Technician
  (SOC 17-3022)

Salary: $45,670 - $51,620

PROGRAM OF STUDY

CAREER LADDER

Job Description: Transportation Safety Engineer

Alternative Job Titles

Traffic Safety Engineer, Highway Safety Engineer, Roadway Design Engineer, Transportation Engineer

Job Description

A Transportation Safety Engineer is committed to obtaining safety goals through continuous improvement of transportation planning, design, operations, and safety investment strategies. Transportation Safety Engineers utilize multiple strategies to integrate safety data and analysis into transportation decision-making processes. They apply their knowledge of systemic safety principles to analyze, assess, and present safety data, and to plan, implement, and evaluate road safety programs and processes. Other duties include:

- Provide direction on development of safety-focused policies and guidelines through collaboration with law enforcement agencies, safety organizations, and other public stakeholders.
- Analyze, synthesize, and present road safety data to relevant stakeholders to aid safety-focused decision-making and investments, including through the development of models and simulations.
- Ensure that transportation plans, roadway designs, and traffic operations and management strategies comply with established safety guidelines and reflect current best practices related to safety performance measures.
- Apply analytical, modeling, and simulation skills as well as qualitative and quantitative research methodologies to develop safety solutions.

Knowledge Requirements

- Analysis/Research/Report Methods
- Regulation/Legislation/Organizational Policies and Goals related to Area
- Principles of Road Safety
- Safety Program Management Practices
- Safety Performance and Mitigation Measures
- Statistical Theory/Methods
- Data Analysis Techniques and Tools
- Principles of Transportation Engineering, Traffic Management, Roadway/Highway Design
- Program Evaluation and Performance Assessment Techniques

Required Skills & Abilities

- Analyze and present data
- Prepare Reports
- Review road designs and planning documents
- Written and Oral Communication
- Project Design
- Project Management/Supervision
- Strategic Mindset
- Complex Problem Solving
- Leadership

Technical Skills Requirements

- Roadway Design Software
- Highway Safety Manual
- Microsoft Office Applications

Education & Work Experience

- Bachelor's degree accepted for most positions. An advanced graduate degree is preferred for some senior positions.
- Professional Engineer licensure is required for many mid-level to senior positions.
- Engineer-in-Training (EIT) status is required for many entry-level positions.

Program of Study: Transportation Safety Engineering

NNTW National Network for the Transportation Workforce

Certifications

Beyond attaining Professional Engineering licensure, Civil Engineers can apply for a variety of additional professional certifications from the Transportation Professional Certification Board (TPCB), which attest to the attainment of a body of knowledge and capability specific to transportation. In the field of transportation safety, the TPCB has developed the Road Safety Professional Certification to recognize the attainment of a given level of practice and knowledge in road safety science.

Year 5-6

Master's Degree in Civil or Transportation Engineering

Year 6: Students complete electives and required research thesis or professional paper requirements for the degree.

Year 5: Students complete core and elective courses within their concentration while selecting specialized independent research activities.

Core Transportation Courses
Traffic Flow Fundamentals
Transportation Systems Planning
Traffic Engineering & ITS

Research Methods Courses
Regression Analysis
Experimental Design and Analysis
Human Factors Research Design

Safety Courses
Transportation Risk & Security
Transportation Safety
Advanced Geometric Design & Highway Safety

Experiential learning includes planning studios / labs, internship, and fieldwork

Year 3-4

Bachelor's Degree in Civil Engineering

Year 4: Students may select electives in specific areas of interest and will fulfill internship, fieldwork, or senior capstone requirements. Core transportation courses may include roadway design, traffic engineering, transportation planning.

Year 3: Students take basic courses in different areas of the Civil Engineering, to include hydrology, geotechnical, structural, and transportation engineering.

GE Courses
Science, Social Sciences, Humanities, Arts & Foundational Core Courses

Transportation-Related Courses
Roadway Design
Traffic Engineering and ITS
Transportation Planning
Transit System Design

Safety-Related Courses
Transportation Safety
Construction Safety
Safety Management
Risk Assessment
Senior Capstone
Internship

Experiential learning includes design courses, labs, internships, & research

Year 1-2

Associate's Degree in Civil Engineering Technology

Year 1 and 2: Course requirements vary by institution. Students will complete institutional requirements for the degree sought. The Associate's degree will provide students with general education requirements as well as basic theoretical knowledge and practical skills in the chosen field. Students wishing to transfer into a 4-year degree program should work with an advisor early on to ensure they take all pre-requisite courses for their intended major.

General Education Courses
Students will develop writing, communication, math, and critical thinking skills.

Transportation-Related Courses
AutoCAD/Engineering Graphics
Surveying
Technical Reporting
Mechanics
GIS
Materials & Testing

Safety-Related Courses
Construction Safety

Transfer Program Prerequisites
Calculus
Chemistry I, II
Physics I, II
Applied Mechanics

Experiential learning includes labs, internships, co-ops, and fieldwork

Year 0

High School Diploma or G.E.D.

Construction or Engineering CTE coursework if available.

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Experiential & Innovative Learning: Transportation Safety Engineering

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging course-work to practice. Many associations provide experiential learning opportunities like design/build or other student competitions; professional conferences and other networking opportunities, as well as student scholarships and other support. In addition, many institutions either require or strongly encourage work-based learning experiences for their students through internships and/or co-ops. Industry and education institutions can work together to ensure that safety-focused experiences and application of safety skills are an important component of these student development experiences. A few examples of relevant transportation engineering experiential learning and professional development sources are provided below:

Highway Safety Data Fellows Program

The Federal Highway Administration and USDOT Secretary's Safety Data Initiative provide a fellowship program to examine safety among the most vulnerable road users including bicyclists and pedestrians.

National Association of Women Highway Safety Leaders, Inc. (NAWHSL)

NAWHSL provides full-time female college students, interns, or employees with scholarships opportunities to attend the Annual Traffic Safety Leadership Conference.

Traffic Safety Scholars Program

The Traffic Safety Scholars (TSS) Program provides awards of up to $1,000 to undergraduate and graduate students to help defray the cost of attending the Lifesavers Conference on Highway Safety Priorities. This conference provides opportunities to learn about highway safety issues from leading experts and network with the largest gathering of highway safety professionals anywhere in the country.

American Society of Safety Professionals (ASSP)

ASSP is a global association of occupational safety professionals that advocates for safer work environments. It supports student chapters and provides scholarships, educational resources, and a student-focused Future Safety Leaders Conference among other professional development and networking opportunities.

National Highway Institute (NHI)

NHI provides trainings and education for highway professionals in order to improve the conditions and safety of roads, highways, and bridges.

American Traffic Safety Services Association (ATSSA)

ATSSA members are focused on making roadways safer. ATSSA members are provided with discounted trainings and event registrations.

International Municipal Signal Association (IMSA)

IMSA provides certification programs for the safe installation, operation and maintenance of public safety systems. Members can access training and certification opportunities, the career center, and an annual conference.

American Society of Civil Engineers (ASCE)

ASCE provides value to civil engineering and civil engineering technology students by expanding their network. Through volunteer opportunities, leadership resources, mentoring, student chapter meetings, scholarships, contests, and competitions, members meet colleagues who share a commitment to the civil engineering profession.

Institute of Transportation Engineers (ITE)

ITE offers a Student Leadership Summit, student competitions in transportation planning and engineering, and professional development opportunities through student chapters.

Association of Pedestrian and Bicycle Professionals (APBP)

APBP provides full time student members with a passion for bicycle and pedestrian transportation with an APBP mentor program and scholarship opportunities for professional meetings.

Association of Metropolitan Planning Organizations (AMPO)

AMPO provides student members discounted rates to join with an opportunity to attend their annual conference and periodic events.

National Operations Center of Excellence (NOCoE)

The National Operations Center of Excellence hosts an annual Transportation Technology Tournament for students and TRB ePortfolio Contest.

State Departments of Transportation

DOTs offer internships for both community college, university and graduate students. Internships or co-ops are available in a number of occupations relating to civil engineering. Some DOTs also employ college students to assist in work related to crash system input and analysis.

Dwight David Eisenhower Transportation Fellowship Program (DDETFP)

The DDETFP awards fellowships to students pursuing master's or doctoral degrees in transportation-related disciplines. As a part of the fellowship program, each year fellows participant in the Transportation Research Board (TRB) Annual Meeting.

Intelligent Transportation Society of America (ITS America)

ITS America is the leading ITS professional organization and is dedicated to advancing research and deployment of intelligent transportation technologies. ITS America offers memberships to students through student chapters at institutes of higher education and provides focused learning and networking opportunities for students considering ITS careers.

Innovative Strategies for Integrating Safety Competencies into Varied Programs of Study

A safety career pathway involves attaining specialized safety competencies within various traditional transportation programs of study. In addition to acquiring academic and technical preparedness within a broader field (e.g. Civil Engineering or Construction), students and incumbent workers on a safety career pathway will pursue research, experiential learning, on-the-job training and other work-based or real-world learning experiences focused on transportation safety. Examples of effective safety integration models are listed that provide curricular and co-curricular value to student safety career preparedness:

Co-Curricular

Transportation Agency/University Research Partnerships

Research partnerships between university faculty and state DOTs are proven sources for safety workforce development when they: 1) are implemented over the long-term; and 2) actively involve faculty and both undergraduate and graduate multi-disciplinary students in the implementation of safety research and project development.

On-Campus DOT Design Units

Many campuses partner with transportation agencies to provide on-campus internship experiences to undergraduate students in roadway design or traffic operations projects. These programs provide students with hands-on design experience and exposure to state DOT standards and practices while building a pipeline into transportation engineering careers.

Safety-Focused Work-Based Learning

Particularly in construction programs, many institutions either require or strongly encourage work-based learning experiences, which can be utilized to attain safety-focused experiences and to apply safety skills in the workplace.

Curricular

Engaged Scholarship

Most universities provide mechanisms to incorporate community projects into student coursework, either through senior design, capstone, or service learning courses. Engagement of transportation organizations with universities to provide safety-focused course-based projects can serve as a powerful student exposure and recruitment tool to safety career pathways. Some universities provide opportunities to scale up these types of engaged scholarship opportunities so that one agency partner can provide multiple projects over the course of an academic year.

Safety-Focused Course-Based Learning

Integration of safety topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of safety-focused case studies and lab exercises into required coursework; and implementation of assignments that demonstrate understanding of safety principles and processes, through development of safety plans, safety data analysis assignments, or implementation of accident investigations or safety audits. Job site visits and field trips have also been identified useful tools for promoting student interest in safety.

Students can design their own externship experience.

Competency-Based Curriculum

A curriculum that meets academic and quality standards, designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, can be designed for safety. Job profiling and the use of "SMEs" should be considered to meet the competency needs of employers. The proliferation of industry-driven professional safety certifications can be used to facilitate this process. Programs of this kind may award credit for prior learning, allowing incumbent workers to achieve credentials by demonstrating knowledge and skills developed on-the-job.

Asynchronous Learning

Provide education and training for students and incumbent workers at times and locations convenient to students and employers, rather than instructors or institutions. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Problem-based learning provides students with opportunities to solve real life problems, often in environments that replicate the workplace (e.g. design within constraints, working on multidisciplinary teams, etc.). Industry engagement with educators to provide real world problem examples and guidance on project constraints enhances student experience.

Work-Based and Experiential Learning

Incorporate opportunities for "learning-by-doing", including internships, co-op work experience, simulations, and team class projects that are assignments from local employers.

U.S. Department of Transportation Federal Highway Administration

West Region Transportation Workforce Center

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Human Factors Engineering Career Pathway Documentation

Career Pathway: Human Factors Safety Engineering

NNTW National Network for the Transportation Workforce

Graduate Degree Master's or PhD Engineering

With specialized research and/or coursework focused on human factors in transportation systems safety; vehicle safety design; safety data analysis and systems performance

Bachelor's Degree

With coursework in Human Factors/Systems/Industrial Engineering, Computer Science, Cognitive Psychology, Human-Centered Design, Research & Statistical Methods and specialized coursework, research, or other experience on transportation safety-related topics

PROGRAM OF STUDY

+2-5 years specialized research experience focused on transportation safety

PhD Preferred

+7-10 years specialized work experience with focus on transportation safety

P.E. Preferred

POS On-Ramp

+3- 5 years work experience applied to transportation safety projects or products.

Career Off-Ramp

E.I.T.

Human Factors Researcher

Salary: $97,568
(Glassdoor)

Senior Human Factors Engineer

Salary: $110,640
(Glassdoor)

Human Factors Engineer (SOC 17-2112)

Salary: $85,880

CAREER LADDER

Job Description: Human Factors Engineer

Alternative Job Titles

Human Factors Researcher

Job Description

A Human Factors Engineer focused on transportation safety utilizes human factors principles to evaluate the interaction between the human element and transportation system elements to identify systemic risk and to design safety solutions. Human Factors Engineers must be able to recognize the capabilities and limitations of road users in terms of behavior choices and reactions to system elements, as well as how demographics influence safety outcomes. Based on knowledge of human factors principles, they investigate, design, and implement transportation system safety solutions; and utilize multiple strategies to integrate road safety and human factors data and analysis into transportation planning and design. Other duties include:

- Utilize psychological and other scientific research methods based on principles related to human behavior and performance to assess safety impacts of behavioral decision-making as well as appropriate mitigation measures.
- Analyze and integrate human performance or human factors related data and knowledge into transportation system design activities.
- Diagnose design deficiencies based on real-world driver behavior.
- Apply knowledge of environmental, cultural and other factors that influence behavior to the design and implementation of behavior change and safety culture enhancement strategies.
- Apply modeling and simulation skills as well as appropriate qualitative, quantitative, user-centered design, and predictive analytics methodologies to identify safety issues and to design solutions, including safety-enhancement devices and technologies.

Knowledge Requirements

- Psychology, Ergonomics, Systems Engineering
- Human Factors Engineering Requirements/Standards
- Road Safety Principles
- Experimental Design
- User Interface Design, Human-Computer Interaction, Interaction Design
- Analysis/Research/Report Methods
- Modeling and Simulation Techniques
- Statistical Theory/Methods
- Usability Analysis

Required Skills & Abilities

- Analyze Data
- Prepare Reports
- Written and Oral Communication
- Product Design, Usability Testing
- Project Management/Supervision
- Mathematical Analysis
- Complex Problem Solving
- Leadership

Technical Skills Requirements

- SPSS or other statistical software
- Adobe; Microsoft Office Applications;

Education & Work Experience

- Bachelor's degree accepted for some positions, but most prefer an advanced graduate degree.
- Professional Engineer licensure is required for many mid-level to senior positions. Engineer-in-Training (EIT) status is required for many entry-level positions.

Program of Study: Human Factors Engineering

Certifications

Beyond attaining Professional Engineering licensure, Human Factors Engineers can apply for a variety of additional professional certifications, which attest to the attainment of a body of knowledge and capability specific to the discipline. In the field of behavioral transportation safety, the Transportation Professional Certification Board (TPCB) has developed the Road Safety Professional Certification to recognize the attainment of a given level of practice and knowledge in road safety science.

Year 5-8

Master's or Doctoral Degree in Industrial or Human Factors Engineering

Years 6-8: Students complete electives and required research thesis or dissertation requirements for the degree.

Year 5: Students complete core and elective courses within their concentration while selecting specialized independent research activities.

Core Human Factors Courses
Human Factors Systems Design
Human Factors Research Design
Cognitive Psychology
Usability Engineering
Human Machine Interactions

Core Transportation Courses
Transportation Safety
Transportation Systems Planning
Traffic Flow Modeling

Interdisciplinary Research Methods
Statistics: Experimental Design & Analysis; Regression Analysis
Psychology: Cognitive Psychology, Research Methods, Behavior Management
Human Factors: Research Methods

Experiential learning includes research/lab work, design work, fieldwork

Year 3-4

Bachelor's Degree in Industrial or Human Factors Engineering

Year 4: Students may select electives in specific areas of interest and will fulfill internship, fieldwork, or senior capstone requirements. Core courses may include human factors design labs, human machine/human computer interactions, and systems or product design.

Year 3: Students take courses in different areas of Human Factors Engineering, to include experimental design, engineering statistics, mechanics, engineering psychology, and user-centered design.

GE Courses
Science, Social Sciences, Humanities, Arts & Foundational Core Courses

Transportation Safety-Related Courses
Transportation Safety
Risk Assessment

Human Factors Courses
Human-Centered Systems Design
Systems Modeling & Simulation
Design & Analysis of Information Systems
Engineering Psychology
Computational Methods

Experiential learning includes design courses, labs, internships & research

Year 1-2

Bachelor's Degree in Progress or Associate's Transfer Degree in Pre-Engineering

Year 1 and 2: Course requirements vary by institution. Students wishing to transfer into a 4-year degree program from a two-year Associate's degree should work with an advisor early on to ensure they take all pre-requisite courses for their intended major.

General Education Courses
Students will develop writing, communication, math, and critical thinking skills.

HF-Related Courses
Mechanics
Statistics
Psychology
Computer Technology/Programming

Transfer Program Prerequisites
Calculus & Differential Equations
Probability and Statistics
Chemistry
Applied Mechanics & Dynamics
Computer Programming

Experiential learning includes design labs/courses, internships, co-ops

Year 0

High School Diploma or G.E.D.

Engineering or Computer Science CTE coursework if available.

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Experiential & Innovative Learning: Human Factors Engineering

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging course-work to practice. Many associations provide experiential learning opportunities like design/build or other student competitions; professional conferences and other networking opportunities, as well as student scholarships and other support. In addition, many institutions either require or strongly encourage work-based learning experiences for their students through internships and/or co-ops. Industry and education institutions can work together to ensure that safety-focused experiences and application of safety skills are an important component of these student development experiences. Examples of relevant human factors engineering experiential learning and professional development sources are provided below:

Highway Safety Data Fellows Program

The Federal Highway Administration and USDOT Secretary's Safety Data Initiative provide a fellowship program to examine safety among the most vulnerable road users including bicyclists and pedestrians.

Strategic Highway Research Program (SHRP)

The Transportation Research Board provides targeted student opportunities to implement and disseminate transportation safety research, such as through its SHRP student paper competition.

National Association of Women Highway Safety Leaders, Inc. (NAWHSL)

NAWHSL provides full-time female college students, interns, or employees with scholarships opportunities to attend the Annual Traffic Safety Leadership Conference.

Traffic Safety Scholars Program

The Traffic Safety Scholars (TSS) Program provides awards of up to $1,000 to undergraduate and graduate students to help defray the cost of attending the Lifesavers Conference on Highway Safety Priorities. This conference provides opportunities to learn about highway safety issues from leading experts and network with the largest gathering of highway safety professionals anywhere in the country.

National Highway Traffic Safety Administration (NHTSA)

The mission of NHTSA is to save lives, prevent injuries, and reduce economic costs due to traffic crashes through education, research, and enforcement. NHTSA provides internship and career opportunities in safety data analysis, driving simulation research, and safety technology design.

Human Factors and Ergonomics Society (HFES)

HFES is the largest professional association for human factors/ergonomics professionals. Student chapters provide opportunities to encourage participation in the discipline and professional development.

National Highway Institute (NHI)

NHI provides trainings and education for highway professionals in order to improve the conditions and safety of roads.

Intelligent Transportation Society of America (ITSA)

The Intelligent Transportation Society of America advances the research and deployment of intelligent transportation technologies to save lives, improve mobility, promote sustainability, and increase efficiency and productivity. ITSA's Education & Advocacy resources include safety related information that may be useful to students. The annual conferences and ITS America Career Center also provide career-oriented resources for students. Students can become members of ITS America to tap into networking and other professional development opportunities through the organization.

Summer Transportation Internship Program for Diverse Groups (STIPDG)

The U.S. Department of Transportation (U.S. DOT), Federal Highway Administration's (FHWA) Office of Innovative Program Delivery offers internships to college students of various backgrounds. The objective of the STIPDG is to provide college/university students with hands-on experience and on-the-job training while working on current transportation-related topics and issues. The STIPDG is open to all qualified applicants but is designed to provide qualified women, persons with disabilities, and members of diverse groups with summer opportunities in transportation where these groups have been underrepresented.

Dwight David Eisenhower Transportation Fellowship Program (DDETFP)

The DDETFP awards fellowships to students pursuing master's or doctoral degrees in transportation-related disciplines. As a part of the fellowship program, each year fellows participate in the Transportation Research Board (TRB) Annual Meeting.

Innovative Strategies for Integrating Safety Competencies into Varied Programs of Study

A safety career pathway involves attaining specialized safety competencies within various traditional transportation programs of study. In addition to acquiring academic and technical preparedness within a broader field (e.g. Civil Engineering or Human Factors Engineering), students and incumbent workers on a safety career pathway will pursue research, experiential learning, on-the-job training and other work-based or real-world learning experiences focused on transportation safety. Examples of effective safety integration models are listed that provide curricular and co-curricular value to student safety career preparedness:

Co-Curricular

Transportation Agency/University Research Partnerships

Research partnerships between university faculty and state DOTs are proven sources for safety workforce development when they: 1) are implemented over the long-term; and 2) actively involve faculty and both undergraduate and graduate multi-disciplinary students in the implementation of safety research and project development.

On-Campus DOT Design Units

Many campuses partner with transportation agencies to provide on-campus internship experiences to undergraduate students in roadway design or traffic operations projects. These programs provide students with hands-on design experience and exposure to state DOT standards and practices while building a pipeline into transportation engineering careers.

Safety-Focused Work-Based Learning

Particularly in construction programs, many institutions either require or strongly encourage work-based learning experiences, which can be utilized to attain safety-focused experiences and to apply safety skills in the workplace.

Curricular

Engaged Scholarship

Most universities provide mechanisms to incorporate community projects into student coursework, either through senior design, capstone, or service learning courses. Engagement of transportation organizations with universities to provide safety-focused course-based projects can serve as a powerful student exposure and recruitment tool to safety career pathways. Some universities provide opportunities to scale up these types of engaged scholarship opportunities so that one agency partner can provide multiple projects over the course of an academic year.

Safety-Focused Course-Based Learning

Integration of safety topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of safety-focused case studies and lab exercises into required coursework; and implementation of assignments that demonstrate understanding of safety principles and processes, through development of safety plans, safety data analysis assignments, or implementation of accident investigations or safety audits. Job site visits and field trips have also been identified useful tools for promoting student interest in safety.

Students can design their own externship experience.

Competency-Based Curriculum

A curriculum that meets academic and quality standards, designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, can be designed for safety. Job profiling and the use of "SMEs" should be considered to meet the competency needs of employers. The proliferation of industry-driven professional safety certifications can be used to facilitate this process. Programs of this kind may award credit for prior learning, allowing incumbent workers to achieve credentials by demonstrating knowledge and skills developed on-the-job.

Asynchronous Learning

Provide education and training for students and incumbent workers at times and locations convenient to students and employers, rather than instructors or institutions. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Problem-based learning provides students with opportunities to solve real life problems, often in environments that replicate the workplace (e.g. design within constraints, working on multidisciplinary teams, etc.). Industry engagement with educators to provide real world problem examples and guidance on project constraints enhances student experience.

Work-Based and Experiential Learning

Incorporate opportunities for "learning-by-doing", including internships, co-op work experience, simulations, and team class projects that are assignments from local employers.

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Transportation Safety
Data Analysis
Career Pathway Documentation

Career Pathway: Transportation Safety Data Management and Analysis

NNTW National Network for the Transportation Workforce

Graduate Degree Master's or PhD

With specialized research and/or coursework focused on transportation safety; safety data, big data, and predictive analytics; advanced computational methods

+2-5 years specialized research or work experience focused on transportation safety

PhD Preferred

Transportation Safety Researcher

- Computer and Information Research Scientist (SOC 15-1111)
- Research Scientist/Mathematician (SOC 15-2021)

Salary: $103,010 - $114,520

Bachelor's Degree Required

Major coursework in Mathematics, GIS, Computer Science, Statistical Analysis, Transportation, or Engineering with specialized coursework, research, or other experience focused on transportation safety-related topics

POS On-Ramp

+1- 5 years work experience applied to transportation safety projects.

Career Off-Ramp

Transportation Safety Data Analyst

- Database Administrator (SOC 15-1141)
- Computer Systems Analyst (SOC 15-1121)
- Statistician (SOC 15-2041)
- GIS Scientist/Technologist (SOC 15-1199)

Salary: $84,060 - $88,510

PROGRAM OF STUDY

CAREER LADDER

Job Description: Transportation Safety Data Analyst

Alternative Job Titles

FARS Manager/Analyst; Database Administrator, Statistician, Computer Systems Analyst, GIS Scientist, Research Scientist/Mathematician

Job Description

A Transportation Safety Data Analyst supports data-driven transportation safety improvements by ensuring that transportation and other relevant organizations collect, manage, and share high quality data in an efficient and coordinated manner to support transportation safety decision-making and resource allocation. They assist others in identifying relationships and trends in data; use techniques to display results of analyses; review data for accuracy, quality, and completeness; establish protocols for data management and security; and utilize multiple strategies to integrate safety data and analysis into transportation decision-making processes. Other duties may include:

- Develop systems and establish processes to ensure data quality and type of data elements are properly collected and validated to enable robust safety analysis.
- Work with stakeholders from both the public and private sectors to establish interoperability between different data sources to support transportation safety data analytics.
- Develop data analysis and data visualization tools, and user interface systems to facilitate data access, user friendly data queries, and data system functionality.
- Use advanced predictive analytics, computational methods, and modeling and simulation techniques to identify and mitigate safety risk.

Knowledge Requirements

- Analysis/Research/Report Methods
- Regulation/Legislation/Organizational/Funding Policies and Goals related to Safety
- Principles of Road Safety
- Statistical Theory/Methods
- Data Analysis Techniques and Tools
- Computer Programming
- Data & Systems Management

Required Skills & Abilities

- Analyze and Present Data
- Highway Safety Reporting & Evaluation
- Written and Oral Communication
- Attention to Detail
- Collaborate across Multiple Divisions and Organizations
- Complex Problem Solving
- Leadership

Technical Skills Requirements

- Computer Programming
- Statistical Software
- Highway Safety Manual
- Microsoft Office Applications

Education & Work Experience

- Bachelor's degree accepted for most positions with coursework in computer science, GIS, mathematics, transportation engineering/safety, and statistics. An advanced graduate degree is preferred for senior research positions.

Program of Study: Safety Data Analysis

Certifications

The Transportation Professional Certification Board (TPCB) offers a Road Safety Professional Certification, which attests to the attainment of a specific level of capability related to transportation safety science knowledge and practice.

Year 5-8

Master's or Doctoral Degree Computer Science, Math/Statistics or Data Science

Years 6-8: Students complete electives and required research thesis or dissertation requirements for the degree.

Year 5: Students complete core and elective courses within their concentration while selecting specialized independent research activities.

Core Courses
Computational Science
Data Mining
Data Analysis
Mathematical Modeling & Simulation
Graphics and Data Visualization

Core Transportation Courses
Transportation Safety
Traffic Simulation & Modeling

Interdisciplinary Research Methods
Experimental Design & Analysis
Naturalistic and Behavioral Data Analysis
Human Factors Research Methods

Experiential learning includes research, applied analysis work

Year 3-4

Bachelor's Degree in Computer Science, GIS, Math/Statistics or Data Science

Year 4: Students may select electives in specific areas of interest and will fulfill internship or capstone design project requirements. Core courses may include software engineering labs or other applied analysis projects.

Year 3: Students take multidisciplinary courses related to computer programming, database management, analytical methods, data visualization, and statistics.

GE Courses
Science, Social Sciences, Humanities, Arts & Foundational Core Courses

Transportation Safety-Related Courses
Transportation Safety
Human Factors

Data Analytics Courses
Methods for Data Analysis
Experimental Design
Data Structures & Algorithms
Database Systems
Computational Methods

Experiential learning includes design courses, labs, internships & research

Year 1-2

Bachelor's Degree in Progress or Associate's Transfer Degree in Data Science or Related

Year 1 and 2: Course requirements vary by institution. Students wishing to transfer into a 4-year degree program from a two-year Associate's degree should work with an advisor early on to ensure they take all pre-requisite courses for their intended major.

General Education Courses
Students will develop writing, communication, math, and critical thinking skills.

Major Coursework
Information Systems
Database Management
Network and Security

Data Structures
Computer Programming
Probability and Statistics

Experiential learning includes design projects, internships, co-ops

Year 0

High School Diploma or G.E.D.

Computer Science CTE coursework if available.

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Experiential & Innovative Learning: Safety Data Analysis

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging course-work to practice. Many associations provide experiential learning opportunities like design or other student competitions; professional conferences and other networking opportunities, as well as student scholarships and other support. In addition, many institutions either require or strongly encourage work-based learning experiences for their students through internships and/or co-ops. Industry and education institutions can work together to ensure that safety-focused experiences and application of safety skills are an important component of these student development experiences. Examples of relevant computer and mathematical experiential learning and professional development sources are provided below:

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The Federal Highway Administration and USDOT Secretary's Safety Data Initiative provide a fellowship program to examine safety among the most vulnerable road users including bicyclists and pedestrians.

Strategic Highway Research Program (SHRP)

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NAWHSL provides full-time female college students, interns, or employees with scholarships opportunities to attend the Annual Traffic Safety Leadership Conference.

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National Highway Traffic Safety Administration (NHTSA)

The mission of NHTSA is to save lives, prevent injuries, and reduce economic costs due to traffic crashes through education, research, and enforcement. NHTSA provides internship and career opportunities in safety data analysis.

Institute of Electrical and Electronics Engineers (IEEE)

The IEEE Computer Society is the world's leading membership organization dedicated to computer science and technology. Serving more than 60,000 members, the IEEE Computer Society is the trusted information, networking, and career-development source for a global community of technology leaders that includes researchers, educators, software engineers, IT professionals, employers, and students.

Bureau of Transportation Statistics (BTS)

The USDOT Bureau of Transportation Statistics provides data on transportation trends, policy, investments, and research across the US. BTS provides fellowship and internship opportunities for students to become involved in addressing technology and policy issues related to transportation.

American Statistical Association (ASA)

The American Statistical Association student chapters provide opportunities for students to connect with other students, attend conferences, apply for scholarships, and have access to classroom resources, as well as a multitude of statistical publications.

Institute for Operations Research and the Management Sciences (INFORMS)

The Institute for Operations Research and the Management Sciences brings together a wide range of information and resources for students considering or pursuing degrees in analytics and data science.

Data Science Association (DSA)

The purpose of the Data Science Association is to create a social and academic environment for Mathematics, Computer Science, Economics, and Data Science majors. It allows students to make connections to companies who work in the field of Big Data and Analytics. DSA gives students the resources and guidance to make them top candidates while applying for jobs or higher education. Members can participate in committees and conferences and have access to DSA education resources.

Big Data and Analytics Association (BDAA)

The Big Data & Analytics Association is the only undergraduate student organization of its kind, prioritizing the education of its members above all else. Weekly BDAA events, include hands-on workshops in which industry professionals teach members about the hottest topics in data analytics, and case competitions in which members put the skills they have acquired to the test. BDAA is located at The Ohio State University, but many of their resources are online and available to the public.

Association for Computing Machinery (ACM)

ACM, the world's largest educational and scientific computing society, delivers resources that advance computing as a science and a profession. ACM student chapters support professional development activities for computer science students.

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Research partnerships between university faculty and state DOTs are proven sources for safety workforce development when they: 1) are implemented over the long-term; and 2) actively involve faculty and both undergraduate and graduate multi-disciplinary students in the implementation of safety research and project development.

On-Campus DOT Design Units

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Safety-Focused Work-Based Learning

Particularly in construction programs, many institutions either require or strongly encourage work-based learning experiences, which can be utilized to attain safety-focused experiences and to apply safety skills in the workplace.

Curricular

Engaged Scholarship

Most universities provide mechanisms to incorporate community projects into student coursework, either through senior design, capstone, or service learning courses. Engagement of transportation organizations with universities to provide safety-focused course-based projects can serve as a powerful student exposure and recruitment tool to safety career pathways. Some universities provide opportunities to scale up these types of engaged scholarship opportunities so that one agency partner can provide multiple projects over the course of an academic year.

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Asynchronous Learning

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Problem-based learning provides students with opportunities to solve real life problems, often in environments that replicate the workplace (e.g. design within constraints, working on multidisciplinary teams, etc.). Industry engagement with educators to provide real world problem examples and guidance on project constraints enhances student experience.

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Road Construction Safety Management Career Pathway Documentation

Career Pathway: Road Construction Safety Management

NNTW National Network for the Transportation Workforce

PROGRAM OF STUDY

Master's Degree
Construction Management or Civil Engineering

With coursework or research focused on systems safety

Bachelor's Degree
Civil or Construction Engineering

With coursework, research, or other specialized experience and/or training on safety management

On-the-job training & experience, Apprenticeship, or Technical College Coursework (Certificate or Associate's Degree)

With training/coursework in heavy equipment operations, construction or civil engineering technology

P.E. Required

+5 years specialized work experience and training focused on systems safety performance, safety leadership, and safety management principles.

SCTPP

P.E. Preferred

E.I.T.

+4-10 years work experience in roadway construction with on-the job experience and specialized training in safety management practices.

CDL
Work Zone Safety Certifications
Flagger training
OSHA 10

POS On-Ramp

+6-24 months work experience with specialized training in safety practices.

Career Off-Ramp

CAREER LADDER

Road Construction Project Manager
- Construction Manager (SOC 11-9021)

Salary: $91,370

Road Construction Supervisor /Project Engineer
- First-line Construction Supervisor (SOC 47-1011)
- Civil Engineer (SOC 17-2051)

Salary: $64,070-$84,770

Road Construction Worker
- Construction Equipment Operator (SOC 47-2073)
- Construction Laborer (SOC 47-2061)

Salary: $34,530-$47,040

Job Description: Road Construction Manager - Safety

Alternative Job Titles

Project Engineer, Construction/Project Manager, Heavy Highway/Civil Construction Superintendent, Project Foreman

Job Description

A Construction Manager for heavy civil and highway/roadway projects is responsible for the overall completion and management of construction projects. Responsibilities include oversight of project quality control, financial controls, production efficiency, site safety, and project management systems and reporting. The position requires knowledge of construction and project management practices, equipment, standards and policies, and job site reporting. Construction Managers provide leadership on safety promotion on the project site. Safety-related competencies include knowledge of systemic safety principles to assess risk, develop safety plans, and promote, implement, and evaluate project safety. Duties include:

- Identify hazards and control measures for each phase of a project.
- Develop safety plans based on risk assessment, incorporating knowledge of safety regulations and compliance measures.
- Utilize effective traffic control techniques to ensure safety of project site workers and those passing through a work zone.
- Implement effective safety measures on site and use safety management techniques to conduct incident investigations, identify deficiencies, and implement effective countermeasures.
- Understand systemic road safety principles and crash reduction factors; ensure road design and construction practices integrate road safety best practices.

Knowledge Requirements

- Construction & Traffic Control Practices
- Health, Safety & Environmental Policies and Compliance
- Job Hazard & Risk Analysis
- Incident Investigation
- Safety Design & Countermeasures
- Project Management Practices
- Construction Equipment
- Estimating/Budgeting/Cost Control
- Quality Assurance and Control

Required Skills & Abilities

- Project Management/Supervision
- Written and Oral Communication
- Organizational Skills
- Time and Task Management Skills
- Teamwork
- Problem Solving
- Interpersonal & Conflict Resolution
- Safety Culture Leadership

Technical Skills Requirements

- Scheduling Software
- Cost Estimating & Tracking Software
- Microsoft Office Applications

Education & Work Experience

- A combination of education and work experience is generally accepted.
- A Bachelor's or Master's degree may be required for some senior positions.
- Additional certifications or licenses may be required by employers (e.g. CDL, OSHA, Safety Trained Supervisor, Work Zone Safety Certifications, Safety Certified Transportation Project Professional).

Program of Study: Road Construction Safety Management

Certifications

Construction Managers can apply for a variety of professional certifications, which attest to the attainment of a specified body of knowledge and capability. In the field of transportation safety, the American Road and Transportation Builders Association (ARTBA) Safety Certification for Transportation Project Professionals provides an industry-recognized credential to those demonstrating specific transportation project safety competencies.

Year 5-6

Master's Degree in Civil or Construction Engineering or Construction Management

Year 6: Students complete electives and required research thesis or professional paper requirements for the degree.

Year 5: Students complete core and elective courses within their concentration while selecting specialized independent research activities.

Core Courses
Industry Law & Regulations
Quality Assurance & Risk Management
Project Delivery Systems
Cost Analysis and Management
Heavy Construction Estimating
Construction Procurement Systems

Safety Courses
Safety Risk Management
Leadership in Construction
Transportation Safety
Data-Driven Construction Health & Safety

Experiential learning includes planning studios / labs, internship, and fieldwork

Year 3-4

Bachelor's Degree in Civil or Construction Engineering or Construction Management

Year 4: Students take senior-level courses and fulfill internship, fieldwork, or senior capstone requirements. Core courses may include heavy equipment methods, structural elements, and project management.

Year 3: Students take specialized technology and core courses such as design, estimating and bidding, mechanics, and foundations.

GE Courses
Science, Social Sciences, Humanities & Arts and Foundational Courses

Construction-Related Courses
Materials & Testing Methods
Design, Information Modeling, Documentation
Budgeting and Finance
Project Planning & Scheduling

Safety-Related Courses
Construction Safety
Transportation Safety
Safety Management
Risk Assessment
Incident Investigation
Work Zone Traffic Control
Senior Capstone
Internship

Experiential learning includes design courses, labs, internships, & research

Year 1-2

Associate's Degree in Civil or Construction Engineering Technology

Year 1 and 2: Course requirements vary by institution. Students will complete institutional requirements for the degree sought. The Associate's degree will provide students with general education requirements as well as basic theoretical knowledge and practical skills in the chosen field. Students wishing to transfer into a 4-year degree program should work with an advisor early on to ensure they take all pre-requisite courses for their intended major.

General Education Courses
Students will develop writing, communication, math, and critical thinking skills.

Construction-Related Courses
AutoCAD
Surveying
Materials Structures & Properties
Concrete Technologies
GIS
Construction Docs & Specifications

Safety-Related Courses
Safety Management
Construction Safety
Incident Investigation
Risk Management

Transfer Program Prerequisites
Calculus
Chemistry I, II
Physics I, II
Applied Mechanics

Experiential learning includes labs, internships, co-ops, and fieldwork

Year 0

High School Diploma or G.E.D.

Construction or Engineering CTE coursework if available.

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Experiential & Innovative Learning: Safety: Road Construction - Safety

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging course-work to practice. Many associations provide experiential learning opportunities like design/build or other student competitions; professional conferences and other networking opportunities, as well as student scholarships and other support. In addition, many institutions either require or strongly encourage work-based learning experiences for their students through internships and/or co-ops. This is particularly true for construction programs. Industry and education institutions can work together to ensure that safety-focused experiences and application of safety skills are an important component of these student development experiences. Relevant highway/road construction safety experiential and work-based learning is available through the following sources:

Association of General Contractors (AGC)

Student chapters of the Association of General Contractors exist at accredited two- and four-year schools offering programs in construction management, construction technology, and construction-related engineering. Membership in an AGC student chapter provides young professionals with an opportunity to observe and develop their skills alongside industry leaders. AGC sponsors contests for student chapters that apply construction knowledge to real-world problems. AGC's Foundation provides scholarships for undergraduates, graduate students, and students pursuing a technical degree or apprenticeship. Opportunities such as job shadowing and career fairs are available through state AGC chapters.

American Society of Civil Engineers (ASCE) Student Chapters

ASCE provides value to civil engineering and civil engineering technology students by expanding their network. Through volunteer opportunities, leadership resources, mentoring, student chapter meetings, scholarships, contests, and competitions, members meet colleagues who share a commitment to the civil engineering profession.

Associated Schools of Construction (ASC)

ASC is the professional association of construction educators and industry practitioners working together for the development and advancement of construction education. Student chapters of ASC exist at 143 four-year colleges and 9 two-year colleges. Regional competitions include a category for Heavy-Civil Construction.

Construction Management Association of America (CMAA)

Local chapters offer opportunities for students to learn about construction projects in their community and to network with members. Many chapters also offer scholarship funding.

Transportation Development Foundation of the American Road and Transportation Builders Association

The Student Transportation Construction Industry Video Contest experience helps students gain a better understanding of the importance of transportation infrastructure investment to the U.S. economy and quality of life and to learn more about the industry and potential career opportunities. The contest is open to post-secondary, college, and graduate students. ARTBA also offers scholarships for post-secondary students and women at the undergraduate or graduate level; and training for construction personnel, including in safety.

SkillsUSA

A national non-profit, SKillsUSA serves teachers, high school, and college students preparing for careers in the skilled trades, and offers safety-focused resources and competitions.

American Society of Safety Professionals (ASSP)

ASSP is a global association of occupational safety professionals that advocates for safer work environments. It supports student chapters and provides scholarships, educational resources, and a student-focused Future Safety Leaders Conference among other professional development and networking opportunities.

Occupational Safety & Health Administration (OSHA)

In addition to offering a variety of safety-focused trainings, local OSHA offices provide safety-focused internships for students interested in safety.

Municipal Public Works Departments

Counties and cities offer opportunities for paid internships, co-ops, and externships. In externship situations, students spend one to three weeks with their hosts at their workplaces for a career exploration experience that usually includes networking, job shadowing, and a focus project. These experiences occur during semester breaks. It is important to emphasize that students can design their own externship experience.

State Departments of Transportation

DOTs offer internships for both community college, university and graduate students. Internships or co-ops are available in a number of occupations relating to asset management: civil engineering, construction, and maintenance. Some DOTs also employ college students to assist in the completion of seasonal work related to highway maintenance, crash system input and analysis, maintenance at roadside rest facilities, and flagging. Some training is provided on the job. DOTs offer rotational programs to entry-level engineers so that they experience different business areas within the organization before selecting a permanent assignment.

Innovative Strategies for Integrating Safety Competencies into Varied Programs of Study

A safety career pathway involves attaining specialized safety competencies within various traditional transportation programs of study. In addition to acquiring academic and technical preparedness within a broader field (e.g. Civil Engineering or Construction), students and incumbent workers on a safety career pathway will pursue research, experiential learning, on-the-job training and other work-based or real-world learning experiences focused on transportation safety. Examples of effective safety integration models are listed that provide curricular and co-curricular value to student safety career preparedness:

Co-Curricular

Transportation Agency/University Research Partnerships

Research partnerships between university faculty and state DOTs are proven sources for safety workforce development when they: 1) are implemented over the long-term; and 2) actively involve faculty and both undergraduate and graduate multi-disciplinary students in the implementation of safety research and project development.

On-Campus DOT Design Units

Many campuses partner with transportation agencies to provide on-campus internship experiences to undergraduate students in roadway design or traffic operations projects. These programs provide students with hands-on design experience and exposure to state DOT standards and practices while building a pipeline into transportation engineering careers.

Safety-Focused Work-Based Learning

Particularly in construction programs, many institutions either require or strongly encourage work-based learning experiences, which can be utilized to attain safety-focused experiences and to apply safety skills in the workplace.

Curricular

Engaged Scholarship

Most universities provide mechanisms to incorporate community projects into student coursework, either through senior design, capstone, or service learning courses. Engagement of transportation organizations with universities to provide safety-focused course-based projects can serve as a powerful student exposure and recruitment tool to safety career pathways. Some universities provide opportunities to scale up these types of engaged scholarship opportunities so that one agency partner can provide multiple projects over the course of an academic year.

Safety-Focused Course-Based Learning

Integration of safety topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of safety-focused case studies and lab exercises into required coursework; and implementation of assignments that demonstrate understanding of safety principles and processes, through development of safety plans, safety data analysis assignments, or implementation of accident investigations or safety audits. Job site visits and field trips have also been identified useful tools for promoting student interest in safety.

Students can design their own externship experience.

Competency-Based Curriculum

A curriculum that meets academic and quality standards, designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, can be designed for safety. Job profiling and the use of "SMEs" should be considered to meet the competency needs of employers. The proliferation of industry-driven professional safety certifications can be used to facilitate this process. Programs of this kind may award credit for prior learning, allowing incumbent workers to achieve credentials by demonstrating knowledge and skills developed on-the-job.

Asynchronous Learning

Provide education and training for students and incumbent workers at times and locations convenient to students and employers, rather than instructors or institutions. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Problem-based learning provides students with opportunities to solve real life problems, often in environments that replicate the workplace (e.g. design within constraints, working on multidisciplinary teams, etc.). Industry engagement with educators to provide real world problem examples and guidance on project constraints enhances student experience.

Work-Based and Experiential Learning

Incorporate opportunities for "learning-by-doing", including internships, co-op work experience, simulations, and team class projects that are assignments from local employers.

U.S. Department of Transportation Federal Highway Administration

West Region Transportation Workforce Center

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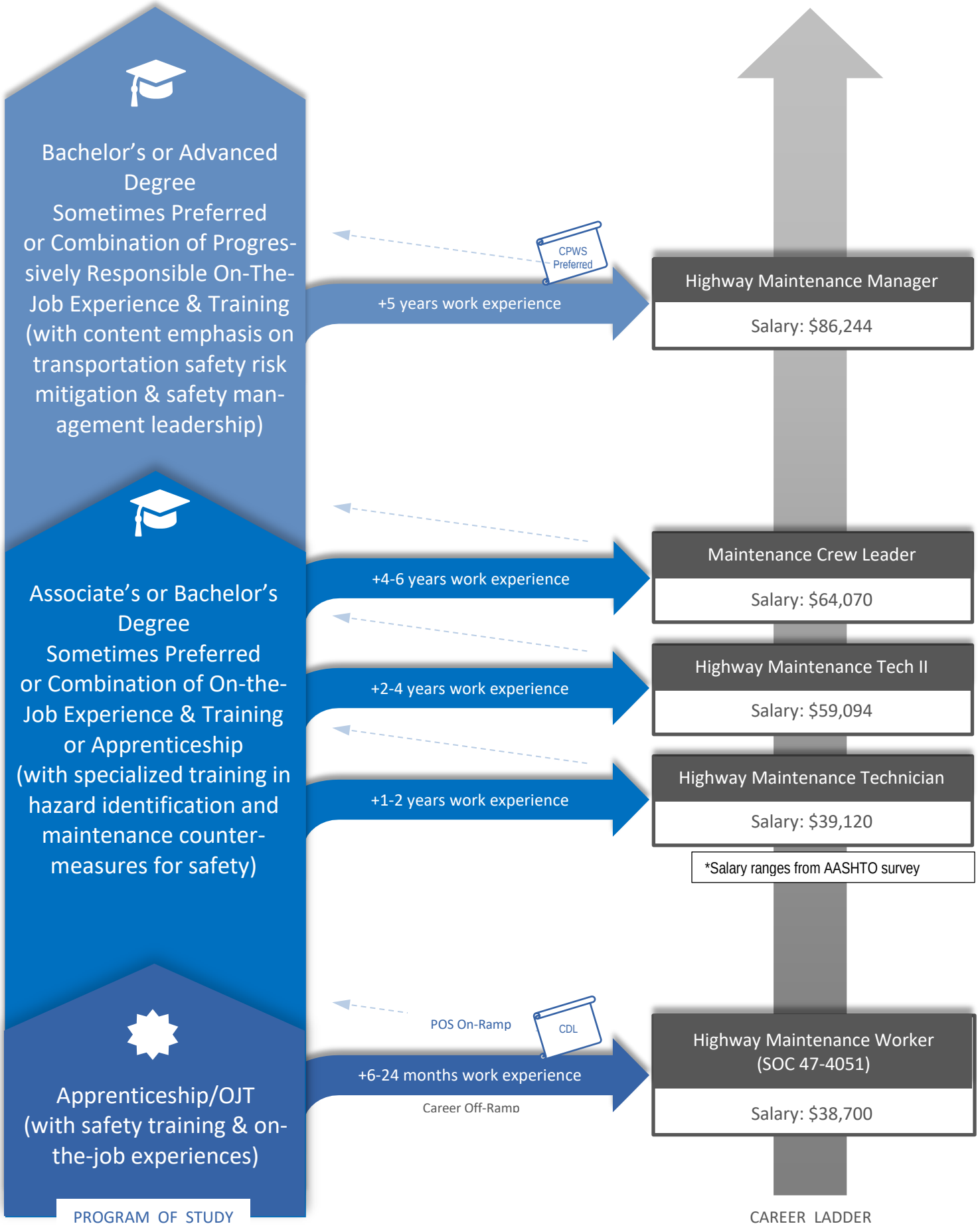
Highway Maintenance Safety Management Career Pathway Documentation

Career Pathway: Highway Maintenance Safety Management

NNTW National Network for the Transportation Workforce



Job Description: Highway Maintenance Safety Manager

Alternative Job Titles

Road Maintenance Manager/Supervisor, Local Roads Supervisor, Public Works Director, Maintenance Superintendent, Maintenance Chief

Job Description

A Road Maintenance Manager is responsible for oversight of maintenance activities in a given administrative district, including overseeing roadway repair, maintenance, and improvement projects, winter maintenance operations, and facilities and asset management. The Maintenance Manager supervises maintenance staff; roadway monitoring, inspection, and permitting processes; disaster and emergency response; and roadway inspection and hazardous materials procedures. As such, execution of duties has a direct impact on the safety of both maintenance workers and the traveling public. Maintenance Managers provide leadership on road safety promotion by means of maintenance activities and practices. Safety-related competencies include knowledge of systemic safety principles to assess risk, develop safety plans, and promote, implement, and evaluate maintenance impacts on road user safety. Duties include:

- Identify hazards and control measures for maintenance activities.
- Develop incident management and other safety plans based on risk assessment, incorporating knowledge of safety regulations and compliance measures.
- Ensure effective traffic control techniques are in place to safeguard workers and those passing through a work zone or site during maintenance activities.
- Implement effective road safety countermeasures through maintenance activities.
- Ensure maintenance staff are able to identify, report, and/or remediate road safety deficiencies.
- Promote a positive organizational safety culture.

Knowledge Requirements

- Roadway/Shoulder/Winter/Bridge/Culvert Maintenance Practices
- Traffic services, including pavement markings, guardrails, MUTCD
- Heavy Equipment Operations
- Equipment Maintenance Practices
- Budgeting/Cost Control; Asset Management
- Health, Safety & Environmental Policies and Compliance
- Hazard & Risk Analysis
- Safety Culture Promotion
- Safety Countermeasures

Required Skills & Abilities

- Project Management/Supervision
- Written and Oral Communication
- Organizational Skills
- Time and Task Management Skills
- Teamwork
- Problem Solving
- Interpersonal & Conflict Resolution
- Leadership

Technical Skills Requirements

- Maintenance management software
- Microsoft Office Applications

Education & Work Experience

- A combination of education and work experience is generally accepted.
- A Bachelor's or Master's degree may be required for some senior positions.
- Additional specific certifications or licenses may be required by employers (e.g. Certified Public Works Supervisor)

Program of Study: Highway Maintenance Safety Management

CPWS - Certified Public Works Supervisor; TPCB Road Safety Professional Certification

Year 3+

Bachelor's degree in Civil or Construction Engineering, Highway Maintenance Management or Related

Year 3 & 4: Curriculum is multi-disciplinary and taught through a safety lens. Training content focused on leadership and safety management.

Year 1 & 2: General education and prerequisite courses are taken in science and math to cement a strong technical background.

Core Courses
Transportation Safety
Asset Management
Budgeting and Finance
Pavements
Materials & Testing Methods
Project Planning and Scheduling

Safety Courses
Design Countermeasures for Safety
Safety Data Analysis
Safety Culture & Leadership
Systemic Safety
Low Cost Safety Countermeasures

Experiential learning includes labs, capstones, fieldwork, co-ops

Year 2+

Training/Certification and/or Associate's Degree - Highway Maintenance Safety Focus

Apprenticeship to Associate Degree/Associate Degree
To attain an Associate's degree, all students must take general education courses that develop basic communication, math, technical, and critical thinking skills, as well as degree-specific requirements. Course offerings related to highway construction and maintenance operations and degree requirements will vary by institution.

Completion of an Apprenticeship provides credit towards a degree at Registered Apprenticeship - College Consortium colleges.

On-the-Job Experience & Training
Progressively responsible on-the-job experience and training can be substituted for degree work to achieve career advancement.

Focused training content on highway maintenance safety includes:

Highway Maintenance Safety Courses
Introduction to Safety Culture
Understanding Human Factors
Overview of the Manual on Uniform Traffic Control Devices
Introduction to Safety Analysis
Maintenance Countermeasures for Safety
Work Zone Safety
Identification and Mitigation of Roadway Safety Hazards
Maintenance Countermeasures for Safety

Experiential learning includes fieldwork, capstone projects, Maintenance Academies

Year 1-2

Apprenticeship or Work-Based Learning

Year 2 Technician: Equipment operation and employee safety are emphasized. Training may involve simulators. Course topics are offered at an intermediate level. Certifications may be available.

Year 1 Trainee: Employees learn highway maintenance practices by working in the field. Coursework supplements the on-the-job portion and embeds certifications. Apprenticeship provides credits toward associate degree with paid related instruction.

Highway Maintenance Safety Courses
Incident Management System
HAZMAT Awareness
Hazard Communication
Trenching & Shoring Awareness
Confined Space Entry
Defensive Driving
Personal Protective Equipment
Hand Tools and Equipment Operation
Promoting Workplace Safety

Safety Certifications
OSHA Certifications
First Aid/CPR Certification
Work Zone Traffic Certification
Work Zone Flagging Certification

Year 0

High School Diploma

Transportation/Public Works-related career academies.

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Experiential & Innovative Learning: Safety: Maintenance

Experiential Learning & Professional Development Opportunities

Professional associations provide professional development and networking opportunities to students and incumbent workers, bridging education to practice. Many associations provide experiential learning opportunities; professional conferences and other networking opportunities, as well as student scholarships and other support. In addition, many institutions either require or strongly encourage work-based learning experiences for their students through internships and/or co-ops. Industry and education/training providers can work together to ensure that safety-focused experiences and application of safety skills are an important component of these professional development experiences. Relevant maintenance experiential and work-based learning is available through the following sources:

American Society of Safety Professionals (ASSP)

ASSP is a global association of occupational safety professionals that advocates for safer work environments. It supports student chapters and provides scholarships, educational resources, and a student-focused Future Safety Leaders Conference among other professional development and networking opportunities.

National Association of County Engineers (NACE)

NACE provides education and training events to county engineers, road managers, and related professionals across the US. In particular, the NACE Safety and Technology committee hosts annual meetings, which offer safety-specific training opportunities. NACE also leads a pilot program on local road safety planning.

Association of General Contractors (AGC)

Student Chapters exist at accredited two- and four-year schools offering programs in construction management, construction technology, and construction-related engineering. Membership in an AGC Student Chapter provides young professionals with an opportunity to observe and develop their skills with current industry leaders. AGC sponsors contests for student chapters that apply construction knowledge to real-world problems. AGC's Foundation provides scholarships for undergraduates, graduate students, and students pursuing a technical degree or apprenticeship. Opportunities such as job shadowing and career fairs are available through state AGC chapters.

Traffic Safety Scholars (TSS) Program

The TSS Program provides awards of up to $1,000 to undergraduate and graduate students to help defray the cost of attending the Lifesavers Conference on Highway Safety Priorities. This conference provides opportunities to learn about highway safety issues from leading experts and network with the largest gathering of highway safety professionals anywhere in the country.

National Highway Institute (NHI)

NHI provides trainings and education for highway professionals in order to improve the conditions and safety of roads, highways, and bridges.

American Traffic Safety Services Association (ATSSA)

ATSSA represents the road safety, traffic safety, and highway safety industry with effective legislative advocacy, traffic control safety training, and a far-reaching member partnership. ATSSA offers a variety of experiential learning and additional training and networking opportunities through its annual convention and traffic expo, mid-year meetings, and National Work Zone Awareness Week activities.

American Public Works Association (APWA)

APWA student membership connects students to a network of professionals. State chapters provide scholarships as a way to attract students to this field. Public Works conferences or expos often include an Equipment Roadeo—a competition for technicians in a number of maintenance occupations to show their skills troubleshooting mechanical issues or maneuvering equipment in various weather conditions. Local winners advance to regional and national Roadeos. These events showcase the latest in technology and equipment and offer an opportunity for a student to engage with public works staff as well as equipment manufacturers.

American Association of State Highway Transportation Organizations (AASHTO)

AASHTO has a standing committee on highway traffic safety, which administers a Safety Leadership Award, and manages the TC3 training program, which offers a variety of safety-focused courses.

State Local Technical Assistance Programs (LTAP)

These FHWA-funded centers offer training and coordination for Local Roads Programs or Road Scholar Programs. Opportunities for students vary by state.

Federal Highway Administration (FHWA) EOT Program

FHWA's Emergency Transportation Operations program provides tools, guidance, capacity building and good practices that aid local and State DOTs and their partners in their efforts to improve transportation network efficiency and public/responder safety when a non-recurring event either interrupts or overwhelms transportation operations.

Federal Highway Administration (FHWA) TIM Program

The Federal Highway Administration has training for safer, faster, stronger, more integrated incident response, through its National Traffic Incident Management Responder Training Program. This program includes web-based training, a communications toolkit, newsletters, and videos that can help to better equip students and professionals in the industry of traffic incident management.

National Traffic Incident Management Coalition (NTIMC)

NTIMC is a multi-disciplinary partnership forum spanning the public safety and transportation communities to coordinate experiences, knowledge, practices, and ideas to improve incident management practices.

Traffic Incident Management Network (TIM)

TIM connects traffic incident management professionals from different disciplines. Through the network, students and professionals focused on traffic incident management can have access to the Responder, the monthly newsletter, webinars, podcast, virtual peer exchanges, and more.

Innovative Strategies for Integrating Safety Competencies into Varied Programs of Study

A safety career pathway involves attaining specialized safety competencies within various traditional transportation programs of study. In addition to acquiring academic and technical preparedness within a broader field (e.g. Civil Engineering or Construction), students and incumbent workers on a safety career pathway will pursue research, experiential learning, on-the-job training and other work-based or real-world learning experiences focused on transportation safety. Examples of effective safety integration models are listed that provide curricular and co-curricular value to student safety career preparedness:

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