



National Transportation Career Pathways Initiative

FINAL PROJECT REPORT

FEBRUARY 2019

Table of Contents

Contents

Executive Summary	1
Transportation Planning	15
Transportation Operations	52
Transportation Environment	143
Transportation Engineering	185
Transportation Safety	254

Executive Summary

Executive Summary

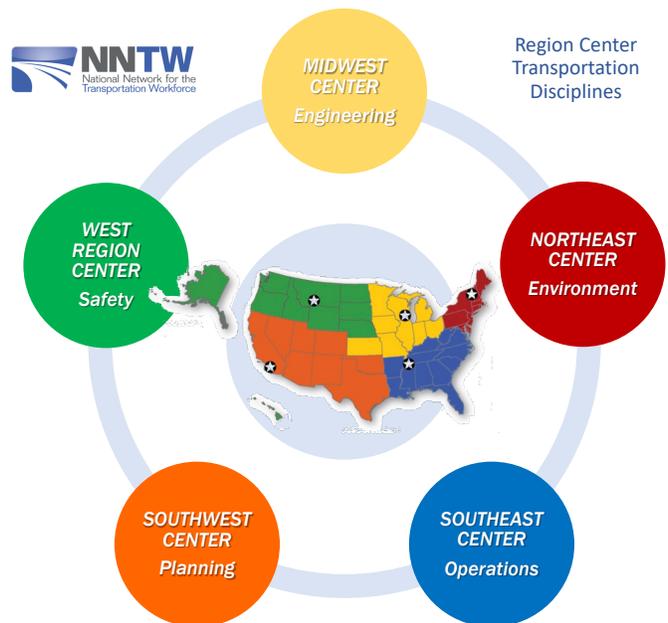


SECTION 1.0 THE CAREER PATHWAY INITIATIVE

1.1 NTCPI Project Overview

In October of 2016, the California State University, Long Beach, Research Foundation (CSULB) was awarded FHWA Grant #DTFH6116H00030, the Transportation Workforce Strategic Initiative, on behalf of the National Network for the Transportation Workforce (NNTW)—a university-based collaborative of five regional transportation workforce centers that provide research and strategic partnerships for FHWA’s Office of Innovative Program Delivery. This initiative sought to establish a set of five discipline-focused career pathways for deployment at post-secondary education/training institutions nationwide, in order to begin development of forward-looking, technology-infused workforce pipelines that lead to critical occupations within the highway transportation sector.

Each NNTW Regional Center was assigned one of the five disciplinary focuses specified by the initiative (see below). CSULB houses one of these centers, the Southwest Transportation Workforce Center (SWTWC) and acts as programmatic lead. In January of 2016, the strategic initiative was renamed the National Transportation Career Pathways Initiative (NTCPI) to better represent its primary objective. The content of this report provides a summary of the research, career pathways, and pathway implementation plans developed by the NNTW Regional Centers and their discipline working group partners during NTCPI’s two-year execution.



Executive Summary

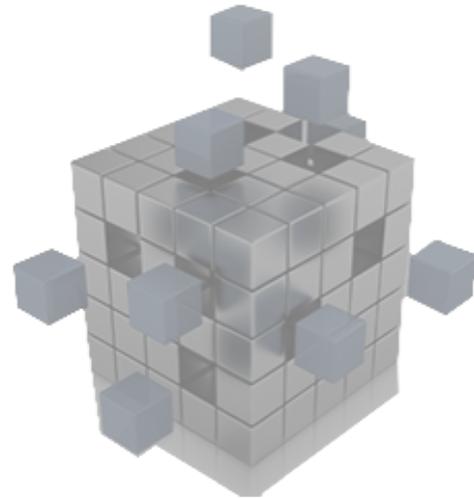
1.2 The NTCPI Final Report

The entire contents of this report (318 pages plus TOC/cover) represent the comprehensive final project report specified by Cooperative Agreement #DTFH6116H00030 page 11 of 18, Task 5 Deliverable. This report is a separate product from the final PowerPoint presentation, also a Task 5 Deliverable, and is provided in PDF format to provide consistent viewing and print quality across multiple computer platforms.

This report is modular by design and may be separated into its five disciplinary components: Transportation Planning, Transportation Operations, Transportation Environment, Transportation Engineering, and Transportation Safety.

This final report is organized as follows:

1. Title Page
2. Table of Contents
3. Executive Summary
4. Transportation Planning
5. Transportation Operations
6. Transportation Environment
7. Transportation Engineering
8. Transportation Safety



Each disciplinary report is organized as follows:

- Cover Page
- SECTION 1: Characterizing the Workforce
- SECTION 2: Career Pathway Design
- SECTION 3: The Six Elements of Pathway Development
- SECTION 4: Career Pathway Implementation
- SECTION 5: Barriers to Deployment
- SECTION 6: References & Documentation
- Career Pathway Document Sets

Executive Summary

SECTION 2.0 PATHWAY IMPLEMENTATION PROJECTS

2.1 Implementation Program Briefs

Each of the disciplinary reports presented within this document contains a detailed career pathway implementation plan for the “shovel-ready” deployment of a pathway demonstration program within the post-secondary education system. These plans are comprehensive in scope and detailed in their presentation, describing partners, timelines, and budget needs. The purpose for these plans is to demonstrate readiness for the next phase of NTCPI: deployment.

As a visual aide to capture broader stakeholder interest, each NNTW Regional Center has also produced a simplified, two-page handout that presents an easily digested plan overview. A copy of these five “program briefs” follows the plan introduction below:

Discipline: Transportation Planning

Program: Transportation Planning Professional Plus Certificate Program

Description: Equip planners with in-demand cross-disciplinary competencies through a series of targeted course modules that lead to a capstone project and professional certification (TPP+).

Discipline: Transportation Operations

Program: Attracting Next Gen Transportation Operations Professionals

Description: Deploy web-based interactive career portal that promotes operations and operations professionals. Design and deploy experiential learning projects for integration into K-16 curriculum.

Discipline: Transportation Environment

Program: Advancing Future Environmental Work & Workers in Transportation

Description: Provide rural ITS workforce with access to in-demand IMSA certifications. Connect existing training curriculum to educational programs that target ITS, Smart City, and Sustainability.

Discipline: Transportation Engineering

Program: Advancing Apprenticeship in Highway Maintenance & Engineering

Description: Facilitate, document, and nationally promote a highway maintenance apprenticeship program. Connect apprenticeship to associate degree program for credit articulation.

Discipline: Transportation Safety

Program: Career Pathways to Safer Transportation Systems

Description: Integrate safety competencies into transportation training, education, and career pathways. Establish road safety training curriculum and an employee recognition template program.

TRANSPORTATION PLANNING PROFESSIONAL PLUS+ CERTIFICATE

Transportation Planning Professional Plus (TPP+) is an innovative training program that teaches skills demanded by employers but not normally taught in traditional planning programs or gained through internships. TPP+ courses are modular, stackable credentials that allow students the freedom to develop their own program. To ensure that planners hit the ground running, TPP+ leverages capstone project-based learning and multi-disciplinary teams where students work together to develop their skillsets.

MODULAR - STACKABLE - CREDENTIALS

Hosted through LBSU's College of Professional & International Education (CPIE) and the Center for International Trade and Transportation, students earn American Planning Association (APA) continuing education credits as part of this ongoing program of professional development.

Transportation planners today are in need of a broad range of cross-disciplinary skills. Skills that allow for communicating with diverse groups using the latest technology, for securing grant-based funding and for marketing the Plan.

TPP+ Topics

- E-commerce and the Battle for the Curb
- The Forgotten Modes: Air and Freight Rail
- Data visualization for planning
- Modeling principles for non-modelers
- Mastering the Public Hearing
- Negotiating Skills
- Working with the Legal Team
- Project Management and Budgeting for Planning
- Working with the private sector
- Marketing the Plan
- Grant writing



TPP+ Partners



Phase 1: Assemble a competency steering committee that includes academic program advisors from APA-accredited college planning programs, representatives from the APA Transportation Planning Division and its local chapters, and industry leaders to determine critical planning professional competencies.

Phase 2: Pilot first TPP+ competency module to establish a framework for a successful program. The non-credit pilot course will be deployed to serve as a co-curricular enhancement for students and working professionals in planning occupations. This pilot will include intake and concluding surveys to inform future scaling efforts.

Phase 3: Scale TPP+ by establishing and marketing a set of corresponding credentials. Once credentials are in place, establish credit for prior learning articulation agreements with local colleges. These modules could become extensions to other community colleges and universities to expand the career pathway.

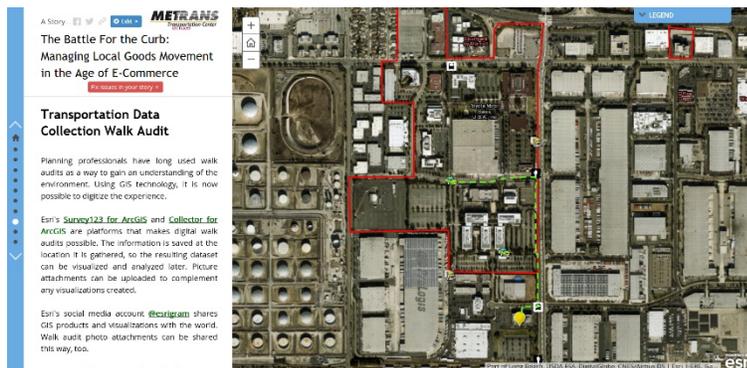
Assess
Assemble a steering committee to assess competency needs.

Pilot
Pilot the first TPP+ competency module.

Scale
Scale TPP+ modules to create professional credential programs.

Program Outcomes

- Industry Needs Assessment
- Competency Steering Committee
- New Curriculum Development
- 6 Stackable Training Modules
- Roadmap for Catalog of Courses
- Pilot of 10 Students/Professionals
- Longitudinal Career Tracking
- Continuing Education Credit
- Professional TPP+ Credential
- Bragging rights at the office



LONG BEACH STATE UNIVERSITY



NATIONAL TRANSPORTATION CAREER PATHWAYS INITIATIVE ATTRACTING NEXT GEN TRANSPORTATION OPERATIONS PROFESSIONALS

THE PROBLEM: FUTURE OF THE TRANSPORTATION OPERATIONS WORKFORCE

An overarching theme in transportation operations is the necessity of a systems approach and ever-changing impacts of technological advances. In the public sector, the rise of Intelligent Transportation Systems (ITS) began rapidly changing the knowledge, skills, and abilities, required of its workforce. Transformative technologies dominate all areas of transportation operations, and occupy a key focus for companies whether from the standpoint of impact on efficiencies and the way business is conducted or the challenges in attracting and retaining an appropriately skilled workforce. It is crucial to examine how we are preparing the workforce of the future to deal with disruptive/ transformative technologies and rapidly changing demands.

Transportation operations of the future requires workers who are:

- Tech-savvy, flexible, responsive, and adaptive to an ever-changing set of technological tools and innovations;
- Effective communicators, particularly with a wide range of stakeholders;
- Knowledgeable of system infrastructure design, connectivity, and interoperability;
- Equipped with data acquisition, management, analysis, modeling, and decision-making skillsets.

OUR SOLUTION: NATIONAL TRANSPORTATION CAREER PATHWAYS INITIATIVE

The Southeast Transportation Workforce Center (SETWC) identified lack of awareness of transportation operations careers as one of the most significant challenges to attracting the next generation workforce. As part of the National Transportation Career Pathways Initiative, SETWC developed a strategic action plan with targeted initiatives to increase awareness and interest in transportation operations careers within traffic, transit and freight contexts within the following occupational clusters: operations management, operations engineering, operations research, and operations technology. Our approach includes two key initiatives:

Interactive Transportation Operations Career Pathway Web Portal

An engaging online resource that allows users to explore a variety of priority operations career pathways through interactive investigation of required skills, training, and education that features a diverse group of industry professionals in a series of Transportation Spotlights.

Transportation Operations Challenge Projects

A collaborative industry-academia approach to creating resources that demonstrate transportation operations careers through developing exciting, interdisciplinary, real-world challenge projects that are relevant to curriculum and can be readily deployed within K-12, technical schools, community colleges, and 4-year universities.



NATIONAL TRANSPORTATION CAREER PATHWAYS INITIATIVE ATTRACTING NEXT GEN TRANSPORTATION OPERATIONS PROFESSIONALS

OUR PARTNERS

Collaborative partnerships between academia and industry are essential for the success of these initiatives. While several organizations are already committed to a leading role in this effort, we will continually engage new partners to increase impact and ensure products reflect a national perspective.

Thank you to our lead partners!



PROGRAM OUTCOMES

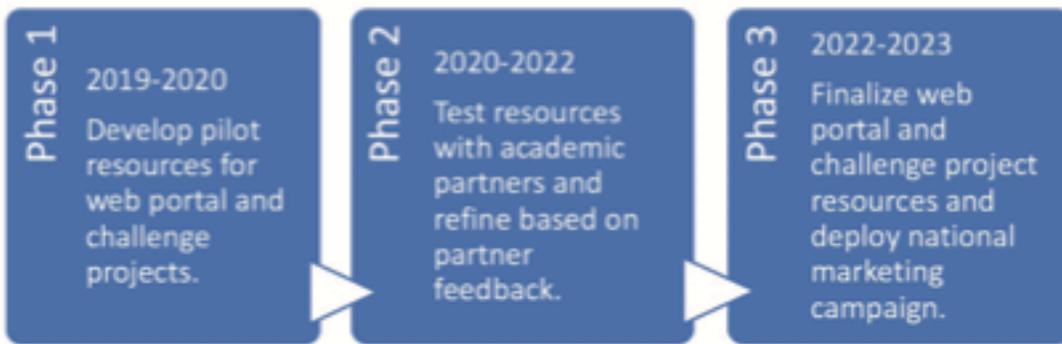
Interactive Transportation Operations Career Pathway Web Portal

- Online, interactive career pathways for all four operations occupational clusters
- Minimum of 5 spotlight profiles developed per occupation

Transportation Operations Challenge Projects

- 15 Challenge Projects developed for high school and post-secondary audiences
- Minimum of 300 students and 50 academic industry partners engaged during project period

PHASED ROLLOUT



Transportation’s environmental workers today work in a wide variety of fields, bringing a high level of interdisciplinary expertise to guide transportation planning and project development to both meet community needs and desires, and consider the impacts on both the natural and human



environment. Private companies and public agencies at the local, state, and federal level employ a corps of workers in diverse fields, from archaeology and air quality monitoring to wildlife biology and watershed planners. These are critical positions and offer excellent opportunities for students to consider contributing to community resilience and sustainability, but there are limited numbers employed in transportation, and limited openings. The National Transportation Career Pathway Initiative (NTCPI) identified many new and emerging fields that are beginning to have a significant impact on environmental quality in the transportation field, and now offer significant growth in the number and breadth of opportunity for the future.

Transportation’s Environmental Growth Fields



Smart Cities, Shared-Use Mobility Systems, Intelligent Transportation Systems, and Sustainability and Resilience Sciences are all new and rapidly growing fields that will impact the future of transportation work and workers. Particularly at the municipal and some state levels, hundreds of millions of dollars of investments are currently being used to address key environmental goals. This deployment is opening up high levels of need for new skills, competencies, and fields to be incorporated into transportation planning and project development, from technicians, to data managers, to leadership.

Action Steps & Challenges

Build an adaptive framework with employers and education partners to present and develop career pathway and education tools that provide certification training enhancement to the current workforce and build a reliable path for future workers to follow into these rapidly changing and developing fields.

- A. **Pilot effort** to test a set of interventions to support the upskilling of current workers needing new skills and create a sustainable delivery system for key certifications and using this as a building block in developing new curriculum and studies for 2- and 4-year institutions.
- B. Design and promote direct **connections between existing training curriculum and educational curriculum** in programs most likely to direct students to ITS, Smart City, and Sustainability career paths.
- C. Refine and test an **interactive pathway tool**, and create a customizable package that allows it to reflect local employers, educational programs, and featured career paths and profiles of current workers.

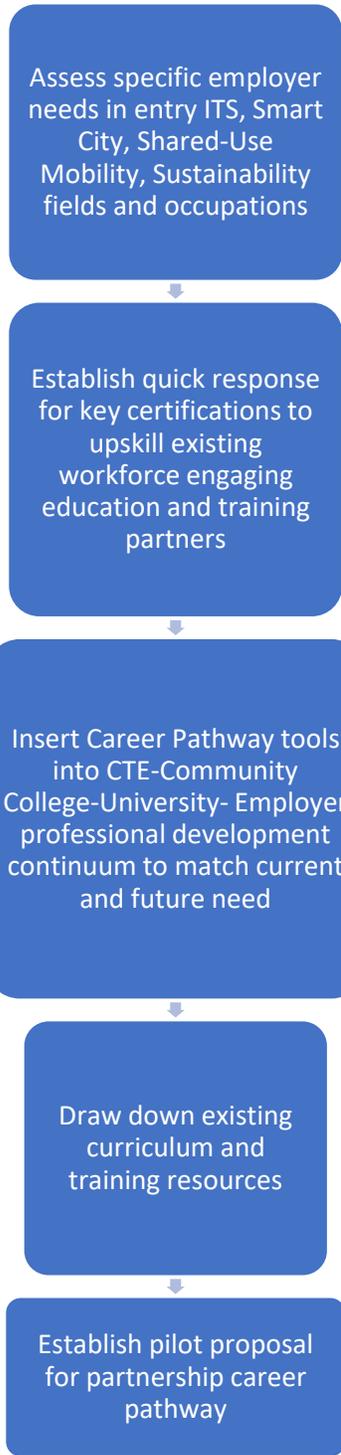
Deploy these initiatives as an integrated approach within a targeted geography to build out the necessary infrastructure to attract, educate, and employ individuals along this emerging career path.



Sampling of new occupations

Emerging Occupation	BLS-related occupational categories
Smart City Coordinator / Transportation Engineering Bureau Chief	Transportation Manager
ITS Systems Director	Computer and Information Systems Managers
Signal Operations Supervisor	Transportation Engineer
Traffic Engineering Manager	Transportation Engineer
ITS Systems Engineer	Computer Systems Engineers/ Architects
Signal Operations Engineer	Electrical Engineer
ITS Technician	Electrical Engineering Technician
	Electrician
	Civil Engineering Technician
	Traffic Technician

Pilot Project



Existing Curriculum Resources

- *IMSA Certifications*
- *Consortium for ITS Training and Education (CITE)*
- *USDOT ITS Professional Capacity Building Program*
- *National Highway Institute*
- *Transportation Tech's ITS Bootcamp*
- *ITE Learning Hub*
- *Emerging University and Community College programs*



Ray LaHood
FORMER SECRETARY OF TRANSPORTATION, USDOT

Resources for Educators
<http://netwc.net/educator/>

Transportation Green Careers
Clean Air
Alternative Fuels
Smart Cities
Bicycle & Pedestrian
Sustainable Communities
Shared Mobility
Advanced Transit
Bicycle Networks
Big Data
Climate Change Mitigation & Adaptation

Career Pathways to the Future
NNTW
National Network for the Transportation Workforce

<http://netwc.net>



ADVANCING APPRENTICESHIP IN HIGHWAY MAINTENANCE & ENGINEERING PLAN

A project of the National Transportation Career Pathway Initiative
3-YEAR PLAN GOALS, ACTIONS, & STRATEGIES



Pathway Visibility for Students and Parents

#1

Embed NTCPI career pathway templates into the following systems.

- Career Cruising
- Wisconsin Career Readiness through Pathways
- CTE Programs of Study
- Student Career Info
- Wisconsin Job Centers
- Bureau of Labor Statistics K12 Career Information
- Military Career Guide

2

Embed maintenance concepts in Youth Apprenticeship (YA).

- Engage with Project Lead The Way for Engineering Technician & Engineering Assistant YA programs.
- Engage with Wisconsin Department of Workforce Development for Civil Engineering Unit /STEM YA Program.



Scale the Highway Maintenance Apprenticeship

#1

Create a replicable model.

- Ensure that the Wisconsin Highway Maintenance Apprenticeship is registered with the US Department of Labor.

2

Document employer/apprentice experiences.

- Facilitate year-long meetings with employers and apprentices to discover challenges, barriers, and lessons learned.
- Prepare report documenting employer's perspective and metrics to evaluate apprenticeship

#3

Promote, present and share the Wisconsin apprenticeship experience.

- Develop materials and communication strategies to reach Wisconsin municipalities, state DOTs and private sector highway maintenance employers.



Create Pathways for Apprentices

#1

Connect apprenticeship to associate degree programs.

- Articulate highway maintenance apprenticeship to Civil Engineering Technology degree at Wisconsin Technical College System.
- Articulate apprenticeship and Engineering Professional Development (UW-Madison) offerings to Highway Maintenance Management Degree at Front Range Community College.
- Document a Prior Learning Assessment for employer materials.

Impact

"This project addresses the entire educational spectrum —high school to professional development. It creates a credential for replication, pathways to new degrees, and develops the resources to help employers attract & retain talent." ...Dr. Teresa Adams, MTWC Director

ISSUES

INVISIBLE CAREER

The maintenance discipline, has not evolved to a point where training is offered at the community college or university level, making it an “invisible” career option for prospective students. Likewise, it is not documented in career guides or career information systems—a source for student, parents and counselors. Many engineers first encounter the maintenance discipline when they begin their agencies’ rotational program.

HIGH DEMAND FOR HIGHWAY MAINTENANCE SKILLS/WORKERS

State DOTs and many jurisdictions identify the lack of a maintenance workers as their greatest workforce challenge.

LACK OF CONNECTION TO POSTSECONDARY SYSTEM

Organizations do not develop training with college credit in mind. By not offering highway maintenance training through the educational system, the transportation sector has missed out on the most efficient channels for implementing innovations in workforce development.

Front Range Community College will begin to articulate credit in 2019. MTWC will help accelerate this innovation.

BUILDING ON MTWC's WORK

MTWC, in an intermediary role, will have, by this project’s start date, been a partner in establishing a statewide apprenticeship in Wisconsin.

MTWC will also have engaged the employers, educated them on the apprenticeship model, recruited subject matter experts, coordinated and funded a DACUM occupational analysis and will have participated in all the steps of the new apprenticeship development process along with the employers who will hire apprentices.



MTWC's APPROACH

A number of principles guided this plan.

- Use apprenticeship—a proven, workforce development strategy to provide consistent training across many employers.
- Provide opportunities for workers to advance in their careers by allowing their work experience to translate to college credit.
- Improve the education of workers who will need to re-skill given advancement of transformational technologies in the work place.
- Advance worker-centric approaches to workforce development.
- Improve visibility of the career pathway by embedding information in the systems used by students, parents, counselors & job seekers.
- Engage the US Department of Labor and its state representatives.

PROJECT OUTCOMES

- Greater transparency of the apprenticeship development process in Wisconsin.
- Greater understanding within municipalities of contemporary workforce development strategies.
- Comprehensive guide for replication.
- List of best practices.
- The use of common metrics across municipalities to measure collective impact.

— PROJECT PARTNERS —

Career Pathways to Safer Transportation Systems

There is growing evidence of industry demand for road safety competencies. However, students, working professionals, and employers may have difficulty identifying a structured training curriculum or program of study. The career pathway solution is the implementation of a nationally replicable model for providing and incentivizing road safety training, education, and competency attainment.



Highlights: The West Region Transportation Workforce Center at Montana State University (MSU) will implement two interrelated programs aimed at integrating safety competencies into transportation training, education, and career pathway streams. For incumbent workers, MSU will establish a road safety training curriculum and employee recognition program that can be implemented by employers and training providers nationwide.



The Road Safety Scholar Recognition Program will:

- Establish a comprehensive curriculum/training roadmap for incumbent transportation workers to obtain core road safety competencies;
- Work through existing training providers (e.g. Local Technical Assistance Programs, etc.) to offer content via in-person trainings and to adapt content to local conditions/needs;
- Identify on-line courses that meet learning objectives to offer flexibility in course delivery mode and timing;
- Develop articulation agreements with degree-granting programs;
- Provide outreach to employees and employers on available incentives for completing safety training, for example, opportunities to attain industry-recognized credentials, a degree, or career benefits such as leadership recognition or advancement.



For pre-career students, MSU will additionally serve as an intermediary between road safety organizations and college and university programs to foster enhanced problem and project-based student learning opportunities to expose multidisciplinary pre-career students to road safety issues and professions.



Transportation & University Partnerships for Engaged Scholarship Program will:

- Provide an adaptable model for integrating road safety awareness and project-based learning experiences into existing multidisciplinary degree program coursework;
- Provide resources and networking opportunities to universities and transportation organizations to foster new collaborations;
- Establish long-term industry-university partnerships to provide continuous engaged scholarship, research, and experiential learning opportunities to pre-career students in safety.

Outcomes

- Increased student awareness, interest, knowledge, and technical skills related to transportation safety issues, solutions, and careers.
- Number of prospective hires and incumbent staff possessing road safety competencies will increase.
- Participants will develop core safety competencies and additional professional credentials and/or career benefits through program participation.



Partners:



National Center for Rural Road Safety

Montana LTAP

Deployment Phases:

- 1 • Safety Scholar curriculum development
• Assessment & participant tracking tool development
• Industry & university outreach
- 2 • Pilot deployment of training program (MT LTAP)
• Pilot deployment of university engaged scholarship program
- 3 • Pilot program assessment
• National dissemination of training curriculum (NACE)
• University/Agency Partnership playbook



The Safety Career Pathways project is part of the National Transportation Career Pathways Initiative, a national consortium supported by the Federal Highway Administration to develop career pathways for critical occupations in nationally significant transportation discipline areas.

For more information on the project, visit: wrtwc.org



Western Transportation Institute



West Region Transportation Workforce Center



U.S. Department of Transportation Federal Highway Administration

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NTCPI

NATIONAL TRANSPORTATION CAREER PATHWAY INITIATIVE

TRANSPORTATION PLANNING

CAREER PATHWAY REPORT

FEBRUARY 2019



THOMAS O'BRIEN, DIRECTOR
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SCOTT JAKOVICH, PROJECT COORDINATOR
SOUTHWEST TRANSPORTATION WORKFORCE CENTER



Transportation Planning

TRANSPORTATION PLANNING

SECTION 1.0 CHARACTERIZING THE WORKFORCE

1.1 The Transportation Planning Workforce

Transportation planning is a crucial specialization within the planning profession, characterized as “the discipline that examines and evaluates the potential of future actions to improve movement of people and goods by motor vehicle, public transportation, walking and cycling in accordance with a set of objectives.”¹ Transportation planners provide cooperative interaction between different community stakeholders and decision makers as they address the broad concerns of mobility, safety, environmentalism, and social equity. Throughout this project, the Southwest Transportation Workforce Center (SWTWC) has worked to clarify the role of the transportation planner—as found in both public and private-sector employment—and the workplace competencies that are considered critical to the effective execution of the transportation planning function.

This effort included identifying key occupations within transportation planning that represent top priorities in terms of unmet demand and projected job growth—research critical to the deployment of new career pathways that will encourage greater participation in this workforce. These career pathways will provide post-secondary institutions with a roadmap to the effective and comprehensive preparation of students for work in this field; preparation in terms of both academic and experiential learning that will yield the knowledge, skills, and abilities (KSAs) that employers demand today, plus new and emerging competencies that will keep workers competitive for years to come.

In characterizing this workforce over the two-year NTCPI project, SWTWC has distilled two problem areas that affect the engagement of students around transportation planning careers and their on-going professional development:

1. A review of current academic planning programs reveals little evidence that experiential learning or the introduction of cross-disciplinary competencies play a significant role in the preparation of transportation planners. In fact, the institutional entrenchment and siloed nature of these traditional programs of study—most all university-



Transportation Planning

based—make them slow to adopt industry change, particularly in the wake of transformational forces like shared mobility, electric/autonomous vehicles, and their related infrastructure requirements.

Having a well-defined and deeply entrenched academic program for the planning profession actually creates a challenge to innovations that might otherwise breach “the wall” that isolates this pathway from other cross-institutional opportunities that could capture a broader base of planning competencies.

2. The reliance on a strict analysis of transportation planning labor market data can actually obscure the wider set of skills and occupations that are also critical to supporting the nation’s transportation infrastructure, such as the planning of transport systems. As such, academic programs and career pathways that are built on this incomplete picture of the planning workplace become destined to produce courses that don’t fully capture the needs of this industry.

By contrast, a reasonably comprehensive analysis of industry demand—one that couples real-time occupational data aggregation tools like EMSI and Burning Glass with a steering committee of industry advisors and survey feedback from a broad network of employer stakeholders—demonstrates the growing scope of responsibilities for today’s transportation planner demands a more diverse set of workplace competencies than is provided by a traditional undergraduate planning program.

These emergent new transportation planner responsibilities include having an understanding of policy and environmental litigation issues, financial planning and programming, infrastructure safety and security, system management and operations, transportation asset management, and experience using modern software to model and convey complex data problems both visually and coupled with GIS-based assets and tags.

In consideration of these institutional limitations, SWTWC has designed the Transportation Planning Plus (TPP+) Certification Program; a series of continuing education and professional development courses that will equip planners with in-demand cross-disciplinary competencies like data visualization and story mapping. Implementation of the TPP+ program and SWTWC’s planning career pathway are presented more fully in Sections 2 and 4 of this report.

Transportation Planning

1.2 Priority Occupations

SWTWC identified high-priority transportation planning occupations through a rigorous process of labor market and real-time job listings analysis that was refined through collaboration with subject matter experts (planning practitioners and their employers) from the Planning Discipline Working Group (DWG), then validated by a broad industry survey conducted by the American Planning Association (APA) and LA Metro.

As expected for a discipline affected by transformational technologies, only a subset of the occupations identified through this process could be linked back to standard occupational classifications (SOCs) tracked by the Bureau of Labor Statistics (BLS); tracking that is critical to forecasting future job growth and labor market demand. As a result, only three of the seven occupations targeted could be validated against BLS projections. And while planners do not make up large segments of the transportation workforce, their function and capabilities represent a critical component in the design, maintenance, and operation of the nation's transportation infrastructure. Essentially, prioritizing which planning occupations are "most critical" is less a factor of raw LMI and more a representation of industry-demand and employer need.

A critical tool in the forecasting of labor demand and job growth over time, BLS can at times be limited by its own classification system; one that is slow to recognize new, emerging, or cross-disciplinary occupations. A lack of standardized LMI directly affects career awareness and pathway development within the K-16 academic system.

The priority occupations identified for transportation planning are shown in Table 1.2.1 below:

Table 1.2.1: Priority Planning Occupations in Highway Transportation

SOC CODE	OCCUPATION	CURRENT # EMPLOYEES, 2016	PROJECTED # EMPLOYEES, 2026	PERCENT CHANGE	2018 MEDIAN ANNUAL WAGE
19-3051	Urban & Regional Planner	36,000	40,600	12.8%	\$71,490
19-3051*	Transportation Planner	36,000	40,600	12.8%	\$71,490
19-3051*	Land Use Planner	36,000	40,600	12.8%	\$71,490
19-3051*	Environmental Planner	36,000	40,600	12.8%	\$71,490
17-1021	Cartographers & Photogrammetrists	12,600	15,000	19.4%	\$63,990
17-1021*	GIS Analyst/Technician	12,600	15,000	19.4%	\$63,990
17-3031	Surveying and Mapping Technician	60,200	66,600	10.6%	\$43,340

* Titles not uniquely identified within the BLS database share common SOC labor market data.

Transportation Planning

In interpreting between available labor market characterizations of the planning workforce and advisory/stakeholder recommendations, and in no small consideration of the highly vertical nature of this transportation discipline, SWTWC selected two categories of occupational priorities to fulfill the need of a 21st-century talent pipeline: “career goal” and “career entry”.

Career goal occupations are those idealized by this occupation, like “Planner”. Career entry occupations are critical to filling the planning pipeline, critical to fulfilling the planning function within an agency, and an essential first-step in the very-focused planning career ladder.

Similarly, most of the career goal targets represent specializations within the planning arena—specializations that are realized through the addition of contextualized education and work experience acquired during a planning student’s graduate-level program. Any of these specializations provide relevance to the transportation planning pathway, as all present equal opportunities for lateral job movement across various industry sectors.

These priority occupations are identified below by their respective career ladder position:

<u>Priority Occupation</u>	<u>Career Ladder Designation</u>
Transportation Planner	primary career goal (ideal)
Urban/Regional Planner	primary career goal (specialization)
Land Use Planner	primary career goal (specialization)
Environmental (Restoration) Planner	primary career goal (specialization)
Cartographers & Photogrammetrists	entry level position
GIS Analyst/Technician	entry level position
Surveying & Mapping Technician	entry level position

1.3 Critical Workforce Competencies

The [NCHRP Report 798](#) “*The Role of Planning in a 21st-Century State DOT*” defines planning as the “*factual, analytical, and collaborative basis for reaching decisions to improve multimodal transportation system performance.*”² Effective planning results in cost-effective, cooperative, and responsive transportation solutions that achieve desired societal outcomes by balancing costs and benefits to communities, the economy, and the environment.

Transportation Planning

Producing sound, long-range transportation and corridor plans is a core activity of state DOTs and other transportation agencies. Thus, these agencies have long staffed their planning programs with professional planners who have the knowledge, skills, abilities, education, and experience required for plan making.

And while traditional planning competencies are well-matched for most needs of a transportation agency, emerging and transformational forces are reshaping the transportation planning and decision-making landscape.³ These forces include:

- Rapidly changing transportation technologies and services, such as connected and automated vehicles, Mobility as a Service, and shared mobility;
- Demographic trends that affect travel behavior and how agencies communicate with their customers and stakeholders;
- Trends in the nature of data and data-driven decision making, including big data, data visualization, analytics, and data governance;
- New approaches to transportation plan making, like performance-based planning and programming, scenario planning, and multi-modal planning;
- Calls for greater precision in projecting the returns on transportation investments; and
- Increasingly dynamic funding, regulatory, and political environments.

SWTWC established which workforce competencies were most critical to transportation planning employers by scanning the in-demand skills/competencies of over 80 planning-related job listings posted by the Southern California Association of Governments (SCAG)—whose occupational specifications are rich with employer expectations—and APA. The results were then categorized, prioritized, and presented to industry stakeholders through an evaluative survey.

As demonstrated in table 1.3.1 below, a comparison of these two sets of job postings reveals a reasonable corroboration between both regional and national employers and presents a fairly comprehensive view of the job competency demands within a typical planning workplace. For comparative clarity, the top five competencies from each data set is shown in Table 1.3.2.

Transportation Planning

Table 1.3.1: In-Demand Planner Competencies, Regional vs National

COMPARISON OF COMPETENCIES IN JOB LISTINGS/DESCRIPTIONS - APA AND SCAG					
Top Five Sought-After Competencies American Planning Association			Top Five Sought-After Competencies Southern California Association of Governments		
Competency	Total Observations or Average Amount	Percentage n = 51	Competency	Total Observations or Average Amount	Percentage n = 32
Written and Oral Communication	31	61%	Regulation/Legislation	23	72%
Collect, Compile, and Analyze Data	24	47%	Principles of Urb./Reg./Trans. Planning	22	69%
Principles of Planning and Development	24	47%	Prepare Reports/Presentations	22	69%
Presentations (Public Speaking)	22	43%	Collect, Compile, Analyze Data	21	66%
Professional Relationships/Interpersonal Skills	21	41%	Complex Problem Solving	19	59%

Competencies/Requirements			Competencies/Requirements		
Competency/Requirement	Total Observations or Average Amount	Percentage n = 51	Competency/Requirement	Total Observations or Average Amount	Percentage n = 32
Analysis/Research/Report Methods	10	20%	Analysis/Research/Report Methods	18	56%
Principles of Planning and Development	24	47%	Statistical Theory/Methods	13	41%
ORG/MGMT/HR Practices	7	14%	Principles of Urb./Reg./Trans. Planning	22	69%
Transportation Modeling	1	2%	PR Techniques	4	13%
Project Management Practices	6	12%	Air Quality Planning	5	16%
Market Research	1	2%	ORG/MGMT/HR Practices	9	28%
Funding/Grant Writing	2	4%	Transportation Modeling	10	31%
Regulation/Legislation Related to Area	16	31%	Project Management Practices	18	56%
Business language, Document Drafting	7	14%	Regulation/Legislation	23	72%
Gov./City Structure (Boards, Councils, Commissions)	9	18%	Economic Forecasting	4	13%
Budgeting/Financial Analysis	4	8%	Env./Sust. Practices	4	13%
Foreign Language	2	4%	Gov./City Structure (Boards, Councils, Commissions)	3	9%
GIS	19	37%	Transportation Development Act	2	6%
Standard Microsoft Applications	12	24%	Budgeting	11	34%
Adobe Tools (Creative, Illustrator)	6	12%	Principles in Transportation Demand Mgmt.	3	9%
CAD	2	4%	GIS	8	25%
Prepare Reports	15	29%	SAS	3	9%
Presentations (Public Speaking)	22	43%	Standard Office Applications	3	9%
Public Interaction	20	39%	Other Software Requirements	4	13%
Customer Service	2	4%	Prepare Reports/Presentations	22	69%
Collect, Compile, and Analyze Data	24	47%	Public Interaction	13	41%
Negotiation	2	4%	Collect, Compile, Analyze Data	21	66%
Plan and Coordinate Projects	17	33%	Plan/Coordinate Projects	10	31%
Teamwork	12	24%	Teamwork	8	25%
Work Independently	10	20%	Work Independently	14	44%
Professional Relationships/Interpersonal Skills	21	41%	Gain Coop./Consensus thr. Disc. and Persuasion	9	28%
Written and Oral Communication	31	61%	Written and Oral Communication	8	25%
Leadership	11	22%	Leadership	11	34%
Management/Supervision	12	24%	Management	10	31%
Prepare/Administer Budgets	4	8%	Prepare/Administer Budgets	8	25%
Multitasking	13	25%	Complex Problem Solving	19	59%
Strategic Mindset	2	4%	Bachelor's Degree	30	94%
Time Management/Organizational	3	6%	Master's Degree	2	6%
Logical Thinking/Problem Solving	6	12%	Work Experience (Average Years)	4.45	N/A
Bachelor's Degree	39	76%	Salary (Average Lower Limit)	\$ 99,018.40	N/A
Master's Degree	3	6%	Salary (Average Upper Limit)	\$ 137,865.37	N/A
AICP	24	47%			
PE	3	6%			
Work Experience (Average Years)	3.45	N/A			
Salary (Average Lower Limit)	\$ 46,653.86	N/A			
Salary (Average Upper Limit)	\$ 61,757.87	N/A			

Legend
Green cells represent the top five most commonly found knowledges and skills/abilities, and the top two technology competencies mentioned. Yellow cells represent the overall top five competencies for the respective scans (presented on top of the page).

Data sources
APA: Nationwide job listings posted at www.planning.org using the key word 'Transportation' as selection criteria
SCAG: Regional (CA) job descriptions found at www.scag.ca.gov using transportation/planning education requirements as

Table 1.3.2: Top Planner Competencies, Regional vs National

TOP 5 COMPETENCIES, SCAG	TOP 5 COMPETENCIES, APA
1. Regulation/Legislation	1. Written & Oral Communication
2. Principles of Planning & Regulations	2. Collect, Compile, Analyze Data
3. Report Prep & Presentation	3. Principles of Planning & Regulations
4. Collect, Compile, Analyze Data	4. Presentations (public speaking)
5. Complex Problem Solving	5. Professional Relationships

Transportation Planning

Unsurprisingly, overlap and agreement exist between these two data sets. Competencies like “Principles of Planning & Regulations” and “Collecting, Compiling, & Analyzing Data” are highly valued by a majority of employers, as are “Report Preparation,” “Presentation & Public Speaking,” and “Written & Oral Communication Skills”. Generally, possessing interpersonal skills and maintaining professional relationships are considered desired traits by employers of transportation planners and their related occupations.

Further, a cross-correlation study of GIS professionals—identified by the Planning DWG as a core technical competency for future planners—confirmed that many of the technical skills associated with GIS occupations demonstrate similar requirements for data analysis, data manipulation, and data acquisition/creation as were captured by this SCAG/APA analysis, revealing these competencies as critical skills for both occupational areas. Similarly, project management, research, report writing, public speaking, personnel management, and budgeting frequently appear in all three job data sets.

More unique to GIS, and expectantly those related planning career ladder entry-level occupations, are requirements for cartography, database maintenance, and data visualization and reporting. Other differences include training, strategic planning, and cost benefit analysis, though here again stakeholder feedback identifies these competencies (more generally, project management skills) as requirements for private-sector planners, who are normally consulting on projects within outside public agencies.

To document this collection of critical planning competencies, SWTWC engaged DOL’s [Competency Model Clearinghouse](#) to build and register a standardized model for the occupational cluster that makes up transportation planning careers. This effort conformed with a primary objective of the NTCPI project: to establish a basis for new competencies in transportation planning anticipated over the next 15 years.

This model provides both rigor and structure for establishing, validating, and representing occupational competencies in a uniform and sharable way that also builds upon occupational standards already established by DOL, including competency standards for occupational clusters within [Transportation, Distribution & Logistics](#), and [Geospatial Technology](#). These existing models, along with competency data captured through SCAG/APA occupational scans, were used to build the draft transportation planning competency model in Figure 1.3.1 below.

Transportation Planning



Figure 1.3.1: DOL Competency Model for Transportation Planning

The DOL model consists of six competency tiers, the first three representing foundational competencies applicable to a large number of industries and occupations. These are categorized as “Personal Effectiveness Competencies”—soft skills usually attained in a home or community, “Academic Competencies”—cognitive functions and thinking styles usually attained in an academic setting, and “Workplace Competencies”—those qualities that help an individual function within an organizational setting. Tiers 4 and 5 represent skills sought after in the transportation industry and planning sector, respectively, while Tier 6 identifies “Management Competencies” and “Occupation-Specific Requirements”.

Transportation Planning

1.4 State of Workforce Readiness

SWTWC efforts to better understand the state of practice for transportation planners and to design efficient, industry-driven career pathways revealed a wide range of available academic planning programs offered through a network of accredited universities. What was also discovered was a general lack of 2-year and K-12 feeder programs that would normally connect students to one of these planning schools from a technical school and community college.

This “transfer gap” restricts access to professional planning positions to those students who are both academically and financially qualified to survive the rigors of a 4 to 6-year program. And while many career paths can ultimately lead to employment as a Transportation or Urban & Regional Planner, the fundamental lack of student engagement at the K-12 and community college levels unnecessarily restricts awareness and access to these professional careers.

What is also apparent is the gap between the learning outcomes promised by these traditional university-based programs and the skills in high demand from industry employers. And where a program’s theoretical content and degree attainment do align with employer job requirements, there is still a clear lack of hands-on experiential learning opportunities that are keeping students from learning critical work-based skills prior to employment.

It is these two critical workforce objectives—increasing student engagement in transportation planning within K-12 and community college communities and providing planners with 21st-century cross-competency skills—that are the objectives of SWTWC’s career pathway implementation plan: the TPP+ Certification Program.

Transportation Planning

SECTION 2.0 CAREER PATHWAY DESIGN

2.1 Pathway Design Methodology

When designing career pathways for transportation planning, SWTWC discovered the planning industry follows a narrow, highly vertical hierarchical structure. This hierarchy applies to planning occupations within multiple industries, given slight alterations for specificity. These variant planning tracks are considered “specializations” within the broader planning occupational cluster, though SWTWC naturally focused on highlighting pathway distinctions that are unique to the transportation industry. In addition to transportation, these other specializations include land use planning, community development, urban and regional planning, comprehensive or long-range planning, and environmental planning.



Regardless of specialization, the career path and program of study documented within this report remain roughly the same. As you proceed up the planning career ladder, knowledge gain becomes collateral to occupational specialization, and access to other specializations becomes easier the higher you progress. This observation is supported by the fact that competencies identified for each successively more senior position overlaps with more occupational requirement from other planner specialties. The top four critical planning specializations are:

- **Transportation Planning:** These planners work alongside government agencies to select/develop plans to organize transit routes for walking, bicycling, bussing, rail, or air.
- **Land Use Planning:** In urban planning, land-use planning seeks to order/regulate land use in an efficient and ethical way, thus preventing land-use conflicts. Governments employ land-use planning to manage development of land within their jurisdictions.
- **Urban & Regional Planning:** These planners develop and use plans and programs that help create communities, accommodate population growth, and revitalize physical facilities in towns, cities, counties, and metropolitan areas.
- **Environmental Planning:** This is urban and regional planning with a focus on sustainability. It aims to analyze and minimize the environmental impacts of proposed construction projects and make sure they meet all environmental regulations.

Transportation Planning

2.2 Pathway Learning Strategies

There are a host of learning strategies designed to engage students in experiences that deepen understanding and content mastery. These approaches are designed to provide students with hands-on opportunities in real-world contexts and settings so that they effectively “learn by doing.” Several learning strategies being deployed by leading workforce development and career technical education professionals would also benefit students of planning academic programs of study. These include:

- **Competency-Based Curriculum:** Curriculum that meets academic and quality standards is designed and organized by competencies required for jobs and is cross-walked with industry skill standards and certifications where applicable.
- **Modularized Curriculum:** Structure and sequence curriculum in modules tied to jobs with multiple entry and exit points, with multiple levels of industry recognized credentials built into the sequenced path-way.
- **Asynchronous Learning:** Provide education and training for students and incumbent workers at times and locations convenient to students and employers.
- **Problem-Based Learning:** Problem-based learning helps students who seek hands-on learning foster team-building and solve real life problems.
- **Experiential Learning:** Incorporate opportunities for "learning by doing", including internships, co-op work experience, and class projects assigned by local employers.
- **Context-Based Learning:** Interpreting new information in context of where and when it occurs and relating it to what we already know.
- **Assessment:** Assessments should be for learning, not of learning. Assessments are important, but only to gauge how to structure lessons for maximum effectiveness.

While these creative and innovative practices are known to increase student learning effectiveness, their implementation is subject to an often bureaucratic, slow-moving, and conservative academic environment. They are recommended for inclusion in any new planning career pathway program, and if piloted, should present an opportunity for institutional change.

Transportation Planning

2.3 Priority Career Pathways

All of the priority occupations identified by SWTWC are technology-driven and require a formal education, whether at the entry or planner levels. There are multiple entry points into this workforce, from technician-level jobs that require technical training or 2-year degrees, to planning and management positions that require 4-year and/or graduate degrees.

Transportation planners can apply for certification with the American Institute of Certified Planners (AICP) and the GIS Certification Institute (GISP). In some instances, Professional Engineer (PE) and Project Management Professional (PMP) designations may also be helpful.

Career Pathway: Transportation Planning

Description/Duties:	Urban freight researcher who studies transportation systems implemented by an organization. Compiles/analyzes data to evaluate effectiveness of implemented models/simulations. Analyzes developmental tide of infrastructure, how current project models can be developed relative to local regulations. Represents administrative approval of transportation/land development projects, making sure local regulations/jurisdictions on land use are followed.
Priority Occupations:	Transportation Planner, Urban & Regional Planner, Land Use Planner, Environment Planner.
Alternative Titles:	Regional Planner, Transit Planner, Transportation Analyst, Transportation Modeler, Transportation Manager.
Support Occupations:	Cartographers & Photogrammetrists, GIS Analyst, GIS Technician, Surveying and Mapping Technician, City/Regional Planning Aide.
Education/Training:	Associate degree with some job experience required for all entry-level positions; a bachelor's degree (Urban & Regional Planning) is required to access mid-level jobs. Planning/management positions require a Master of Planning graduate degree plus 5 to 8-years of work experience. GISP/AICP credentials preferred at most levels.

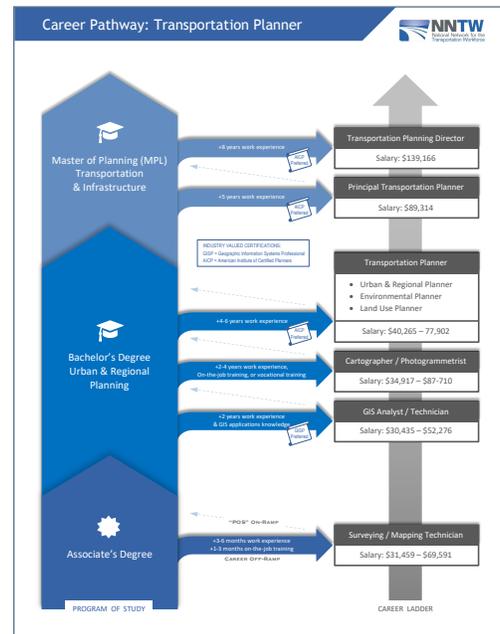
Transportation Planning

2.4 Career Pathway Documentation

All transportation planning career pathways and priority occupations identified by this initiative and referenced previously within this report are documented using four standardized templates: a pathway graphic, job description, program of study, and experiential learning aide.

Career Pathway Graphic: This template juxtaposes career entry points into the transportation planning profession against exit points from an academic program of study in transportation planning, with interconnecting arrows noting any special requirements for prior work experience or certifications necessary to gain access to each occupational level (e.g., its job titles and wage earnings).

In this example, an associate degree represents the minimum education required to enter into this career path, which ranges upwards to director-level positions that require an advanced degree in planning along with industry certifications and significant work experience.



Job Description: The priority occupation job description, like the Transportation Planner example shown at right, describes an occupation in terms of its typical employment role, alternative industry job titles, priority competency requirements, required education/training levels and credential attainment, expectations for job-related work experience, and typical salary range. All job descriptions, KSAs, education, and experiential requirements are compiled from an analysis of current online job postings for each title within an occupational pathway. Salary data (PayScale or Salary.com) reflects the lowest and highest values documented on the career ladder of this occupation's corresponding Pathway Graphic.



Transportation Planning

Program of Study: This prescriptive articulation of student course assignments and academic load is meant to present an optimal and efficient educational roadmap for students interested in pursuing a transportation planning career. Its baseline is a high school diploma (all planning career ladder entry points require some college), after which two-year, four-year, and graduate degree programs are detailed in terms of their course sequences.

The Certified Planner designation (AICP), while shown at the top of this academic plan, is actually a valued industry credential at multiple career levels. It's requirement for prior work experience is why its placed here at the top of the plan, after acquiring academic credentials.

Program of Study: Transportation Planner

AICP - Certified Planner
 Transportation planners can apply for a certificate with the American Institute of Certified Planners (AICP). Exams can be taken twice a year by planners fulfilling educational and work-related prerequisites. Certified planners reportedly make \$18,000 more annually on average (www.planning.org/certification).

Year 5-6: Master of Planning - Transportation & Infrastructure
 Year 6: Students choose electives either from their choice, or other, concentration. Electives can also be taken from a certificate program, for example "Certificate in Transportation Systems".
 Year 5: During the first year, students take core courses. They can also choose a planning concentration for their studies, within which they choose from a selection of concentration courses.
Core Courses: International Leadership, Economics for Policy & Planning, Planning Theory, Statistics & Mapping from Data, Comparative Int'l Development, The Social Context of Planning, The Legal Environment of Planning, Planning History & Urban Form.
Concentration Courses: Modeling & Operations Research, Intro Transportation Planning Law, Port Engineering, Planning & Ops, Environmental Impact, Urban Economic Analysis, GIS for Policy & Planning, Transportation Systems Analysis, Transportation & Environment.
Experiential learning includes planning studies / labs, internships, and fieldwork.

Year 3-4: Bachelor's Degree in Urban & Regional Planning
 Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs and field-work are an internship recommended, leading to a career exploration oriented to find an internship.
 Year 3: Students take specialized courses such as geographic information tools, introductory GIS, quantitative/qualitative urban research, methods, planning and zoning.
GE Courses: Science & Technology Synthesis, Social Sciences Synthesis, Humanities & Synthesis.
Planning-Related Courses: Quantitative Urban Research Methods, Qualitative Urban Research Methods, Planning Theory, Maps, Graphics, & Lab.
Planning-Related Courses: Planning in the Public Sector, Legal Foundations of Planning, Urban Problems/Seminar, Community-Based Urban Design, Fieldwork, Internship, Intermediate GIS & Lab.
Experiential learning includes planning studies / labs, internships, and fieldwork.

Year 1-2: Associate's Degree / Pursuing Bachelor's Degree
 Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. The requisite courses provide students with a basic understanding of theoretical and practical skills.
 Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.
GE Courses: Analytical Reading, Expository Writing, Critical Thinking, Mathematics, Oral Communication, Public Policy & Design, Basic Economics, Public Science, Sociology.
Planning-Related Courses: Intro to Urban Planning Theory, Sustainable Development of Cities.
Lower-Division / Major Prerequisites: Intro to Graphic Communication, Tools Used by Urban Studies & Planning, Planning Theory, Quantitative Urban Research Methods, Qualitative Urban Research Methods, General Plan & Zoning, Urban Policy & Planning, GIS & Planning Applications, Economics.

Year 0: High School Diploma
 Transportation-related career academics.

Partners: U.S. Department of Transportation Federal Highway Administration, NNTWC (National Network for the Transportation Workforce).
*This includes a student work agreement by the Federal Highway Administration under Agreement No. DTFR19-00000000. Funding will be provided to the Federal Highway Administration by the U.S. Department of Transportation. Funding will be provided to the Federal Highway Administration by the U.S. Department of Transportation.

Experiential Learning: A number of experiential learning programs are recommended for this career path as a way to augment a traditional academic program of study with critical on-the-job experience. As can be seen in this example, programs and program sponsors are listed along with their direct applicability to student learning through targeted, work-based developmental opportunities that include internships, project assignments, professional mentoring-matching, and networking.

Also documented here are innovative learning strategies for educators and pathway deployment teams. These are modern, academically proven approaches to delivering curriculum in non-traditional ways that maximize a student's ability to acquire, comprehend, and retain instructional content and its applicable KSAs.

Experiential & Innovative Learning: Planning

Experiential Learning Programs for Planning Students
 In addition to academic and technical preparation, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparation:

- Sierra Club:** Students of the Angeles Chapter Transportation Committee have the opportunity to engage with other members, leaders of the organization, and community members to network and develop impactful campaigns and initiatives.
- Association for Public Policy Analysis & Management (APPAM):** APPAM provides graduate student members with an opportunity to attend regional conferences and participate in a mentor-matching program.
- 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.
- 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.
- Southern California Association of Governments (SCAG):** SCAG offers college students paid internships that provide practical work experience and an opportunity to develop meaningful relationships with experts in their program of study. SCAG also offers local scholarships to high school and community college students and a link-week including with a local planning agency, council of governments, or SCAG.
- San Diego Association of Governments (SANDAG):** SANDAG offers paid internships for students with graduate coursework in urban planning, public policy, or related fields focusing on transportation planning. This one-year position provides a hands-on learning experience with guidance and mentoring of senior staff.

Innovative Learning Strategies for a Planning Program of Study
 To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within a transportation planning program of study. These learning strategies include:

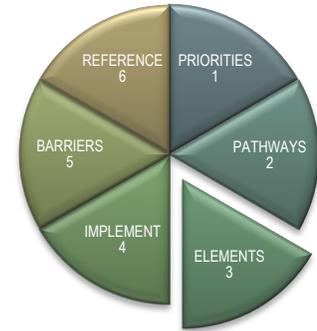
- Competency-Based Curriculum:** Curriculum that meets academic and quality standards that is designed and organized by competencies required for the job and cross-walked with industry skill standards and certifications, where applicable, job profiling and the use of "SMART" should be considered to meet the competency needs of business.
- Modularized Curriculum:** Structure and sequence curriculum in modules tied to jobs with multiple entry/exit points, with multiple levels of industry recognized credentials built into the sequenced pathway.
- Asynchronous Learning:** Provide education and training for students and incumbent workers at their own pace, 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 helps students who seek hands-on learning and want to be media-makers foster team building and solve real life problems.
- Experiential Learning:** Incorporate opportunities for "learning by doing", including internships, on-job work experience, simulations, and team class projects that are assignments from local employers.
- Context-Based Learning:** Incorporating new information in the context or place of where and when it occurs and relating it to what we already know, we come to understand and meaning. To design effective strategies for learning requires an understanding of how context shapes learning.
- Individual Learning:** Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

Partners: U.S. Department of Transportation Federal Highway Administration, NNTWC (National Network for the Transportation Workforce).
*This includes a student work agreement by the Federal Highway Administration under Agreement No. DTFR19-00000000. Funding will be provided to the Federal Highway Administration by the U.S. Department of Transportation. Funding will be provided to the Federal Highway Administration by the U.S. Department of Transportation.

Transportation Planning

SECTION 3.0 THE SIX ELEMENTS OF PATHWAY DEVELOPMENT

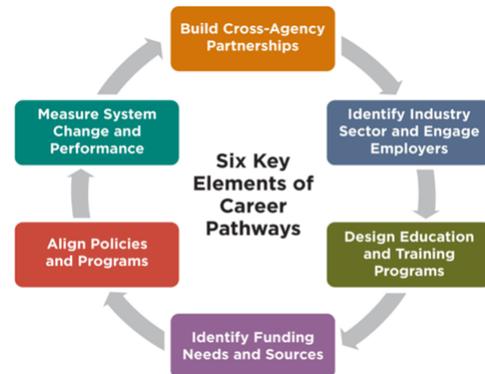
All NNTW implementation plans follow the six key elements of career pathway development, established by the Employment Training Association (ETA) of the Department of Labor (DOL), which are designed to guide state and local workforce development teams through the steps necessary for developing a comprehensive 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 Planning workforce—and an implementation plan for deploying those pathways into the post-secondary educational continuum, the SWTWC team approached this ETA system using the following strategies:



3.1 Build Cross-Agency Partnerships & Clarify Roles

As the goal for this implementation plan is to ensure students are made aware of transportation operations career pathways and have the opportunity to participate in experiential learning that will engage and inspire them to consider these careers, SWTWC's approach to developing partnerships includes the full academic pipeline—from K-12 to higher education—as well as industry. Ultimately, education institutions must work together to develop alignment between programs and to establish clear pathways for progression along priority career paths. And for programs to meaningfully prepare students for the workforce, industry stakeholders must be involved in identifying the core competencies to be addressed, in creating real-world problems and projects, and in mentoring and inspiring students to pursue operations careers. Thus, successful and fully collaborative partnerships are the key to success of this plan.

Transportation Planning

3.2 Identify Industry Sectors & Engage Employers

SWTWC's industry engagement begins with the Planning DWG, which includes both active and diverse industry partners. To develop the partnerships necessary to bring this implementation plan to scale, the support of professional organizations like APA are critical. SWTWC will work through such organizations and their networks to ensure national and sustained impact.

3.3 Design Education & Training Programs

The creation of cross-disciplinary competency modules for students and professional planners is based on the fact that traditional academic programs are not addressing these employment readiness expectations of industry employers. While it may be possible to partner with and update university curriculum, the advocacy process and timeline involved is potentially overwhelming. Instead, offering planning students and incumbent professionals an opportunity to upskill through a series of extra-curricular courses is a direct and quickly-piloted alternative.

3.4 Identify Funding Needs & Sources

Funding is required not just for implementation and scale of this plan, but also for its rigorous longitudinal evaluation. SWTWC's will submit a funding proposal to the National Science Foundation, in addition to pursuing organizational partnerships that yield resource leveraging.

3.5 Align Policies & Programs

Developing a robust transportation planning workforce requires increasing student engagement around this career path and better aligning academic programming to industry need.

3.6 Measure System Change & Performance

SWTWC will track a number of program metrics—including student participants, assessment testing, evaluative surveys, stakeholder feedback, curriculum development, and industry engagement, to affect a feedback cycle of measurement and refinement. Long-term longitudinal tracking of student career choice is also a proposed performance metric that will be piloted as part of the first TPP+ module launch. This includes any shift in student perception, awareness, or career pursuit within the transportation planning pathway.

Transportation Planning

SECTION 4.0 CAREER PATHWAY IMPLEMENTATION

4.1 Project Title

“Transportation Planning Professional Plus Certification”

4.2 Workforce Priority

In Spring 2018, SWTWC piloted a career pathway demonstration for the transportation planning discipline, that would test, validate, and document strategies for pathway deployment and the challenges/barriers institutions face in implementing such programs. Taking the form of a customized “Intro to GIS” class, this demonstration pilot introduced CTE students at Los Angeles Trade Technical College (LATTC), along with their dual-enrolled Los Angeles Unified School District classmates, to the transportation planning career path and the use of GIS technology in a planner’s typical work activities.

In this class, the use of industry contextualized curriculum, work-based project learning, accessible class scheduling, and strong employer engagement were measured to evaluate their success in steering early student career objectives. For students, this pilot provided a glimpse into the world of the transportation planner, experienced first-hand through actual fieldwork and candid discussions with industry practitioners.

Through the introduction of SWTWC’s clearly-articulated academic and occupational pathways, students were also exposed to the multiple levels of interesting, forward looking employment opportunities within this growth sector.

Over the course of researching this discipline and designing and evaluating its demonstration pilot, it became clear that few of the current academic planning programs available to planners today emphasize experiential learning (co-curricular activities) or introduce cross-disciplinary competencies in their academic plan.

As demonstrated in the 2018 pilot, both of these missing components can play a significant role in engaging K-12 and community college students around this relatively unknown career path, while at the same time prepare them for work as a modern transportation planner, using readily available tools like contextualized instruction and work-based learning activities.



Transportation Planning

4.3 Project Description

The Transportation Planning Professional Plus (TPP+) Certificate program is intended to complete a planner's academic preparation by offering a series of extra-curricular courses in the form of modular, non-credit professional development opportunities. This course series, which culminates in a capstone project and professional certification, will deliver a set of in-demand, cross-disciplinary workplace competencies to students within a graduate planning program of incumbent professionals seeking to upskill and/or advance in their career.

By replicating CSULB's Center for International Trade & Transportation's proven Global Logistics Specialist and Marine Terminal Operator programs—both offering a series of non-credit, modular, and fee-based professional development courses that lead to professional certifications—SWTWC brings experience and infrastructure to this TPP+ implementation.

TPP+ Program Highlights:

- Industry recognized approach.
- Hierarchical, modular credentialing.
- Leads to planning professional designation.
- Supported by SoCal Universities, APA, Esri, HNTB.
- Offers credit-by-exam; credit for prior learning.
- Sustainable; fee-based instruction is self-supporting.
- Capstone project-based learning, students collaborate in multi-disciplinary teams.
- Students receive direct access to employers; incumbent career advancement.

To achieve this, SWTWC will assemble a new competency steering committee of practicing industry professionals, who collectively will perform a needs assessment to determine which competencies are most valued by employers (and missing from new-hires), then prioritize them in terms of their deployment within the modular/stackable course framework of TPP+.

Once a modular TPP+ course framework is designed, syllabi prepared, and a pilot curriculum developed, SWTWC will launch the first course at its own continuing education facility on the CSULB campus. Pilot participants will be recruited from partner organizations, the USC Price School of Public Policy, and from APA's local chapter membership.

Transportation Planning

TPP+ Module Competencies:

- Presenting complex problems using GIS story maps.
- Understanding land use policy and regulations.
- Working with environmental studies and litigation teams.
- Rendering complex scenarios through data visualization.
- Public and community engagement.
- Esri ArcMap for Dummies.

Full scale deployment of the TPP+ program will include access to multiple, stackable modules that culminate in a student capstone project and a professional certification. SWTWC will work with project partner APA to endorse the TPP+ certificate nationally and to recognize its courses for continuing education credit. Articulation agreements for credit transfer (credit by exam or credit for prior learning) with local colleges and universities will also be negotiated.

4.4 Implementation Partners

SWTWC thanks its partners for their continued engagement, contribution, and commitment to developing workforce solutions that positively impact the lives of students and the incumbent workforce. In their support of this career pathway pilot implementation for the transportation planning discipline, each of these valued partners have agreed to participate as key contributors to this plan's deployment, success, and long-term sustainability. SWTWC's partner organizations, including their roles and responsibilities, are presented below:

Los Angeles Trade Technical College (LATTC): As both a deployment and implementation partner, LATTC provides access to underrepresented student populations, facilities for classroom orientation and facilitation, on-campus recruitment resources, access to their CTE Transportation Pathway student pipeline, and connection to their Transportation Workforce Institute employer network and high school program. As a funding recipient of California's Strong Workforce program—which seeks to develop more workforce opportunity and lift low-wage workers into living-wage jobs—LATTC is also a valued funding provider for pilot courses.



Transportation Planning

Pima Community College (PCC): Like LATTTC, Pima is another partner launch site in Arizona for scaling and replicating the 2018 “Intro to GIS” planning demonstration pilot. Pima’s mostly rural and tribal student population will benefit from exposure to the transportation planning career path and its documented career potential, while at the same time providing SWTWC with new feedback and refinement on this K-12 to community college to university bridge program.



PimaCommunityCollege

USC Price METRANS Transportation Center: The Sol Price School of Public Policy at the University of Southern California is the first of five regional universities with an APA-accredited planning program to partner with SWTC on TPP+. As home of the METRANS Transportation Center—a responsibility shared with CSULB, USC and its broad network of industry partners will play a critical role in assessing the competencies and workplace skills most desired for their planner incumbents, advising on curriculum development and experiential learning activities, providing professional planning faculty advisors, and evaluating the outcomes of the first TPP+ module pilot.



Statewide Director for Advanced Transportation & Logistics: As part of the California Community College Chancellor’s Office “Doing What Matters for Jobs and the Economy” initiative, the Office of ALT oversees all transportation-related workforce projects, collaboratives, and initiatives within the state of California. This office provides the comprehensive network infrastructure necessary to fully assess, pilot, and scale the TPP+ program through to capstone certification.



Esri: An international supplier of geographic information system software, web GIS, and geodatabase management applications, Esri is a major contributor to pilot deployment through the licensing of its ArcGIS software and providing in-class guest lecturers and access to GIS data sets.



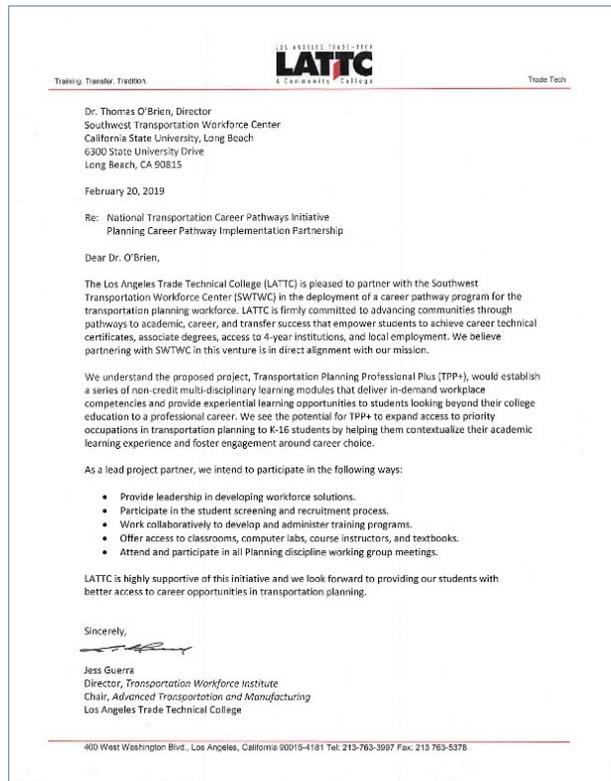
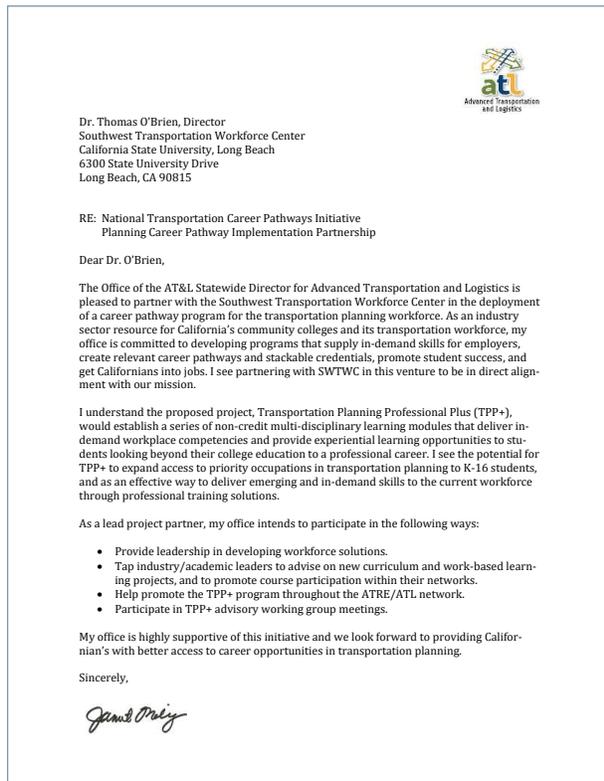
Southern California Association of Governments (SCAG): Another critical industry partner, SCAG is the nation's largest metropolitan planning organization, representing six counties, 191 cities, and more than 18 million residents. SCAG offers internships, guest lecturers, assessment committee advisors, subject matter expertise, and access to a wide cache of research project data.



Transportation Planning

4.5 Partner Commitments

In an expression of their commitment to the deployment and mission of this implementation plan, SWTWC partners have “signed-on” as key contributors of time, expertise, resources, and in some cases funding, through the authorized letters of agreement presented below. It is this level of engagement that makes a program of this scale possible.



Transportation Planning

USCPrice
Sol Price School of Public Policy

Genevieve Giuliano
Margaret and John Ferraro Chair in Effective Local Government
Director, METRANS Transportation Center

February 19, 2019

Dr. Thomas O'Brien, Director
Southwest Transportation Workforce Center
California State University, Long Beach
6300 State University Drive
Long Beach, CA 90815

RE: National Transportation Career Pathways Initiative
Planning Career Pathway Implementation Partnership

Dear Dr. O'Brien,

The METRANS Transportation Center, Sol Price School of Public Policy, University of California, is pleased to partner with the Southwest Transportation Workforce Center in the deployment of a career pathway program for the transportation planning workforce. METRANS recognizes the importance of transportation and urban planning in our regional economy and remains firmly committed to creating and articulating clear career pathways that promote student access to higher learning, success in their academic endeavors, and that open up opportunities for a professional career. We believe partnering with SWTWC in this venture is in direct alignment with our mission.

We understand the proposed project, Transportation Planning Professional Plus (TPP+), would establish a series of non-credit multi-disciplinary learning modules that deliver in-demand workplace competencies to students in planning programs and to professional planners. Modeled after the successful Global Logistics Specialist and Marine Terminal Operator programs, SWTWC would host TPP+ courses that are taught by industry professionals, offer continuing education credit, and culminate in a transportation planning capstone project and TPP+ professional credential.

As a lead project partner, we intend to participate in the following ways:

- Test pilot TPP+ courses with Price School students.
- Advise on a needs assessment of competency module learning objectives.
- Support an NSF proposal for longitudinal tracking of student career choice.
- Attend and participate in Planning discipline working group meetings.

University of Southern California
650 Childs Way, Los Angeles, CA 90089-0626 Tel 213 740-3956 Fax 213 740-0001
giuliano@usc.edu



METRANS is highly supportive of this initiative. We look forward to better equip-ping professionals for career opportunities in transportation planning.

Sincerely,



Genevieve Giuliano
Professor and Director
Margaret and John Ferraro Chair in Effective Local Government

2


Pima County Community College District

Community Campus
Office of the Vice President of Workforce Development
401 North Main Avenue
Tucson, Arizona 85724-1422
Telephone (520) 298-6466
Fax (520) 298-6469
tcccd@pcccd.edu

February 18, 2019

Dr. Thomas O'Brien, Director
Southwest Transportation Workforce Center
California State University, Long Beach
6300 State University Drive
Long Beach, CA 90815

RE: National Transportation Career Pathways Initiative
Planning Career Pathway Implementation Partnership

Dear Dr. O'Brien,

Pima Community College (PCC) is pleased to partner with the Southwest Transportation Workforce Center (SWTWC) in the deployment of a career pathway program for the transportation planning workforce. PCC is firmly committed to advancing communities through pathways to academic and career success that empower students to achieve career technical certificates, associate degrees, career training programs, and continuing education. We believe partnering with SWTWC in this venture is in direct alignment with our mission.

We understand the proposed project, Transportation Planning Professional Plus (TPP+), would establish a series of non-credit multi-disciplinary learning modules that deliver in-demand workplace competencies and provide experiential learning opportunities to students looking beyond their college education to a professional career. We see the potential for TPP+ to expand access to priority occupations in transportation planning to K-16 students by helping them contextualize their academic learning experience and foster engagement around career choice.

As a lead project partner, PCC intends to participate in the following ways:

- Provide leadership in developing workforce solutions.
- Participate in the student screening and recruitment process.
- Work collaboratively to develop and administer training programs.
- Offer access to classrooms, computer labs, course instructors, and textbooks.
- Attend and participate in all Planning discipline working group meetings.

PCC is highly supportive of this initiative and we look forward to providing our students with better access to career opportunities in transportation planning.

Sincerely,



Ian R. Roark, Ed.D., Vice President of Workforce Development

Cc: Lee D. Lambert, Chancellor & CEO
David Dore, Ed.D., President

Transportation Planning

4.6 Project Outcomes

During the first year of deployment, SWTWC, in collaboration with its Planning Steering Committee and implementation partners, will deliver the following project outcomes:

Transportation Planning Professional Plus Initiative

1. Pilot Bridge Program Launch w/ 10 Students, Pima Community College.
2. Quarterly Convenings: Planning Steering Committee.
3. Transportation Planning Industry Needs Assessment Report.
4. Project Plan w/ Syllabi for Full Rollout, TPP+ Program.
5. New Curriculum, Pilot TPP+ Competency Module.
6. Pilot TPP+ Course Launch w/ 10 Students, Cal State Long Beach.
7. Credit Articulation Agreement, USC/CSULB Academic Programs.
8. APA Credential Endorsement; CE Credit Authorization.
9. NSF Funding Proposal for Student Career Tracking.

4.7 Project Timeline

The proposed implementation activities for project year 2019-2020 are outlined below:

Transportation Planning Professional Plus Initiative

- | | |
|---|------------------------------|
| 1. Replicate Bridge Program at Pima | July – December 2019 |
| 2. Assemble & Convene Steering Committee | July 2019, Quarterly |
| 3. Complete Industry Needs Assessment | August 2019 |
| 4. Validate thru Broad Network Survey | September 2019 |
| 5. Establish Framework, TPP+ Series | September – November 2019 |
| 6. Develop Syllabi, TPP+ Credential | October – December 2019 |
| 7. Develop Curriculum, Pilot Module | November 2019 – January 2020 |
| 8. Identify Faculty, Train-the-Trainer | October 2019, January 2020 |
| 9. Promote, Recruit, Enroll Students | January 2020 |
| 10. Launch Pilot (10 Students Min) | Spring 2020 |
| 11. Measure, Evaluate, Report, Refine | June 2020 |
| 12. Establish Roadmap, Full Rollout | April 2020 |
| 13. Establish Credit Articulation, Post-Secondary | May 2020 |
| 14. Establish Credit/Certificate Endorsement, APA | June 2020 |
| 15. Submit First-Year Project Report | July 2020 |
| 16. Develop Student Pathway Tracking Strategy | January – February 2020 |
| 17. Submit NSF Funding Proposal (est.) | March 2020 |

Transportation Planning

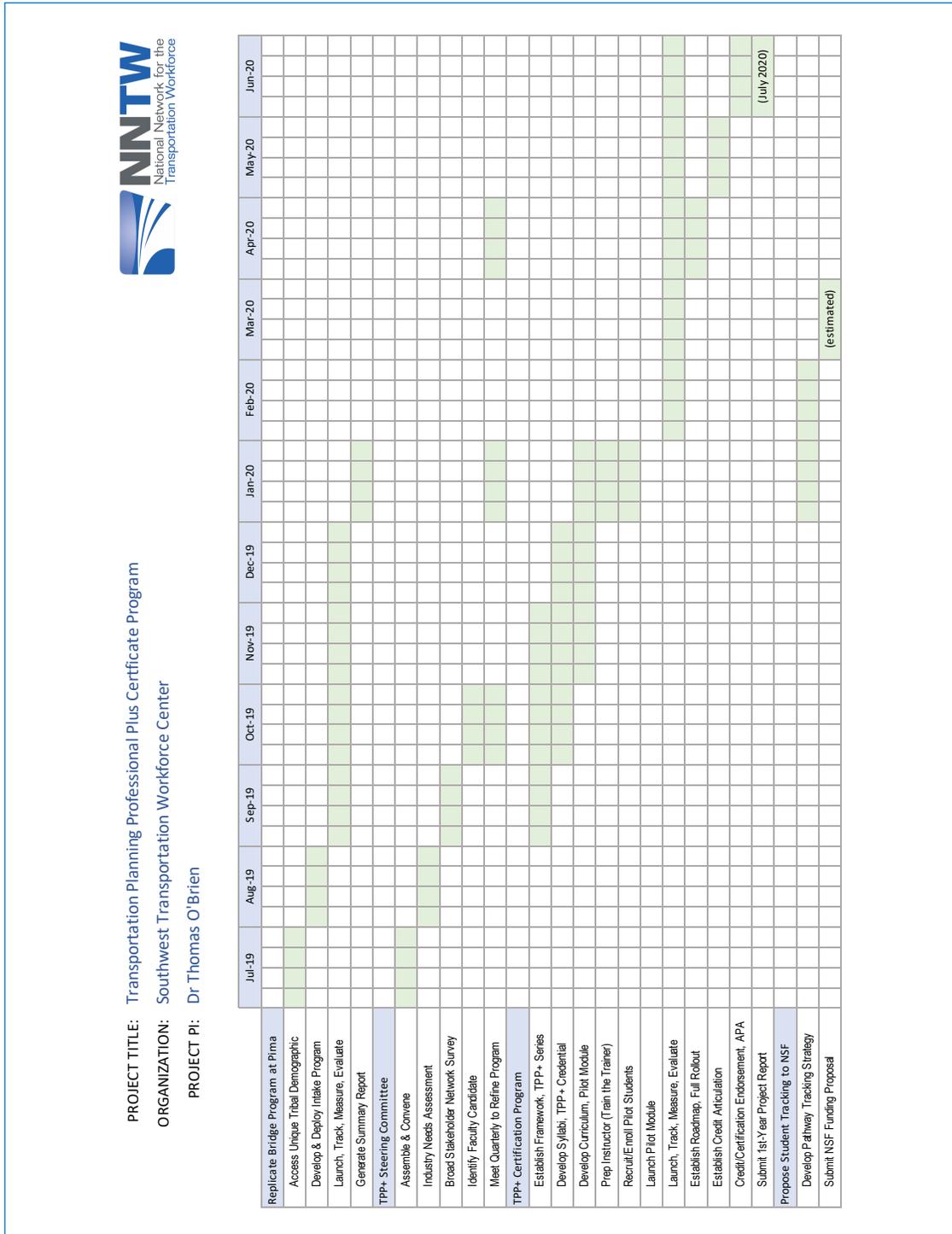
4.8 Project Budget

The first-year budget for this deployment allocates the personnel, travel, and material needs listed below. Successive annual budget requirements are projected to be similar.

Budget Item	Annual Costs	Match	Total Budget
Personnel	\$60,000	\$15,000	\$75,000
Fringe Benefits	\$30,000	\$7,500	\$37,500
Travel & Per Diem	\$6,000	\$1,500	\$7,500
Supplies & Materials	\$6,000	\$1,500	\$7,500
Professional Services	\$10,000	\$2,500	\$12,500
Facilities & Administration (F&A Rate 25%)	-----	-----	-----
Annual Totals:	\$140,000	\$35,000	\$175,000

Transportation Planning

4.9 First Year Workplan



Transportation Planning

SECTION 5.0 BARRIERS TO DEPLOYMENT

Labor Market Forecasting

A number of factors present challenges to the deployment of innovative workforce preparation strategies within traditional education and training systems. As has been discussed, most all workforce and economic development investment, while on its face may be guided by industry demand, is justified to funders using standardized labor market data. Thus, truck driver training programs are easy to justify, while automated vehicle technician is less so.



As long as labor market occupational classifications and economic forecasting lags behind the adoption of emerging job titles and their related career fields, the funding and scaling of education and training programs that services these emerging areas will continue to be disproportionate to their actual industry demand.

Institutional Change

Well established institutions and entrenched academic programs are by nature resistant to change and slow to adopt to new industry demands. Whether deploying innovative learning strategies into existing programs to maximize student attention and retention, modifying curriculum in response to industry advisories and evolving demands, or maintaining current levels of faculty expertise through a program of continuous professional development, virtually all not-for-profit academic institutions are resistant to these types of change.

Internship Learning Outcomes

There is a healthy and productive push towards increasing experiential learning opportunities during a student's academic journey, and internships are the primary go-to for achieving this critical on-the-job experience. Oddly though, there remains an unspoken disconnect between the duties and responsibilities of a typical internship and those of the actual target occupation. This presents students with an opportunity to "work" and experience the workplace environment, but too seldom are they engaged in actual career-oriented work-based learning. This mismatch between an employer's need for a ready workforce and a student's exposure to actual work-based occupational competencies renders some internships ineffective.

Transportation Planning

SECTION 6.0 REFERENCES & DOCUMENTATION

6.1 Acronyms & Abbreviations

AICP = American Institute of Certified Planners
ALT = Advanced Transportation & Logistics
APA = American Planning Association
BLS = Bureau of Labor Statistics
CTE = Career & Technical Education
DOL = Department of Labor
DOT = Department of Transportation
DWG = Discipline Working Group
FHWA = Federal Highway Administration
GIS = Geographic Information Systems
GISP = Geographic Information Systems Professional
ETA = Employment Training Association
ITS = Intelligent Transportation Systems
KSA = Knowledge, Skills, and Abilities
LATTC = Los Angeles Trade Technical College
LMI = Labor Market Information
NCHRP = National Cooperative Highway Research Program
NNTW = National Network for the Transportation Workforce
NTCPI = National Transportation Career Pathways Initiative
PCC = Pima Community College
PE = Professional Engineer
PMP = Project Management Professional
SCAG = Southern California Association of Governments
SOC = Standard Occupational Classification
SWTWC = Southwest Transportation Workforce Center
TPP+ = Transportation Planning Professional Plus
TRB = Transportation Research Board
USC = University of Southern California



Transportation Planning

6.2 Citations & Attributions

In-report superscripted citations and/or attributions are expanded below:

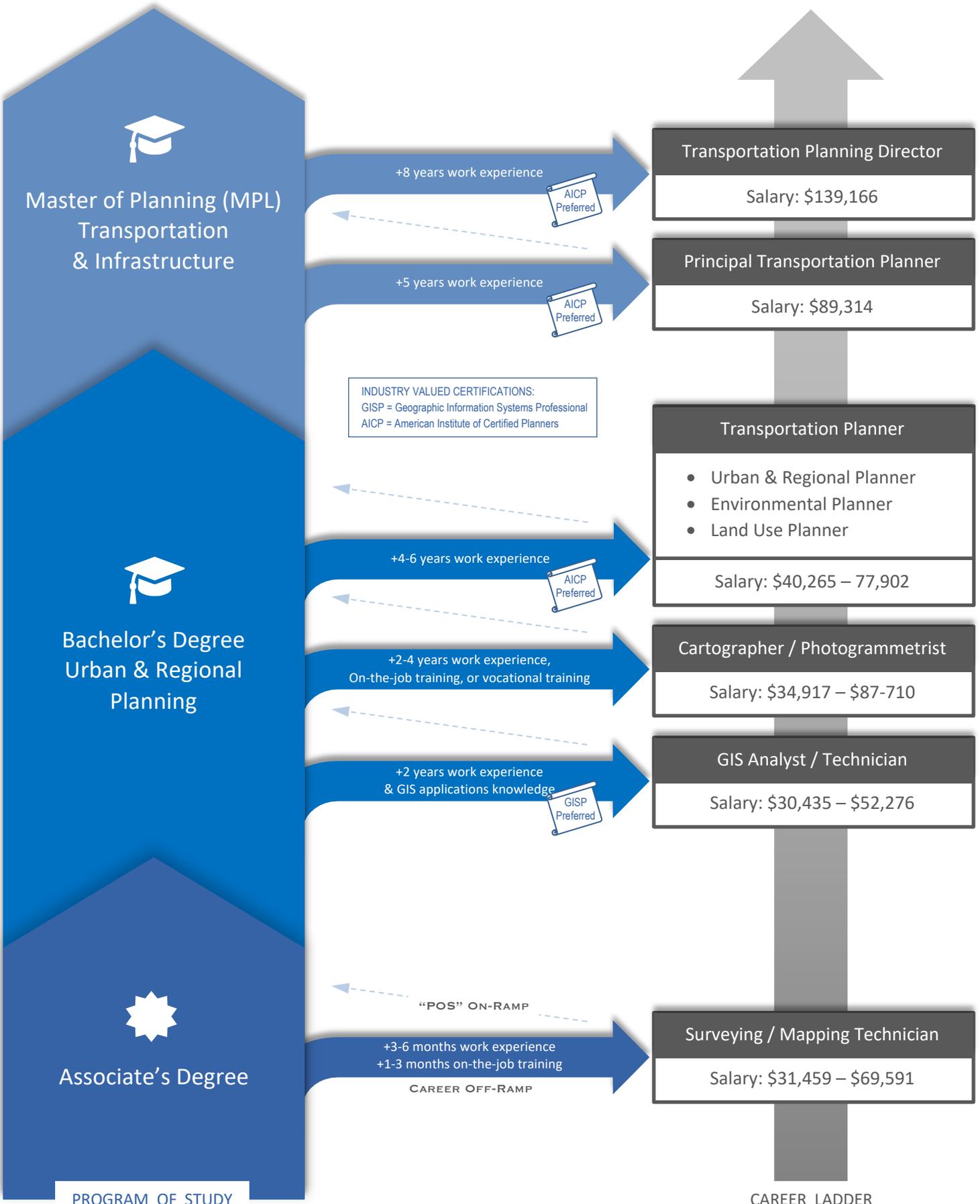
- 1) The Professional Transportation Planner® (PTP) certification program (available at <http://www.tpcb.org/ptp/>) (Feb 25, 2018)
- 2) NCHRP Report 798: The Role of Planning in a 21st Century State DOT (available at <http://www.trb.org/Publications/Blurbs/172210.aspx>) (Feb 25, 2018)
- 3) Ibid. (Feb 25, 2018)

6.3 Career Pathway Documentation

Each of the transportation operations priority occupations and career pathways detailed in this report have been formally documented for use as a career guidance resource in the deployment of pathway initiatives within the post-secondary education/training continuum. A list of those documents is followed by an instantiation of each on the pages that follow:

Transportation Planning

Career Pathway Graphic, Job Description (Cartographer), Job Description (GIS Analyst), Job Description (Survey Tech), Job Description (Planner), Program of Study, Experiential & Innovative Learning



Alternative Job Titles

Aerial Photogrammetrist, Cartographic Designer, Digital Cartographer, Mapper, Photogrammetric Technician, Stereo Compiler, Stereoplotter Operator

Job Description

Cartographers and photogrammetrists collect, measure, and interpret geographic information in order to create and update maps and charts for regional planning, education, and other purposes. They create maps and perform aerial surveys for governments to aid in urban and regional planning, by gathering information from geodetic surveys (land surveys that account for the curvature of the Earth's surface) and remote-sensing systems like aerial cameras, satellites, and light-imaging detection and ranging (LIDAR) technology. Cartographers are mapmakers who design user-friendly maps. Photogrammetrists are specialized mapmakers who use various technologies to build models of the Earth's surface and its features for the purpose of creating maps. Other duties typically include:

- Create visual representations of data, such as annual precipitation patterns.
- Examine and compile data from ground surveys, reports, aerial photographs, and satellite images.
- Prepare maps in digital or graphic form for environmental and educational purposes.
- Plan aerial and satellite surveys to ensure complete coverage of the area in question.
- Collect and analyze geographic and spatial data, such as elevation and distance.
- Develop base maps that allow for GIS data to be layered on top.

Knowledge Requirements

- Earth Geometry & Geodesy
- Geospatial Systems & Technologies
- Design Techniques, Tools & Principles
- GIS, GPS, Other Measurement Systems
- Cartography, ArcGIS Map Design
- Understanding of GIS, GPS, LIS
- Remote Sensing & Photogrammetry
- Mathematics & Number Systems
- Surveying & Data Collection
- Computers & Electronics
- Information Retrieval
- Map Creation

Required Skills & Abilities

- Reading Comprehension
- Critical/Analytical Thinking
- Active Listening & Learning
- Written & Oral Presentation
- Prepare Reports & Presentations
- Inductive/Deductive Reasoning
- Interacting with Computers
- Getting & Evaluating Information
- Making Decisions & Problem Solving
- Identify Objects, Actions & Events
- Determine Compliance with Standards
- Assess Visual Information

Technical Skills Requirements

- ArcGIS, GeoCart, TerraScan, Kork Mapping
- AutoCAD, Microstation, Cosmo, Vega Prime
- Adobe Illustrator, Aldus Freehand, CorelDraw

Typical Salary

- \$34,917 - \$87,710, based on experience
(Source: PayScale)

Education & Work Experience

- A bachelor's degree in cartography, geography, geomatics, or surveying is typically required.
- Typically requires several years of work-related experience, on-the-job training, or vocational training.
- Certification from the American Society for Photogrammetry and Remote Sensing (ASPRS) is desirable.
- Some states require licensing as a surveyor, others for photogrammetry and remote sensing.

Alternative Job Titles

GIS Technician, GIS Specialist, Land Survey Technician, Cartographic Technician, Survey CAD Technician

Job Description

GIS analysts use geographic information system technology to identify assets, variables, and trends in different locations. Their work involves collaborating with computer-aided design (CAD) technicians, developing web apps and tools, and integrating GIS with other technologies. GIS analysts usually work regular business hours, with occasional weekend work necessary to meet important deadlines. Some amount of travel may be required for field work. Typically more for entry-level employees, this position often does not require significant research experience, ability to do advanced programming, or higher education. The GIS analyst position is well suited to analytical thinkers who enjoy statistics and numerical data, have good communication skills, and work well as part of a team. Other duties typically include:

- Convert paper maps into GIS data sets that can be used to identify where locations have been developed.
- Manipulate and analyze geographical information to be presented in reports or presentations.
- Maintain a geographical library in accordance with the latest trends and newest information.
- Develop internet apps and tools to present GIS data on corporate websites for clients.
- Study mathematical styles used in successful GIS plans, programs, and commodities, so that they can be applied or improved upon in other applications.

Knowledge Requirements

- Earth Geometry & Geodesy
- Geospatial Systems & Technologies
- Analysis, Research & Reporting Methods
- Statistical Theory & Methods
- GIS, GPS, Other Measurement Systems
- Remote Sensing & Photogrammetry
- Mathematics & Number Systems
- Cartography, ArcGIS Map Design
- Understanding of GIS, GPS, LIS
- Asset & Database Management
- Spatial Modeling & Analysis
- Surveying, Data Collection
- Project Management Practices

Required Skills & Abilities

- Prepare Reports & Presentations
- Plan & Coordinate Projects
- Public Speaking & Interaction
- Foster/Support Teamwork
- Written & Oral Presentation
- Work Independently
- Problem Solving
- Critical/Analytical Thinking
- Collect, Compile & Analyze Data
- Develop & Document Procedures
- Assess Visual Information
- Perform Data Research

Technical Skills Requirements

- Esri ArcGIS, 3D/Network/Spatial Analyst
- AutoCAD, QGIS, GRASS, PCI, MS Office
- Python, SQL, C++, Visual Basic, Java

Typical Salary

- \$30,435 - \$52,276, entry-level
(Source: PayScale)

Education & Work Experience

- Bachelor's or master's degree in geography, computer science, engineering, or a related field.
- Prior GIS applications knowledge with 2 years work experience are preferred in this job market.
- A GIS Professional (GISP) designation is advantageous (offered by the GIS Certification Institute).

Alternative Job Titles

Survey Technician, Mapping Technician, Instrument Man, Chainman, Stereoplotter Operator, Photogrammetric Compilation Specialist, Aerotriangulation Specialist, Agricultural GPS Mapper

Job Description

Surveying and mapping technicians collect data and make maps of the Earth's surface, usually under the direction of an engineer, surveyor, cartographer, or photogrammetrist. They obtain data for use in construction, mapmaking, boundary location, mining, or other purposes, and may calculate mapmaking information and create maps from sources such as surveying notes, aerial photography, satellite data, or other maps to show topographical features, political boundaries, and other features. Surveying technicians work outside extensively and can be exposed to all types of weather, while mapping technicians work primarily indoors on computers. Most surveying and mapping technicians work for firms that provide engineering, surveying, and mapping services on a contract basis. Local governments also employ these workers in highway and planning departments. Other duties typically include:

- Visit sites to record survey measurements and other descriptive data.
- Operate surveying instruments, such as electronic distance-measuring equipment.
- Enter data from surveying instruments into computers, either in the field or in an office.
- Produce maps showing boundaries, water locations, elevation, and other features of the terrain.
- Assist photogrammetrists by laying out aerial photographs in sequence to identify areas not captured by aerial photography.

Knowledge Requirements

- General Computers & Electronics
- Geography & Geospatial Systems
- Engineering & Technology
- Basic Document Drafting
- Operate Specialized Equipment
- Mathematics & Number Systems
- Knowledge of Surveying Equipment
- Understanding of GIS, GPS, LIS

Required Skills & Abilities

- Precise, Accurate & Detail Oriented
- Dependable & Cooperative
- Exercise Independent Judgement
- Meet Tight Deadlines
- Communicate with Team Members
- Follow Spoken Instructions
- Physical Stamina (stand for long hours)
- Problem Solver, Critical Thinker
- Work with Minimal Supervision
- Active Learner & Listener
- Reading Comprehension

Technical Skills Requirements

- CAD (3D Nature Visual Studio)
- Adobe Freehand, Illustrator, Photoshop
- Strong Computer Skills; MS Office Tools

Typical Salary

- \$31,459 - \$69,591, entry-level
(Source: PayScale)

Education & Work Experience

- High school diploma or equivalent; bachelor's degree with some technical education preferred.
- Entry positions may require 3 to 6 months of work experience and 1 to 3 months on-the-job training.
- Certifications of technical competency are offered by the American Society for Photogrammetry & Remote Sensing, National Society of Professional Surveyors, and the GIS Certification Institute.

Alternative Job Titles

Planner, Transit Planner, Transportation Analyst, Transportation Modeler, Transportation Manager, Urban & Regional Planner, Land Use Planner, Environmental Planner

Job Description

A Transportation Planner is committed to taking on the role of urban freight researcher who studies the operation of transportation systems implemented by an organization. On a daily basis, the analysis and compilation of data is carried out to evaluate the effectiveness of implemented transportation models and simulations. A Transportation Planner therefore works to analyze the developmental tide of the infrastructure, and how current project models potentially can be developed to weigh against it local regulations. In that role, one therefore bears the responsibility of representing the administrative approval of transportation-and land development projects carried out by an organization, to make sure that local regulations and jurisdictions on land use are being followed. Other duties include:

- Attend regular meetings and collaborate with engineers, public officials, and public stakeholders to resolve transportation design and environmental issues stemming from civic projects and public policies.
- Compose and summon technical reports on plans within regional and urban programs and policies.
- Monitor and assess regional/urban production.
- Supervise the work of hired consultants and interns; carry out public outreach to promote a consensual dialogue on the future development of civic projects.

Knowledge Requirements

- Analysis/Research/Report Methods
- Gov. Structure (Boards, Councils, Commissions)
- Regulation/Legislation Related to Area
- Principles of Planning & Development
- Transportation Modeling
- Project Management Practices
- Asset Management Practices
- Budgeting/Financial Analysis
- Document Drafting
- Statistical Theory/Methods
- Principles of Urban/Regional/Trans. Planning
- Data Visualization & Presentation
- Principles in Trans. Demand Management

Required Skills & Abilities

- Prepare Reports & Presentations
- Plan & Coordinate Projects
- Public Speaking & Interaction
- Foster/Support Teamwork
- Work Independently
- Written & Oral Communication
- Management/Leadership
- Prepare/Administer Budgets
- Multitasking
- Strategic Mindset
- Complex Problem Solving
- Collect, Compile, Analyze Data

Technical Skills Requirements

- ArcGIS, ArcView, TRAFFIX, SAS
- AutoCAD, MS Access, MS Office, SQL
- Adobe Illustrator, Adobe Photoshop

Typical Salary

- \$40,265 - \$77,902, entry-level
(Source: PayScale)

Education & Work Experience

- Master's degree in planning preferred; bachelor's degree accepted for a majority of positions.
- Up to 5 years prior work-related experience required for senior or management-level positions.
- American Institute of Certified Planners (AICP) and/or Professional Engineer (PE) certifications desirable.

Year 5-6



AICP – Certified Planner

Transportation planners can apply for a certificate with the American Institute of Certified Planners (AICP). Exams can be taken twice a year by planners fulfilling educational and work-related prerequisites. Certified planners reportedly make \$16,000 more annually on average (www.planning.org/certification).



Master of Planning – Transportation & Infrastructure

Year 6: Students choose electives either from their chosen, or other, concentration. Electives can also be taken from a certificate program, for example “Certificate in Transportation Systems”.

Year 5: During the first year, students take core courses. They can also choose a planning concentration for their studies, within which they choose from a selection of concentration courses.

Core Courses

Intersectoral Leadership
Economics for Policy & Planning
Planning Theory
Statistics & Arguing from Data
Comparative Intl Development
The Social Context of Planning
The Legal Environment of Planning
Planning History & Urban Form

Concentration Courses

Modeling & Operations Research
Intro Transportation Planning Law
Port Engineering: Planning & Ops
Environmental Impact
Urban Economic Analysis
GIS for Policy & Planning
Transportation Systems Analysis
Transportation & Environment

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

Year 3-4



Bachelor’s Degree in Urban & Regional Planning

Year 4: Students take senior-level courses and fulfill internship and fieldwork requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory GIS, quantitative/qualitative urban research, methods, planning and zoning.

GE Courses

Science & Technology Synthesis
Social Sciences Synthesis
Humanities & Synthesis

Planning-Related Courses

Quantitative Urban Research Methods
Qualitative Urban Research Methods
Planning Theory
Maps, Graphics, & Lab

Planning-Related Courses

Planning in the Public Sector
Legal Foundations of Planning
Urban Transportation Planning
Urban Problems Seminar
Community-Based Urban Design
Fieldwork
Internship
Intermediate GIS & Lab

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

Year 1-2



Associate’s Degree / Pursuing Bachelor’s Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Mathematics
Oral Communication
Public Policy & Design
Basic Economics
Political Science
Sociology

Planning-Related Courses

Intro to Urban Planning Theory
Sustainable Development of Cities

Lower-Division / Major Prerequisites

Intro to Graphic Communication
Tools Used by Urban Studies & Planning Professionals
Planning Theory
Quantitative Urban Research Methods
Qualitative Urban Research Methods
General Plan & Zoning
Urban Policy & Planning
GIS & Planning Applications Economics

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Planning Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

Sierra Club

Students of the Angeles Chapter Transportation Committee have the opportunity to engage with other members, leaders of the organization, and community members to network and develop impactful campaigns and initiatives.

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.

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.

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.

Southern California Association of Governments (SCAG)

SCAG offers college students paid internships that provide practical work experience and an opportunity to develop meaningful relationships with experts in their program of study. SCAG also offers local scholarships to high school and community college students and a two-week internship with a local planning agency, council of governments, or SCAG.

San Diego Association of Governments (SANDAG)

SANDAG offers paid internships for students with graduate coursework in urban planning, public policy, or related fields focusing on transportation planning. This one-year position provides a hands-on learning experience with guidance and mentoring of senior staff.

Innovative Learning Strategies for a Planning Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within a transportation planning program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards that is designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of "SMEs" should be considered to meet the competency needs of business.

Modularized Curriculum

Structure and sequence curriculum in modules tied to jobs with multiple entry/exit points, with multiple levels of industry recognized credentials built into the sequenced pathway.

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 helps students who seek hands-on learning and want to be media-makers foster team-building and solve real life problems.

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.

Context-Based Learning

By interpreting new information in the context or place of where and when it occurs and relating it to what we already know, we come to understand its relevance and meaning. To design effective strategies for learning requires an understanding of how context shapes learning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

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NTCPI

NATIONAL TRANSPORTATION CAREER PATHWAY INITIATIVE

TRANSPORTATION OPERATIONS

CAREER PATHWAY REPORT

FEBRUARY 2019



STEPHANIE IVEY, DIRECTOR
MARTIN LIPINSKI, ASSOCIATE DIRECTOR
SOUTHEAST TRANSPORTATION WORKFORCE CENTER



Transportation Operations

TRANSPORTATION OPERATIONS

SECTION 1.0 CHARACTERIZING THE WORKFORCE

1.1 The Transportation Operations Workforce

The transportation industry is facing unprecedented change, both in terms of the significance of new technologies to transportation systems and in the pace of the technological advances themselves. In fact, transformative technologies and services are identified as the top critical transportation issue by the Executive Committee of the Transportation Research Board (TRB) (NAS, 2018). The transportation operations workforce is characterized by a diverse set of occupations supporting the safe, reliable, and efficient movement of both people and goods. Central to this mission is the integration of transformative technologies to improve operational outcomes, and the necessity of a systems approach.

Transportation operations includes not only the Transportation Systems Management & Operations (TSMO) aspect of public sector traffic operations, but also similar roles in both transit and freight realms. The Southeast Transportation Workforce Center (SETWC) approached transportation operations in a way that addresses occupations within the three realms of traffic, transit, and freight.

While job titles may differ across these realms, there are many similar job functions which provide workers with cross-cutting skillsets and opportunities to navigate career options across modes. Operations professionals are involved in the actual logistics of the movement of people and freight, encompassing aspects such as managing roadway congestion, clearing traffic incidents, enhancing transit services to increase ridership and customer satisfaction, driving transit or freight vehicles, and optimizing freight flows and intermodal operations.

Occupations in the operations workforce range from drivers and front-line technicians to engineers and computer and data scientists. Due to the nature of these functions, operations professionals must be well versed in and constantly adapting to new technologies that disrupt the way work is conducted and enable significant operational improvements.



Transportation Operations

1.2 Priority Occupations

High-priority transportation operations occupations were identified through a multi-pronged research approach that included conducting literature review, national labor market analysis, employer job data analysis, integrating expert advisory insight, and incorporating a broad stakeholder engagement and feedback loop. The final set of occupations identified revealed overlap across traffic, transit, and freight in terms of priorities, and some specialized occupations were deemed more critical for a particular mode. The priority occupations identified for each realm are listed below. To help visualize the overlap between realms, those occupations common to all three are shown in blue text; those common to two are shown in green:

Operations Realm: Traffic

Priority Occupations

Project & Program Manager
 Computer & Information Systems Manager
 Operations Planner
 Traffic Signal or ITS Technician
 Traffic Incident / Operations Center Manager
 Civil / Traffic Engineer

Operations Realm: Transit

Priority Occupations

Project & Program Manager
 Computer & Information Systems Manager
 Operations Planner
 Commercial Driver
 Diesel Mechanic
 Civil / Transit Engineer

Operations Realm: Freight

Priority Occupations

Project & Program Manager
 Computer & Information Systems Manager
 Operations Planner
 Commercial Driver
 Diesel Mechanic
 Data Science Analyst / Logistician
 Industrial Eng. / Operations Research Analyst

Transportation Operations

Table 1.2.1 below connects these priority occupations to their labor market data, including SOC designation (where applicable), standardized titles, employment projections, and median annual wage, all based on Bureau of Labor Statistics (BLS) data from their [Occupation Outlook Handbook](#) (BLS, 2018). Greater detail on all occupations are provided in Section 2.3.

Table 1.2.1: Priority Operations Occupations in Highway Transportation

SOC CODE	OCCUPATION	CURRENT # EMPLOYEES, 2016	PROJECTED # EMPLOYEES, 2026	PERCENT CHANGE	2017 MEDIAN ANNUAL WAGE
n/a	Project & Program Manager	n/a	n/a	n/a	n/a
11-3021	Computer & Info Systems Mgr.	367,600	411,400	11.90	\$139,220
n/a	Operations Planner	n/a	n/a	n/a	n/a
53-6041	Traffic Tech (Traffic Signal / ITS)	6,600	7,200	9.10	\$45,670
n/a	Traffic Incident / Ops Center Mgr.	n/a	n/a	n/a	n/a
17-2051	Civil Engineers (Traffic / Transit)	303,500	335,700	10.60	\$84,770
53-3032	Heavy & Tractor-Trailer Driver (Commercial Driver)	1,871,700	1,980,100	6.00	\$42,480
53-3021	Bus Drivers, Transit / Inner-city (Commercial Driver)	179,300	195,400	9%	\$40,780
49-3031	Diesel Service Tech / Mechanic	278,800	304,600	9.00	\$46,360
13-1081	Logistician	148,700	159,000	6.90	\$74,590
17-2122	Industrial Engineer	257,900	283,000	10.00	\$85,880
15-2031	Operations Research Analyst	114,000	145,300	27%	\$81,390

1.3 Critical Workforce Competencies

Transportation operations is a fast-paced field requiring a unique set of competencies from its workforce, from crucial interpersonal skills and the ability to adapt to rapidly changing environments to highly technical knowledge, skills, and abilities (KSAs). The key challenge is that the nature of operations work is highly interdisciplinary, and no one educational path typically prepares someone for an operations job (a significant amount of on-the-job training is also required). To be successful, operations workers must be willing to develop competencies in areas outside their education or training background.

Transportation Operations

Specifically, the transportation operations discipline requires workers who are:

- ✓ *Tech-savvy;*
- ✓ *Flexible, responsive, and adaptive to ever-changing technological tools/innovations;*
- ✓ *Capable of performing well under pressure and of making good decisions in high stress/high stakes environments;*
- ✓ *Effective communicators, particularly with a wide range of stakeholders;*
- ✓ *Knowledgeable of system infrastructure design and connectivity; and*
- ✓ *Equipped with skillsets related to data acquisition, management, analysis, modeling, and decision-making.*

While all occupations require specialized KSAs, a core set of competencies are important broadly across the operations workforce. In particular, the following are common requirements across many operations roles, from entry to senior level:

Knowledge:	Knowledge of local agency procedures/standards Knowledge of transportation operations practice
Skills:	Communication skills, written and verbal Computer/software skills Analytical, mathematical, or problem-solving skills Interpersonal skills Time and task management skills Professional judgement
Abilities:	Ability to be innovative or creative Ability to work well on a team Ability to work in fast-paced or stressful environments

Technical positions in operations typically require specialized skillsets related to equipment, software, or other tools, while those requiring advanced degrees (e.g., engineering) require additional skills related to management and knowledge of specific technologies or design standards. Figure 1.3.1 below illustrates the most sought-after competencies for traffic signal or ITS technicians. Figure 1.3.2 illustrates the competencies required of traffic engineers.

Transportation Operations

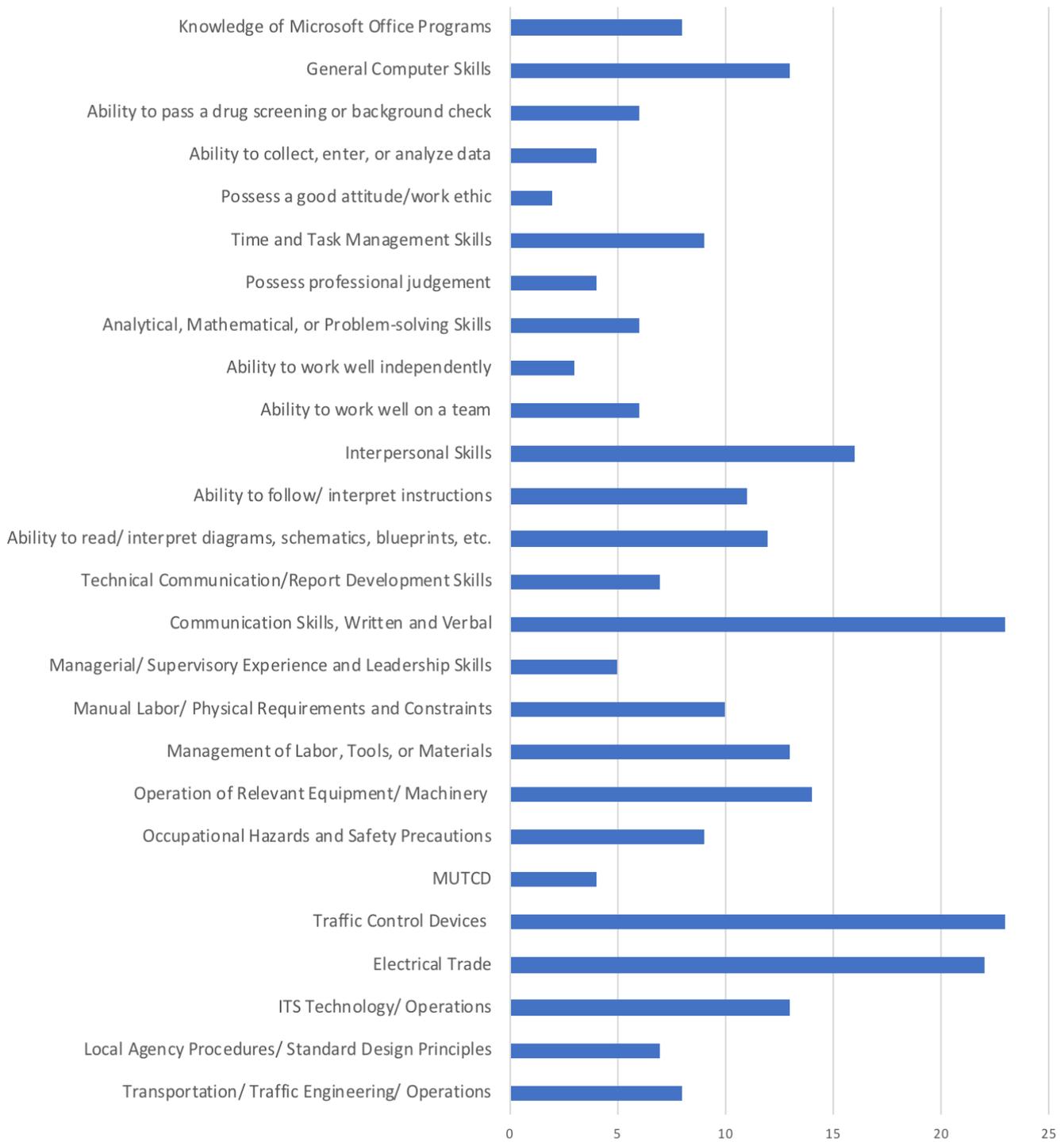


Figure 1.3.1. Most Sought-After Competencies for Traffic Signal/ITS Technicians

Transportation Operations

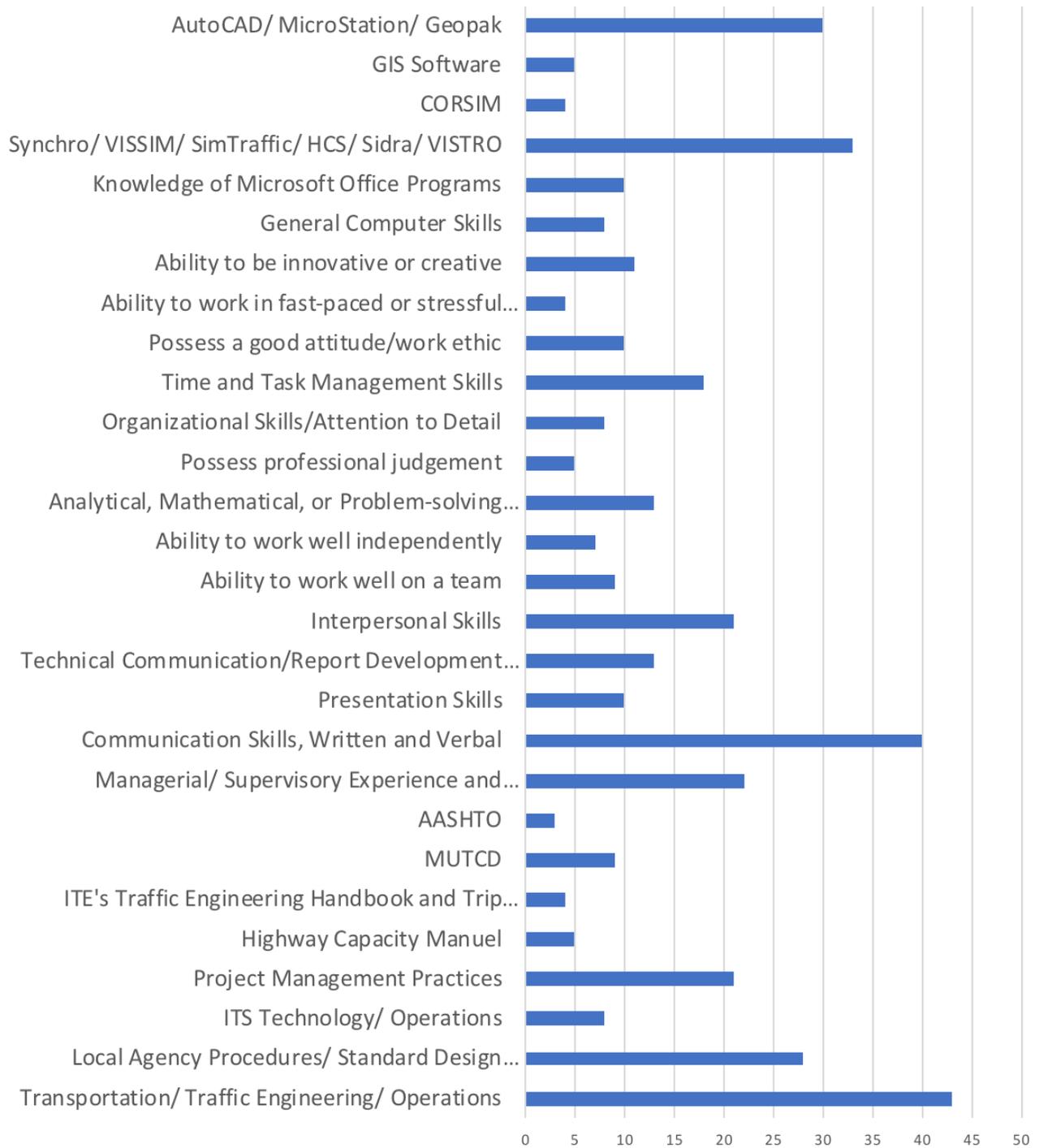


Figure 1.3.2. Most Sought-After Competencies for Traffic Engineers

Transportation Operations

The broad competency requirements for occupations in the transportation operations traffic realm are depicted by this Department of Labor (DOL) competency pyramid (Figure 1.3.3):

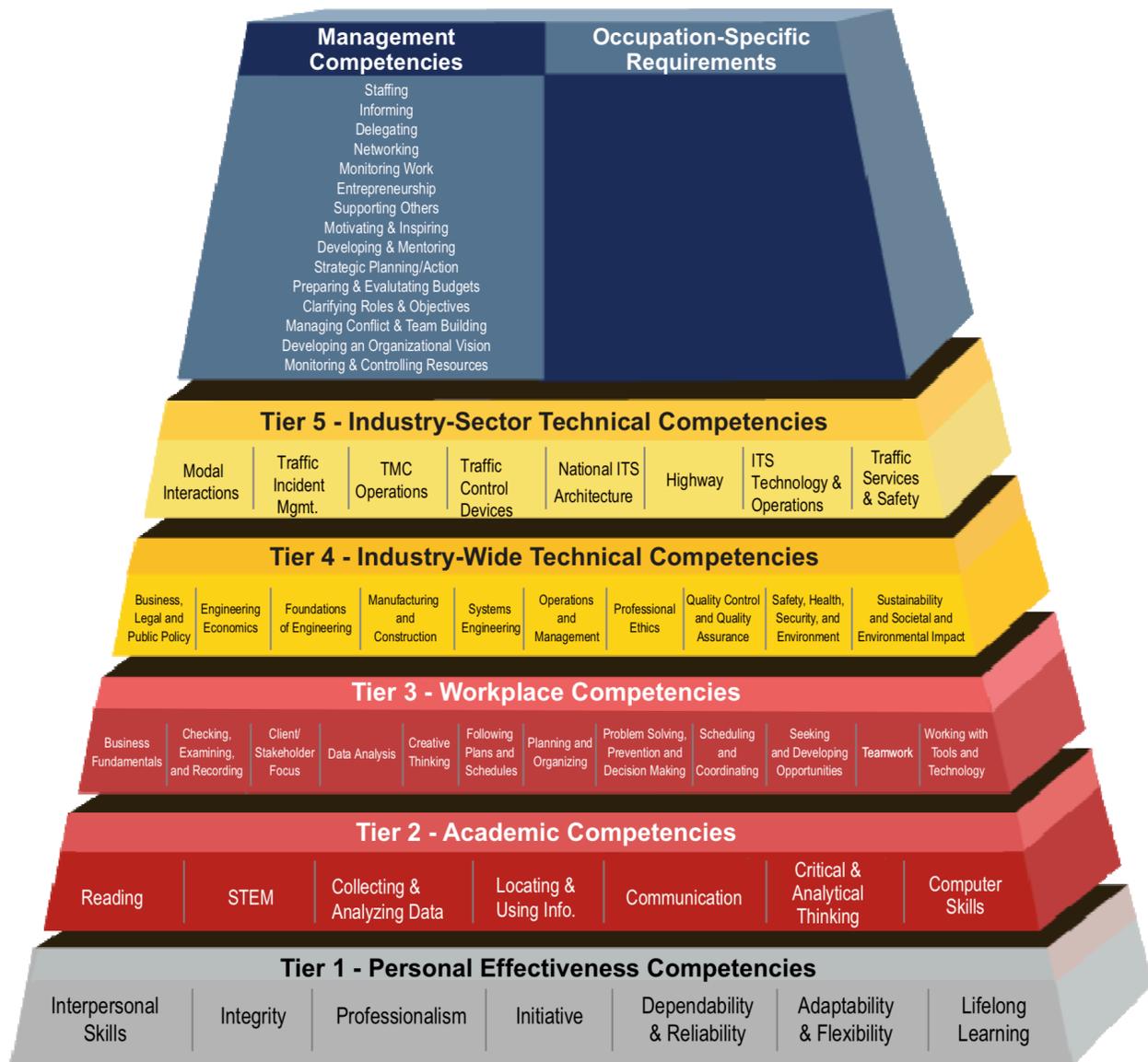


Figure 1.3.3. Competency Pyramid for Traffic Operations

Transportation Operations

The broad competency requirements for occupations in the transportation operations transit realm are depicted by this DOL competency pyramid (Figure 1.3.4):

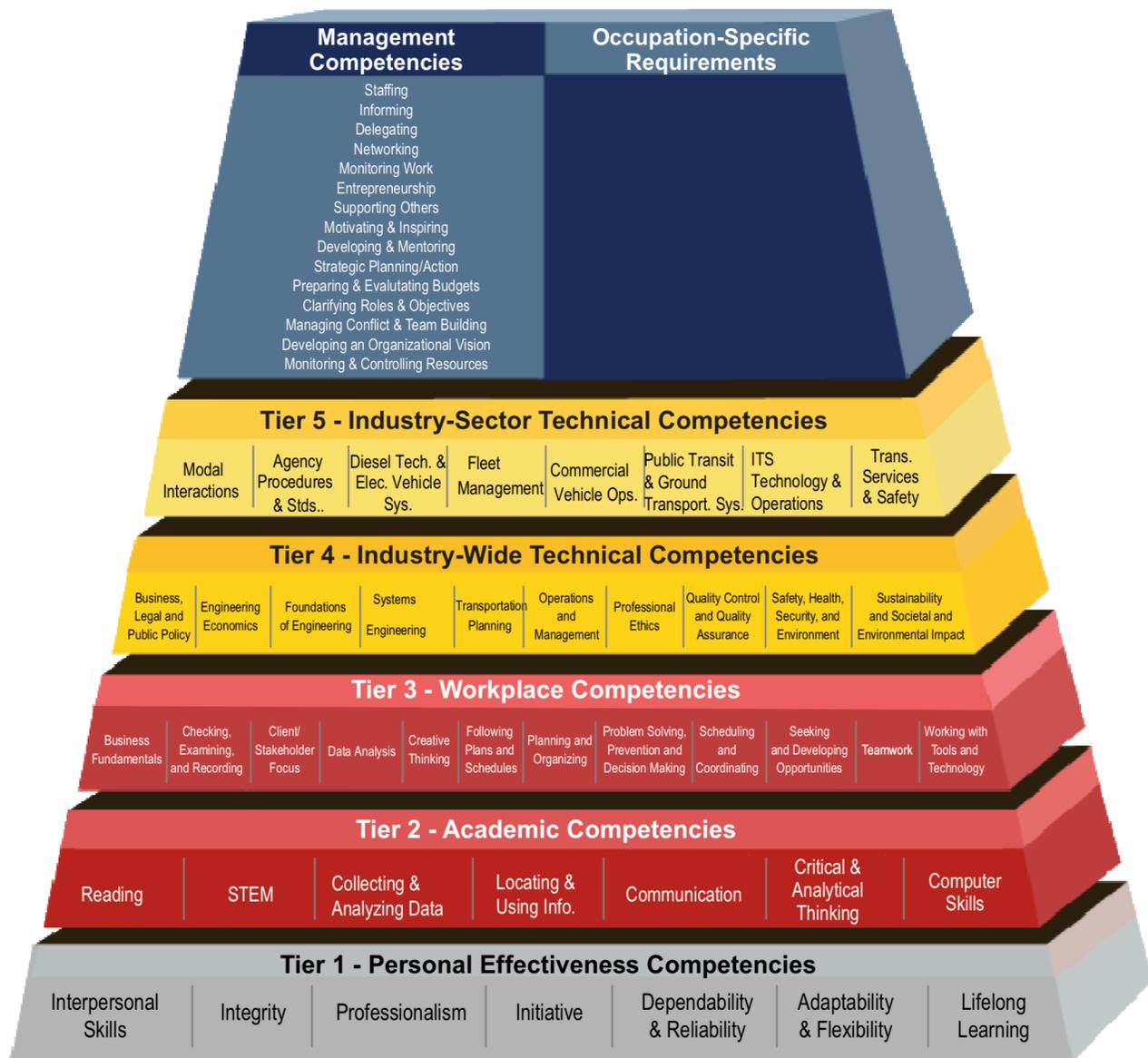


Figure 1.3.4. Competency Pyramid for Transit Operations

Transportation Operations

And finally, the broad competency requirements for occupations in the transportation operations freight realm are depicted by this DOL competency pyramid (Figure 1.3.5):

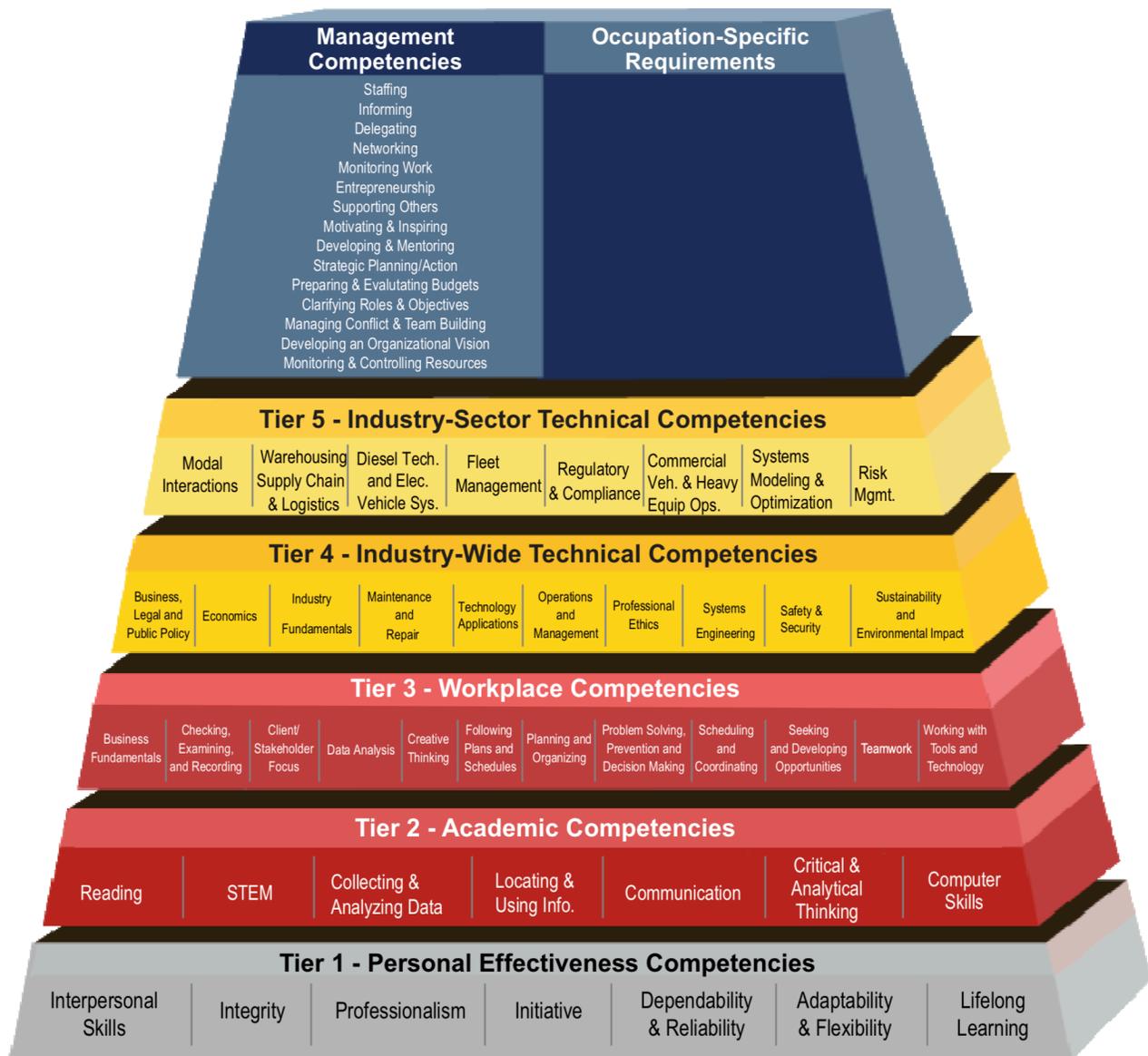


Figure 1.3.5. Competency Pyramid for Freight Operations

Transportation Operations

1.4 State of Workforce Readiness

The primary challenge for readiness of the transportation operations workforce is that transportation operations as a specific pathway through a specific discipline does not exist. Beyond the more entry-level positions, there are no common pathways for entering into a transportation operations career.

As the complexity and interdisciplinary nature of these jobs continues to increase, this further complicates the career pathway model and the mechanisms needed to introduce students to these careers, within the bounds of a traditional academic program.

At the core, operations workers must possess a wide array of technical and interpersonal competencies. And, while workers are being trained in relevant fields, it is a challenge for employers to find the number of technically qualified workers they need.

This worker deficit is a function of a lack of new candidates in the pipeline, competition for qualified workers from other industry sectors, and difficulty in attracting workers into a largely unknown field. Employers face even greater challenges in finding workers with a background in the type of complex problem-solving environment inherent to transportation operations.

At the highest levels, a career in transportation operations involves not only ITS/IT, data analytics and modeling, engineering design, decision making, and management of complex projects, but also an in-depth understanding of logistics, policy, interagency interactions, emergency management, and other safety or risk-mitigating practices.

There are numerous education and training backgrounds that are relevant to operations careers, but none provide students with the cross-cutting and highly interdisciplinary training that is required for success in an operations role. This means a significant amount of on-the-job training must occur, and workers must be prepared to continually seek opportunities for professional development.

Transportation Operations

SECTION 2.0 CAREER PATHWAY DESIGN

2.1 Pathway Design Methodology

In creating pathways for priority occupations in transportation operations, SETWC not only considered input from its Operations Discipline Working Group (DWG) and national stakeholder network, but also reviewed programs of study across numerous institutions (technical colleges, community colleges, and universities), analyzed job descriptions from a national sampling of public and private sector agencies, and reviewed occupational information mined from data warehouses like BLS and Burning Glass. This led to the development of a set of career pathway documentation—a pathway graphic, program of study, job specification, and experiential learning assessment—that collectively represent each priority occupation. Several of these occupations can be characterized by a lack of any single career path for pursuing that particular field. “Computer & Information Systems Manager” for example, may represent a background in computer science, computer engineering, or management information systems. Similarly, a “Traffic Technician” may have taken the path of electronics, electrical engineering technology, computer technology, or a number of other related technical fields. These complexities were addressed by demonstrating multiple programs of study relevant to a particular occupation and are reflected as such in the corresponding career pathway graphic, program of study, and experiential learning descriptions, where appropriate.



2.2 Pathway Learning Strategies

There are a host of learning strategies designed to engage students in experiences that deepen understanding and content mastery. These approaches—including experiential learning, problem-based learning, and context-based learning—are designed to provide students with hands-on opportunities in real-world contexts and settings so that students effectively “learn by doing.” Other strategies are designed to facilitate access to content so that students can integrate further education along with full-time jobs and other commitments, such as modularized curriculum and asynchronous learning. And, all exemplary learning practices should consider the diversity of learners and tailor content delivery to varied learning styles. Further, competency-based curriculum provides learners and employers with better understanding of skills developed through a particular program, and creates an opportunity for

Transportation Operations

alignment with industry certifications, when appropriate. Additional innovative practices integrating multiple such strategies include:

Online “Micro-Learning”: This approach provides short, content-rich exploration of career opportunities and training modules that lead to a new form of stackable credentialing through badges and other forms of recognition, typically subject to the agency hosting the content. Two examples of effective online micro-learning are:

- [Transportation Tech](#) provides cutting-edge online training for intelligent transportation system (ITS) and connected vehicle (CV) professionals.
- [Memphis Works](#) connects job seekers to jobs in advanced manufacturing, information technology (IT), health sciences, and transportation. It provides career exploration and engaging sector overviews tailored to the local market, profiles professionals in a wide range of jobs within these industry sectors, helps users develop tailored resumes and apply directly to specific job postings, and provides online modules that allow users to build skills and collect badges.

Industry Challenges: This approach engages industry in defining challenge projects and competitions to deploy in classrooms from K-12 through college. This type of experiential learning is particularly important for demonstrating connections to course content and real-world applications. It also provides an opportunity to highlight new technologies and help students “build a picture” of what a particular career field entails. This becomes particularly impactful when industry professionals engage in a mentoring or advisory role. Examples of industry challenges include the National Operations Center of Excellence (NO-CoE) developed [TRB Student Competition](#), where students develop and submit TSMO ePortfolios, and the [Transportation Technology Tournament](#) jointly sponsored by NOCoE and USDOT’s ITS Joint Program Office for Professional Capacity Building.

Industry Academies: Perhaps one of the most interesting models is that of industry-driven post-secondary education and training, where employers develop their own internal programs that are offered to candidates immediately following high school graduation. No formal post-secondary education or training is required for these students to enter a job, and candidates who successfully complete these employer-based programs are immediately hired. Examples of industry academies largely come from private corporations, such as a

Transportation Operations

large transportation operations company in need of candidates with computer programming and data analysis skills. In this example, the employer is piloting their own internal program that will allow interested high school graduates to go directly into relatively high-paying programming jobs upon academy completion.

The most critical and common element to all of these innovative practice examples is they are industry-engaged. Academic and industry silos cannot exist if successful workforce development strategies and programs are to be developed and deployed.

2.3 Priority Career Pathways

All priority occupations identified through this research are highly technical, whether at the technician or leadership level. There are a variety of entry points into this workforce, from technician-level jobs that require technical training or 2-year degrees, to engineering, data science, and management positions that require 4-year degrees and beyond.

In all, ten career pathways were developed in four key clusters—operations management, systems/operations engineering, operations research and data science, and operations technology—that represent the transportation operations discipline across three primary realms: traffic, transit, and freight. Some of these occupations are relevant to more than one cluster, as “Civil Engineer” represents an engineering role in both traffic and transit realms. But having civil engineering background also presents a strong candidacy for Project & Program Manager, Operations Planner, and Traffic Incident or Operations Center Manager positions. Figure 2.3.1 below lays out these four career clusters and their underlying priority occupations.

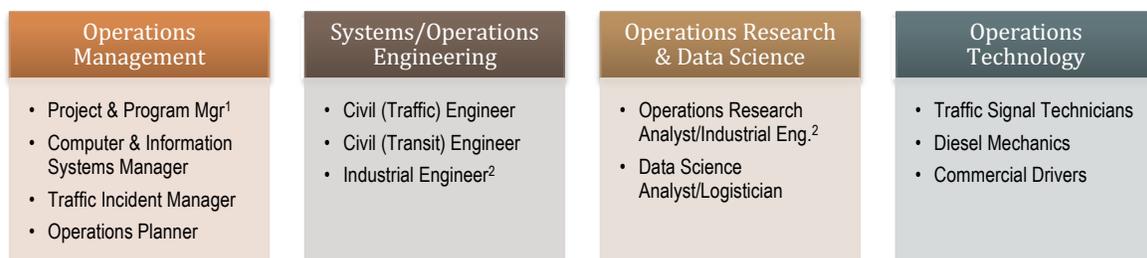


Figure 2.3.1. Transportation Operations Career Clusters & Priority Occupations

¹ Project & Program Manager is documented as a senior-level position in multiple pathways and several career clusters.

² Industrial Engineer is documented in the Operations Research & Data Science career cluster.

Transportation Operations

2.3.1 Career Cluster: Operations Management

Career Pathway: Computer & Information Systems Management

Description/Duties: Set and manage the overall IT agenda for an organization. Entry-level positions include IT Specialist and IT Analyst. A bachelor's degree is typically required for positions within this pathway. Work experience and/or additional education allows access to advanced positions like IT Security Engineer, IT Manager, IT System Administrator, Senior Specialist, or similar leadership roles. This pathway is a priority within traffic, transit, and freight operations.

Priority Occupations: Computer & Information Systems Manager.

Support Occupations: Engineering Technician, IT Technician.

Education/Training: Bachelor's degree in computer science, management information systems, engineering, mathematics, or other related fields are required for most positions in this pathway.

Career Pathway: Traffic Incident Management

Description/Duties: Detects, monitors, responds to various traffic management data sources/incidents to maintain safety and efficiency on local roadway systems. Entry-level positions include Traffic Management Dispatcher and Traffic Management Operator. An associate's or bachelor's degree is typically required for more advanced positions, while work experience and/or additional education allows access to Traffic Management Center Supervisor, Field Operations Supervisor, Incident Management Engineer/Coordinator, or similar leadership roles. This pathway is a priority within traffic operations.

Priority Occupations: Traffic Incident Manager, Traffic Engineering.

Support Occupations: Emergency Response.

Education/Training: Safety management, civil engineering, other related fields.

Transportation Operations

Career Pathway: Operations Planners

Description/Duties: Manage complex projects and systems and conduct transportation planning analyses and studies, such as corridor/traffic/freight operations planning or multi-modal/transit-oriented projects. Entry-level positions include Operations Planning Intern and Operations Planner. A bachelor's degree is typically required for positions within this pathway. Work experience and/or additional education allows access to advanced positions like Operations Planner II, Regional Operations Director, or similar leadership roles. This pathway is a priority within traffic, transit, and freight operations.

Priority Occupations: Operations Planner.

Education/Training: Bachelor's degree in civil, transportation, or industrial engineering, urban or transportation planning, supply chain logistics, or other related fields are required for most positions in this pathway.

2.3.2 Career Cluster: Systems/Operations Engineering

Career Pathway: Traffic Engineering

Description/Duties: Executes traffic signal/operations and ITS system design projects using civil engineering principles. Entry level positions include Associate Engineer and Engineering Intern. A bachelor's degree in civil engineering is required for all positions within this pathway. Work experience and/or additional education allows advancement to Traffic Operations Program/Project Manager, Advanced Traffic Operations Engineer, Senior Project Engineer, or a similar leadership role. This pathway is a priority within traffic operations.

Priority Occupations: Project & Program Manager, Traffic Engineer.

Support Occupations: Engineering Technician, Traffic Signal/ITS Technician.

Education/Training: Civil Engineering program.

Transportation Operations

Career Pathway: Transit Engineering

Description/Duties: Develops, analyzes, inspects, designs transit infrastructure, transit stations, buildings, elevated/underground structures, or bridges. Entry-level positions include Associate Engineer and Engineering Intern. A bachelor's degree in civil engineering is required for all positions within this pathway. Work experience and/or additional education allows advancement to Project Manager, Senior Project Manager, Senior Project Engineer, or a similar leadership role. This pathway is a priority within transit operations.

Priority Occupations: Project & Program Manager, Transit Engineer.

Support Occupations: Engineering Technician.

Education/Training: Civil Engineering Program.

2.3.3 Career Cluster: Operations Research & Data Science

Career Pathway: Transportation Data Science

Description/Duties: Extracts, organizes, integrates, analyzes, and communicates information obtained from transportation or supply chain data sources. Entry-level positions include Logistics Analyst and Data Scientist. An associate or bachelor's degree is required for positions in this pathway. Work experience and/or additional education allows access to positions like Transportation Analyst III, Transportation Operations Manager, Senior Logistics Analyst, Senior Data Scientist, Senior Manager of Global Logistics, or a similar leadership role. While a priority within freight operations, the importance of this pathway is expected to rapidly expand within traffic and transit.

Priority Occupations: Data Science Analyst/Logistician.

Support Occupations: Database Analyst, Logistics Tech, Project & Program Manager.

Transportation Operations

Education/Training: Associate or bachelor's degree in computer science, management information systems, economics, information science, engineering, mathematics, or other related fields.

Career Pathway: Transportation Operations Research

Description/Duties: Use advanced mathematical/analytical methods to analyze/solve complex problems, assess risk, provide data-driven approaches to decision-making. Entry-level positions include Logistics Analyst Intern and Industrial Engineer I. A bachelor's degree is typically required for positions in this pathway. Work experience and/or additional education allows access to positions like Director of Supply Chain Engineering, Senior Operations Analyst, or similar leadership roles. This pathway is a priority within freight operations.

Priority Occupations: Industrial Eng./Ops Research Analyst, Project & Program Manager.

Support Occupations: Engineering Technician.

Education/Training: Bachelor's degree in engineering (industrial, electrical, systems, or mechanical), operations research, logistics, computer science, mathematics, or other related fields are required (advanced degrees preferred) for many positions in this pathway.

2.3.4 Career Cluster: Operations Technology

Career Pathway: Traffic Signal/ITS Technology

Description/Duties: Installs, maintains, repair ITS equipment, including traffic signal cabinets/electronics and loop detection systems. Entry-level positions include ITS Tech and Traffic Systems/Signal Tech I. An associate or bachelor's degree is typically required for advancement. Work experience and/or additional education allows access to senior positions like Traffic Systems Supervisor, Traffic Signal/ITS Engineer, Traffic Systems/Signal Technician II, or a similar leadership role. This pathway is a priority within traffic operations.

Transportation Operations

Priority Occupations: Traffic Signal/ITS Technician, Traffic Engineering.

Support Occupations: Electrician, Heavy Equipment Operators.

Education/Training: While not always required for entry-level positions, an associate or bachelor's degree in electronics, engineering technology, computer technology, civil/electrical engineering, or other related fields are preferred for more advanced positions.

Career Pathway: Diesel Technology

Description/Duties: Perform mechanical repairs and preventative maintenance on fleet vehicles and heavy equipment in transit/freight. Entry-level positions include Diesel Mechanic and Heavy Equipment Mechanic. Vocational/technical training is required to advance within this career path. Work experience and/or additional training allow access to senior positions like Diesel Mechanic III, Senior Diesel Mechanic, or a similar leadership role. This pathway is a priority within transit and freight operations.

Priority Occupations: Diesel Mechanic/Diesel Shop Technician.

Education/Training: Vocational or technical training in diesel/automotive mechanics is preferred for most positions. Diesel mechanics interested in pursuing a 4-year degree should consider engineering technology or mechanical engineering due to the related nature of these fields.

Career Pathway: Commercial Driving

Description/Duties: The safe/efficient transport of passengers/goods by vehicle, following traffic laws and applicable regulations while making stops and deliveries according to schedule and assigned route. Entry-level positions include Paratransit Driver and Truck Driver Class A require a commercial driver's license (CDL) with specific endorsements based on vehicle type and passengers/cargo. A bachelor's degree is typical for advanced positions within this pathway. Work experience and/or additional education access senior positions like

Transportation Operations

Transit Operator Supervisor, Commercial Driver Trainer, or a similar leadership role. This pathway is a priority within transit and freight operations, though a CDL is preferred in some traffic occupations.

Priority Occupations: Heavy and Tractor-Trailer Truck Drivers, Bus Driver.

Support Occupations: Laborers / Material Movers, Material Moving Machine Operators.

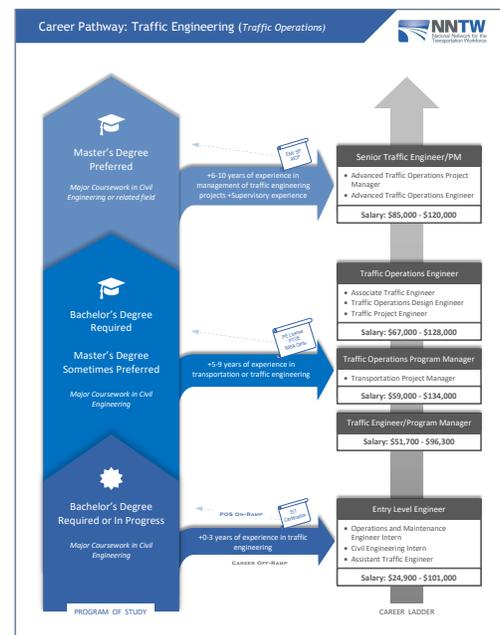
Education/Training: A CDL is required for entry into this profession. Bachelor's degree in business, transportation, safety, or other related fields are required for some advanced positions.

2.3.5 Career Pathway Documentation

All career pathways and priority occupations identified as priorities by this initiative and referenced previously within this report are documented using four standardized templates: a pathway graphic, job description, program of study, and experiential learning aide.

Career Pathway Graphic: Demonstrates entry points into the profession, training/educational requirements, priority job titles, and salary ranges. A “program of study” is juxtaposed against a corresponding career ladder, with arrows connecting the pathways as entry/exit points. Wage data is nationalized for each position (Salary.com) and certifications are shown where they enhance career access.

In this Traffic Engineering example, a bachelor's degree in civil engineering is the minimum educational requirement to access a career position, while advancement upwards requires a combination of work experience, certification, and advanced degrees. Access to “Advanced Traffic Operations Project Manager” requires at least 6-10 years of work experience, a college degree (preferably master's), with recommendations for certifications and licensure for Professional Engineer (PE), Envision Sustainability Professional (ENV SP), and American Institute of Certified Planners (AICP).



Transportation Operations

Job Description: The priority occupation job description, like the Traffic Engineer example shown at right, describes an occupation in terms of its typical employment role, alternative industry job titles, priority competency requirements, required educational/training levels and degree/credential attainment, expectations for job-related work experience, and typical salary range. All job descriptions, KSAs, education, and experience requirements were compiled from an analysis of numerous online job postings for each title within an occupational pathway. Salary data (Salary.com) reflects the lowest and highest values documented on the career ladder of this occupation's corresponding pathway graphic.

Program of Study: At least one program of study is established for each career pathway, each presenting an education/training roadmap that starts with a high school diploma. Associate, bachelor's, and master's degrees are documented where applicable, and each program details licensing or certifications necessary for the field. For those occupations accessible from multiple academic pathways, multiple programs of study are provided. As an example, few stand-alone college programs exist for emerging fields like data science, so its workforce may possess a variety of academic backgrounds. Therefore, example programs are documented for data science, supply chain, and business information systems.

The Traffic Engineering example at right documents a program of study for civil engineering. Relevant courses for 2-year, 4-year, and post graduate study are described, and since a professional engineering license is important for advancement, details on this certification is also provided.

Job Description: Traffic Engineer (Traffic Operations)

Alternative Job Titles
Entry-Level Engineer, Traffic Operations Engineer, Traffic Operations Program/Project Manager, Traffic Engineer, Traffic Program/Project Manager, Advanced Traffic Operations PM/Engineer

Job Description
A traffic engineer will execute traffic signal, traffic operations, and intelligent transportation system design projects using civil engineering principles. A traffic engineer may work on traffic warrant and parking studies, transportation planning studies, traffic event management studies, and traffic signal/roadway design projects. Other design projects may include integration of connected and automated vehicle infrastructure, roundabouts, pavement markings, signage, and temporary traffic control devices. A senior engineer may review and make recommendations on existing and proposed signals, delineations, roadway lighting, and pavement markings. A traffic engineer should execute traffic engineering functions and activities to ensure efficient and safe traffic operations. An engineer with project management duties will manage project scope, schedule, and budget and serve as lead to bring a project to completion. Other responsibilities may include:

- Use of engineering software and equipment to perform engineering tasks.
- Collection and preparation of data for evaluation and engineering reports.
- Coordination of projects from planning through final design.
- Design or management of transportation facilities operations.
- Management of staff and technical resources for a given engineering project.
- Coordination of project tasks across a variety of stakeholders.

Knowledge Requirements

- Transportation/ Traffic Engineering/ Operations
- Local Agency Procedures/ Standard Design Principles
- Project Management Practices
- MUTCD
- ITS Technology/ Operations
- Highway Capacity Manual
- ITE's Traffic Engineering Handbook and Trip Generation Manual
- ASHTO

Technical Skills Requirements

- Synchro, VISSIM, SimTraffic, HCS, Sidra, VISTRO, CORSIM, AutoCAD, Microstation
- GIS Software, Google
- General Computer Skills, MS Office

Education & Work Experience

- Master's degree preferred, bachelor's degree required.
- Major coursework in civil engineering with traffic or transportation emphasis sometimes preferred. EIT/PE License commonly required, FTCE sometimes preferred.

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Managerial/ Supervisory Experience and Leadership Skills
- Interpersonal Skills
- Time and Task Management Skills
- Technical Communication/Report Development Skills
- Analytical, Mathematical, or Problem-solving Skills
- Ability to be innovative or creative
- Presentation Skills
- Possess a good attitude/work ethic
- Ability to work well on a team
- Organizational Skills/Attention to Detail
- Ability to work well independently
- Possess professional judgement
- Ability to work in fast-paced or stressful environment

Typical Salary

- \$24,900 - \$34,000

Program of Study: Civil Engineering

Professional Engineering License
Traffic/Transit engineers who have worked under a licensed engineer for four years qualify to take the PE exam to obtain their license. The average salary increase for those with a PE license is 5%. Students must obtain engineering degrees from an ABET accredited institution to be eligible for professional licensure.

Master's of Science in Civil Engineering
Concentrations: Traffic Engineering, Transit Operations

Year 6: Students choose electives from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They can also choose either a traffic engineering or transit operations concentration for their studies, within which they choose from a selection of concentration courses.

Typical Core Courses

- Applied Statistics
- Numerical Analysis
- Transportation System Analysis
- Traffic Engineering Operations
- Traffic Flow Theory
- Transportation Planning

Concentration Courses

- Traffic Modeling and Simulation
- Transportation & Environment
- Advanced Traffic Signal Systems
- Transportation Network Analysis
- Freight Demand Modeling
- Urban Transportation Engineering
- Transit Planning and Operations

Bachelor's Degree in Civil Engineering

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended enrolling in career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory GIS, quantitative/qualitative research. They are introduced to courses across the spectrum of civil concentrations.

GE Courses

- Calculus 2 / 3
- Differential Equations
- Social Science, Synthesis
- Humanities & Symbolic

Civil Engineering Core Courses

- Structural Analysis
- Fluid Mechanics
- Soil Mechanics
- Civil Engineering Materials
- Engineering Statistics
- Transportation Systems Engineering

Elective Courses

- Highway Design
- GIS for Civil Engineers
- Urban Transportation Planning
- Public Safety/Transportation
- Transportation Safety
- Intelligent Transportation Systems
- Traffic Engineering
- Transportation Systems Management and Operations

Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

- Analytical Reading, Expository Writing
- Critical Thinking
- Oral Communication
- General Chemistry
- Economics
- Political Science
- Sociology

Civil Engineering-Related Courses

- Intro to Engineering Concepts
- Engineering Materials
- Intro to Surveying

Lower-Division / Major Prerequisites

- Algebra II
- Pre-Calculus / Calculus
- Intro to Computer Programming
- Intro to AutoCAD
- GIS Special Applications

High School Diploma
Transportation-related career academics.

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Transportation Operations

Experiential Learning: Recommended experiential learning programs are cataloged for each pathway, as demonstrated by the example at right compiled for civil engineering students interested in traffic or transit engineering. Professional organizations frequently offer experiential learning through competitions, projects, workshops, conferences, or other resources, and often provide networking opportunities for students. The relevant organization for each program is identified where applicable, along with avenues for pursuing local/national internships or apprenticeships. Innovative approaches to learning are also prescribed as a way to make the career pathway more learning efficient for students, and are largely the same recommendations for all operations pathways.

Experiential & Innovative Learning: Civil Engineer



Experiential Learning Programs for Civil Traffic/Transit Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness.

American Society of Civil Engineers (ASCE) Student Chapters

ASCE provides value to civil engineering and civil engineering technology students by expanding their network. Through webinars, opportunities, leadership resources, mentoring, student chapter meetings, scholarships, contests, and competitions, members meet colleagues who share a commitment to the civil engineering profession. Competitions of interest to Powers Engineers include the National Concrete Canoe Competition and International Contest on Long Term Pavement Performance Data Analysis. Students attend regional conferences to compete and to present technical papers.

Summer Transportation Internship Program for Diverse Groups (STIPD)

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 STIPD 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 STIPD 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.

Transportation Tech

TransportationTech.com provides online, on-demand educational curricula for Intelligent Transportation Systems and Connected Vehicle technology. Transportation Tech content is designed and developed to encourage students to choose careers in ITS as well as train current ITS and CV technicians in the field. The site features a free ITS Boot Camp for students, as well as an informative online magazine (The Accelerator) focused on innovations in transportation technology.

American Public Transportation Association (APTA)

APTA provides research, conference and workshops, and other resources for professionals in the public transportation industry, but also has significant programming for youth. APTA offers teachers guides to help integrate public transportation related issues into K-12 schools, hosts a Biennial Youth Summit to introduce high school students from across the country to career opportunities in public transportation, hosts a Transit Virtual Career Network that profiles a variety of transit occupations, and has had leadership academies for early career and experience professionals.

Municipal Traffic Engineering Departments

Coaching and direct offer opportunities for paid internships, co-ops, and apprenticeships. In apprenticeship 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 civil engineering roles, including design, operations, and maintenance. Some DOTs also employ college students to assist in the completion of seasonal work related to highway maintenance, crash system repair and analysis, maintenance at roadside rest facilities, and flagging. Some training is provided on the job. DOTs offer seasonal programs to entry-level engineers so that they experience different business areas within the organization before selecting a permanent assignment.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships, and financial support through its Dwight D. Eisenhower Transportation Fellowship Program to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

American Association of State Transportation Highway Officials (AASTHO)

While students are not eligible for AASTHO membership, the website offers an email subscription to the Daily Transportation Update of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments – brief videos of topics. Other videos feature CEOs and other leaders in the transportation world. AASTHO provides a strong social media presence communicating issues, projects, and announcements.

American Public Works Association (APWA)

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credits hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field.

Engineers Without Borders USA

Engineers Without Borders provides service-learning opportunities for students at the local and international levels. The national organization offers internships while students chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

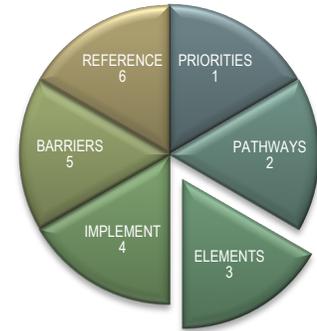
Institute of Transportation Engineers (ITE)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation planning and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

Transportation Operations

SECTION 3.0 THE SIX ELEMENTS OF PATHWAY DEVELOPMENT

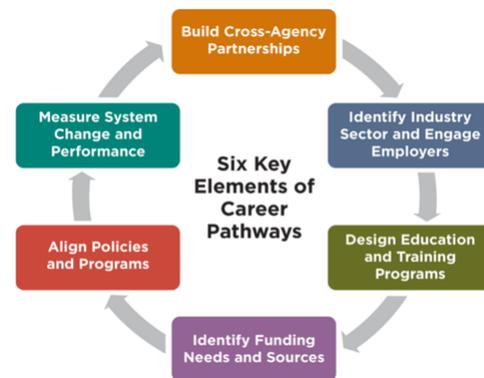
All NNTW implementation plans follow the six key elements of career pathway development, established by the Employment Training Association (ETA) of the Department of Labor (DOL), which are designed to guide state and local workforce development teams through the steps necessary for developing a comprehensive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



These six elements are:

7. Build Cross-Agency Partnerships & Clarify Roles
8. Identify Industry Sectors & Engage Employers
9. Design Education & Training Programs
10. Identify Funding Needs & Sources
11. Align Policies & Programs
12. Measure System Change & Performance

In the design of career pathways that are critical to the Operations workforce—and an implementation plan for deploying those pathways into the post-secondary educational continuum, the SETWC team approached this ETA system using the following strategies:



3.1 Build Cross-Agency Partnerships & Clarify Roles

As the goal for this implementation plan is to ensure students are made aware of transportation operations career pathways and have the opportunity to participate in experiential learning that will engage and inspire them to consider these careers, our approach to developing partnerships includes the full academic pipeline—from K-12 to higher education—as well as industry. Ultimately, education institutions must work together to develop alignment between programs and to establish clear pathways for progression along priority career paths. And for programs to meaningfully prepare students for the workforce, industry stakeholders must be involved in identifying the core competencies to be addressed, in creating real-world problems and projects, and in mentoring and inspiring students to pursue operations careers. Thus, successful and fully collaborative partnerships are the key to success of this plan.

Transportation Operations

3.2 Identify Industry Sectors & Engage Employers

Transportation operations encompasses a diverse set of industry stakeholders, from public and private-sector to traffic, transit, and freight-focused organizations. Our industry engagement begins with the Operations DWG, which includes several active and diverse industry partners. To fully develop the partnerships needed to take this plan to scale, the support of professional organizations and national centers such as NOCoE are incredibly important. Our strategy is to work through such organizations and their networks to ensure national and sustained impact. It is also essential to begin with a local pilot to demonstrate impact, refine materials, and develop success stories that are effective in motivating additional industry partners to engage.

3.3 Design Education & Training Programs

The approach to creating additional educational experiences for students is based on the fact that it is not feasible to create a separate “transportation operations” academic program of study. Instead, it is necessary to integrate operations-focused content into existing programs with already packed curriculum. To accomplish this, curricula must be carefully crafted to align with existing courses, resources must be developed to minimize instructor burden in adding new curricula to a course, and the content should be flexible enough to be used in a variety of settings—both formal and informal—to maximize potential impact.

3.4 Identify Funding Needs & Sources

Funding is required not just for implementation and scale of this plan, but also for its rigorous longitudinal evaluation. SETWC’s approach to funding this project includes submitting proposals to private foundations and/or federal agencies such as the National Science Foundation, Department of Education, or Department of Labor, as well as seek corporate sponsorship and other in-kind support. SETWC will also pursue organizational partnerships, such as with NOCoE and ITE or other professional organizations, for long-term sustainability.

3.5 Align Policies & Programs

The key to developing a robust transportation operations workforce is through increased visibility and better alignment of industry needs with academic program outputs. This requires collaboration across K-12 and higher education to ensure pathways for progression are not

Transportation Operations

only clear, but feasible. As an example, many community colleges have 2-year engineering programs that may not fully transfer to a university due to accreditation issues, leaving students faced with a much longer time to degree completion than anticipated.

It is critical that these institutions work together to develop alignment across programs and minimize “credit loss” in the transfer process. This is already underway between the University of Memphis and Southwest Tennessee Community College; lessons learned from this process will be shared broadly to facilitate similar arrangements between other institutions.

At the high school level, it is important that any curriculum developed aligns to standards for core subject areas—such as math and science—to facilitate deployment within secondary programs. Dual enrollment and dual credit options in high schools must also be maximized so that students realize less time to degree completion.

Integration of rigorous real-world projects, such as proposed through this implementation plan, can also assist with creating a common set of experiences that increase rigor and make it easier to create a case for dual enrollment or credit.

3.6 Measure System Change & Performance

To determine system change and performance, it is necessary to track a variety of impact metrics. Numbers of students, educators, institutions, and industry partners engaged in the implementation program must be tracked so that local, regional, and national participation is documented. Shifts in perception, awareness, and interest of students must also be examined and provides important evidence for demonstrating impact.

Understanding impact of the implementation program from both the educator and employer perspective is also crucial for program refinement and long-term sustainability.

Transportation Operations

SECTION 4.0 CAREER PATHWAY IMPLEMENTATION

4.1 Project Title

“Attracting Next-Gen Transportation Operations Professionals”

4.2 Workforce Priority

An overarching theme in transportation operations is the necessity for a systems approach and the ever-changing impacts of technological advances. In the public sector, the rise of ITS has rapidly changed the competency requirements of its workforce. Transformative technologies dominate all areas of operations and occupy a key focus for both private employers and public agencies, whether from the standpoint of impact on efficiencies and the way business is conducted or challenges in attracting and retaining an appropriately skilled workforce. It is crucial to examine how we are preparing the workforce of the future to deal with disruptive/transformational technology and rapidly changing workplace demands.

In 2018, SETWC developed an approach to addressing these workforce challenges by focusing on career pathway solutions that provide demonstrable achievements for both students, in terms of articulating a continuum of learning and occupational opportunity, and employers, by providing a technically agile and comprehensively skilled talent pool. All research, education, and industry engagement efforts are guided by the FHWA stance that the nation’s ability to successfully deliver and manage an efficient, safe, and effective transportation system is dependent on the knowledge, skills, and abilities of the transportation workforce.

4.3 Project Description

A set of priority occupations within transportation operations was identified through collaboration with the Operations DWG and an extensive research effort that included literature review, labor market analysis, broad stakeholder surveys, and a validation feedback loop. The priority occupations identified span the operational areas of traffic, transit, and freight, and highlight a significant overlap across these segments of the transportation industry.

Additionally, four career clusters emerged from this analysis, including operations management, systems/operations engineering, operations research and data science, and operations



Transportation Operations

technology. Documentation for 10 career pathways falling within these clusters was developed to launch this implementation project, each including a graphical career pathway model, priority job specifications, an associated program of academic study and/or training, and a catalog of relevant experiential learning programs designed to enhance student workplace skills.

In evaluating this occupational research and the readiness of the operations workforce, SETWC has designed a career pathway implementation that specifically addresses these findings:

- ***It is important to tell the story*** of transportation operations so that potential candidates understand the value of these workers in our society. By “putting a face” on these occupations, candidates better visualize themselves in these roles.
- ***Integrating experiential learning into academic programs*** through innovative interdisciplinary partnerships and demonstrating to students the opportunities available within transportation operations are key to developing career awareness and relevant competencies for the workforce of the future.

The primary initiatives that are part of this solution are:

1. **Transportation Operations Career Pathway Portal:** This engaging online web resource will allow users to explore a variety of career pathways through an interactive investigation of the skills, training, and education required to access these priority occupations. To demonstrate pathway accessibility, the portal will introduce students to a diverse group of industry professionals through a series of “Transportation Spotlights” that will help humanize and personalize these often-opaque career options.

Note: By June 30, 2019, SETWC will deploy a fully developed operations career path for a one priority occupation, to begin its demonstration of this portal initiative.
2. **Transportation Operations Challenge Projects:** This initiative fosters a collaborative industry-academia approach to creating resources that demonstrate transportation operations careers through the development of exciting, interdisciplinary, real-world challenge projects that are relevant to existing curriculum and can be readily deployed within K-12, technical schools, community colleges, and 4-year universities.

Transportation Operations

Note: By June 30, 2019, SETWC will develop three challenge project statements (one for traffic, transit, and freight) and identify additional partners for pilot deployment.

Beyond the initial efforts noted, SETWC proposes to fully develop an interactive web portal that includes resources for each of the priority occupations identified under NTCPI, and to develop an extensive repository of challenge projects that have been pilot tested and prepared for full-scale deployment to multiple institutions. Over the course of the four-year implementation period, more than 300 students are forecast to be impacted by this deployment.

Further, to maximize outreach to target student populations, promotional strategies will be deployed to engage faculty and students around Transportation Operations Challenge Projects and to increase the visibility and use of the Transportation Operations Career Pathway Portal.

Long-term, this plan provides for the extensive assessment and revision of products in order to ensure that users receive the resources that best address their interests and needs. SETWC will also look at opportunities to develop a rigorous longitudinal tracking program through a carefully designed research proposal submitted to a private foundation or government agency, such as the National Science Foundation, Department of Education, or Department of Labor.

4.4 Implementation Partners

SETWC thanks its partners for their continued engagement, contribution, and commitment to developing workforce solutions that positively impact the lives of students and the incumbent workforce. In their support of this career pathway pilot implementation for the transportation operations discipline, each of these valued partners have agreed to participate as key contributors to this plan's deployment, success, and long-term sustainability. SETWC's partner organizations, including their roles and responsibilities, are presented below:

National Operations Center of Excellence (NOCoE): Director Patrick Son is an active member of the Operations DWG and leads a variety of student-focused initiatives designed to increase interest in TSMO. Son will play a key role in implementation planning and expanding the deployment of initiatives to non-local partners. NOCoE is key to providing a venue for sustaining this resource long-term.



Transportation Operations

Tennessee Department of Transportation (TDOT): TDOT already provides representatives to the Operations DWG, guest speakers for a pilot TSMO course developed/deployed by SETWC at the University of Memphis (UM) in Spring 2018, staff for workshops with high school students in SETWC's Summer Transportation Academy, and representatives for operations-related panels and sessions during UM hosted events like the annual [State of Freight Conference](#) and [Choosing Transportation Summit](#). TDOT will play an important role in implementation planning by helping develop transportation challenge projects, facilitating spotlights of transportation operations staff, and providing mentors for students in challenge project activities.



Southwest Tennessee Community College (SWTCC): Currently embarking on an effort to better align pre-engineering programs with UM's four-year engineering degree pathways, SWTCC offers an excellent opportunity for piloting Transportation Operations Challenge Projects and deploying the Transportation Operations Career Pathway Portal with students.



East High Transportation-STEM (T-STEM) Academy: A result of SETWC's partnership with Shelby County Schools, the [T-STEM Academy](#) is a perfect setting for integrating both challenge projects and the web portal at the high school level. Strong industry-academia partnerships will also facilitate pilot deployment of challenges and engagement of professional and student (college) mentors with participating T-STEM students.



Gannett Fleming: Vice President Eric Rensel is a prominent member of the Operations DWG and national leader in the Institute of Transportation Engineers. Through Rensel's leadership, Gannett Fleming will partner on the challenge project initiative to help develop project statements, provide mentors, and to identify opportunities for scale and replication.



TRC Engineering: Memphis-area Transportation Operations Project Engineer Michael Rebick will lead TRC's engagement efforts in the challenge project initiative, by providing input to project statements, mentors, and developing opportunities for scale and replication.



Transportation Operations

As implementation scales beyond the demonstration pilots, these partnerships will be tapped to leverage their expertise and networks to expand the initiatives:

Institute of Transportation Engineers (ITE): Several ITE members participate in the Operations DWG, and locally TSITE has been very active with both UM and the T-STEM Academy. These alliances will continue to play a prominent role in finalizing implementation planning and pilot deployments. ITE's role will increase in importance with full-scale implementation, due to its ability to engage members through local, section, district, and national venues.



Greater Memphis IT Council: As an industry partner, this council offers significant local expertise in transportation operations through its public and private-sector members and is targeted to become a prime candidate for engagement in local pilot initiatives.



To achieve scale, existing relationships with NOCoE, ITE, TRB standing committees, and other Operations DWG members will be leveraged to identify additional partners to achieve regional and national replication goals.

4.5 Partner Commitments

In an expression of their commitment to the deployment and mission of this implementation plan, SETWC partners have “signed-on” as key contributors of time, expertise, resources, and in some cases funding, through the authorized letters of agreement presented below. It is this level of engagement that makes a program of this scale possible.

Transportation Operations



November 26, 2018

Dr. Stephanie Ivey, Director
Southeast Transportation Workforce Center
University of Memphis
202B Engineering Administration
Memphis, TN 38152

RE: National Transportation Career Pathways Initiative
Operations Career Pathway Implementation Partnership

Dear Dr. Ivey,

Gannett Fleming is pleased to partner with the Southeast Transportation Workforce Center (SETWC) in the deployment of a career pathway program for the transportation operations workforce. Gannett Fleming is firmly committed to advancing the transportation operations workforce through investing time in initiatives that promote operations careers and inspire the next generation workforce. We believe partnering with SETWC in this venture is in direct alignment of this goal.

We understand the proposed project seeks to expand awareness of and interest in priority occupations in the transportation operations discipline, by offering K-12 and post-secondary students opportunities to participate in real-world operations projects that engage them in exciting problems to illuminate the important role of transportation operations professionals.

As a lead project partner, we intend to participate in the following ways:

- Participate in overall challenge model development process.
- Provide leadership in developing operations challenge projects.
- Provide staff to serve as mentors to students participating in operations challenges.
- Work collaboratively to identify opportunities for scale and replication.
- Attend and participate in all Operations discipline working group meetings.

Gannett Fleming is highly supportive of this initiative and we look forward to working with SETWC to provide students with better understanding of and motivation to pursue career opportunities in transportation operations.

Sincerely,

Eric Rensel
Vice President
Gannett Fleming, Inc.

Gannett Fleming, Inc.
P.O. Box 67100 • Harrisburg, PA 17106-7100 | 207 Senate Avenue •
Camp Hill, PA 17011-2316 | t: 717-763-7211 • f: 717-763-8150
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December 21, 2018

Dr. Stephanie Ivey, Director
Southeast Transportation Workforce Center
University of Memphis
202B Engineering Administration
Memphis, TN 38152

RE: National Transportation Career Pathways Initiative
Operations Career Pathway Implementation Partnership

Dear Dr. Ivey,

The National Operations Center of Excellence (NOCOe) is pleased to partner with the Southeast Transportation Workforce Center (SETWC) in the deployment of a career pathway program for the transportation operations workforce. NOCOe is firmly committed to advancing the transportation operations workforce through investing time in initiatives that promote operations careers and inspire the next generation workforce, and is leading numerous initiatives in this area. We believe partnering with SETWC in this venture is in direct alignment with our mission.

We understand the proposed project seeks to expand awareness of and interest in priority occupations in the transportation operations discipline, by offering K-12 and post-secondary students opportunities to participate in real-world operations projects that engage them in exciting problems to illuminate the important role of transportation operations professionals.

As a lead project partner, we intend to participate in the following ways:

- Participate in overall challenge model development process.
- Provide leadership in developing operations challenge projects.
- Help identify mentors for students participating in operations challenges.
- Work collaboratively to identify opportunities for scale and replication.
- Investigate options for sustaining this program through NOCOe.
- Attend and participate in all Operations discipline working group meetings.

NOCOe is highly supportive of this initiative and we look forward to working with SETWC to provide students with better understanding of and motivation to pursue career opportunities in transportation operations.

Sincerely,

Patrick Son, P.E.
Managing Director
National Operations Center of Excellence



P.O. Box 780 • Memphis, TN 38101-0780 • (901) 333-5000 • www.southwest.tn.edu

November 26, 2018

Dr. Stephanie Ivey, Director
Southeast Transportation Workforce Center
University of Memphis
202B Engineering Administration
Memphis, TN 38152

RE: National Transportation Career Pathways Initiative
Operations Career Pathway Implementation Partnership

Dear Dr. Ivey,

Southwest Tennessee Community College (SWTCC) is pleased to partner with the Southeast Transportation Workforce Center (SETWC) in the deployment of a career pathway program for the transportation operations workforce. SWTCC recognizes the importance of transportation in our regional economy and is firmly committed to creating clear career pathways and transfer opportunities for our students in operations-related disciplines. We believe partnering with SETWC in this venture is in direct alignment of our goals.

We understand the proposed project seeks to expand awareness of and interest in priority occupations in transportation operations, by offering K-12 and post-secondary students opportunities to participate in real-world operations projects that engage them in exciting problems to illuminate the important role of transportation operations professionals.

As a lead project partner, we intend to participate in the following ways:

- Participate in overall challenge model development process.
- Provide leadership in identifying relevant SWTCC programs and transfer pathways.
- Identify courses/faculty for challenge project implementation.
- Work collaboratively to identify opportunities for scale and replication.
- Attend and participate in all Operations discipline working group meetings.

SWTCC is highly supportive of this initiative and we look forward to working with SETWC to provide students with better understanding of and motivation to pursue career opportunities in transportation operations.

Sincerely,

Anita Brocklin
Associate Vice President, Workforce, Economic Development & Continuing Education
Southwest Tennessee Community College
(o) 901-333-4018
(m) 901-605-9399
abrocklin1@southwest.tn.edu

Macon Cove Campus • Union Avenue Campus • Fayette Site • Gill Center • Maxine A. Smith Center • Millington Center • Whitehaven Center

Southwest Tennessee Community College, a Tennessee Board of Regents institution, is an affirmative action/equal opportunity college.



STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
TRAFFIC OPERATIONS DIVISION
SUITE 300, JAMES K. POLK BUILDING
NASHVILLE, TENNESSEE 37243
(615) 741-8017

JOHN C. SCHROER
COMMISSIONER

BILL HASLAM
GOVERNOR

December 14, 2018

Dr. Stephanie Ivey, Director
Southeast Transportation Workforce Center
University of Memphis
202B Engineering Administration
Memphis, TN 38152

RE: National Transportation Career Pathways Initiative
Operations Career Pathway Implementation Partnership

Dear Dr. Ivey,

The Tennessee Department of Transportation (TDOT) is pleased to partner with the Southeast Transportation Workforce Center (SETWC) in the deployment of a career pathway program for the transportation operations workforce. TDOT is firmly committed to advancing the transportation operations workforce through investing time in initiatives that promote operations careers and inspire the next generation workforce. We believe partnering with SETWC in this venture is in direct alignment with our shared mission.

We understand the proposed project seeks to expand awareness of and interest in priority occupations in the transportation operations discipline, by offering K-12 and post-secondary students opportunities to participate in real-world operations projects that engage them in exciting problems to illuminate the important role of transportation operations professionals.

As a lead project partner, we intend to participate in the following ways:

- Attend Operations Discipline Working Group meetings.
- Participate in overall challenge model development process.
- Provide leadership in developing operations challenge projects.
- Identify TDOT mentors for students participating in operations challenges.
- Work collaboratively to identify opportunities for scale and replication, particularly by replicating in other TDOT regions across the state.

TDOT is highly supportive of this initiative and we look forward to working with SETWC to provide students with better understanding of and motivation to pursue career opportunities in transportation operations.

Sincerely,

Brad Freeze, PE
Director, TDOT Traffic Operations Division

Transportation Operations



November 29, 2018

Dr. Stephanie Ivey, Director
Southeast Transportation Workforce Center
University of Memphis
202B Engineering Administration
Memphis, TN 38152

RE: National Transportation Career Pathways Initiative
Operations Career Pathway Implementation Partnership

Dear Dr. Ivey,

TRC Engineering, Inc. (TRC) is pleased to partner with the Southeast Transportation Workforce Center (SETWC) in the deployment of a career pathway program for the transportation operations workforce. TRC is firmly committed to advancing the transportation operations workforce through investing time in initiatives that promote operations careers and inspire the next generation workforce. We believe partnering with SETWC in this venture is in direct alignment of this goal.

We understand the proposed project seeks to expand awareness of and interest in priority occupations in the transportation operations discipline, by offering K-12 and post-secondary students opportunities to participate in real-world operations projects that engage them in exciting problems to illuminate the important role of transportation operations professionals.

As a lead project partner, we intend to participate in the following ways:

- Participate in overall challenge model development process.
- Provide leadership in developing operations discipline projects.
- Provide staff to serve as mentors to students participating in operations challenges.
- Work collaboratively to identify opportunities for scale and replication.
- Attend and participate in all Operations discipline working group meetings.

TRC is highly supportive of this initiative and we look forward to working with SETWC to provide students with better understanding of and motivation to pursue career opportunities in transportation operations.

Sincerely,


Michael F. Rebeck, PE
Transportation Operations Project Engineer
mrebeck@trcsolutions.com



Lisha T. Brooks
Executive Principal



December 13, 2018

Dr. Stephanie Ivey, Director
Southeast Transportation Workforce Center
University of Memphis
202B Engineering Administration
Memphis, TN 38152

RE: National Transportation Career Pathways Initiative
Operations Career Pathway Implementation Partnership

Dear Dr. Ivey,

As Executive Principal of East High T-STEM Academy, I am pleased to confirm our partnership with the Southeast Transportation Workforce Center (SETWC) in the deployment of a career pathway program for the transportation operations workforce. I recognize the importance of transportation in our regional economy and am committed to ensuring T-STEM students are aware of the diverse opportunities available to them through transportation careers. I believe partnering with SETWC in this venture is in direct alignment with the goals for T-STEM.

I understand the proposed project seeks to expand awareness of and interest in priority occupations in transportation operations, by offering K-12 and post-secondary students opportunities to participate in real-world operations projects that engage them in exciting problems and illuminate the important role of transportation operations professionals.

As a lead project partner, we intend to participate in the following ways:

- Participate in overall challenge model development process.
- Provide leadership in identifying relevant high school courses or extracurricular options for integrating challenges.
- Work collaboratively to identify opportunities for scale and replication.
- Attend and participate in Operations discipline working group meetings.

T-STEM Academy is highly supportive of this initiative and we look forward to working with SETWC to provide students with better understanding of and motivation to pursue career opportunities in transportation operations.

Sincerely,



Transportation Operations

4.6 Project Outcomes

Current year activities are focused on developing an initial model for the operations career pathway resource, industry-academia and interdisciplinary partnerships, and problem statements for Transportation Operations Challenge Projects. Future years will focus on expanding the web resource and development and deployment of challenge projects into a variety of educational settings. Impact will be evaluated through documentation of web resource use, pre/post-surveys of challenge project participants, and the tracking of students pursuing operations careers. The expected outcomes for a 2019-2020 deployment include:

First-Year Outcomes: Transportation Operations Career Pathway Portal

1. Online, interactive career pathways will be fully developed for all operations career clusters, with a minimum of 5 spotlights per occupation.
2. A promotional strategy and campaign will be developed/deployed to increase awareness of the web portal, with outreach taking place through SETWC stakeholders and professional organizations/networks NNTW, ITE, NOCoE, and CUTC.
3. Portal site tracking will determine use and impact of awareness strategies.

First-Year Outcomes: Transportation Operations Challenge Projects

1. Three challenge projects will be deployed into higher education during the Fall 2019 semester, impacting 30 students. Assessment instruments will be developed, distributed, and evaluated to refine each challenge project, and final project descriptions will be shared online via SETWC and NOCoE websites.
2. Full-scale deployment will occur in Spring of 2020, with three higher-ed institutions in multiple states using each of the three projects within a course. A minimum of 90 students will participate in challenge projects and program evaluation. The Spring 2020 cohort will be developed through existing relationships with faculty who are teaching courses relevant to challenge projects offered at other institutions.
3. Promotional materials will be developed using pictures and quotes from challenge project participants to increase awareness of and interest in the delivery of these projects at higher-ed institutions across the country. A comprehensive awareness campaign (newsletters, social media, website) during early 2020 will recruit participants for the

Transportation Operations

Fall semester. In addition to SETWC stakeholders, outreach will take place through professional organizations and national networks like NNTW, ITE, NOCoE, and CUTC.

4. Three challenge projects will be modified for use in K-12 classrooms and piloted at three schools during the 2019-2020 academic year, with 50 students participating.
5. Three additional projects will be developed in 2019-2020 for piloting in 2020-2021.

4.7 Project Timeline

The proposed initiative activities for 2019-2020 are outlined below:

Transportation Operations Career Pathway Portal

- | | |
|---|------------------|
| 1. Develop transportation operations profile sheet
<i>(for promotion of portal and challenge projects)</i> | August 2019 |
| 2. Develop interactive pathways for first career cluster | April 2020 |
| 3. Finalize pathways in online portal based on DWG input | June 2020 |
| 4. Develop tracking system | June 2020 |
| 5. Report on project status | Quarterly |
| 6. Meet with Operations DWG | Quarterly |
| 7. Repeat 1-4 for remaining career clusters | April 2021/22/23 |
| 8. Develop national promotional strategy | March 2020 |
| 9. Deploy marketing strategy (ongoing) | December 2020 |
| 10. Track portal users and impact | Annual |
| 11. Meet with Operations DWG for review | Quarterly |
| 12. Final implementation plan impact report | June 2023 |

Transportation Operations Challenge Projects

- | | |
|---|---------------|
| 1. Recruit project participants for AY 2019-2020
<i>(includes faculty, students, industry mentors)</i> | Summer 2019 |
| 2. Develop modified challenge projects for K-12 | Summer 2019 |
| 3. Pilot projects with local academic partners
<i>(evaluate/survey students and partners)</i> | December 2019 |
| 4. Deploy projects with expanded multi-state partners | Spring 2020 |
| 5. Develop national recruitment strategy | March 2020 |
| 6. Deploy marketing strategy (ongoing) | |

Transportation Operations

- | | |
|---|-----------------|
| 7. Develop three new challenge projects | May 2020 |
| 8. Recruit participants for AY 2020-2021 | June 2020 |
| 9. Repeat 1-4, 6-7 for expanded projects/partners
(15 projects impacting 300 students and 50 partners) | June 2021/22/23 |
| 10. Report on project status | Quarterly |
| 11. Meet with Operations DWG for review | Quarterly |
| 12. Final implementation plan impact report | June 2023 |

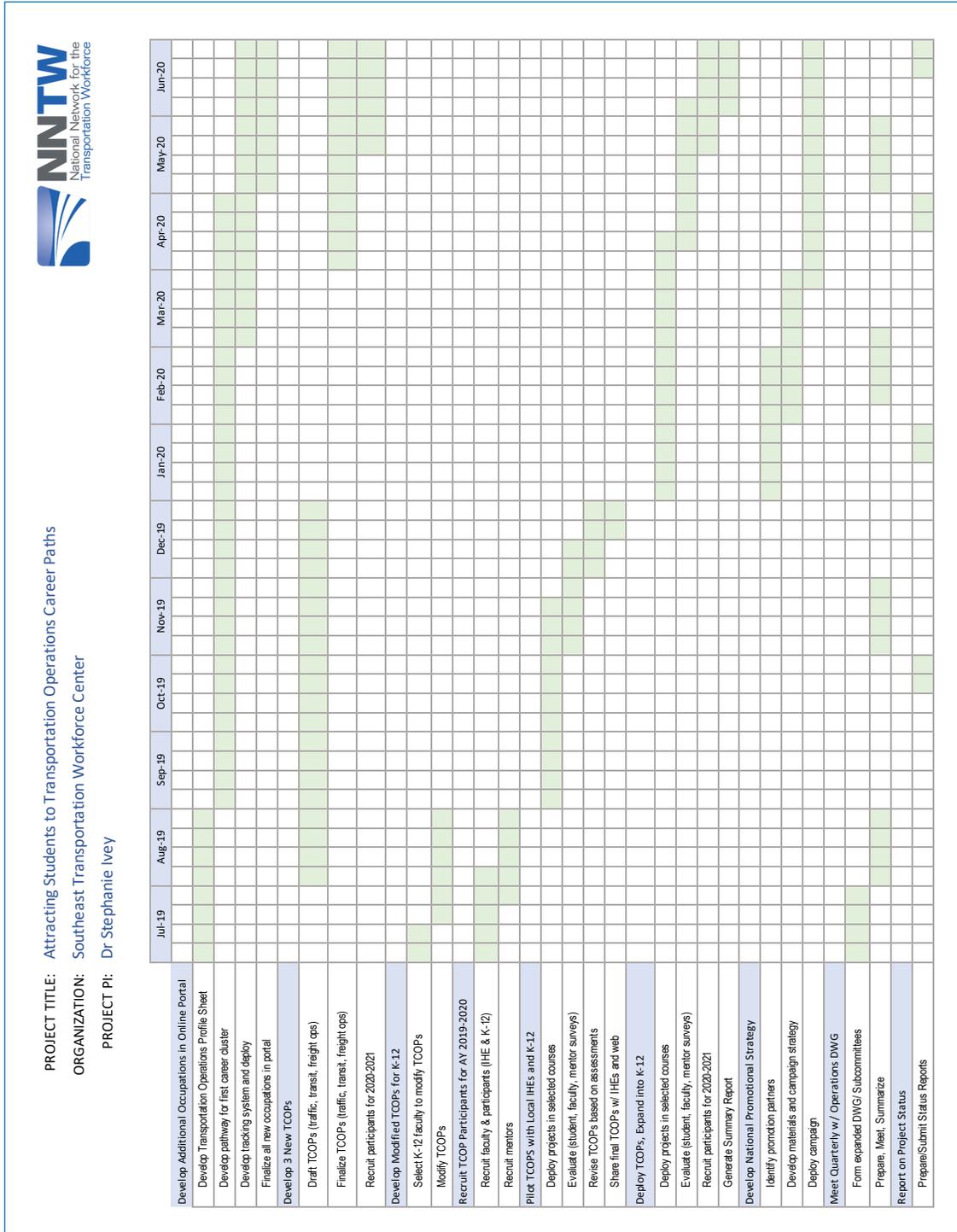
4.8 Project Budget

The first-year budget for this deployment allocates the personnel, travel, and material needs listed below. Successive annual budget needs may increase as additional institutions are included in challenge project delivery and assessment:

Budget Item	Annual Costs	Match	Total Budget
Personnel	\$45,000	\$11,000	\$56,000
Fringe Benefits	\$14,500	\$5,400	\$19,900
Travel & Per Diem	\$4,000	\$1,000	\$5,000
Supplies & Materials	\$5,000	\$1,000	\$6,000
Participant Support	\$15,000	\$2,000	\$17,000
Facilities & Administration (F&A Rate 43.5%)	-----	-----	-----
Annual Totals:	\$113,500	\$28,400	\$141,900

Transportation Operations

4.9 First Year Workplan

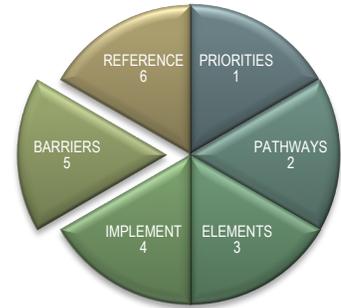


Transportation Operations

SECTION 5.0 BARRIERS TO DEPLOYMENT

Limited Awareness

A key barrier to deploying an implementation plan such as the one proposed here is a general lack of understanding of the importance of transportation operations—the unique skillset requirements of its workforce and the similarities across traffic, transit, and freight realms—even among industry professionals. Thus, a key outcome of this plan is the development of a transportation operations profile sheet and outreach to potential partners within academia and industry to broaden perspectives of the operations profession.



Funding Requirements

Diversifying the sources of funding to support this implementation is crucial to addressing funding challenges.

Partner Engagement

To ensure that partners remain engaged for both the short and long-term, a program must be designed to demonstrate “quick wins” so that partners see value in remaining involved. Additionally, it is very important that collaborative activities are well organized, that they designate clear roles, responsibilities, and outcomes, and that all stakeholder values are clearly communicated and reflected in project activities.

Modifying Curriculum

To create the best opportunities for integration of challenge projects into existing courses, it is very important to have K-12, community college, and university faculty involved in developing projects such that there is clear alignment between course content and goals and that resources are developed to support project integration and relieve faculty of lengthy preparation time for successful implementation.

Long-Term Sustainability

National professional organizations and centers are the key to ensuring widespread awareness of implementation project resources and long-term sustainability.

Transportation Operations

SECTION 6.0 REFERENCES & DOCUMENTATION

6.4 Acronyms & Abbreviations

BLS = Bureau of Labor Statistics

CUTC = Council of University Transportation Centers

CV = Connected Vehicles

DOL = Department of Labor

DOT = Department of Transportation

DWG = Discipline Working Group

FHWA = Federal Highway Administration

ETA = Employment Training Association

ITE = Institute of Transportation Engineers

ITS = Intelligent Transportation Systems

K-12 = Kindergarten to 12th Grade

KSA = Knowledge, Skills, and Abilities

NOCoe = National Operations Center of Excellence

NNTW = National Network for the Transportation Workforce

NTCPI = National Transportation Career Pathways Initiative

SETWC = Southeast Transportation Workforce Center

SOC = Standard Occupational Classification

SWTCC = Southwest Tennessee Community College

T-STEM = Transportation Science, Technology, Engineering, and Mathematics

TDOT = Tennessee Department of Transportation

TOCPP = Transportation Operations Career Pathway Portal

TRB = Transportation Research Board

TSITE = Tennessee Section Institute of Transportation Engineers

TSMO = Transportation Systems Management and Operations

UM = University of Memphis



Transportation Operations

6.5 Career Pathway Documentation

Each of the transportation operations priority occupations and career pathways detailed in this report have been formally documented for use as a career guidance resource in the deployment of pathway initiatives within the post-secondary education/training continuum. A list of those documents is followed by an instantiation of each on the pages that follow:

Commercial Driving

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Computer & Information Systems Management

Career Pathway Graphic, Job Description, Program of Study (Computer Engineering), Program of Study (Computer Science), Experiential & Innovative Learning

Transportation Data Science

Career Pathway Graphic, Job Description, Program of Study (Business Information), Program of Study (Data Science), Program of Study (Supply Chain), Experiential & Innovative Learning

Diesel Technology

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Transportation Operations Research

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Operations Planning

Career Pathway Graphic, Job Description, Program of Study (Civil Engineering), Program of Study (Industrial Engineering), Program of Study (Supply Chain), Experiential & Innovative Learning

Traffic Engineering

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Traffic Incident Management

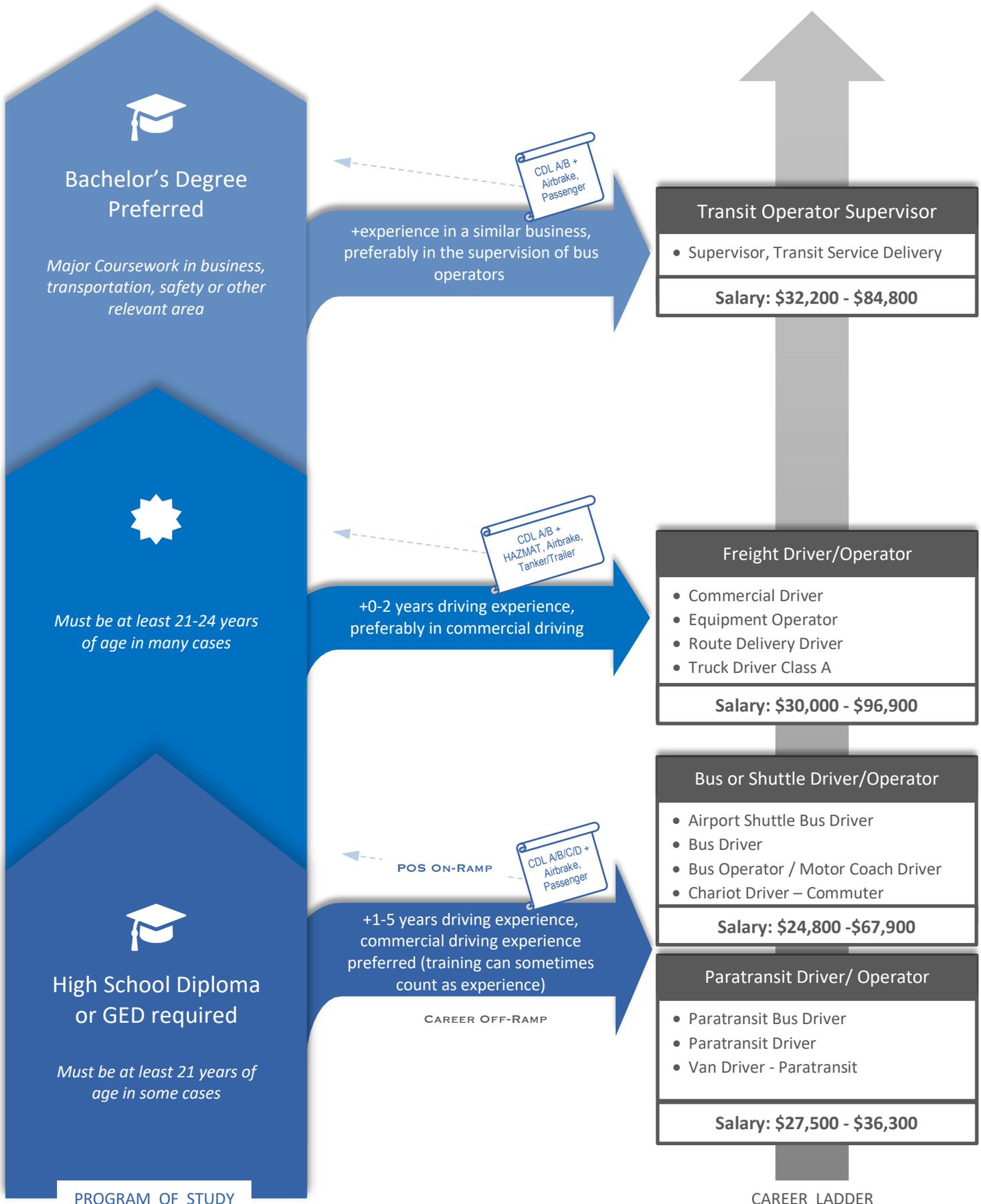
Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Traffic Signal/ITS Technology

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Transit Engineering

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning



Bachelor's Degree Preferred

Major Coursework in business, transportation, safety or other relevant area

+experience in a similar business, preferably in the supervision of bus operators

CDL A/B + Airbrake, Passenger

Transit Operator Supervisor

- Supervisor, Transit Service Delivery

Salary: \$32,200 - \$84,800



Must be at least 21-24 years of age in many cases

+0-2 years driving experience, preferably in commercial driving

CDL A/B + HAZMAT, Airbrake, Tanker/Trailer

Freight Driver/Operator

- Commercial Driver
- Equipment Operator
- Route Delivery Driver
- Truck Driver Class A

Salary: \$30,000 - \$96,900



High School Diploma or GED required

Must be at least 21 years of age in some cases

+1-5 years driving experience, commercial driving experience preferred (training can sometimes count as experience)

POS ON-RAMP

CDL A/B/C/D + Airbrake, Passenger

Bus or Shuttle Driver/Operator

- Airport Shuttle Bus Driver
- Bus Driver
- Bus Operator / Motor Coach Driver
- Chariot Driver – Commuter

Salary: \$24,800 - \$67,900

CAREER OFF-RAMP

Paratransit Driver/ Operator

- Paratransit Bus Driver
- Paratransit Driver
- Van Driver - Paratransit

Salary: \$27,500 - \$36,300

Alternative Job Titles

Bus or Shuttle Operator or Driver, Paratransit Operator or Driver, Supervisor- Transit Service Delivery, Equipment Operator

Full-time City Driver, Local Class A Driver, Local Fuel Driver, Motor Vehicle Operator, OTR Company Driver, Overnight CDL Driver

Job Description

Transit operators or drivers are responsible for the safe and efficient transport of passengers by operating transit vehicles and following traffic laws and applicable regulations. Transit commercial drivers operate busses or other revenue service vehicles to transport customers over routes with specified stops. The main objectives of a transit driver are to safely operate transit vehicles according to an established schedule and route, collect fares from passengers, perform inspections of vehicles before and after operation, and complete relevant incident reports. Transit operators might also sometimes be required to assist senior passengers or passengers with disabilities board transit vehicles.

Commercial freight drivers operate trucks or tractor trailers to make deliveries or transport goods according to a schedule and assigned route. Freight drivers should operate a commercial vehicle in a safe and efficient manner, and they must do so in accordance with applicable laws for commercial vehicle operations. Freight operators might also be asked to determine the condition of the truck or vehicle before and after use and to report any issues.

Knowledge Requirements

- Local Agency Procedures
- Local Geography
- English Language
- Occupational Hazards and Safety Precautions

Technical Skills Requirements

- Ability to operate relevant equipment or software
- General Computer Skills
- Knowledge of Microsoft Office Programs

Required Skills & Abilities

- Ability to perform manual labor/ meet physical requirements
- Communication Skills, Written and Verbal
- Interpersonal Skills
- Ability to pass a background check/ drug screening
- Possess professional judgement
- Ability to work a flexible/irregular schedule
- Ability to work well independently
- Time and Task Management Skills
- Ability to follow/ interpret instructions
- Possess a good attitude/work ethic
- Time and Task Management Skills

Typical Salary

- \$24,800 - \$96,900

Education & Work Experience

- High school diploma or GED required.
- CDL Class A, B, or C required with Passenger/ Airbrake Endorsements needed in most cases.
- Must be 21 years of age in many cases; must possess a clean driving record.



Additional Endorsements

T: Double/Triple Trailers (requires a knowledge test)

P: Passenger Vehicles (requires both a knowledge and a skills test)

N: Tank Vehicles (requires a knowledge test)

H: Hazardous Materials (requires a knowledge test and the TSA Threat Assessment)

X: Tank Vehicle/Hazardous Materials Combination (requires a knowledge test and the TSA Threat Assessment)

S: School Bus (Requires both a knowledge and a skills test)

Additional Requirements to Acquire a Commercial Driver's License (CDL)

Applicants must be at least 21 years of age, and must apply by state and pay an application fee. Applicants must also typically provide evidence of identity and social security, proof of state and US residency, submit a completed medical examination report and certificate, and pass a vision test.



Other related majors

Commercial drivers may also pursue bachelors and higher degrees in other related majors including: safety, business, transportation, logistics, or other relevant areas to enhance their knowledge and skillsets and advance their careers.



CDL Training Programs

The average length for a full time Class A CDL program is 7 weeks. Class B and C programs are typically shorter due to the smaller number of vehicles these licenses are qualified to operate. The course length will depend on the organization offering the program, the type of license class, whether endorsements will be added, and the state's driving hour requirement

Typical Program Credentials

Class A License: allows for operation of tractor-trailers, truck and trailer combinations, tractor-trailer buses, tanker vehicles, livestock carriers, flatbeds, with a gross combination weight rating greater than 26,000 pounds.

Class B License: allows for operation of straight trucks, large buses, segmented buses, box trucks, dump trucks with small trailers with gross combination weight rating greater than 26,000 and/or a vehicle that is towing another vehicle weighing up to 10,000 pounds.

Class C License: allows for operation of small HAZMAT vehicles, passenger vans, combination vehicles not described in Class A or B or transporting hazardous materials.



High School Diploma

Transportation-related career academies

Experiential Learning for Commercial Drivers

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

American Trucking Associations (ATA)

The ATA is the leading advocate for the trucking industry, committed to developing and advocating research-based policies and educating policymakers and the general public about the essential role trucking plays in the economy. ATA provides an extensive news blog, webinars, and links to several radio shows including Tech Talk with TMC, TruckingAmerica, and Red Eye Radio Podcasts featuring ATA members. These resources can provide students with additional knowledge related to the trucking industry not covered in class.

US Department of Labor Apprenticeship (USDOL)

The USDOL offers resources related to apprenticeships in high-demand occupations in many fields, including transportation. Commercial driving is one such field. In addition, the USDOL site provides information about National Apprenticeship Week, which is hosted in November each year. The site offers a listing of all National Apprenticeship Week events across the country so that students can get involved or learn more about apprenticeship through a local event.

Commercial Vehicle Training Association

The Commercial Vehicle Training Association (CVTA) is the largest association representing commercial truck driver training programs in the United States. CVTA's primary mission is to advance and support the commercial driver training industry through advocacy, education programs, and certification programs to help members produce the safest drivers possible. Although they do not offer a student membership, the site features a blog that provides information on current trends and issues that are relevant to those entering the profession.

Women in Trucking Association (WiT)

WiT is a non-profit organization focused on the transportation and logistics industry. WiT's mission is to encourage the employment of women in the trucking industry, promote their accomplishments and minimize obstacles faced by women working in the trucking industry. WiT offers a mentoring program, professional networking, an e-newsletter, and a live, call-in show on SiriusXM focused on issues women face in the industry. WiT also offers a scholarship program for female students through the WiT Foundation.

Innovative Learning Strategies for Commercial Drivers

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within a commercial driving program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards that is designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of "SMEs" should be considered to meet the competency needs of business.

Modularized Curriculum

Structure and sequence curriculum in modules tied to jobs with multiple entry/exit points, with multiple levels of industry recognized credentials built into the sequenced pathway.

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

Instruction that helps students who benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Incorporate opportunities for "learning-by-doing", including internships, apprenticeships, co-op work experience, and simulations developed by local employers.

Context-Based Learning

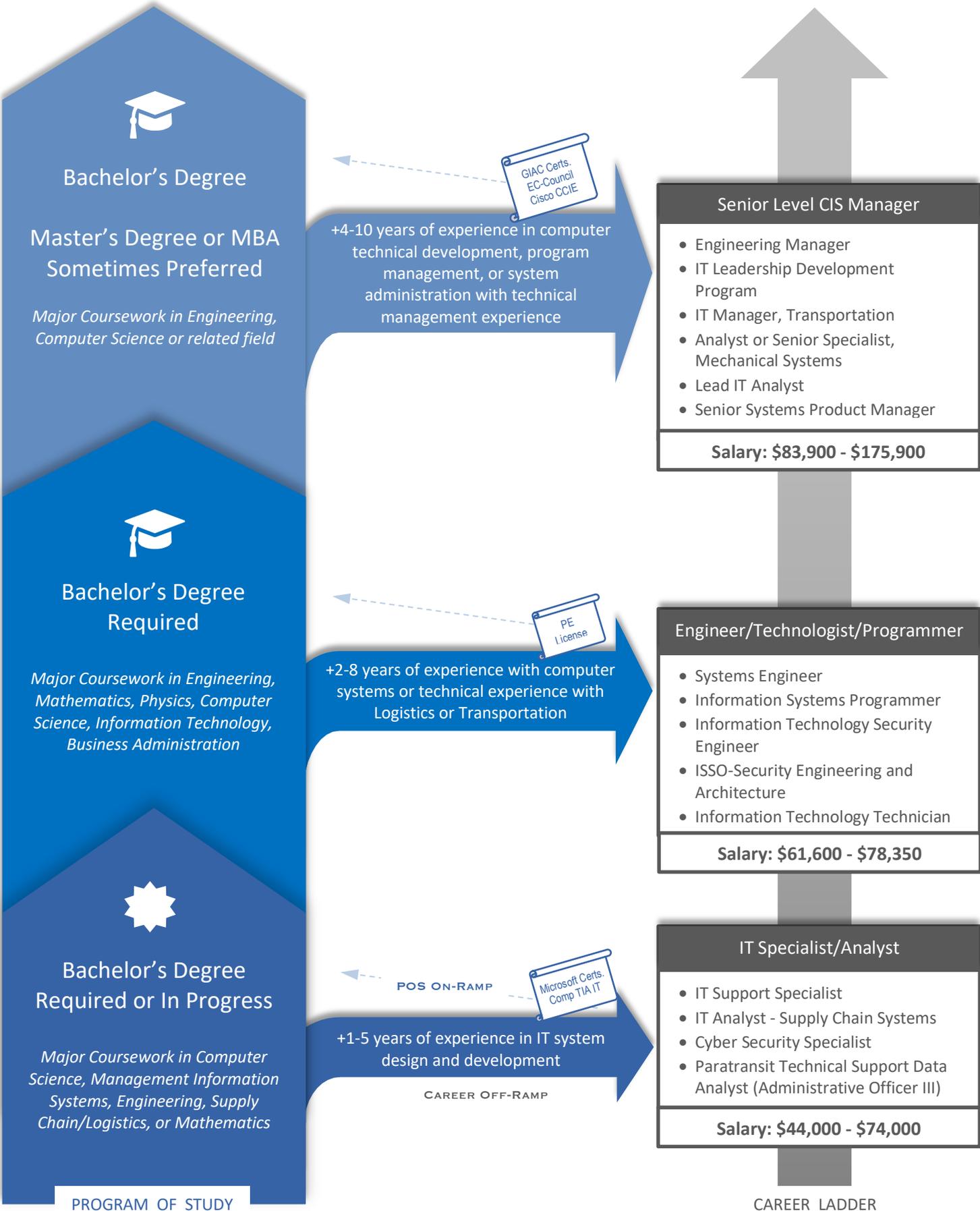
By interpreting new information in the context or place of where and when it occurs and relating it to what we already know, we come to understand its relevance and meaning. To design effective strategies for learning requires an understanding of how context shapes learning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

Industry Academies

Employers develop their own internal programs that are offered to candidates immediately following high school graduation. No formal post-secondary education or training is required for these students to enter a job, and candidates who successfully complete these employer-based programs are immediately hired.



Bachelor's Degree

Master's Degree or MBA Sometimes Preferred

Major Coursework in Engineering, Computer Science or related field



+4-10 years of experience in computer technical development, program management, or system administration with technical management experience

Senior Level CIS Manager

- Engineering Manager
- IT Leadership Development Program
- IT Manager, Transportation
- Analyst or Senior Specialist, Mechanical Systems
- Lead IT Analyst
- Senior Systems Product Manager

Salary: \$83,900 - \$175,900



Bachelor's Degree Required

Major Coursework in Engineering, Mathematics, Physics, Computer Science, Information Technology, Business Administration



+2-8 years of experience with computer systems or technical experience with Logistics or Transportation

Engineer/Technologist/Programmer

- Systems Engineer
- Information Systems Programmer
- Information Technology Security Engineer
- ISSO-Security Engineering and Architecture
- Information Technology Technician

Salary: \$61,600 - \$78,350



Bachelor's Degree Required or In Progress

Major Coursework in Computer Science, Management Information Systems, Engineering, Supply Chain/Logistics, or Mathematics

POS ON-RAMP



+1-5 years of experience in IT system design and development

CAREER OFF-RAMP

IT Specialist/Analyst

- IT Support Specialist
- IT Analyst - Supply Chain Systems
- Cyber Security Specialist
- Paratransit Technical Support Data Analyst (Administrative Officer III)

Salary: \$44,000 - \$74,000

PROGRAM OF STUDY

CAREER LADDER

Alternative Job Titles

IT Specialist or Analyst, Engineer, Systems Engineer, Technologist, Programmer, Cyber Security Specialist, Senior Level Computer Information Systems Manager, IT System Administrator, Supervisory Transportation Security Specialist

Job Description

Computer and Information Systems Managers are responsible for effectively setting and managing the overall information technology agenda for a company or organization. These professionals oversee all computer systems and network architecture, and may also be responsible for system security protocols. In this role, computer system managers may be responsible for:

- Promoting technical implementation at the architecture level, implementing technical solutions, and providing technical support to other users,
- Performing security testing and assessment, developing mitigation plans, and documenting results,
- Assessing, reporting on, and communicating risk and vulnerabilities in computer system architecture,
- Leading security or IT initiatives across multiple teams, communicating with engineering managers or other disciplines along the way,
- Coordinating complex or large-scale projects, estimating work efforts, establishing deadlines and priorities, and managing resources, and
- Managing or coordinating the work of other computer-related positions including analysts and programmers.

Knowledge Requirements

- IT Practices/Computer Science Principles
- Transportation Operations
- Project Management practices (budgeting, scheduling, etc.)
- Data Analytics
- Statistical Analysis/Modeling
- LTL/Freight Forwarding Practices
- Rail Industry

Technical Skills Requirements

- General Computer Skills
- Knowledge of Microsoft Office Programs
- Linux
- SQL
- SAP

Typical Salary

- \$44,000 - \$175,900

Education & Work Experience

- Master's degree preferred in some cases; bachelor's degree required.
- Major coursework in Computer Science, Information Technology, MIS, or other technical field.
- For entry-level positions, between 1-2 years of work experience is commonly desired.

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Ability to work well on a team
- Managerial/Supervisory Experience, Leadership Skills
- Ability to work well independently
- Technical Communication and Report Development Skills
- Possess a good attitude/work ethic
- Possess professional judgement
- Interpersonal Skills
- Time and Task Management Skills
- Organizational Skills/Attention to Detail
- Analytical, Mathematical, or Problem-solving Skills
- Ability to collect, enter, or analyze data
- Ability to work in fast-paced or stressful environment
- Presentation Skills

Year 5-6



Professional Engineering License

Computer engineers who have worked under a licensed engineer for four years qualify to take the PE exam to obtain their license. The average salary increase for those with a PE license is 5%. Students must obtain engineering degrees from an ABET accredited institution to be eligible for professional licensure.



Master's of Science in Computer Engineering

Year 6: Students choose electives either from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses and choose a concentration if applicable.

Computer Engineering Core Courses

Linear Systems Analysis
Random Signals & Noise
Linear Programming
Dynamic Programming
Stochastic Processes
Decision Analysis

Concentration Courses

Image Processing
Information Theory
Multimedia Info Process
Artificial Intelligence
Modern Microprocessors
Computer Vision

Year 3-4



Bachelor's Degree in Computer Engineering

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, systems design, data analysis, methods, planning and processing.

GE Courses

General Chemistry
Social Sciences Synthesis
Humanities & Synthesis
Calculus 2 / 3
Differential Equations

Computer Engineering Courses

Logic Design of Digital Systems
Probability and Random Variables
Data Structures
Signals and Systems
Fundamental Algorithms
Systems Programming

Elective Courses

Intro to Computer Networks
Computer Systems Architecture
Electric Energy Systems Components
Intro to VSLI
Communication System Design
Electromagnetic Compatibility
Power Electronic Circuits

Year 1-2



Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Physics
Sociology

Computer Engineering-Related Courses

Electric Circuits 1 / 2
C++ for Technicians
Microcontroller System Design
Computer Networks and Systems

Lower-Division / Major Prerequisites

Algebra and Trig 1 / 2
Pre-Calculus / Calculus I

Year 0



High School Diploma

Transportation-related career academies.

Year 5-6



Master's of Science in Computer Science

Year 6: Students choose electives from their chosen concentration and also complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They also choose a concentration for their studies, within which they choose from a selection of concentration courses.

Typical Core Courses

Fundamentals of Software Engineering
Operating/Distributed Systems
Foundations of Computing
Algorithms/Problem Solving
Computer Systems Organization
Software Systems

Concentration Courses

Intro to Data Mining
Intro to Machine Learning
Markov Chains in Computer Science
Computer Graphics
Web Security
Numerical Mathematics
Databases and Scripting Languages

Year 3-4



Bachelor's Degree in Computer Science

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory programming, quantitative/qualitative research, and problem solving.

GE Courses

Calculus 2 / 3
Intro to Linear Algebra
Social Sciences Synthesis
Humanities & Synthesis

Computer Science Core Courses

Discrete Structures
Problem Solving with Computers
Database Process and Design
Network/Information Assurance
Software Engineering
Operating Systems

Elective Courses

Programming in C+
Web Design and Development
Intro to Java Programming
Intro to Python Programming
Wireless and Mobile Computing
Computer Security
Models of Computation
Data Visualization

Year 1-2



Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Political Science
Sociology

Computer Technology -Related Courses

Intro to Computer Networking
Programming and Logic
Network Security

Lower-Division / Major Prerequisites

Algebra II
Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to Linux
Introductory Statistics

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Computer and Information Systems Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

National Cybersecurity Society (NCSS)

The National Cybersecurity Society is a non-profit organization focused on providing cybersecurity education, awareness and advocacy to small businesses. The NCSS provides cybersecurity education tailored to the needs of the small business owner; helps small businesses assess their cybersecurity risk; distributes threat information to business owners so that they will be more knowledgeable about the threats facing their business; and provides advice on the type of services needed to stay safe online.

The 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.

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 provides the computing field's premier Digital Library and serves its members and the computing profession with leading-edge publications, conferences, and career resources.

Black Data Processing Associates (BDPA)

BDPA has been a leader and pioneer in technology and STEM training for IT professionals and High School students since 1986. The National High School Computer Competition (HSCC) program which is a hands-on training program, has introduced tens of thousands of high school students to coding and application development while also presenting opportunities for students to obtain college scholarships due to the generosity of sponsors and partners.

CyberPatriot the National Youth Cyber Education Program

CyberPatriot the National Youth Cyber Education Program created by the Air Force Association (AFA) to inspire K-12 students toward careers in cybersecurity or other science, technology, engineering, and mathematics (STEM) disciplines critical to our nation's future. CyberPatriot offers several programs for K-12 students such as the National Youth Cyber Defense Competition, AFA Summer Camps, the Elementary School Cyber Education Initiative, the Cybereducation Literature Series and CyberGenerations.

The Association for Unmanned Vehicle Systems International (AUVSI)

Students involved in an AUVSI Student Chapter, gain experience in the industry and receive guidance from professionals in the chapter. Drones are emerging as a safer method for bridge inspection.

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 under-represented.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its Dwight David Eisenhower Transportation Fellowship Program to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

Innovative Learning Strategies for a Computer and Information Systems Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within computer-related program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards that is designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of "SMEs" should be considered to meet the competency needs of business.

Modularized Curriculum

Structure and sequence curriculum in modules tied to jobs with multiple entry/exit points, with multiple levels of industry recognized credentials built into the sequenced pathway.

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

Instruction that helps students who benefit from hands-on learning foster team-building skills while solving real-life problems.

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.

Context-Based Learning

By interpreting new information in the context or place of where and when it occurs and relating it to what we already know, we come to understand its relevance and meaning. To design effective strategies for learning requires an understanding of how context shapes learning.

Individual Learning

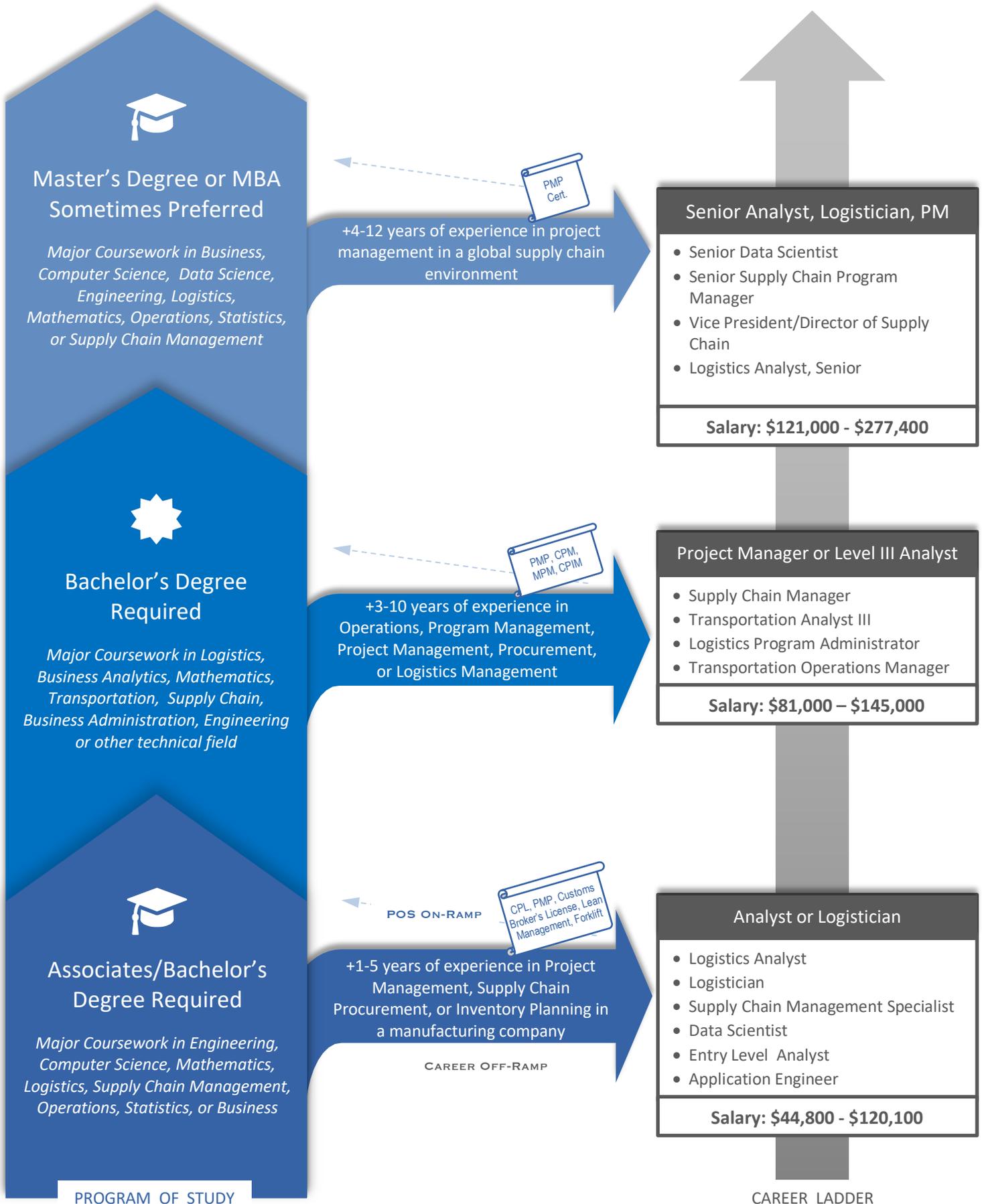
Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

Online "Micro-Learning"

This approach provides short, content-rich exploration of career opportunities and training modules that lead to a new form of stackable credentialing through badges and other forms of recognition, typically subject to the agency hosting the content.

Industry Academies

Employers develop their own internal programs that are offered to candidates immediately following high school graduation. No formal post-secondary education or training is required for these students to enter a job, and candidates who successfully complete these employer-based programs are immediately hired.



Alternative Job Titles

Entry Level Analyst or Logistician, Analyst or Logistician, Strategic Data Analyst, Program/Project Manager, Logistics Program Administrator, Senior Analyst or Project Manager, Senior Logistician, Supply Chain Management Specialist

Job Description

The data science analyst or logistician is responsible for extracting, organizing, integrating, analyzing, and communicating information obtained from a variety of transportation or supply chain data sources. The analyst/logistician will analyze data using SQL, SAP, and other standard statistical software and tools to inform business decisions and drive efficient performance across supply chain and logistics operations. The work of the analyst/logistician might also support inventory and asset management, cost savings, internal strategic analysis, mode selection/freight consolidation efforts, product tracking, customer service initiatives, and metric reporting to promote operations performance. The analyst/logistician that also serves as a project or program manager oversees all aspects of a project, supervising progress over the entire project life cycle.

Knowledge Requirements

- Transportation, Warehousing, Supply Chain, and Logistics
- Project Management Practices
- Material Handling/Manufacturing
- Statistical Analysis, Modeling and Optimization
- Local Agency Procedures/ Standard Design Principles
- Computer Science/Software Engineering

Technical Skills Requirements

- Knowledge of Microsoft Office Programs
- General Computer Skills
- Access, SQL, or other database software
- Project Management Software
- SAS, SAP ERP

Typical Salary

- \$44,800 - \$277,400

Education & Work Experience

- Bachelor's degree required for a majority of positions; associate's degree satisfies education requirements in some cases.
- Major coursework in Management Information Systems, Computer Science, Economics, Engineering, Finance, Logistics, Mathematics, Information Science, Operations, Statistics, Supply Chain, or Transportation.
- A combination of education and work experience that fulfill the requirements is acceptable.

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Analytical, Mathematical, or Problem-solving Skills
- Interpersonal Skills
- Time and Task Management Skills
- Organizational Skills/Attention to Detail
- Possess a good attitude/work ethic
- Ability to work well on a team
- Managerial/Supervisory Experience, Leadership Skills
- Ability to collect, enter, or analyze data
- Possess professional judgement
- Technical Communication/Report Development Skills
- Presentation Skills
- Ability to work well independently
- Ability to work in a fast paced/stressful environment

Year 5-6

Master's of Science in Management Information Systems

Year 6: Students choose electives from their chosen concentration and also complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They also choose a concentration for their studies, within which they choose from a selection of concentration courses.

Typical Core Courses

Advanced Database Management
Advanced Systems Analysis and Design
MIS Project Management
Information Systems Design
Business Information Security
Data Warehousing

Concentration Courses

Human Information Processing
Technology Commercialization
Organizational Change & Development
Foundations of Entrepreneurship
Survey of Management
International Business Policy
Survey of Marketing

Year 3-4

Bachelor's Degree in Business Information and Technology

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses that address programming development, introductory information technology, effective communication and critical thinking tools, and global business environment.

GE Courses

Calculus 2 / 3
Intro to Linear Algebra
Social Sciences Synthesis
Humanities & Synthesis

BIT Core Courses

Applied Program Development
Systems Analysis Methods
Database/Information Management
Enterprise Architecture
Strategic IT Project Management
Strategy/Management/Acquisition

Elective Courses

Global Information Technology
Mobile Application Development
Global Outsourcing/Technology
Project Management Tools and leadership
Fundamental/Software Testing
Web Site Development
Application Program Development

Year 1-2

Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Political Science
Sociology

Computer Technology -Related Courses

Intro to Computer Networking
Programming and Logic
Network Security

Lower-Division / Major Prerequisites

Algebra II
Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to Linux
Introductory Statistics

Year 0

High School Diploma

Transportation-related career academies.

Year 5-6



Master's of Science in Data Science

Year 6: Students choose electives from their chosen concentration and also complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They also choose a concentration for their studies, within which they choose from a selection of concentration courses.

Typical Core Courses

Probability and Statistics
Algorithms for Data Science
Statistical Inference and Modeling
Computer Systems for Data Science
Machine Learning
Data Science Capstone and Ethics

Concentration Courses

Intro to Data Mining
Markov Chains in Computer Science
Computer Graphics
Web Security
Numerical Mathematics
Databases and Scripting Languages

Year 3-4



Bachelor's Degree in Data Science

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as information systems, marketing, logistics, supply chain and statistics.

GE Courses

Statistics 1 / 2
Written Communication
Social Sciences Synthesis
Humanities & Synthesis

Data Science Core Courses

Introduction to Programming
Programming for Analytics
Predictive Modeling
Data Mining
Applied Analytics Capstone
Big Data Analytics

Elective Courses

Multimedia Databases
Algorithms in the Real World
Optimization
Graphical Models
Machine Learning
Operating Systems Implementation

Year 1-2



Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Political Science
Sociology

Data Science -Related Courses

Intro to Analytics
Data Structures for Analytics
Analytical Methods
Data Visualization

Lower-Division / Major Prerequisites

Pre-Calculus / Calculus I
Intro to Programming
Intro to Databases
Probability and Statistics

Year 0



High School Diploma

Transportation-related career academies.

Year 5-6



Master's of Science in Supply Chain Management

Year 6: Students choose electives from their chosen concentration and also complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses and choose a specific topic of study for their Master's project or thesis.

Typical Core Courses

Supply Chain Simulation
Strategic Supply and Cost Mgmt
Innovation & Risk Management
Distribution, Logistics and Network Management
Integrated Global Supply Chain Management

Concentration Courses

Global Supply Chain Management
Machine Learning
Humanitarian Logistics
Procurement Fundamentals
Urban Last-Mile Logistics
Freight Transportation

Year 3-4



Bachelor's Degree in Supply Chain Management

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as analytics tools, introductory programming, strategy and management development.

GE Courses

Statistics 1 / 2
Written Communication
Social Sciences Synthesis
Humanities & Synthesis

Supply Chain Core Courses

Business Analytics-Statistics
Operations Management
Supply Management
Supply Chain Strategy
Operations Planning

Elective Courses

Business Ethics
Demand Management
Lean Operations
Integrated Process Management
Global Strategic Sourcing
International Business Strategy
Information Management
Financial Management

Year 1-2



Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Environmental Science
Sociology

Supply Chain -Related Courses

Intro to Logistics and Supply Chain
Purchasing and Inbound Logistics
Intro to Transportation Management
Productions/Operations

Lower-Division / Major Prerequisites

Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to Databases
Intermediate Statistics

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Data Science/Logistics Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

American Statistical Association (ASA)

The American Statistical Association student chapters provide opportunities for students to connect with other students interested in statistics and interact with prominent statisticians locally and at national meetings. They also encourage students to continue studying statistics and provide career information in the statistical sciences. Students and professionals have the opportunity to attend conferences, apply for scholarships, have access to classroom resources, as well as a multitude of statistical publications.

The 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. Through this organization both students and professionals can take advantage of resources such as the analytics program database, video library, scholarships, conferences, publications related to the data science profession and much more.

Digital Analytics Association (DAA)

The DAA is a global organization that makes analytics professionals more effective and valuable through professional development and networking. The University Membership category is a new and unique opportunity for universities to gain global recognition among the digital analytics community and provide new resources to its students and faculty. For one annual membership fee, all faculty and students within a digital analytics programs will receive full membership benefits.

Some of these benefits include professional development and career resources, as well as access to conferences and international member directories.

Council of Supply Chain Management Professionals (CSCMP)

CSCMP is devoted to connecting, developing, and educating logistics and supply chain professionals throughout their careers, starting with students. The organization hosts an annual supply chain conference (Edge) as well as numerous roundtables focused on industry hot topics. Members receive a subscription to CSCMP's *Supply Chain Quarterly*, access to research and case studies, and a member-only directory to enhance networking opportunities.

Transportation Club

Transportation Clubs are found in cities across the country and are organizations made up of transportation, distribution, and logistics professionals. The Clubs, such as the Transportation Club of Memphis, host monthly professional development sessions and other industry-related events. The Clubs offer students an opportunity to network with professionals and learn about industry trends in an out-of-classroom setting.

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 also have access to the DSA library which includes podcasts, slides, videos, and academic papers, that can all be of assistance to students and professionals in the data science and logistics fields.

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 meetings are host to a variety of insightful events, including hands-on workshops in which industry professionals teach our 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.

Logistics and Transportation Association of North America (LTNA)

The Logistics & Transportation Association of North America is a member-driven networking organization consisting of individual members, non-profit clubs, associations and corporate entities involved in every aspect of transportation logistics and supply chain management throughout the United States and Canada. LTNA members are recognized experts in the planning, execution and subsequent tracking of supply chain logistics orders and assignments. LTNA members enjoy the perks of the annual LTNA conference, scholarships, member directories, and more.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its Dwight David Eisenhower Transportation Fellowship Program to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

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 under-represented.

Innovative Learning Strategies for a Data Science Analysts/Logisticians Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within data science and logistics programs of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

Modularized Curriculum

Structured and sequenced curriculum in modules tied to jobs with multiple entry and exit points and multiple levels of industry-recognized credentials built into the pathway.

Asynchronous Learning

Education and training for students and incumbent workers provided at times and locations convenient to students and employers. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Instruction that helps students who benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs,

co-op work experiences, simulations, and class projects that are assignments from local employers.

Context-Based Learning

Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

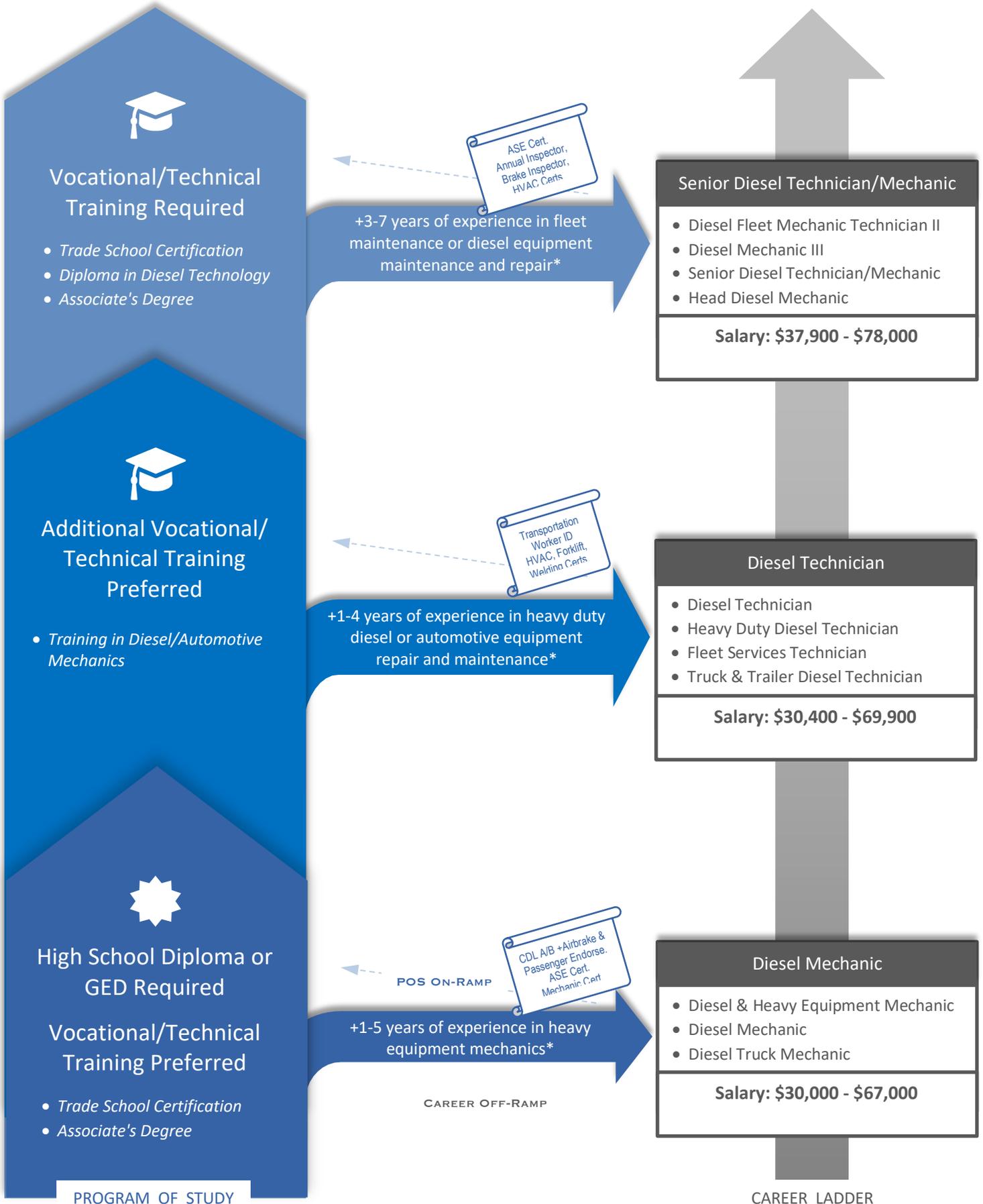
Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

Online "Micro-Learning"

This approach provides short, content-rich exploration of career opportunities and training modules that lead to a new form of stackable credentialing through badges and other forms of recognition, typically subject to the agency hosting the content.

Industry Academies

Employers develop their own internal programs that are offered to candidates immediately following high school graduation. No formal post-secondary education or training is required for these students to enter a job, and candidates who successfully complete these employer-based programs are immediately hired.



*Education can count toward experience in some cases.

Alternative Job Titles

Diesel Mechanic, Diesel Truck Mechanic, Diesel Technician, Fleet Mechanic, Senior Diesel Technician/ Mechanic, Mobile Mechanic, Mobile Diesel Technician, Truck & Trailer Diesel Mechanic Technician

Job Description

Diesel mechanics or technicians are responsible for performing mechanical repairs and preventative maintenance on fleet vehicles and heavy equipment in transit and freight. They are fluent in the maintenance and repair of mechanical, electrical, hydraulic, and diesel systems. Diesel mechanics or technicians also complete repair or service reporting, order and inventory necessary parts, fabricate necessary parts or equipment, develop and execute service or repair processes, and provide road call or emergency service calls.

Knowledge Requirements

- Knowledge of Vehicle Systems
- Mechanical Aptitude
- Equipment Management Practices
- Electrical and Hydraulic Systems
- Diesel Technology
- Occupational Hazards and Safety Precautions
- Local Agency Procedures/ Standard Design Principles
- Welding and Cutting

Technical Skills Requirements

- Ability to operate relevant equipment or software
- General Computer Skills
- Knowledge of Microsoft Office Programs

Typical Salary

- \$30,000 - \$78,000

Education & Work Experience

- Trade school certification or additional vocational training preferred; high school diploma or GED required.
- 2-5 years of experience required for all levels; education can replace experience in many cases.
- Driver's license required; CDL Class A or B required in some cases; ASE certifications preferred in some cases.

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Ability to follow/ interpret instructions
- Ability to perform manual labor/ meet physical requirements
- Interpersonal Skills
- Ability to work a flexible/irregular schedule
- Analytical, Mathematical, or Problem-solving Skills
- Ability to work well on a team
- Possess a good attitude/work ethic
- Time and Task Management Skills
- Technical Communication/Report Development Skills
- Organizational Skills/Attention to Detail
- Managerial/ Supervisory Experience and Leadership Skills
- Ability to work well independently
- Possess professional judgement

ASE Certification

Those who have worked as an apprentice mechanic for two years qualify to take a series of ASE certification exams. The certification proves one's commitment to the field and allows for a more specialized career path. The annual salary increase for those with their ASE Certification is \$10,000 a year.

Other related majors

Diesel mechanics students may also pursue bachelors and higher degrees in other related majors including: Engineering Technology, Electrical and Computer Engineering, and Mechanical Engineering to enhance their knowledge and skillsets and advance their careers.

Bachelor of Science in Diesel Technology

Students can pursue a BS in diesel technology where they will spend four years learning a vast array of aspects of the diesel repair and maintenance field. They spend time in the classroom learning about engines and systems, diagnostics, welding, and electrical/fuel systems. This is coupled with time in the garage putting their knowledge to practical application to be used in the workforce.

General Education Courses

Written Communication
Mathematics
Natural Science
Social Science
Humanities/Fine Arts
Technology

Diesel Technology Courses

Diesel Electrical Systems
Automatics
Heating and Air Conditioning
Shop Procedures
Welding Theory
Heavy Duty Power Trains
Diesel Engine Diagnosis & Repair
Advanced Fuel Systems
Hydraulics and Pneumatics

Diesel Technology Program

Requirements for these programs may vary by institution (public, private, for-profit), however; the typical program length is 20 months and all programs seek to mimic workflows found in the real world and to provide students with relevant hands-on experience. Program variations are typically due to specific industry needs in a local area, as technical programs are often designed around industry input to ensure students are prepared for the local workforce. Students in these programs will become proficient in many aspects of diesel repair and diagnostics. Programs prepare students for their ASE exams and graduation allows students to become exempt from one of the two years of required experience before becoming ASE Certified. To qualify students for ASE certification, programs must be ASE (formerly NATEF) accredited.

Typical Program Credentials

Certificates (stackable):
Preventative Maintenance
Service Technician Helper
Diesel Engine Assembler
Diesel Technician Apprentice
Diesel Technician Assistant
Diploma:
Diesel Technician

Diesel Course List

Gasoline & Diesel Engine Services and Repair
Diesel Truck Manual Transmission
Diesel Truck Brake Systems & Chassis
Diesel Truck Steering & Suspension Systems
Automotive Climate Control Systems & Repair
Diesel Truck Transport Refrigeration
Diesel Truck Preventative Maintenance
Diesel Hydraulic Systems
Vehicle Electronic Systems

Diesel Mechanic/Heavy Truck Maintenance Career Diploma

These abbreviated programs are designed to equip students with knowledge and skillsets that enable them to more rapidly enter the workforce. Such programs may be completed in as little as seven months. Typical programs include instruction on repairing diesel engines, brake systems, and shop safety practices. These programs also help students prepare for the ASE Certification in Medium-Heavy Trucks.

Typical Courses

Truck Electrical Systems
Truck HVAC Systems
Tires, Suspension and Steering
Truck Electronics and Engine Controls

Typical Courses

Intro to Diesel Truck Mechanics
Truck Maintenance Fundamentals
Truck Engines
Fuel Systems
Drivelines and Transmissions
Troubleshooting and Repair

High School Diploma

Transportation-related career academies

Experiential Learning for Diesel Mechanics

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

National Automotive Technicians Education Foundation (NATEF)

The NATEF is a national automotive training program accreditation body. Programs that receive accreditation are considered to be the elite auto mechanic education programs in the United States. The status of an auto mechanic education program is measured against whether it is capable of qualifying students for ASE certification upon completion of the curriculum. The NATEF website offers a searchable portal for students to find accredited programs in their area. NATEF also offers career tips and other resources, including links to scholarship opportunities for both tuition and tools.

Association of Diesel Specialists (ADS)

ADS's mission is to provide education and networking opportunities to members of the diesel community. While ADS does not offer student memberships, organization memberships are free for training programs offering diesel courses, allowing students to access its resources. Students can also visit the ADS website to view a virtual tradeshow or find information about training opportunities and the annual ADS International Convention.

Association of Equipment Management Professionals (AEMP)

The AEMP Education Foundation seeks to build awareness of career opportunities and provide scholarships to high school graduates that wish to gain the skills to become a heavy equipment diesel technician. Each year AEMP offers thousands of dollars in scholarships to students attending qualified schools offering a two-year diesel technician program. AEMP also recognizes annually a Technician of the Year, to showcase career pathways and highlight outstanding role models in the field.

US Department of Labor Apprenticeship (USDOL)

The USDOL offers resources related to apprenticeships in high-demand occupations in many fields, including transportation. Diesel Mechanics is one such field. In addition, the USDOL site provides information about National Apprenticeship Week, which is hosted in November each year. The site offers a listing of all National Apprenticeship Week events across the country so that students can get involved or learn more about apprenticeship through a local event.

Innovative Learning Strategies for Diesel Mechanics

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within a diesel mechanics program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards that is designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of "SMEs" should be considered to meet the competency needs of business.

Modularized Curriculum

Structure and sequence curriculum in modules tied to jobs with multiple entry/exit points, with multiple levels of industry recognized credentials built into the sequenced pathway.

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

Instruction that helps students who benefit from hands-on

learning foster team-building skills while solving real-life problems.

Experiential Learning

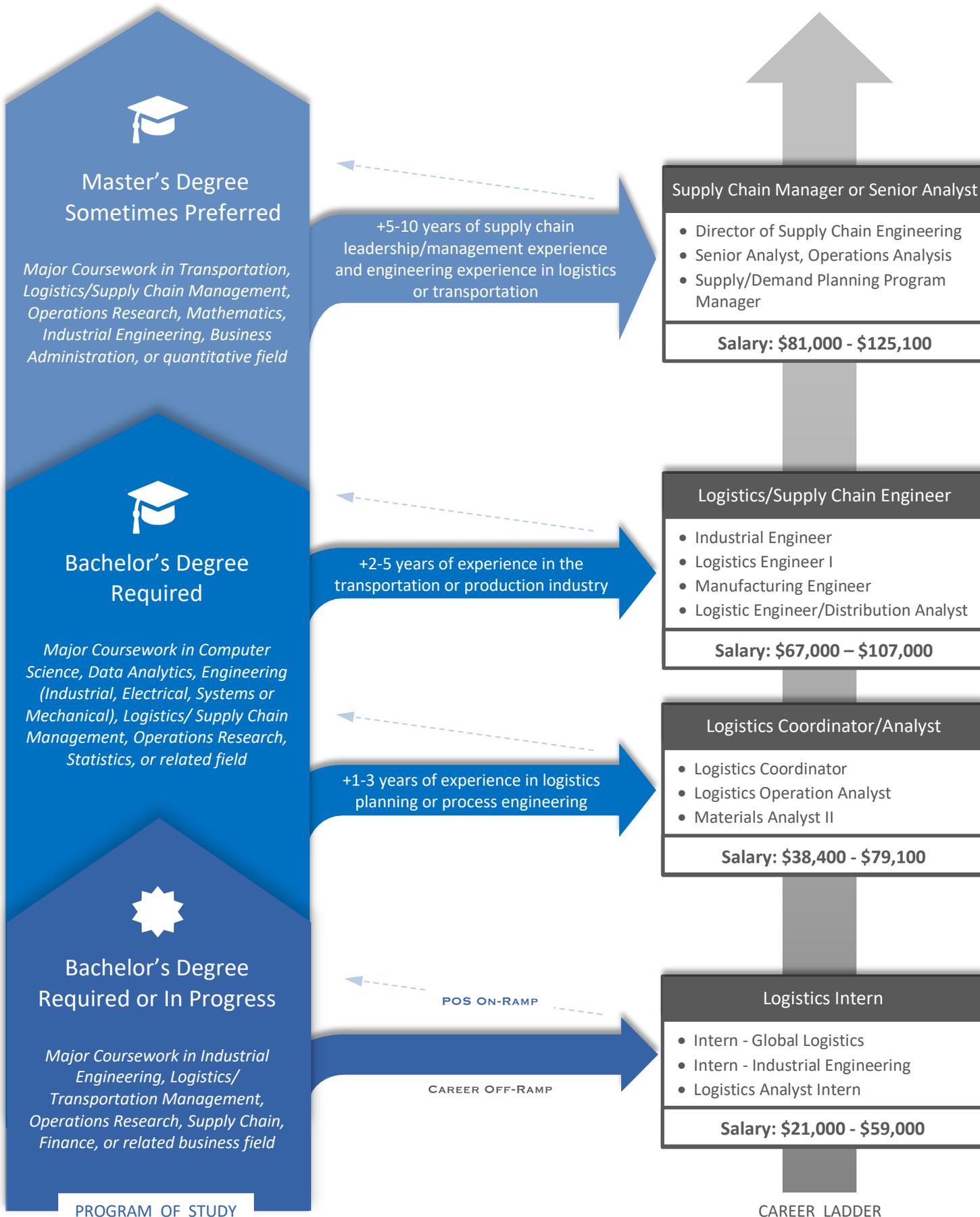
Incorporate opportunities for "learning-by-doing", including internships, apprenticeships, co-op work experience, and simulations developed by local employers.

Context-Based Learning

By interpreting new information in the context or place of where and when it occurs and relating it to what we already know, we come to understand its relevance and meaning. To design effective strategies for learning requires an understanding of how context shapes learning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.



Alternative Job Titles

Logistics Analyst Intern, Logistics Coordinator or Analyst, Materials Analyst, Industrial Engineer I or II, Distribution Analyst, Logistics/Supply Chain Engineer, Manufacturing Engineer, Transportation Analyst, Supply Chain Manager, or Senior Operations Analyst

Job Description

Industrial engineers and operations research or modeling analysts working in transportation operations use advanced mathematical and analytical methods to analyze and solve complex problems, assess risk, and provide a data-driven approach to decision-making. They might be involved in numerous types of projects including process improvement plans, warehouse and labor management, capital projects, inventory and equipment planning, cost saving initiatives, or logistics process design. Utilizing industrial engineering skills inherent in process flow analysis, operational project planning, efficiency or process improvement studies, statistical and mapping analysis, and time and motion studies, the industrial engineer or operations analyst will be involved in planning and designing new transportation operations, supporting existing operations, and developing comprehensive supply chain solutions.

Knowledge Requirements

- Transportation, Warehousing, Supply Chain, and Logistics
- Project Management Practices
- Statistical Analysis, Modeling and Optimization
- Material Handling/Manufacturing
- Operations Research/ Industrial Engineering Practices
- Local Agency Procedures/ Standard Design Principles
- 6 Sigma and Lean Practices

Technical Skills Requirements

- AutoCAD, MicroStation, Geopak
- SAS, SAP ERP
- General computer skills
- Knowledge of Microsoft Office Programs
- Access, SQL, or other database software

Education & Work Experience

- Advanced degree preferred; bachelor's degree required.
- Major coursework in Industrial Engineering or business field accepted.

Typical Salary

- \$38,400 - \$125,000

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Analytical, Mathematical, or Problem-solving Skills
- Interpersonal Skills
- Time or task management skills
- Possess professional judgement
- Ability to collect, enter, or analyze data
- Ability to work well on a team
- Ability to work well independently
- Managerial/ Supervisory Experience and Leadership Skills
- Technical Communication/Report Development Skills
- Possess a good attitude/work ethic
- Presentation Skills
- Organizational Skills/Attention to Detail
- Ability to work a flexible/irregular schedule
- Ability to work in a fast paced/stressful environment
- Ability to pass a background check/ drug screening



Professional Engineering License

Industrial engineers who have worked under a licensed engineer for four years qualify to take the PE exam to obtain their license. The average salary increase for those with a PE license is 5%. Students must obtain engineering degrees from an ABET accredited institution to be eligible for professional licensure.

Year 5-6



Master's of Science in Industrial Engineering

Year 6: Students choose electives either from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They can also choose an operations research concentration within which they choose from a selection of concentration courses.

Operations Research Core Courses

Queueing Systems
Decision Analysis
Linear Programming
Dynamic Programming
Stochastic Processes
Decision Analysis
Programming Optimizations Methods

Concentration Courses

Production and Inventory Control
Facility Planning
Material Handling Systems
Scheduling
Plant Flow Systems
Financial Engineering
Fundamentals of Supply Chain Management

Year 3-4



Bachelor's Degree in Industrial Engineering

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory programming, quantitative/qualitative research, methods, planning and processing.

GE Courses

General Chemistry
Social Sciences Synthesis
Humanities & Synthesis
Calculus 2 / 3
Differential Equations

Industrial Engineering Courses

Engineering Economics
Engineering Statistics
Operations Research
Ergonomics
Data Processing
Human Systems Interaction

Elective Courses

Production and Inventory Control
Decision Analysis
Facility Planning
Queueing Systems
Human Error and System Failure
Manufacturing Operations
Total Quality Engineering

Year 1-2



Associate Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Economics
Political Science
Sociology

Industrial Engineering-Related Courses

Intro to Industrial Processes Simulations
Industrial Systems Analysis
Basic Circuit Analysis
Industrial Safety Procedures

Lower-Division / Major Prerequisites

Algebra II
Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to MATLAB/Simulink

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Industrial Engineering/ Operations Research Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

Engineers Without Borders USA

Engineers Without Borders provides service-learning opportunities for students at the local and international levels. The national organization offers internships while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

Municipal Engineering 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.

National Society of Black Engineers (NSBE)

NSBE offers resources to students across the entire educational spectrum including retention, scholarships, leadership, and soft skills training through local networks and regional conferences. NSBE provides community STEM training for individuals who may want to mentor younger students.

National Society of Professional Engineers (NSPE)

Students can be members of NSPE and attend student chapters or local chapters to learn more about licensing and to network with professionals. The website offers a job board that can be filtered by internship opportunities. Students can log in to experience the virtual Professional Engineers Day event to learn more about the Professional Engineering (PE) license and to hear about the work PEs do from practitioners in the field.

Society of Hispanic Professional Engineers (SHPE)

The Society of Hispanic Professional Engineers program offers support and development to increase degree persistence and attainment as well as aid undergraduates in professional development for a transition into either a STEM career or pursuit of a graduate degree.

Society of Women Engineers (SWE)

Open to all genders, SWE chapters exist in many institutions of higher education. Chapter activities range from mentoring, K-12 outreach, career and industry presentations, and opportunities for technical competitions, scholarships and national conference attendance.

The 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. Through this organization both students

and professionals can take advantage of resources such as the analytics program database, video library, scholarships, conferences, publications related to the data science profession and much more.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its Dwight David Eisenhower Transportation Fellowship Program to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

Institute of Industrial & Systems Engineers (IISE)

The IISE is the world's largest professional society dedicated to the support of the industrial and systems engineering profession, and offers education, training, and research related to the field. Students joining IISE make valuable networking connections, are eligible for discounted training courses, can engage in IISE's online community, can learn about industry advances through the monthly IISE publication, and can join the IISE's Young Professional's group to connect with mentors and learn about job and internship opportunities.

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 under-represented.

Institute of Transportation Engineers (ITE)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation planning and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

The Association for Unmanned Vehicle Systems International (AUVSI)

Students involved in an AUVSI Student Chapter, gain experience in the industry and receive guidance from professionals in the chapter. Drones are emerging as a safer method for bridge inspection.

Innovative Learning Strategies for an Industrial Engineers/ Operations Research Analysts Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within related programs of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

Modularized Curriculum

Structured and sequenced curriculum in modules tied to jobs with multiple entry and exit points and multiple levels of industry-recognized credentials built into the pathway.

Asynchronous Learning

Education and training for students and incumbent workers provided at times and locations convenient to students and employers. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Instruction that helps students who benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs, co-op work experiences, simulations, and class projects that are assignments from local employers.

Context-Based Learning

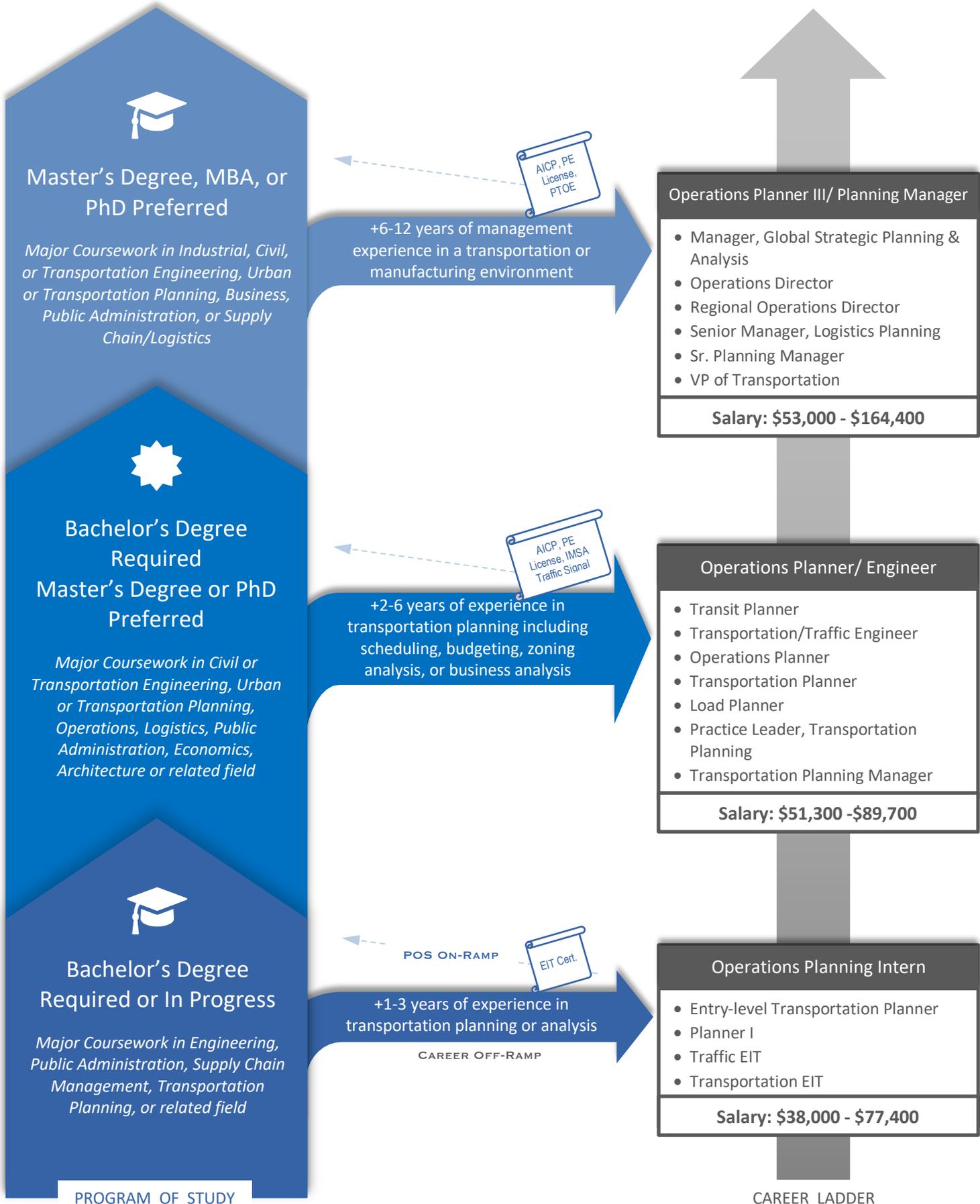
Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

Online "Micro-Learning"

This approach provides short, content-rich exploration of career opportunities and training modules that lead to a new form of stackable credentialing through badges and other forms of recognition, typically subject to the agency hosting the content.



Alternative Job Titles

Operations Planning Intern, Transportation Planner, Operations Planner or Engineer, Operations Planner III, Planning Manager, Principal Planner in Transportation

Job Description

An operations planner is involved in managing complex projects and systems and conducting many types of transportation planning analyses or studies including corridor planning, traffic operations planning, multi-modal or transit-oriented projects, or freight operations planning. An operations planner may perform transportation development planning, system and route performance analyses, operational assessments, transportation project feasibility studies, and market research for transportation projects. An operations planner might also perform field review, field data collection, site and infrastructure assessments, project finance and governance, grant initiatives, public or stakeholder outreach, and other on-site project support. An operations planner may complete assessments using analytical tools such as GIS to evaluate data, identify trends, and develop any project-related documentation.

Knowledge Requirements

- Transportation Planning or Engineering
- Local Agency Procedures/ Standard Design Principles
- Project Management practices (budgeting, scheduling, etc.)
- Travel Demand Modeling
- ITS Technology/Operations

Technical Skills Requirements

- General Computer Skills
- Knowledge of Microsoft Office Programs
- GIS
- AutoCAD/MicroStation/Geopak/VISSIM

Typical Salary

- \$38,000 - \$164,400

Education & Work Experience

- Master's degree or MBA preferred in many cases; bachelor's degree required.
- Major coursework in Civil or Transportation Engineering or Transportation Planning.
- AICP or EIT Certifications sometimes required.

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Interpersonal Skills
- Technical Communication/Report Development Skills
- Ability to work well on a team
- Time and Task Management Skills
- Possess professional judgement
- Possess a good attitude/work ethic
- Ability to work well independently
- Managerial/Supervisory Experience, Leadership Skills
- Analytical, Mathematical, or Problem-solving Skills
- Organizational Skills/Attention to Detail
- Presentation Skills
- Ability to collect, enter, or analyze data
- Ability to work in fast-paced or stressful environment



Professional Engineering License

Traffic/Transit engineers who have worked under a licensed engineer for four years qualify to take the PE exam to obtain their license. The average salary increase for those with a PE license is 5%. Students must obtain engineering degrees from an ABET accredited institution to be eligible for professional licensure.

Year 5-6



Master's of Science in Civil Engineering

Concentrations - Traffic Engineering Transit Operations

Year 6: Students choose electives from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They can also choose either a traffic engineering or transit operations concentration for their studies, within which they choose from a selection of concentration courses.

Typical Core Courses

Applied Statistics
Numerical Analysis
Transportation System Analysis
Traffic Engineering Operations
Traffic Flow Theory
Transportation Planning

Concentration Courses

Modeling & Operations Research
Public Transportation Engineering

Concentration Courses

Traffic Modeling and Simulation
Transportation & Environment
Advanced Traffic Signal Systems
Transportation Network Analysis
Freight Demand Modeling
Urban Transportation Engineering
Transit Planning and Operations

Year 3-4



Bachelor's Degree in Civil Engineering

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory GIS, quantitative/qualitative research. They are introduced to courses across the spectrum of civil concentrations.

GE Courses

Calculus 2 / 3
Differential Equations
Social Sciences Synthesis
Humanities & Synthesis

Civil Engineering Core Courses

Structural Analysis
Fluid Mechanics
Soil Mechanics
Civil Engineering Materials
Engineering Statistics
Transportation Systems Engineering

Elective Courses

Highway Design
GIS for Civil Engineers
Urban Transportation Planning
Pedestrian/Bike Transportation
Transportation Safety
Intelligent Transportation Systems
Traffic Engineering
Transportation Systems Management and Operations

Year 1-2



Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
General Chemistry
Economics
Political Science
Sociology

Civil Engineering-Related Courses

Intro to Engineering Concepts

Engineering Materials
Intro to Surveying
Lower-Division / Major Prerequisites
Algebra II
Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to AutoCAD
GIS Spatial Applications

Year 0



High School Diploma

Transportation-related career academies.

Year 5-6



Professional Engineering License

Industrial engineers who have worked under a licensed engineer for four years qualify to take the PE exam to obtain their license. The average salary increase for those with a PE license is 5%. Students must obtain engineering degrees from an ABET accredited institution to be eligible for professional licensure.



Master's of Science in Industrial Engineering

Year 6: Students choose electives either from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They can also choose an operations research concentration within which they choose from a selection of concentration courses.

Operations Research Core Courses

Queueing Systems
Decision Analysis
Linear Programming
Dynamic Programming
Stochastic Processes
Decision Analysis
Programming Optimizations Methods

Concentration Courses

Production and Inventory Control
Facility Planning
Material Handling Systems
Scheduling
Plant Flow Systems
Financial Engineering
Fundamentals of Supply Chain Management

Year 3-4



Bachelor's Degree in Industrial Engineering

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory programming, quantitative/qualitative research, methods, planning and processing.

GE Courses

General Chemistry
Social Sciences Synthesis
Humanities & Synthesis
Calculus 2 / 3
Differential Equations

Industrial Engineering Courses

Engineering Economics
Engineering Statistics
Operations Research
Ergonomics
Data Processing
Human Systems Interaction

Elective Courses

Production and Inventory Control
Decision Analysis
Facility Planning
Queueing Systems
Human Error and System Failure
Manufacturing Operations
Total Quality Engineering

Year 1-2



Associate Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Economics
Political Science
Sociology

Industrial Engineering-Related Courses

Intro to Industrial Processes Simulations
Industrial Systems Analysis
Basic Circuit Analysis
Industrial Safety Procedures

Lower-Division / Major Prerequisites

Algebra II
Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to MATLAB/Simulink

Year 0



High School Diploma

Transportation-related career academies.

Year 5-6



Master's of Science in Supply Chain Management

Year 6: Students choose electives from their chosen concentration and also complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses and choose a specific topic of study for their Master's project or thesis.

Typical Core Courses

Supply Chain Simulation
Strategic Supply and Cost Mgmt
Innovation & Risk Management
Distribution, Logistics and Network Management
Integrated Global Supply Chain Management

Concentration Courses

Global Supply Chain Management
Machine Learning
Humanitarian Logistics
Procurement Fundamentals
Urban Last-Mile Logistics
Freight Transportation

Year 3-4



Bachelor's Degree in Supply Chain Management

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as analytics tools, introductory programming, strategy and management development.

GE Courses

Statistics 1 / 2
Written Communication
Social Sciences Synthesis
Humanities & Synthesis

Supply Chain Core Courses

Business Analytics-Statistics
Operations Management
Supply Management
Supply Chain Strategy
Operations Planning

Elective Courses

Business Ethics
Demand Management
Lean Operations
Integrated Process Management
Global Strategic Sourcing
International Business Strategy
Information Management
Financial Management

Year 1-2



Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Environmental Science
Sociology

Supply Chain -Related Courses

Intro to Logistics and Supply Chain
Purchasing and Inbound Logistics
Intro to Transportation Management
Productions/Operations

Lower-Division / Major Prerequisites

Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to Databases
Intermediate Statistics

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Planning Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

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.

Institute of Transportation Engineers (ITE)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation planning and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

Municipal Traffic Engineering 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.

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 civil engineering roles, including planning. DOTs offer rotational programs to entry-level engineers so that they experience different business areas within the organization before selecting a permanent assignment.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its Dwight David Eisenhower Transportation Fellowship Program to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

National Operations Center of Excellence (NOCoE)

The National Operations Center of Excellence's site has a multitude of resources for students and professionals in traffic operations. Resources include a searchable Knowledge Center with publications, tools, case studies, on-demand learning, and research. Students can also get involved in experiential learning through the annual Transportation Technology Tournament and TRB ePortfolio Contest.

Innovative Learning Strategies for a Planning Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within a transportation planning program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards that is designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of "SMEs" should be considered to meet the competency needs of business.

Modularized Curriculum

Structure and sequence curriculum in modules tied to jobs with multiple entry/exit points, with multiple levels of industry recognized credentials built into the sequenced pathway.

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 helps students who seek hands-on learning and want to be media-makers foster team-building and solve real life problems.

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.

Context-Based Learning

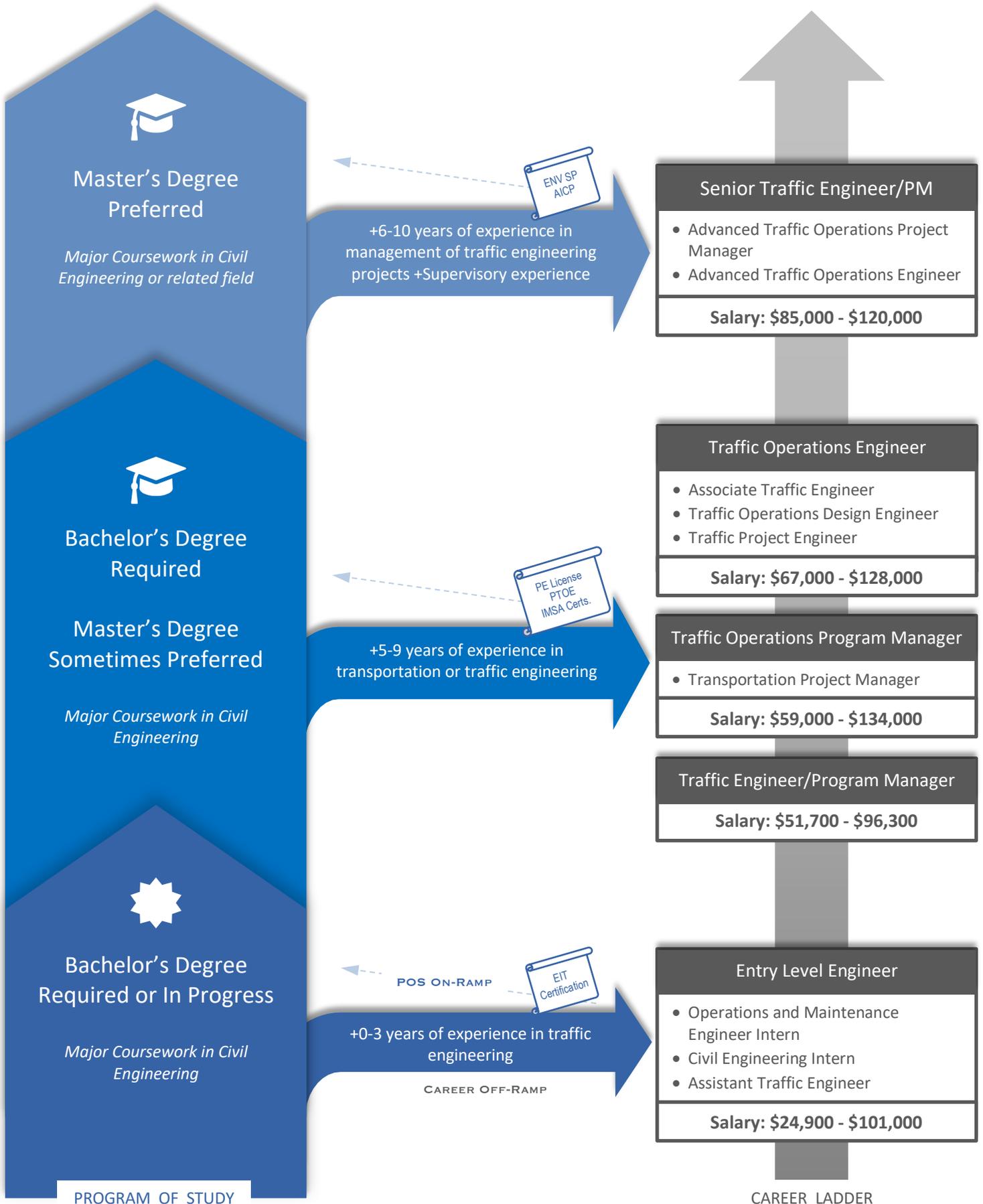
By interpreting new information in the context or place of where and when it occurs and relating it to what we already know, we come to understand its relevance and meaning. To design effective strategies for learning requires an understanding of how context shapes learning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

Online "Micro-Learning"

This approach provides short, content-rich exploration of career opportunities and training modules that lead to a new form of stackable credentialing through badges and other forms of recognition.



Alternative Job Titles

Entry-Level Engineer, Traffic Operations Engineer, Traffic Operations Program/Project Manager, Traffic Engineer, Traffic Program/Project Manager, Advanced Traffic Operations PM/Engineer

Job Description

A traffic engineer will execute traffic signal, traffic operations, and intelligent transportation system design projects using civil engineering principles. A traffic engineer may work on traffic warrant and parking studies, transportation planning studies, traffic event management studies, and traffic signal/roadway design projects. Other design projects may include integration of connected and automated vehicle infrastructure, roundabouts, pavement markings, signings, and temporary traffic control devices. A senior engineer may review and make recommendations on existing and proposed signals, delineation, roadway lighting, and pavement markings. A traffic engineer should execute traffic engineering functions and activities to ensure efficient and safe traffic operations. An engineer with project management duties will manage project scope, schedule, and budget and serve as lead to bring a project to completion. Other responsibilities may include:

- Use of engineering software and equipment to perform engineering tasks.
- Collection and preparation of data for evaluation and engineering reports.
- Coordination of projects from planning through final design.
- Design or management of transportation facilities operations.
- Management of staff and technical resources for a given engineering project.
- Coordination of project tasks across a variety of stakeholders.

Knowledge Requirements

- Transportation/ Traffic Engineering/ Operations
- Local Agency Procedures/ Standard Design Principles
- Project Management Practices
- MUTCD
- ITS Technology/ Operations
- Highway Capacity Manual
- ITE's Traffic Engineering Handbook and Trip Generation Manual
- AASHTO

Technical Skills Requirements

- Synchro, VISSIM, SimTraffic, HCS, Sidra, VISTRO, CORSIM, AutoCAD, MicroStation
- GIS Software, Geopak
- General Computer Skills, MS Office

Education & Work Experience

- Master's degree preferred; bachelor's degree required.
- Major coursework in civil engineering with traffic or transportation emphasis sometimes preferred.
- EIT/PE License commonly required; PTOE sometimes preferred.

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Managerial/ Supervisory Experience and Leadership Skills
- Interpersonal Skills
- Time and Task Management Skills
- Technical Communication/Report Development Skills
- Analytical, Mathematical, or Problem-solving Skills
- Ability to be innovative or creative
- Presentation Skills
- Possess a good attitude/work ethic
- Ability to work well on a team
- Organizational Skills/Attention to Detail
- Ability to work well independently
- Possess professional judgement
- Ability to work in fast-paced or stressful environment

Typical Salary

- \$24,900 - \$134,000



Professional Engineering License

Traffic/Transit engineers who have worked under a licensed engineer for four years qualify to take the PE exam to obtain their license. The average salary increase for those with a PE license is 5%. Students must obtain engineering degrees from an ABET accredited institution to be eligible for professional licensure.

Years 5-6



Master's of Science in Civil Engineering Concentrations: Traffic Engineering, Transit Operations

Year 6: Students choose electives from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They can also choose either a traffic engineering or transit operations concentration for their studies, within which they choose from a selection of concentration courses.

Typical Core Courses

Applied Statistics
Numerical Analysis
Transportation System Analysis
Traffic Engineering Operations
Traffic Flow Theory
Transportation Planning

Concentration Courses

Modeling & Operations Research
Public Transportation Engineering

Concentration Courses

Traffic Modeling and Simulation
Transportation & Environment
Advanced Traffic Signal Systems
Transportation Network Analysis
Freight Demand Modeling
Urban Transportation Engineering
Transit Planning and Operations

Years 3-4



Bachelor's Degree in Civil Engineering

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory GIS, quantitative/qualitative research. They are introduced to courses across the spectrum of civil concentrations.

GE Courses

Calculus 2 / 3
Differential Equations
Social Sciences Synthesis
Humanities & Synthesis

Civil Engineering Core Courses

Structural Analysis
Fluid Mechanics
Soil Mechanics
Civil Engineering Materials
Engineering Statistics
Transportation Systems Engineering

Elective Courses

Highway Design
GIS for Civil Engineers
Urban Transportation Planning
Pedestrian/Bike Transportation
Transportation Safety
Intelligent Transportation Systems
Traffic Engineering
Transportation Systems Management and Operations

Years 1-2



Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
General Chemistry
Economics
Political Science
Sociology

Civil Engineering-Related Courses

Intro to Engineering Concepts
Engineering Materials
Intro to Surveying

Lower-Division / Major Prerequisites

Algebra II
Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to AutoCAD
GIS Spatial Applications

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Civil Traffic/Transit Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

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. Competitions of interest to Pavement Engineers include the National Concrete Canoe Competition and International Contest on Long-Term Pavement Performance Data Analysis. Students attend regional conferences to compete and to present technical papers.

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 under-represented.

Transportation Tech

TransportationTech.com provides online, on-demand educational curricula for Intelligent Transportation Systems and Connected Vehicle technology. Transportation Tech content is designed and developed to encourage students to choose careers in ITS as well as train current ITS and CV technicians in the field. The site features a free ITS Boot Camp for students, as well as an informative online magazine (The Accelerator) focused on innovations in transportation technology.

American Public Transportation Association (APTA)

APTA provides research, conference and workshops, and other resources for professionals in the public transportation industry, but also has significant programming for youth. APTA offers teachers guides to help integrate public transportation-related lessons into K-12 schools, hosts a Biennial Youth Summit to introduce high school students from across the country to career opportunities in public transportation, hosts a Transit Virtual Career Network that profiles a variety of transit occupations, and has two leadership academies for early career and experience professionals.

Municipal Traffic Engineering 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 civil engineering roles, including design, operations, 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.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its Dwight David Eisenhower Transportation Fellowship Program to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

American Association of State Transportation Highway Officials (AASHTO)

While students are not eligible for AASHTO membership, the website offers an email subscription to the Daily Transportation Update of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

American Public Works Association (APWA)

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field.

Engineers Without Borders USA

Engineers Without Borders provides service-learning opportunities for students at the local and international levels. The national organization offers internships while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

Institute of Transportation Engineers (ITE)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation planning and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

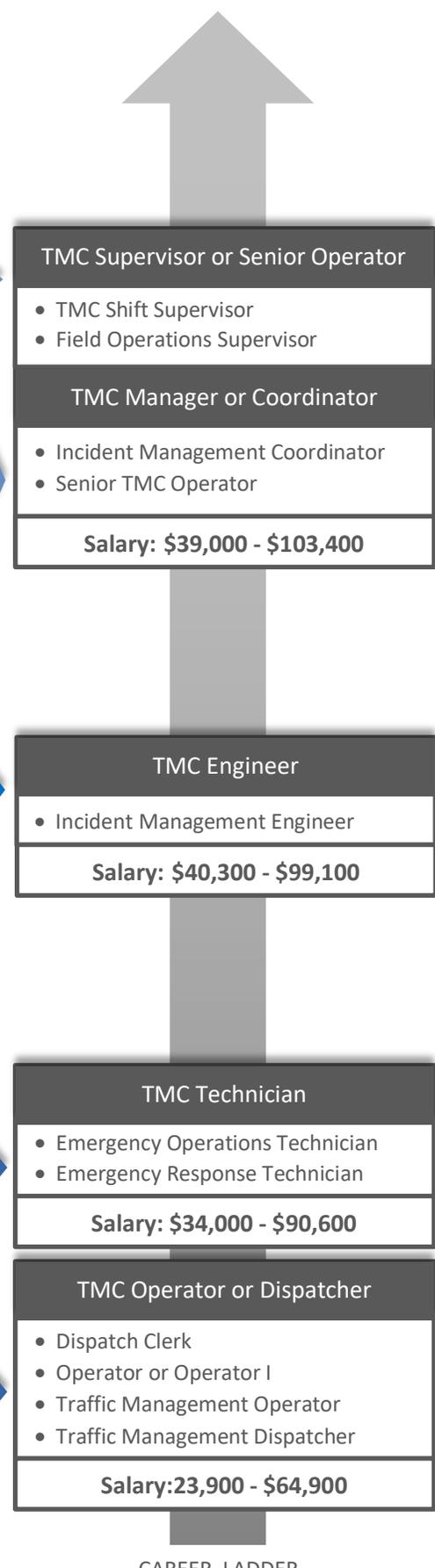
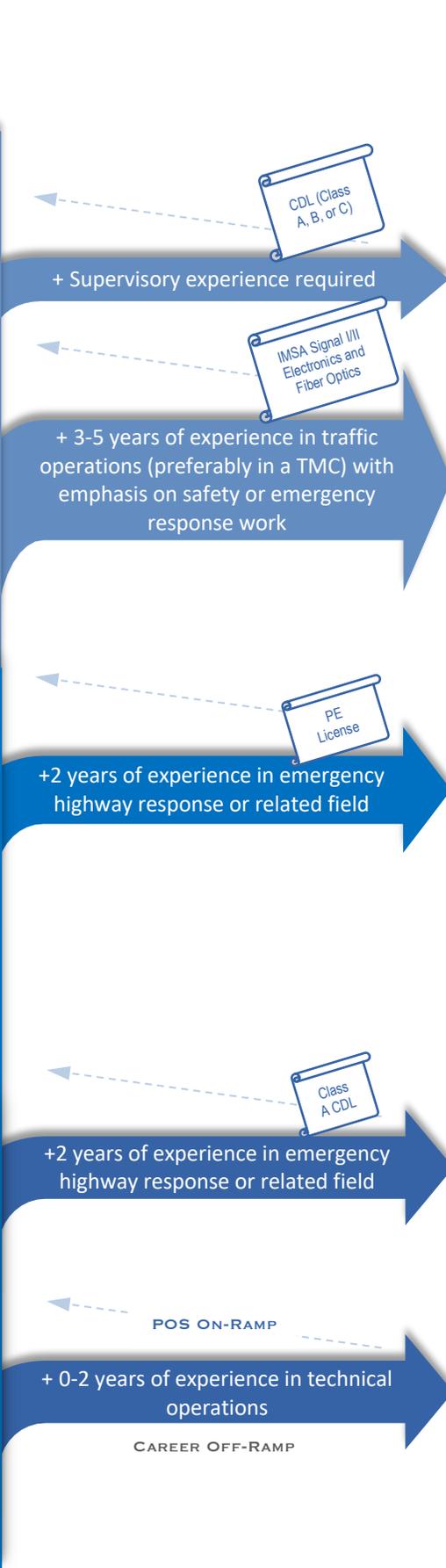
Associate's Degree, Bachelor's Degree, or at least some college preferred

Major Coursework in Safety Management, Civil Engineering, or related field

Bachelor's Degree Required

High School Diploma or GED Required

PROGRAM OF STUDY



Alternative Job Titles

TMC Operator or Dispatcher, TMC Manager or Coordinator, TMC Technician or Engineer, TMC Supervisor or Senior Operator

Job Description

A traffic incident manager will detect, monitor, and respond to various traffic management data sources and incidents to maintain safety and efficiency on local roadway systems. Real-time sources of traffic data may include CCTV cameras, other video detection sources, traffic sensors (weather, speed, and volume), traffic flow systems, alarms, police scanners, public phone calls, etc. A traffic incident manager may be asked to analyze or assess traffic events like construction zones, special events, congestion, traffic incidents, evacuations, or traffic equipment malfunctions. A traffic incident manager may also be asked to develop or implement response scenario plans for such incidents, including traffic control plans that indicate sign placement and traffic management plans at the scene. A traffic incident manager may help clear or manage major traffic incidents by providing information like the approximate duration of the traffic disruption, number of injuries or fatalities, number of lanes blocked, as well as to confirm or coordinate the arrival of emergency first response teams. Through coordination with local response teams and use of dynamic message signs and other ITS devices, the traffic incident manager will help mitigate traffic congestion by providing clear and concise safety information concerning local traffic incidents in roadway systems.

Knowledge Requirements

- TMC Operations
- Operation of Relevant Machinery/ Equipment
- Transportation/ Traffic Engineering/ Operations
- Regional Highway Systems
- Traffic Incident/ Congestion Management
- ITS Technology/ Operations
- Local Agency Procedures/ Standard Design Principles
- Project Management Practices

Technical Skills Requirements

- General Computer Skills
- Knowledge of Microsoft Office Programs
- TMS software
- SunGuide Software
- GIS Software

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Interpersonal Skills
- Technical Communication/Report Development Skills
- Time and Task Management Skills
- Ability to work in fast-paced or stressful environment
- Managerial/ Supervisory Experience and Leadership Skills
- Possess professional judgement
- Analytical, Mathematical, or Problem-solving Skills
- Possess good attitude/ work ethic
- Ability to collect, enter, or analyze data
- Ability to work well independently
- Organizational Skills/Attention to Detail

Typical Salary

- \$23,900 - \$103,400

Education & Work Experience

- Bachelor's degree or some college preferred; high school diploma or GED required.
- CDL sometimes required; OTJ required in some cases.
- For entry-level positions, between 1-3 years of work experience is commonly desired.



Professional Engineering License

Traffic/Transit engineers who have worked under a licensed engineer for four years qualify to take the PE exam to obtain their license. The average salary increase for those with a PE license is 5%. Students must obtain engineering degrees from an ABET accredited institution to be eligible for professional licensure.

Year 5-6



Master's of Science in Civil Engineering

Concentrations - Traffic Engineering Transit Operations

Year 6: Students choose electives from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They can also choose either a traffic engineering or transit operations concentration for their studies, within which they choose from a selection of concentration courses.

Typical Core Courses

Applied Statistics
Numerical Analysis
Transportation System Analysis
Traffic Engineering Operations
Traffic Flow Theory
Transportation Planning

Concentration Courses

Modeling & Operations Research
Public Transportation Engineering

Concentration Courses

Traffic Modeling and Simulation
Transportation & Environment
Advanced Traffic Signal Systems
Transportation Network Analysis
Freight Demand Modeling
Urban Transportation Engineering
Transit Planning and Operations

Year 3-4



Bachelor's Degree in Civil Engineering

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory GIS, quantitative/qualitative research. They are introduced to courses across the spectrum of civil concentrations.

GE Courses

Calculus 2 / 3
Differential Equations
Social Sciences Synthesis
Humanities & Synthesis

Civil Engineering Core Courses

Structural Analysis
Fluid Mechanics
Soil Mechanics
Civil Engineering Materials
Engineering Statistics
Transportation Systems Engineering

Elective Courses

Highway Design
GIS for Civil Engineers
Urban Transportation Planning
Pedestrian/Bike Transportation
Transportation Safety
Intelligent Transportation Systems
Traffic Engineering
Transportation Systems Management and Operations

Year 1-2



Associate's Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
General Chemistry
Economics
Political Science
Sociology

Civil Engineering-Related Courses

Intro to Engineering Concepts

Engineering Materials
Intro to Surveying
Lower-Division / Major Prerequisites
Algebra II
Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to AutoCAD
GIS Spatial Applications

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Traffic Incident/Op Center Managers

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

American Association of State Transportation Highway Officials (AASHTO)

While students are not eligible for AASHTO membership, the website offers an email subscription to the Daily Transportation Update of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief video casts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

American Public Works Association APWA

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field. Members also have access to the APWA Reporter magazine, online discussion forms, conferences, and certifications.

American Traffic Safety Services Association (ATSSA)

American Traffic Safety Services Association (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.

Federal Highway Administration (FHWA) EOT Program

The Federal Highway Administration'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.

Intelligent Transportation Society of America (ITS AMERICA)

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. The Knowledge Center provides a webinar archive and technology scans, while the

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 resources through the organization.

Municipal Traffic 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.

National Operations Center of Excellence (NOCoE)

The National Operations Center of Excellence's site has a multitude of resources for students and professionals in traffic operations. Resources include a searchable Knowledge Center with publications, tools, case studies, on-demand learning, and research. Students can also get involved in experiential learning through the annual Transportation Technology Tournament and TRB ePortfolio Contest. They also have a multitude of videos and toolkits that can help traffic incident and operations center managers raise awareness of emergency responders across the country that work tirelessly to help save lives at the scene of traffic incidents.

National Traffic Incident Management Coalition (NTIMC)

Launched in 2004, the National Traffic Incident Management Coalition (NTIMC) is a multi-disciplinary partnership forum spanning the public safety and transportation communities to coordinate experiences, knowledge, practices, and ideas. NTIMC is committed to safer and more efficient management of all incidents that occur on, or substantially affect, the nation's roadways in order to enhance the safety of on-scene responders and of motorists passing or approaching a roadway incident. The NTIMC provides a number of resources that can benefit traffic incident management students and professionals.

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 incident management: civil engineering, operations, 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.

Traffic Incident Management Network (TIM)

The goal of the Traffic Incident Management Network is to connect traffic incident management professionals from different disciplines, provide a forum to discuss developing issues of national interest, keep practitioners apprised of the latest industry information, and garner important input from practitioners. Through this network, that is free to join, students and professionals focused on traffic incident management can have access to the Responder, the monthly newsletter, webinars, podcast, virtual peer exchanges, and more.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its Dwight David Eisenhower Transportation Fellowship Program to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

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 under-represented.

Institute of Transportation Engineers (ITE)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation operations and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

Innovative Learning Strategies for Traffic Incident/Op Center Managers

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within traffic incident/operations related programs of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

Modularized Curriculum

Structured and sequenced curriculum in modules tied to jobs with multiple entry and exit points and multiple levels of industry-recognized credentials built into the pathway.

Asynchronous Learning

Education and training for students and incumbent workers provided at times and locations convenient to students and employers. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Instruction that helps students who benefit from hands-on

learning foster team-building skills while solving real-life problems.

Experiential Learning

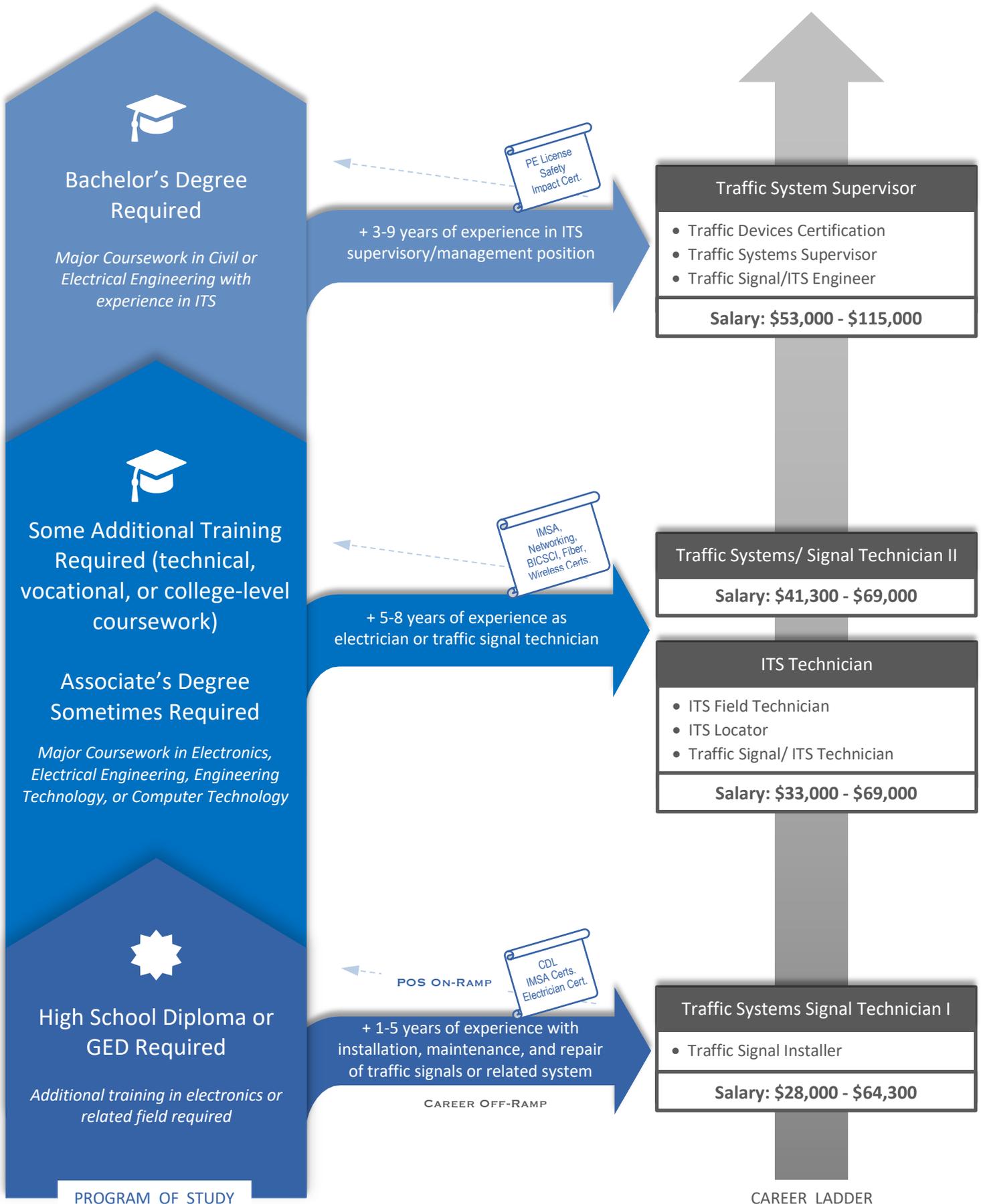
Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs, co-op work experiences, simulations, and class projects that are assignments from local employers.

Context-Based Learning

Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.



Alternative Job Titles

ITS Technician, Traffic Systems/Signal Technician I, Traffic Systems/Signal Technician II, Traffic System Supervisor

Job Description

A traffic signal or intelligent transportation system (ITS) technician is responsible for the installation, maintenance, and/or repair of ITS and traffic signal systems including traffic signal cabinets, loop detection systems, and traffic signal electronics. A traffic signal or ITS technician might also assist with the development of traffic studies and design plans such as for ITS infrastructure, traffic signals, signing, pavement marking, construction sequencing, and traffic control plans. The technician may troubleshoot ITS and traffic signal equipment and make recommendations to repair or resolve any issues in a given system. These technicians may also be responsible for the maintenance of spare equipment and parts, including inventory management and documentation. Relevant technology includes CCTV systems, dynamic message signs, travel time readers, vehicle detection systems, and fiber optics and wireless systems. A traffic signal or ITS technician should ensure that traffic signal installation and related activities are conducted in compliance with applicable traffic control device regulations, standards, and specifications.

Knowledge Requirements

- Traffic Control Devices
- Electrical Trade
- Operation of Relevant Equipment/ Machinery
- ITS Technology/Operations
- Management of Labor, Tools, or Materials
- Manual Labor/Physical Requirements and Constraints
- Occupational Hazards and Safety Precautions
- Transportation, Traffic Engineering, and Operations
- Local Agency Procedures/ Standard Design Principles
- MUTCD

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Interpersonal Skills
- Ability to read/ interpret diagrams, schematics, blueprints, etc.
- Ability to follow/ interpret instructions
- Time and Task Management Skills
- Technical Communication/Report Development Skills
- Ability to work well on a team
- Analytical, Mathematical, or Problem-solving Skills
- Ability to pass a drug screening or background check
- Managerial/ Supervisory Experience and Leadership Skills
- Possess professional judgement
- Ability to collect, enter, or analyze data

Technical Skills Requirements

- General Computer Skills
- Knowledge of Microsoft Office Programs

Typical Salary

- \$28,000- \$115,000

Education & Work Experience

- Associate's or bachelor's degree preferred; high school diploma or GED required.
- Major coursework/training in electronics or electrical engineering commonly requested.
- Commercial Driver's License and IMSA Certifications in Traffic Signals commonly required.

Year 5-6



Master's of Science in Engineering Technology

Year 6: Students choose electives from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses and choose a concentration if applicable.

Core Courses

Project Planning & Scheduling
Engineering Analysis
Engineering Statistics

Concentration Courses

Advanced Quality Control
System Design
Internet of Things and Cybersecurity
Engineering Technology Capstone
Advanced Sensor Technology
Introduction to Project Management

Year 3-4



Bachelor's Degree in Engineering Technology

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses in their area of concentration.

GE Courses

General Chemistry
Social Sciences Synthesis
Humanities & Synthesis

Engineering Technology Courses

Solid State Technology
Circuit Analysis
Digital Technology
Electronic Communication
Analysis for Engineering Tech.

Elective Courses

Industrial Electronics
Advanced Electronic Communication
Electrical Power & Motor Control
Programmable Logic Controllers
Advanced Programmable Logic Controllers
Automation and Robotics
Server Applications Programming
Computer Network Technology

Year 1-2



Associate Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
Psychology
Physics
Sociology

Engineering Technology-Related Courses

Electric Circuits 1 / 2
C++ for Technicians
Automation Control Systems
Microprocessor Systems

Lower-Division / Major Prerequisites

Algebra and Trig 1 / 2
Pre-Calculus / Calculus I

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for ITS/Signal Maintenance Technicians

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

US DOT Intelligent Transportation Systems Joint Program Office (ITSJPO)

The ITSJPO offers numerous resources to extend learning outside of traditional classroom boundaries. The ITSJPO website features free webinars and training programs, information on industry hot topics, links to exciting research innovations and its pilot programs, and a free e-newsletter that keeps subscribers informed of important news and upcoming events. The ITS Professional Capacity Building Program features additional resources and training designed for students, including a series of ITS case studies.

TransportationTech

TransportationTech.com provides online, on-demand educational curricula for Intelligent Transportation Systems and Connected Vehicle technology. Transportation Tech content is designed and developed to encourage students to choose careers in ITS as well as train current ITS and CV technicians in the field. The site features a free ITS Boot Camp for students, as well as an informative online magazine (The Accelerator) focused on innovations in transportation technology.

National Highway Institute (NHI)

The NHI provides training and education for highway professionals, including offering several free or low cost online ITS training courses. The site also archives completion information for a users' courses, and creates an unofficial transcript of training completed.

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 through webinars, white papers, articles on specific technologies, and meetings at the state, national, and international levels.

State Departments of Transportation

DOTs offer internships for community college, university and graduate students. Internships or co-ops are available in a number of occupations relating to ITS technicians. 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.

National Operations Center of Excellence (NOCoE)

The National Operations Center of Excellence's site has a multitude of resources for students and professionals in traffic operations. Resources include a searchable Knowledge Center with publications, tools, case studies, on-demand learning, and research. Students can also get involved in experiential learning through the annual Transportation Technology Tournament and TRB ePortfolio Contest.

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 under-represented.

International Municipal Signal Association (IMSA)

IMSA is dedicated to providing quality certification programs for the safe installation, operation and maintenance of public safety systems; delivering value for members by providing the latest information and education in the industry. Members get special access to not only the IMSA Journal, but also discounted certification opportunities, discounted annual conference prices, the career center, and more. IMSA offers student memberships that provide access to discounted education and certification opportunities, a subscription to the IMSA Journal, and online tracking of continuing education credits.

Association for Unmanned Vehicle Systems International (AUVSI)

The Association for Unmanned Vehicle Systems International is the world's largest nonprofit organization dedicated to the advancement of unmanned systems and robotics. AUVSI members work in the defense, civil and commercial markets. AUVSI members gain access to the world's largest unmanned systems community. From exclusive networking events to exciting business development opportunities. Membership is available for both professionals and students to take advantage of numerous opportunities to get connected, get informed and get involved all year long.

Innovative Learning Strategies for ITS/Traffic Signal Maintenance Technicians

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within ITS/signal maintenance programs of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards that is designed and organized by competencies required for jobs and cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of "SMEs" should be considered to meet the competency needs of business.

Modularized Curriculum

Structure and sequence curriculum in modules tied to jobs with multiple entry/exit points, with multiple levels of industry recognized credentials built into the sequenced pathway.

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

Instruction that helps students who benefit from hands-on learning foster team-building skills while solving real-life problems.

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.

Context-Based Learning

By interpreting new information in the context or place of where and when it occurs and relating it to what we already know, we come to understand its relevance and meaning. To design effective strategies for learning requires an understanding of how context shapes learning.

Individual Learning

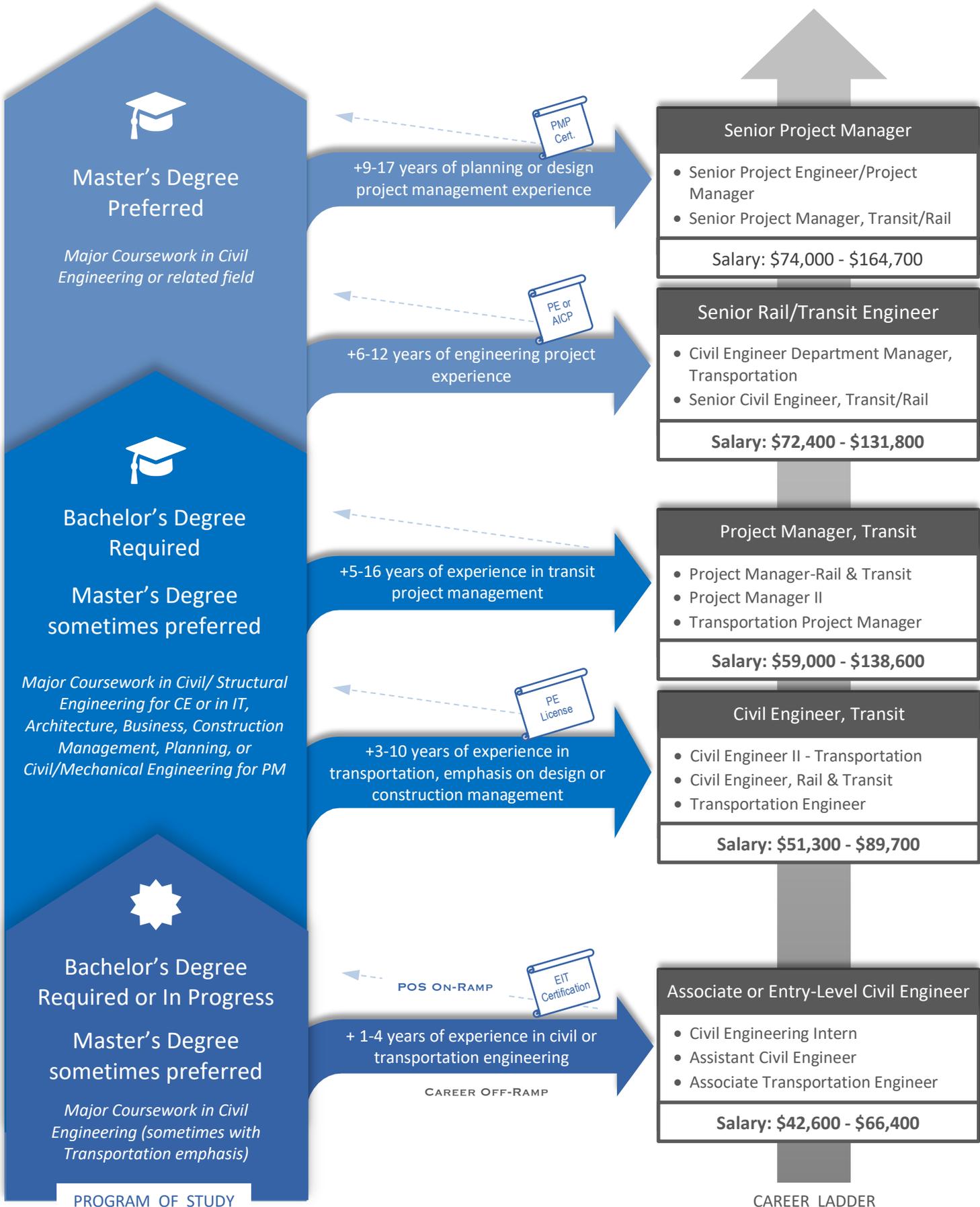
Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

Online "Micro-Learning"

This approach provides short, content-rich exploration of career opportunities and training modules that lead to a new form of stackable credentialing through badges and other forms of recognition, typically subject to the agency hosting the content.

Industry Academies

Employers develop their own internal programs that are offered to candidates immediately following high school graduation. No formal post-secondary education or training is required for these students to enter a job, and candidates who successfully complete these employer-based programs are immediately hired.



Alternative Job Titles

Associate or Entry-Level Civil Engineer, Graduate Rail Engineer, Rail & Transit Structural Engineer, Transportation Engineer, Rail Transit Project Manager, Senior Civil Engineer - Transit/Rail, Transit & Rail Senior Project Manager

Job Description

A civil transit engineer will develop, analyze, inspect, and/or design transit infrastructure, transit stations, buildings, underground structures, or elevated structures or bridges. A civil transit engineer will often perform field surveys, develop transit plans, secure permitting for transit infrastructure, prepare engineering design reports, prepare construction plans, respond to structural emergencies, and/or prepare contract documents for rail or transit engineering projects. A civil transit engineer will often participate in on-site reviews of project locations to monitor progress and ensure conformance to design specifications and safety standards. A civil transit engineer may also perform transit/traffic analysis, transportation operations, ITS and safety concepts, and pedestrian improvement plans. A civil transit engineer may utilize AutoCAD or Civil 3D software in plans for transit facility designs, diagrams, or models, and to execute engineering tasks. A civil transit engineer will coordinate with local officials to ensure compliance of design in accordance with transit agency standards and specifications. A civil transit engineer with project management duties will also develop and manage a transit project's design scope, proposal, schedule, and resource estimates, as well as coordinate efforts of the design team or supervises related support staff.

Knowledge Requirements

- Civil Engineering in Transit Industry
- Knowledge of Local Agency Procedures/ Standard Design Principles
- Project Management Practices
- Transit Operations
- AASHTO

Technical Skills Requirements

- AutoCAD, Civil 3D, MicroStation, or similar
- Knowledge of Microsoft Office Programs
- General Computer Skills
- Project Management Software: MS Project or Primavera
- MGSFlood, HydroCAD, WaterCAD, or similar
- Synchro, VISSIM, SimTraffic, HCS, Sidra, VISTRO, or similar
- GIS Software

Required Skills & Abilities

- Communication Skills, Written and Verbal
- Interpersonal Skills
- Managerial/ Supervisory Experience and Leadership Skills
- Technical Communication/Report Development Skills
- Ability to work well on a team
- Analytical, Mathematical, or Problem-solving Skills
- Possess a good attitude/work ethic
- Ability to be innovative or creative
- Presentation Skills
- Time and Task Management Skills
- Possess professional judgement
- Organizational Skills/Attention to Detail
- Ability to work well independently

Typical Salary

- \$51,301 - \$164,700

Education & Work Experience

- Master's degree preferred; bachelor's degree in Civil Engineering required
- EIT/PE License commonly required; PTOE, PMP, or AICP sometimes preferred.
- Experience with local DOT or government agency sometimes requested.



Professional Engineering License

Traffic/Transit engineers who have worked under a licensed engineer for four years qualify to take the PE exam to obtain their license. The average salary increase for those with a PE license is 5%. Students must obtain engineering degrees from an ABET accredited institution to be eligible for professional licensure.

Year 5-6



Master's of Science in Civil Engineering

Concentrations - Traffic Engineering Transit Operations

Year 6: Students choose electives from their chosen concentration. Students also work to complete either their Master's project or Master's thesis.

Year 5: During the first year, students take core courses. They can also choose either a traffic engineering or transit operations concentration for their studies, within which they choose from a selection of concentration courses.

Typical Core Courses

Applied Statistics
Numerical Analysis
Transportation System Analysis
Traffic Engineering Operations
Traffic Flow Theory
Transportation Planning

Concentration Courses

Modeling & Operations Research
Public Transportation Engineering

Concentration Courses

Traffic Modeling and Simulation
Transportation & Environment
Advanced Traffic Signal Systems
Transportation Network Analysis
Freight Demand Modeling
Urban Transportation Engineering
Transit Planning and Operations

Year 3-4



Bachelor's Degree in Civil Engineering

Year 4: Students take senior-level courses and fulfill internship and field-work requirements. Programs not requiring an internship recommended engaging a career exploration counselor to find an internship.

Year 3: Students take specialized courses such as graphic communication tools, introductory GIS, quantitative/qualitative research. They are introduced to courses across the spectrum of civil concentrations.

GE Courses

Calculus 2 / 3
Differential Equations
Social Sciences Synthesis
Humanities & Synthesis

Civil Engineering Core Courses

Structural Analysis
Fluid Mechanics
Soil Mechanics
Civil Engineering Materials
Engineering Statistics
Transportation Systems Engineering

Elective Courses

Highway Design
GIS for Civil Engineers
Urban Transportation Planning
Pedestrian/Bike Transportation
Transportation Safety
Intelligent Transportation Systems
Traffic Engineering
Transportation Systems Management and Operations

Year 1-2



Associate Degree / Pursuing Bachelor's Degree

Year 2: Students should continue to complete their GE courses and begin taking lower-division requirement courses. Pre-requisite courses provide students with a basic understanding of theoretical and practical skills.

Year 1: Students are required to take general education courses, but it is also recommended they work to fulfill their degree prerequisite requirements.

GE Courses

Analytical Reading, Expository Writing
Critical Thinking
Oral Communication
General Chemistry
Economics
Political Science
Sociology

Civil Engineering-Related Courses

Intro to Engineering Concepts

Engineering Materials
Intro to Surveying
Lower-Division / Major Prerequisites
Algebra II
Pre-Calculus / Calculus I
Intro to Computer Programming
Intro to AutoCAD
GIS Spatial Applications

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Civil Traffic/Transit Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

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. Competitions of interest to Pavement Engineers include the National Concrete Canoe Competition and International Contest on Long-Term Pavement Performance Data Analysis. Students attend regional conferences to compete and to present technical papers.

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 under-represented.

TransportationTech

TransportationTech.com provides online, on-demand educational curricula for Intelligent Transportation Systems and Connected Vehicle technology. Transportation Tech content is designed and developed to encourage students to choose careers in ITS as well as train current ITS and CV technicians in the field. The site features a free ITS Boot Camp for students, as well as an informative online magazine (The Accelerator) focused on innovations in transportation technology.

American Public Transportation Association (APTA)

APTA provides research, conference and workshops, and other resources for professionals in the public transportation industry, but also has significant programming for youth. APTA offers teachers guides to help integrate public transportation-related lessons into K-12 schools, hosts a Biennial Youth Summit to introduce high school students from across the country to career opportunities in public transportation, hosts a Transit Virtual Career Network that profiles a variety of transit occupations, and has two leadership academies for early career and experience professionals.

Municipal Traffic Engineering 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

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and graduate students. Internships or co-ops are available in a number of civil engineering roles, including design, operations, 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.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its Dwight David Eisenhower Transportation Fellowship Program to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

American Association of State Transportation Highway Officials (AASHTO)

While students are not eligible for AASHTO membership, the website offers an email subscription to the Daily Transportation Update of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

American Public Works Association (APWA)

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field.

Engineers Without Borders USA

Engineers Without Borders provides service-learning opportunities for students at the local and international levels. The national organization offers internships while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

Institute of Transportation Engineers (ITE)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation planning and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

National Society of Black Engineers (NSBE)

NSBE offers resources to students across the entire educational spectrum including retention, scholarships, leadership, and soft skills training through local networks and regional conferences. NSBE provides community STEM training for individuals who may want to mentor younger students.

National Society of Professional Engineers (NSPE)

Students can be members of NSPE and attend student chapters or local chapters to learn more about licensing and to network with professionals. The website offers a job board that can be filtered by internship opportunities. Students can log in to experience the virtual Professional Engineers Day event to learn more about the Professional Engineering (PE) license and to hear about the work PEs do from practitioners in the field.

Society of Hispanic Professional Engineers (SHPE)

SHPE programs offer support and development to increase degree persistence and attainment as well as aid undergraduates in professional development for a transition into either a STEM career or pursuit of a graduate degree.

Society of Women Engineers (SWE)

Open to all genders, SWE chapters exist in many institutions of higher education. Chapter activities range from mentoring, K-12 outreach, career and industry presentations, and opportunities for technical competitions, scholarships and national

conference attendance.

The Association for Unmanned Vehicle Systems International (AUVSI)

Students involved in an AUVSI Student Chapter, gain experience in the industry and receive guidance from professionals in the chapter. Drones are emerging as a safer method for bridge inspection.

National Operations Center of Excellence (NOCoE)

The National Operations Center of Excellence's site has a multitude of resources for students and professionals in traffic operations. Resources include a searchable Knowledge Center with publications, tools, case studies, on-demand learning, and research. Students can also get involved in experiential learning through the annual Transportation Technology Tournament and TRB ePortfolio Contest.

WTS International

WTS is an international organization dedicated to building the future of transportation through the global advancement of women. WTS provides students with networking opportunities and professional development through engagement with WTS student and professional chapters, an annual conference, and the TransportationYou program.

Innovative Learning Strategies for a Civil/Transportation Engineer Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within an engineering program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

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Problem-Based Learning

Instruction that helps students who benefit from hands-on learning foster team-building skills while solving real-life problems.

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Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs, co-op work experiences, simulations, and class projects that are assignments from local employers.

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NTCPI

NATIONAL TRANSPORTATION CAREER PATHWAY INITIATIVE

TRANSPORTATION ENVIRONMENT

CAREER PATHWAY REPORT

FEBRUARY 2019



GLENN MCRAE, DIRECTOR
PEGGY O'NEIL VIVANCO, PROJECT COORDINATOR
NORTHEAST TRANSPORTATION WORKFORCE CENTER



The University of Vermont



Transportation Environment

TRANSPORTATION ENVIRONMENT

SECTION 1.0 CHARACTERIZING THE WORKFORCE

1.1 The Transportation Environment Workforce

The environmental workforce in transportation emerges from highly interdisciplinary knowledge sets, skills and backgrounds to take on a wide range of responsibilities and functions. [FHWA's Environment Section](#) identifies more than 20 distinctive fields¹, each with their own distinctive career pathway, including:

- Fish, Wildlife, Plants & Rare Species
- Sustainability Systems
- Resilience
- Transit & TDM
- Bicycle & Pedestrian initiatives
- Planning & Modeling
- Compliance-Focused Environmental Mgmt.
- Compliance in Projects & Public Process
- Parks & Recreation Areas
- Landscape Stewardship
- Farmland Soils and Agriculture
- Air Quality & Health
- Surface Water Quality
- Noise Abatement
- Hydrological Studies
- Community Impact Assessment
- Cultural Resources
- Waste Management & Remediation
- Hazardous Materials
- EV Infrastructure / AV / CV systems

Workers tend to hold singular positions in transportation agencies or organizations covering these fields and are often scattered across multiple divisions, from air quality to planning to materials to roadside biology. These positions are important for organizations to meet their environmental mandates and missions, however there is no way to reliably document the number of workers currently employed in this transportation sector using available data; a differentiation from roles and occupations in other sectors.

In seeking to identify growing occupations and fields that advance environmental quality in the transportation sector—occupations representing areas of significant job growth—research into priority occupations within the environmental discipline took direction from findings of initiatives like the USDOT's Smart City Challenge², and state-specific initiatives like the Massachusetts Commission on the Future of Transportation³. For the latter, the intent is to “*respond to the twin transportation challenges of the 21st century – climate change and congestion*”; a



Transportation Environment

concise summation by Massachusetts Transportation Secretary Stephanie Pollack⁴. The emerging fields encompassed by Smart City Technology⁵, ITS, and Shared-Use Mobility⁶ lead to significant investments at city and state levels in all of these fields, exerting real job pressures in certified workers in critical ITS knowledge (e.g., traffic and signal technicians and engineers).

In identifying growing occupational fields in the environmental discipline and addressing technological impact on that workforce, research surfaced a number of new or transforming positions requiring additional training and education all along the post-secondary continuum.

These emerging positions—ranging from bike-share technicians/coordinators to data managers to sustainability directors—are experiencing a rapid rise in demand, particularly at the municipal level. The investments being made in smart city technology and infrastructure, shared-use mobility systems and ITS are resulting in demands for new skills and qualifications among workers, and a new class of occupational grouping not yet reflected in labor market databases nor adequately addressed by post-secondary education and degree programs.

The industry has not yet settled on occupational titles or classifications, and so sufficient data is simply not available to examine historical trends or future projections to identify occupational priorities. Real-time review of job postings and demand to fill positions related to work in these fields does allow for a grouping of related, existing classifications as noted in Table 1.1.1 below. For this project, NETWC has focused on building new career pathways that tie together a series of emerging, high-demand occupations.

Table 1.1.1: Emerging Occupations in ITS / Smart City Career Path

EMERGING OCCUPATION	CLOSEST BLS OCCUPATIONAL CATEGORY
Smart City Coordinator / Transportation Engineering Bureau Chief	Transportation Manager
ITS Systems Director	Computer & Information Systems Managers
Signal Operations Supervisor	Transportation Engineer
Traffic Engineering Manager	Transportation Engineer
ITS Systems Engineer	Computer Systems Engineers/Architects
Signal Operations Engineer	Electrical Engineer
ITS Technician	Electrical/Civil Engineering Technician Electrician, Traffic Technician

Transportation Environment

1.2 Priority Occupations

Research into emerging environmental occupations and ways in which new technologies and processes are changing existing occupational competencies, led to a broad review of occupational areas that include more general formative fields. Sustainable Transportation, which is dominated by “new mobility” modes, supports the growth of a workforce engaged in the increasingly rapid deployment of ITS and smart city technologies. This is evidenced by increasingly large investments⁷ and a broad need for addressing congestion and greenhouse gas emissions—and a rapid build-out of infrastructure, software, and data tracking to transform regional surface transportation engineering, operations, and planning—in ways that advance key environmental objectives. Tracking the growth of new sustainability and smart city departments—the projects they oversee and their hiring trends—resulted in a research focus on a set of emerging occupations that can be grouped into a single new pathway.

Table 1.2.1 provides a “best-match” relationship between these emerging occupations (shown in blue) and BLS listings with parallel occupational titles (shown in grey). By examining job postings for new positions, researchers have made a reasonable alignment to current LMI.

Table 1.2.1: Priority Environmental Occupations in Transportation

O*NET CODE	OCCUPATION	CURRENT # EMPLOYEES, 2016	PROJECTED # EMPLOYEES, 2026	PERCENT CHANGE	MEDIAN SALARY 2017
	Smart City Coordinator / Transportation Eng. Bureau Chief				\$114,852*
11-3071.01	Transportation Manager	116,000	125,700	8%	\$92,460
	ITS Systems Director				\$137,381*
11-3021	Computer & Info Systems Mgr	368,000	400,500	12%	\$139,220
	Signal Operations Supervisor				\$97,638*
17-2051.01	Transportation Engineer	304,000	329,000	12%	\$84,770
	Traffic Engineering Manager				\$66,500*
17-2051.01	Transportation Engineer	304,000	329,900	12%	\$84,770
	ITS Systems Engineer				\$55,728*
15-1199.02	Computer Systems Eng. / Architect	287,000	307,400	8%	\$88,510
	Signal Operations Engineer				\$67,000*
17-2071	Electrical Engineer	188,000	201,900	8%	\$95,060
	ITS Technician				\$33,263*
17-3023.03	Electrical Engineering Technician	137,000	149,000	4%	\$63,660

* Emerging occupational salary data is derived from a survey of job postings (January – September 2018)

Transportation Environment

1.3 Critical Workforce Competencies

Examining job postings and specifications through a variety of search tools (Burning Glass, Indeed, LinkedIn) provides common data points across occupations noted in this pathway. Unsurprisingly, the most sought-after critical competencies cited by industry employers—in interviews and in job posts—were similar to any field facing the dynamics of rapid growth and technological change. This is further verified by a LinkedIn U.S. Emerging Jobs Report⁸, where the number one competency cited was:

- ✓ *Communication Skills*

This demonstrates the importance employers place on this attribute above all others, including technical competences. The next five competencies could also be relevant in any number of rapidly evolving fields:

- ✓ *Ability to Deal Effectively with the Public*
- ✓ *Ability to Work on a Team*
- ✓ *Ability to Work Independently*
- ✓ *Analytical Skills*
- ✓ *Project Management Practices*

And the final five are more technical competencies directed at the field itself:

- ✓ *ITS Master Planning Studies*
- ✓ *ITS Communications Technologies & Implementation*
- ✓ *Transportation/Traffic Engineering Operations*
- ✓ *Ability to Read/Interpret Diagrams, Schematics, Blueprints*
- ✓ *Ability to Collect, Enter, and Analyze Data*

Collectively, the complete list of occupational competencies and their relative employment demand (appearance within surveyed job posts), is shown below in Figure 1.3.1:

Transportation Environment

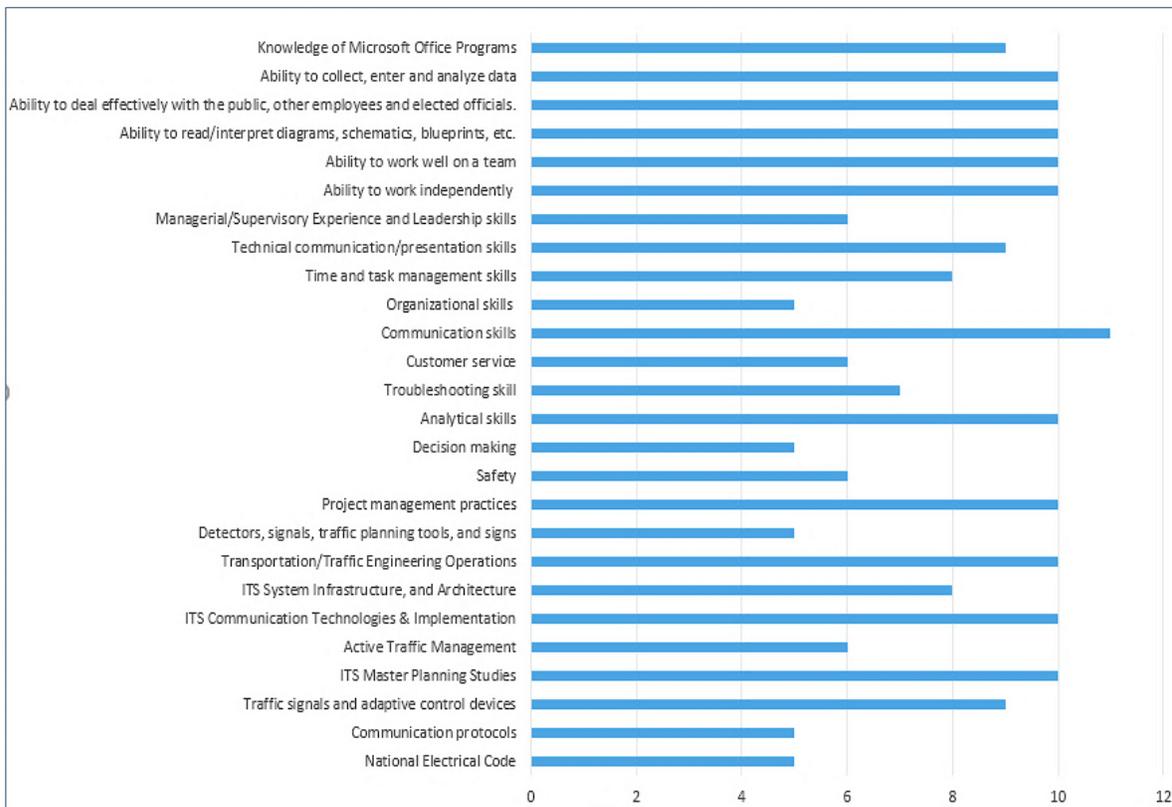


Figure 1.3.1: Key Competencies for ITS / Smart City Occupations

1.4 State of Workforce Readiness

Like much of the transportation workforce, those occupations addressing environmental work within the field is challenged in three major ways:

1. It is an aging workforce. Professional and technical occupations need new training and professional development to keep pace of rapid changes in the field, and there are insufficient organizational knowledge transfer systems in place.
2. New entrants are scarce, and the field is ill-defined as a “field of choice.” Many of the skills/competencies can be applied to other fields with a greater presence in workforce development and career promotion arenas, resulting in uneven competition. Transportation does not have the cachet or coordinated emphasis of other major clusters, nor has it received any significant attention in workforce development initiatives.

Transportation Environment

Accordingly, workforce development literature is full of references for the need of sufficient and equitable transportation options for workers to get to jobs, but almost devoid of reference to the need for growing/developing a workforce to operate and maintain that transportation system.

While Transportation, Distribution, and Logistics is one of DOL's career clusters, programs focused on preparing students for immediate job placement are mostly split between automotive mechanics and distribution/warehousing efforts, not transportation operations, engineering, or planning.

3. Post-secondary educational programs may have robust pipelines in disciplines that feed into the transportation sector, but the increasingly interdisciplinary nature of transportation occupations is not well-served by siloed educational programs and departments.

Specifically, the emerging field of ITS/Smart-City and its hybrid occupations are all formative. There is no uniformity on nomenclature or how it is being developed across geographies. In many cases, it is being subsumed into existing positions and occupational titles.

The challenge and opportunity to deploying an ITS/Smart-City career pathway is to contribute to a broader uniformity so that this field can be better identified, attract new entrants, and provide a better-defined education and training pathway.

Transportation Environment

SECTION 2.0 CAREER PATHWAY DESIGN

2.1 Pathway Design Methodology

This field's pathway represents a new emerging subfield that is being designed through practice and the development of new positions, organizational departments, and advances in technology. As communities make significant real-time investments into infrastructure and processes, an emerging workforce with professional expertise and specialized competencies is required to carry out the work in sufficient capacity to maintain and growth these new smart systems.



This career pathway resulted from a study, over the first half of 2018, of organizational structures in emerging smart cities, job postings for related positions where ITS and smart city technology investments were being made, and a review of academic programs that were attempting to comprehensively approach the education of this future workforce.

2.2 Pathway Learning Strategies

Programs of study supporting career pathways into jobs related to smart cities, ITS, and sustainable communities, with a focus on transforming transportation systems, have a rich set of innovative opportunities for students to pursue. These include applied research, experiential learning, and other work-based or community service project-based learning focused on preparing students and their communities for transformative transportation systems.

These programs require a range of competencies both in traditional transportation engineering or planning programs of study, as well as academic and technical preparedness in emerging interdisciplinary fields. As the structure of Sustainability and Smart Cities degree programs rapidly become formalized, these learning strategies are recommended for these fields:

On-Campus Community Design Units: Many campuses partner with transportation agencies, local governments, and private employers to provide on-campus internship or community service-learning experiences to undergraduates. These programs provide students with hands-on design and problem-solving experience and exposure to a variety of organizations that also serves to build a pipeline to future careers.

Transportation Environment

Work-Based Learning: Many institutions require or strongly encourage work-based learning experiences through internships. Industry and education institutions can work together to ensure that sustainable transportation-focused experiences and application of related skills are an important component of these student development experiences.

Engaged Scholarship: Most universities incorporate community projects into student coursework, either through senior design, capstone, or service-learning courses. Engagement of transportation organizations with universities to provide transportation-focused course-based projects can serve as a powerful student exposure and recruitment tool to sustainable transportation career paths. Some universities provide opportunities to scale these types of 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—utilizing the Educational Partnerships for Innovation in Communities ([EPIC](#)) model spearheaded by the University of Oregon.

Course-Based Learning: Integration of safety topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of Smart City and ITS case studies and lab exercises into required coursework, and assignments that demonstrate understanding of various technologies and processes. Job site visits and field trips have also been identified as useful tools for promoting student interest.

Competency-Based Curriculum: Curriculum that meets academic and quality standards—designed and organized by competencies required for jobs and cross-walked with industry skill standards/certifications—can be designed for ITS and entry-level jobs in smart city technologies and data collection/management systems. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of employers. The proliferation of industry-driven professional ITS certifications can be used to facilitate this process. Such programs may award credit for prior learning, allowing incumbent workers to acquire credentials by demonstrating KSAs developed on-the-job.

Work-Based & Experiential Learning: Organizations at the city government, transportation agency, or private consulting/engineering firms incorporate opportunities for learning-by-doing, including internships, co-op work experience, simulations, and team class projects.

Transportation Environment

In one example, a private-sector employer offers a one-year trial employment for graduates who have interned with the company and are interested in exploring work in what they term the “new mobility” field. Similar experiential programs of note include:

- [Northeastern University, MA Transportation Engineering](#)
A co-op program that allows students to work in an engineering practice prior to graduation.
- [US DOT Summer Internship Program for Diverse Groups](#)
A paid internship to expose students to transportation and prepare them for public service.
- [Massachusetts Department of Transportation Engineering Internship](#)
Opportunities for field-work based internships with a MassDOT Civil Engineer.
- [Metropolitan Transportation Commission High School Internship](#)
Explores the role of public transportation agencies in transportation operations.
- [Volpe: The National Transportation Systems Center](#)
Internships for high school to graduate level to help resolve real-world transportation problems.
- [Arizona State University ProMod](#)
Allows students to work closely with faculty and peers by engaging in real-world projects.

2.3 Priority Career Pathways

The ITS / Smart City career pathway encompasses seven priority occupations:

Priority Occupation: **ITS Technician.**

Description/Duties: Diagnose, troubleshoot, and repairing complex electronic ITS and communication systems and evaluate equipment problems by interpreting blue prints, schematics, and wiring diagrams. Must be able to modify or construct new ITS equipment and work independently and under the supervision of a technical supervisor.

Education/Training: AS in Electrical Engineering, Engineering Tech, Computer Tech; Registered Communications Distribution Designer, Cisco/BICSI certifications, Fiber, Wireless, Comtrain Tower Climbing, IMSA Traffic Signal, Work Zone Safety, Electrical Technician, OSHA-10, CDL.

Transportation Environment

Priority Occupation: Signal Operations Engineer.

Description/Duties: Install, operate, and maintain electrical/electronic traffic signal control devices, lighting systems, and ITS communication systems. Design, build, test, and install electronic auxiliary timing circuits; develop, implement, and document preventative maintenance programs to minimize future problems and to keep the traffic signal system in optimum operating condition.

Education/Training: BS in Civil/Electrical Engineering, Telecommunications, or Data Sciences. MUTCD/NEC requirements, Maintenance of Traffic Standards, AutoCAD, SEPAC, TACTICS, CONCERT, and SCOOT training.

Priority Occupation: ITS Systems Engineer.

Description/Duties: Plan/design a broad range of applied systems/technologies with a focus on a sustainable transportation systems. Experience in transportation engineering with focus on ITS. Self-motivated and solutions-oriented working as a team in the technical design, cost, documentation, management, quality, and scheduling of projects.

Education/Training: BS in Civil/Electrical Engineering, Telecommunications, or Data Sciences. AutoCAD, SEPAC, TACTICS, CONCERT, and SCOOT training.

Priority Occupation: Traffic Engineering Manager.

Description/Duties: Plan, assign, supervise work of Traffic Engineering Division. Manage personnel, prepare budgets, approve procurements, monitor expenditures, manage transportation and radio communication projects. Support design and operational management of roadway networks; solve traffic safety, operational, congestion problems.

Education/Training: BS in Civil/Electrical Engineering, Telecommunications, or Data Sciences. PE license; Microstation; AutoCAD; traffic operations studies; traffic analysis (SimTraffic/Synchro), ITS design; MUTCD.

Transportation Environment

Priority Occupation: Signal Operations Supervisor.

Description/Duties: Supervise engineering team to develop plans, instructions, cost estimates for installation, operation, maintenance of traffic signals and ITS, as well as Traffic Signal Specialists and others responsible for civil engineering in planning, design, construction, operation, and maintenance of municipal public works projects.

Education/Training: MS/BS in Civil/Electrical Engineering, Telecommunications, or Data Sciences. PE license preferred. AutoCAD, training on SEPAC, TACTICS, CONCERT, SCOOT platforms; MUCTD requirements.

Priority Occupation: ITS Systems Director.

Description/Duties: Provide progressive technology solutions to improve operations; ensure ITS is functioning reliably/efficiently. Maintain, administer, and manage ITS technologies and process improvement. Deploy upgrades/patches; manage ITS maintenance staff and strategic plan; maintain documentation of ITS infrastructure.

Education/Training: MS Civil Engineering or Data Sciences.

Priority Occupation: Smart City Coordinator.

Description/Duties: Collaborate to devise Smart City solutions to ensure projects are well-coordinated. Assist in managing, analyzing, interpreting data produced through Smart City implementations. Work with departmental IT teams to consult on Smart City projects being proposed; ensure projects are supportable/maintainable. Engage community through public outreach events; ensure initiatives further the city's digital/social equity goals and broadband strategy.

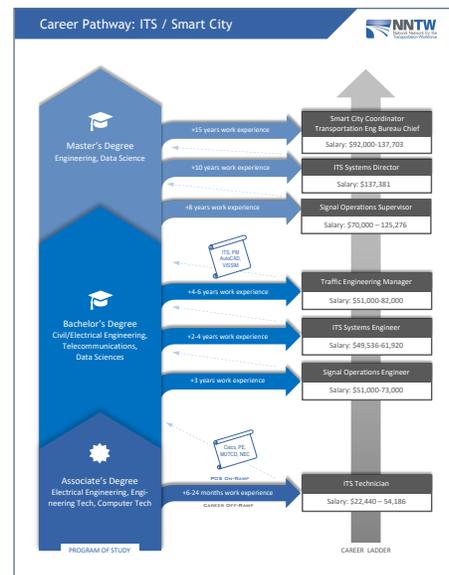
Education/Training: MS/BS in Public Policy, Urban Planning, Communications.

Transportation Environment

2.3.1 Career Pathway Documentation

All career pathways and priority occupations identified as priorities by this initiative and referenced previously within this report are documented using four standardized templates: a pathway graphic, job description, program of study, and experiential learning aide.

Career Pathway Graphic: This pathway illustration presents the post-secondary education/training as a series of steps leading to successively higher credentials and employment opportunities in the emerging career ladder of ITS / Smart Cities. It presents a logical sequence of occupational opportunity and credentialing and showcases occupational possibilities within this pathway. This graphic presents incumbent employees with a professional development roadmap that can lead to mastery of their current job or promotion to a new or different position. It also demonstrates opportunities and the diversity of positions for students engaged in studies or seeking career guidance related to this field.



Job Description: A key data source for understanding this emerging field was job postings from cities engaged in building a competent workforce to support its smart city and ITS goals. Various posts were used to build a picture of occupational interrelationship in this pathway design. Though job titles are diverse, and no singular lexicon has yet emerged, the field continues to go through a great deal of churn. This has to do in part with the variety in how organizations are structuring their efforts and placing employees, whether its cities building-out their IT department or others basing their efforts in Planning or Public Works Departments. It has been observed however, that there is a more consistent focus on what the key competencies, technical skills, and knowledge requirements are across the spectrum of occupations.



Transportation Environment

Program of Study: Programs of study in this field are still developing. In crafting prototypes, NETWC researchers drew from conventional programs in areas that address key competencies and proposed outcomes that lead to the KSAs identified in the related job postings.

The Design & Management example at right documents a program of study for civil or transportation engineering. Relevant courses for 2-year, 4-year, and post graduate study are listed, and where relevant professional licensure is indicated to support career advancement. Details on critical pathway certifications are also provided.

Experiential Learning: Recommended experiential learning programs are cataloged for this pathway, as demonstrated by the example at right compiled for civil engineering students interested in ITS / Smart City occupations. Professional organizations frequently offer experiential learning through competitions, projects, workshops, conferences, or other resources, and often provide networking opportunities for students. Examples of experiential learning in this field are taken from some of the few developed post-secondary programs in the country with a stated focus on producing ITS / Smart City professionals. These approaches parallel what other more conventional STEM efforts have produced in other fields.

Program of Study: ITS / Smart City Design & Management 

Certifications
Professional Engineering licensure may be required for some positions. In gaining the necessary experience to qualify for these positions it is likely that candidates will have acquired a number of key certifications that attest to the attainment of a body of knowledge and capability specific to transportation and related ITS and smart city technologies. In these fields, certifications for applied and process work are essential (e.g., GIS, CADD, INRA Traffic Signals, AutoCAD Electrical, MATCOE, THE USDOT ITS Studies, [Local Agency Building Program](#) offers an ITS Standards Training series appropriate for students and practitioners).

Years 5-6
Master's Degree, Civil/Transportation Engineering, Urban Planning, or Sustainability
 Year 6: Students complete electives and required research thesis or professional paper requirements for the degree.
 Year 5: Complete core and elective courses within their concentration while selecting specialized/independent research and practice activities.
Core Courses
 Sustainability and Systems Thinking
 Problem Solving (or Discipline)
 Transportation Systems Planning
Research Methods Courses
 Dynamic Modeling/Statistical Modeling
 GIS for Planners
 Survey Research, Multivariate Statistics
Other Courses
 Mitigation, Adaptation, & Resilience
 Environmental Ethics & Policy
 Urban Infrastructure
 Communications for Public Engagement
 Project Management
 Environmental Impact Assessment
 Traffic Engineering and ITS
 Experimental learning includes planning studios / labs, internship, and practicum.

Years 3-4
Bachelor's Degree, Civil/Transportation Engineering, Urban Planning, or Sustainability
 Year 4: Select electives in areas of interest and fulfill internship, fieldwork, or senior capstone. Core Transportation & Sustainability/Smart City courses.
 Year 3: Take core courses in different areas of Civil Engineering, Urban Planning, or Business, depending on focus.
 Year 2-3: In a traditional BS/BA program, students take core distribution courses and select path for Major.
GE Courses
 Science, Social Sciences, Humanities, Arts & Foundational Core Courses with emphasis on communications
Sustainability/Smart City Courses
 Sustainable Cities
 Equity and Sustainability
 Dynamic Modeling
 Urban Policy and Governance
 Sustainable Urbanism
General Transportation Planning & Engineering Courses
 Transportation Systems & Planning
 Traffic Engineering & ITS
 Urban Planning
Other
 Required Major courses
 Senior Capstone
 Internship
 Experimental learning includes design labs, internships, clubs, and conferences.

Years 1-2
Associate's Degree in Eng/Electrical Tech, Applied Information, Telecom
 Year 1 and 2: Course requirements vary by institution. Students will complete institutional The Associate's degree and key certifications will provide students with general education requirements as well as and practical skills and competencies in the chosen field.
General Education Courses
 Students will develop writing, communications, math, and critical thinking skills.
Applied Skills Courses
 AutoCAD/Engineering Graphics
 GIS, Electrical
Specific Field Courses & Certification
 Each field has a set curriculum and a set of specific industry or discipline related certifications that can be built into the curriculum.
 Experimental learning includes labs, internships, co-ops, and fieldwork.

Year 0
High School Diploma or G.E.D.
 Computer or Engineering CTE coursework if available.

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Experiential & Innovative Learning: ITS / Smart City



Innovative Strategies for Integrating ITS/Smart City Competencies into Varied Programs of Study

Programs of study supporting career pathways into careers working with Smart Cities (SCs) are in development with a focus on transferring transportation systems as a core focus involves creating a range of competencies both in traditional transportation engineering or planning programs of study, as well as acquiring academic and technical preparedness in emerging interdisciplinary fields. Sustainability and Smart Cities degree programs are rapidly emerging. In all cases these programs rely heavily on innovative opportunities for students to pursue applied research, experiential learning, other work-based or community service project based learning experiences focused on preparing students and their communities for transformative transportation systems. Examples of effective models are listed that provide value to student career preparedness:

Co-Curricular

On-Campus Community Design Units

Many campuses partner with transportation agencies, local governments and private employers to provide on-campus internship or community service learning experiences to undergraduate students in various problem sets. These programs provide students with hands-on design and problem-solving experiences and exposure to a variety of organizations that also serves to build a pipeline to future careers.

Work-Based Learning

Many institutions either require or strongly encourage work-based learning experiences for their students through internships. Industry and education institutions can work together to ensure that sustainable transportation-focused experiences and application of related skills are an important component of these student development experiences.

Co-op Programs

Continental

Engaged Scholarship

Most universities provide mechanisms to integrate community projects into student coursework, either through senior design, capstone, or service learning courses. Engagement of transportation organizations with universities to provide transportation-focused course-based projects can serve as a powerful student exposure and recruitment tool to sustainable transportation career pathways. Some universities provide opportunities to work on 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—utilizing the Educational Partnerships for Innovation in Communities (EPIC) model spearheaded by the University of Oregon (epic.org).

Course-Based Learning

Integration of safety topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of Smart City and ITS case studies and lab exercises into required coursework, and implementation of assignments that demonstrate understanding of various technologies and processes, through development of ITS and Smart City plans. Job site visits and field trips have also been identified useful tools for promoting student interest.

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 ITS and entry level jobs in deploying smart city technologies and data collection and management systems. Job profiling and the use of "SMETS" should be considered to meet the competency needs of employers. The proliferation of industry-driven professional ITS 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 contexts 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 use assignments from local employers.

Experiential Programs (examples)

- **Northwestern University, IA, Transportation Engineering** <https://www.nyu.edu/about/transportation-engineering>. Offers a co-op program that provides students the opportunity to work in an engineering practice prior to graduation.
- **US DOT Summer Internship Program for Diverse Groups** <https://www.transportation.gov/education/transportation-city> and internship program to expose students to transportation industry and prepare them for public service.

Transportation Environment

SECTION 3.0 THE SIX ELEMENTS OF PATHWAY DEVELOPMENT

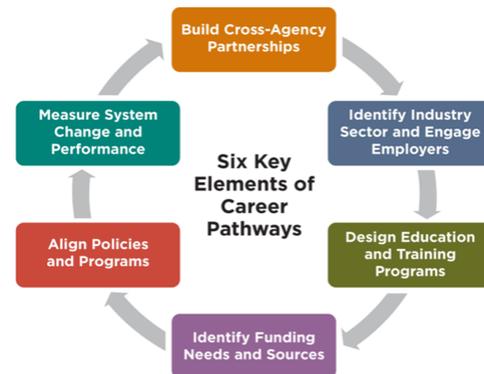
All NNTW implementation plans follow the six key elements of career pathway development, established by the Employment Training Association (ETA) of the Department of Labor (DOL), which are designed to guide state and local workforce development teams through the steps necessary for developing a comprehensive 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 Environment workforce—and an implementation plan for deploying those pathways into the post-secondary educational continuum, the NETWC team approached this ETA system using the following strategies:



3.1 Build Cross-Agency Partnerships & Clarify Roles

Outreach to form partnerships was directed both at organizations who had members on the Environment DWG and NETWC's network of partners. In order to align resources, needs, and the ability of the NETWC team to play an active role, specific pilot project locations were sought out with New England partners. Southeast Maine's Regional Planning Organization identified a clear and related program among employers that affected their region but had wide applicability, and allowed for a rapid identification of employers, educational partners, and resources to establish a pilot that could lead to a more sustained program, serving as a building block along multiple levels in the career pathway progression we had identified.

Transportation Environment

3.2 Identify Industry Sectors & Engage Employers

Outreach through the Southeast Maine RPO is an ongoing effort and we are accepting their lead and timeline in developing these connections. In a parallel development with another DWG member, NETWC is engaging nationally with the U.S. Conference of Mayors Workforce Development Council to establish direct connections with specific workforce councils in cities engaged in Smart City development as future partners. This outreach needed to move along specific official channels that in the end did not coincide with the project parameters.

3.3 Design Education & Training Programs

In the last decade, and even more so in the last three years, a great number of curriculum units and programs have been built-out (e.g., CITE, ITSPCB, NHI, ITE, Transportation Tech) to address the need for post-secondary curriculum suitable for deployment in technical colleges, community colleges, and universities. The focus of this implementation plan is to determine how these resources can be best deployed into existing post-secondary programs to jumpstart training efforts that meet immediate employer needs, while providing a building block for more comprehensive certificate and degree programs.

3.4 Identify Funding Needs & Sources

Funding provides a facilitative resource that allows for coordinating working relationships between partners, gathering necessary resources, helping to insure academic integrity, and reaching-out more broadly to employer networks. Employers have demonstrated willingness to invest in programs and training that help them meet their immediate employee development needs, and it is our operating assumption they will continue to do that. To meet all three objectives for this implementation, independent funding is necessary for NETWC to operate as convener and facilitator to establish value and document ROI for partners to engage in these efforts, with the ultimate goal of creating initiative self-sustainability for the future.

3.5 Align Policies & Programs

In particular, a better alignment of the Transportation, Distribution, and Logistics career cluster in career and technical education (CTE) and secondary education programs with the ITS / Smart City Technology needs of communities, organizations, and private employers is needed.

Transportation Environment

Looking to dual-enrollment programs between participating community college programs and appropriate CTE programs to initiate a growing pipeline of knowledgeable and interested entrants will be helpful. Finally, creating specific incentives and opportunities for work-based learning through OJT, new registered apprenticeships, and incumbent worker retraining programs will provide a more robust program capable of producing work ready applicants.

3.6 Measure System Change & Performance

NETWC applies the following strategies to measure pathway system performance, specifically as related to its proposed pathway demonstration pilot program:

- Can the pilot establish a training and certification regime that both upskills current workers and provides credentials to potential new applicants?
- Is the pilot replicable? Will employers and educational/training institutions support its continuance and growth?
- Is there a regional leadership team in place that can leverage the experience of the pilot to grow into a continuum of programming to produce new work-ready applicants for positions along the career spectrum?
- Are existing curriculum materials flexible and applicable enough to be easily integrated, and do they provide a framework to expand future programming?
- Is there a broader interest base for future students to move into this field (e.g., faculty and student engagement in such programming as ITE student chapters)?
- Are university and college career awareness and student recruitment programs incorporating ITS / Smart City materials?

Transportation Environment

SECTION 4.0 CAREER PATHWAY IMPLEMENTATION

4.1 Project Title

“Advancing Future Environmental Workers in Transportation”

4.2 Workforce Priority

New and emerging workforce occupations in the areas of Smart City Technology, ITS, and Shared-Use Mobility, share a core thread with other transportation disciplines in advancing and engaging in work that contributes to major advances in environmental quality. Yet problematically, they have not yet manifested in traditional post-secondary academic environmental programs.

While the first real job pressures are being felt in certified workers in critical ITS knowledge—like traffic and signal technicians and engineers, a number of the new or transforming positions that require training and education all along the post-secondary continuum are seeing rapid rises in demand, particularly at the municipal level.

Providing the knowledge and skills necessary for workers to be competent and effective in these high-technology occupations is becoming a critical factor in sustaining the satisfactory workforce growth necessary to meet the employment demands of this growing sector.

4.3 Project Description

This implementation plan builds an adaptive framework to develop career pathway and educational tools that provide academic and training enhancement to the current workforce, and to demonstrate a reliable pathway for future workers to follow into this rapidly changing and developing field. This plan proposes four distinct interventions to be deployed in geographically proscribed areas, each seeking to lay a foundation for building a career path approach to meeting short and long-term employer needs in partnership with educational institutions.

Collectively, these initiatives will pilot a system to build and advance a career path framework within a local context; one that engages employers around a very specific and expressed need.



Transportation Environment

This provides an opportunity to not just create a programmatic approach to meeting that immediate need, but to use the engagement with employers and partnership building with educational organizations to plant the seeds of a continuum of activity to create sustainable program growth that can be attached to emerging needs along the continuum of work.

Initiative 1: Upskill Incumbent Workers: In Maine, there is a significant problem with finding IMSA-certified personnel to work on any type of signal project⁹. In the Fall of 2017, Maine DOT paid the training costs for anyone interested in upskilling, particularly those incumbents seeking additional credentials (e.g., Traffic Signal Tech Level I & II, Traffic Signal Construction Tech Level II, and Traffic Signal Design/Engineering Tech Level II). Both the Maine and New Hampshire chapters of ITE have been in dialogue about hosting another round of training in Fall 2018 to keep up with the growing need.

This presents an opportunity to create a pilot that serves a more rural/smaller city region, specifically to engage the education and workforce development community to build out technician-level classes that are accessible to both current workers at DOTs, private sector companies, and current CTE/STEM students in related programs. Such a pilot would increase access to IMSA and other key certifications in support of a growing workforce need in expanding smart technologies within these regions. This pilot would serve as a link to ongoing career pathways in the field to maintain a flow of future qualified workers in the field.

This first initiative pilot would target three key objectives:

1. Establish a sustainable platform that offers training and certifications (like IMSA) to incumbent professionals, while also engaging new training and education partners.
2. Engage post-secondary education partners in an exploration of future skill needs and career opportunities (Table 4.3.1.) related to ITS / Smart City technology and examine what resources can be readily integrated into curriculum for certificate and degree programs. This effort will follow on the recommendations of the USDOT ITS Professional Capacity Building (PCB) academic white paper¹⁰. ITS PCB has a growing repository of teaching materials¹¹ and hosts annual workshops¹² for post-secondary faculty; this pilot will link area educators to these resources and communities of practice. It will also explore introducing ITE student chapters at colleges in Maine and New Hampshire.

Transportation Environment

3. Engage university career awareness programs to link curriculum and activities to an exploration of career opportunities in the emerging ITS / Smart City field, by introducing resources and career awareness efforts to middle and high school students.

Table 4.3.1: ITS / Smart City Programming Resources

<p>IMSA Certifications</p>	<p>Indicate individuals have met prerequisite qualifications and passed an examination from an impartial, nationally-recognized association, to establish qualifications to perform specific technical tasks. Moderated programs are held at various locations throughout the year. IMSA certifications include: Electronics in Traffic Signals; Fiber Optics for ITS, Traffic, Fire Alarm, and Communication System Technician; Microprocessors in Traffic Signals; Signs and Pavement Markings; Traffic Signals; Traffic Signal Inspector; Transportation Center System Specialist; Work Zone Traffic Control Safety.</p>
<p>CITE Consortium for ITS Training & Education</p>	<p>Courses and certificate programs include: TSMO Planning and Implementation; ITS Project Management; Performance Measurement; Traffic Engineering & Operations; ITS Telecomm & CV Systems.</p>
<p>NHI National Highway Institute Curriculum</p>	<p>Provides free/paid training for professionals, including Traffic Signal Timing Concepts, Traffic Signal Timing Concepts, ITS Awareness WBT; Improving Highway Safety with ITS, Systems Engineering Fundamentals for ITS, and ITS Deployment Analysis System (IDAS).</p>
<p>ITS Bootcamp Transportation Tech</p>	<p>Addresses the shortage of training materials, curriculum, standards, procedures, and certification capability for ITS and CV technicians. Appropriate for Technical and Community Colleges, universities and organizational training programs.</p>
<p>ITE Learning Hub</p>	<p>Offers webinar courses and on-demand recordings of related presentations, and certifications like: Road Safety Professional, Professional Transportation Planner, and Professional Traffic Operations Engineer.</p>
<p>ITS PCB Professional Capacity Building Program (USDOT)</p>	<p>The ITS ePrimer provides transportation professionals with fundamental concepts and practices related to ITS technologies. This online resource helps practicing professionals and students better understand how ITS is integrated into the planning, design, deployment, and operations of surface transportation systems. ITS ePrimer is a stand-alone reference document for the practitioner as well as a text for education and training programs (Standards Training Modules).</p> <p>ITS PCB offers free ITS standards training:</p> <ul style="list-style-type: none"> • A 56-module training series for practitioners in state/local highway and transit agencies who seek the skills to procure, test, implement, and operate standards-based ITS systems and devices. Consultants, system designers, integrators, and testers will also find the training informative. • A 21-module transit training series focused exclusively on standards used in transit applications, giving practitioners skills to help them effectively procure/utilize standards used in transit systems.

Transportation Environment

Initiative 2: Connect Training to Education: Design and promote direct connections between training being developed by professional organizations to keep pace with these rapidly changing technologies/standards and those higher-education programs most likely to direct students to ITS, Smart City, and Shared-Use Mobility careers.

This initiative would seek direction from key area employers and the results of NCHRP 20-07/Task 408 *Transportation System Management and Operations (TSMO) Workforce: Skills, Positions, Recruitment, Retention, and Career Development*¹³. This overview of current (2017) educational programs and practices for recruitment and career development will provide a foundation for proposals for new or enhanced curriculum in existing programs and specific workforce training support programs.

Initiative 3: Host Pathway Tools: Even as work to develop four distinct career pathways continues, key education/training partners will host pilot pathway information and tools to test access and usability from both employer-facing and student-facing perspectives. To evaluate how best to present pathway information in a way that would attract future students and workers into these careers, NETWC has prototyped an [interactive web-based tool](#).

Initiative 4: Local Customization: Create a customizable package that would allow pathway tools to more easily reflect local employers, educational programs, featured career paths, and profiles of current workers.

4.4 Implementation Partners

The role of the NETWC in this implementation will be facilitative. As NTCPI research advanced, the environmental fields and occupations moved into areas beyond the internal expertise of NETWC staff and affiliates. As a result, the delivery and adoption of tools and programs will rely on active partners. The organizations below represent anticipated partners for the pilot project deployment and supporting activities. Signed letters of agreement from each partner will be obtained as this implementation plan is made actionable, including the assignment of host sites to pilot pathway tools and contribute to regional pathway guides.

Employers & Associations: Southern Maine Planning & Development Commission
State DOTs, LTAPs, ITE Chapters (Maine, New Hampshire)

Transportation Environment

Credentialing & Certification:	IMSA New England Chapter
Community Colleges:	Southern Maine Community College
Universities:	University of Maine (Orono) University of Southern Maine (Portland) University of New Hampshire (Durham)
Education Curriculum:	Consortium for Innovative Transportation Education ITS Professional Capacity Building (USDOT) Transportation Tech ITS Bootcamp National Highway Institute ITE Learning Hub

Outreach will be conducted to leaders at key university programs with an initiative related to smart cities, such as [Arizona State](#), [UC Berkeley](#), [Georgia Tech](#), and [Columbia University](#).

4.5 Project Outcomes

The expected outcomes for a 2019-2020 deployment include:

Upskill Incumbent Workers

1. Assessment of specific employer needs in entry level ITS fields and certifications.
2. Evaluation of previous training efforts set up by employers and partners.
3. Facilitation of a specific training to meet an urgent certification need.
4. Engagement of one community college and one university program in the training.
5. Plan to develop or modify curriculum in at least one community college and one university program to prepare students directly for key certifications.

Connect Training to Education

1. Assessment by a community college and university program on how to integrate existing independent resources into their curriculum and programs.
2. Draft pilot outline of integrative program at each institution for deployment in 2020.

Transportation Environment

Host Pathway Tools

1. Assessment by a community college and university program on how to integrate at least one of the four target career pathways into existing degree programs.
2. Establish a draft pathway model for consideration within each institution.

Local Customization

1. Customized demonstration of at least one interactive pathway tool linking at least one education program directly with local employer workforce needs and opportunities.

4.6 Project Timeline

An implementation deployment timeline for the 2019-2020 is proposed below, with an appreciation for the many competing scheduling factors of educational programming. New programming, curriculum review, and student recruitment/engagement requires multiple semesters, so final tests/trials may require an additional semester.

Upskill Incumbent Workers

- | | |
|---|----------------|
| 1. Establish DWG for Pilot Project | July 2019 |
| 2. Report on assessment of employer need | August 2020 |
| 3. Evaluate previous training efforts | September 2019 |
| 4. Facilitate training to meet certification need | November 2019 |
| 5. Engage academic program in training | November 2019 |
| 6. Plan to develop/modify preparatory curriculum | April 2020 |
| 7. Plan to establish pathway certifications (ongoing) | June 2020 |
| 8. Report on project status; meet with DWG | Quarterly |

Connect Training to Education

- | | |
|---|-----------------------------|
| 1. Curriculum integration assessment | September 2019 – April 2020 |
| 2. Draft pilot outline of integrative program | April – June 2020 |

Host Pathway Tools

- | | |
|-----------------------------------|--------------------------------|
| 1. Pathway integration assessment | September 2019 – February 2020 |
| 2. Establish draft pathway model | March – May 2020 |

Local Customization

- | | |
|--|---------------------|
| 1. Custom demonstration of interactive pathway | January – June 2020 |
|--|---------------------|

Transportation Environment

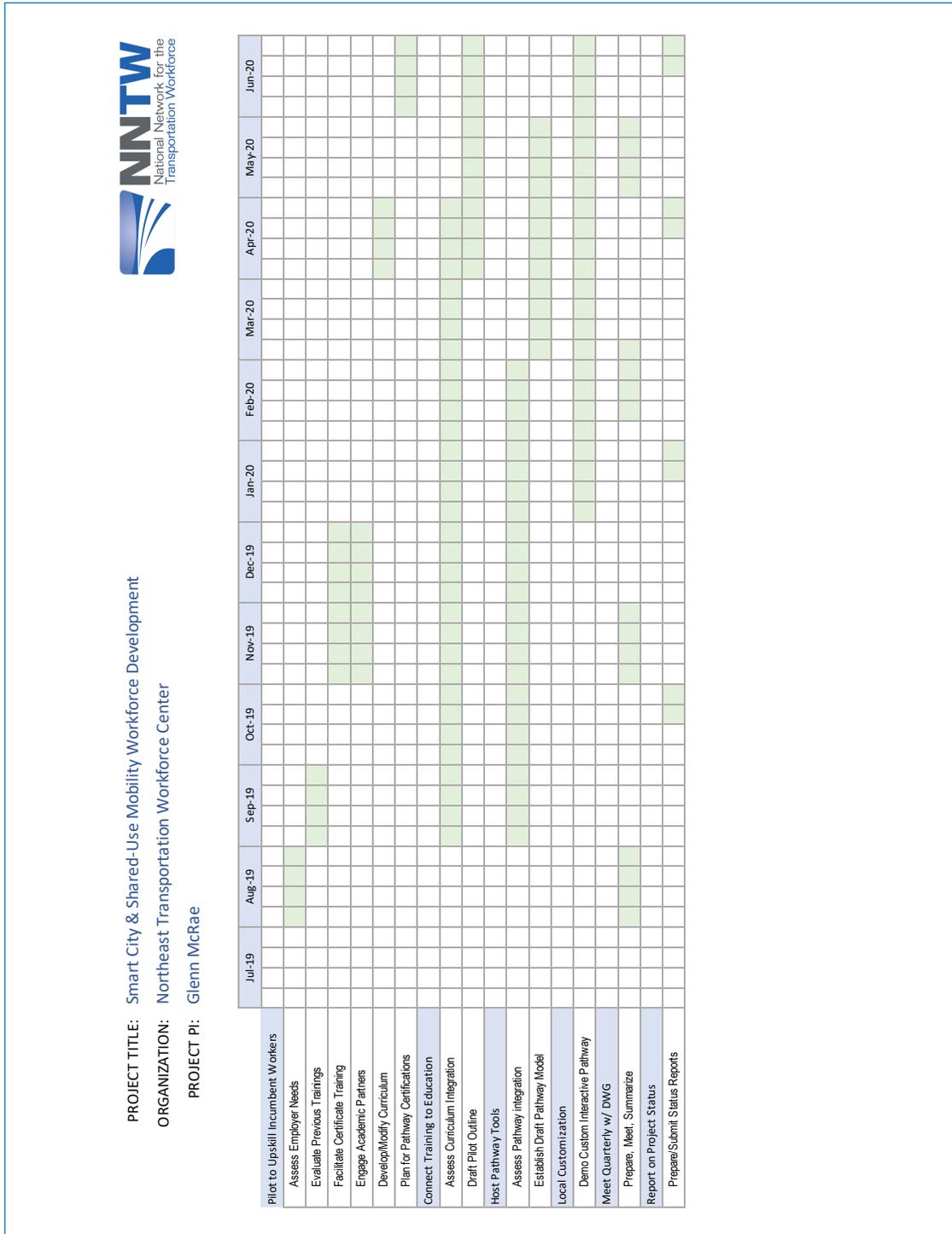
4.7 Project Budget

The first-year budget for this deployment allocates the personnel, travel, and material needs listed below. Successive annual budget needs may increase as additional institutions are included in curriculum and pathway product development efforts:

Budget Item	Annual Costs	Match	Total Budget
Personnel	\$52,000	\$3,000	\$55,000
Fringe Benefits	\$23,400	\$1,350	\$24,750
Travel & Per Diem	\$2,500	\$0	\$2,500
Supplies & Materials	\$3,000	\$0	\$3,000
Participant Support	\$0	\$10,000	\$10,000
Facilities & Administration (F&A Rate 28%)	\$22,652	\$8,899	\$31,551
	-----	-----	-----
Annual Totals:	\$103,552	\$23,249	\$126,801

Transportation Environment

4.8 First Year Workplan



Transportation Environment

SECTION 5.0 BARRIERS TO DEPLOYMENT

Lack of Long-Term Clarity/Commitment by project funders on developing long-term pathway programs blunts the engagement of partners in these multi-year efforts. Potential partners are naturally concerned about committing to pilot efforts and program development that will take years to complete, without having clear and consistent messaging at the federal level among DOT, DOL and Department of Education offices.



ACTION: Consistent and clear messaging from FHWA on the infrastructure available to move projects forward and ensure consistent, long-term communication and partnership support. This should be a key mission for the Center for Transportation Workforce Development (CTWD), and active efforts to engage counterparts at the Departments of Labor and Education are required to provide clear messaging to local employer-academic institution partnerships.

Competing Interests & Limited Capacity among post-secondary educational institutions to undertake new and specific workforce development and career path initiatives.

ACTION: A compelling case will need to be made, perhaps starting with partnerships at the state or regional workforce development boards.

Career Pathway Awareness. This discipline, whether Environmental Transportation or ITS / Smart City, lacks a high-level presence in the imagination of future job seekers and the more structured tools of workforce development professionals. Most emerging occupations do not show up in LMI data searches and many are hybrids that cross several existing occupations. Educational programming needs to follow both employer demand and student interest.

ACTION: Familiarity is a necessary foundation to create attraction. Employment data in existing fields can showcase (in very general terms) the likelihood of future employment in a field with specific skills and competencies. Still, that does not guarantee attraction from new job seekers (e.g., skilled trades, truck drivers). NETWC will address this in two ways: an informational and activity focus in career awareness programs that run at partner colleges, and development of career profiles in priority occupations attached to interactive pathway tools.

Transportation Environment

SECTION 6.0 REFERENCES & DOCUMENTATION

6.1 Acronyms & Abbreviations

BLS = Bureau of Labor Statistics
 CDL = Commercial Driver's License
 CITE = Canadian Institute of Transportation Engineers
 CTE = Career Technical Education
 CTWD = Center for Workforce Development
 CUTC = Council of University Transportation Centers
 CV = Connected Vehicles
 DOL = Department of Labor
 DOT = Department of Transportation
 DWG = Discipline Working Group
 FHWA = Federal Highway Administration
 EPIC = Educational Partnerships for Innovation in Communities
 ETA = Employment Training Association
 IMSA = International Municipal Signal Association
 ITE = Institute of Transportation Engineers
 ITS = Intelligent Transportation Systems
 KSA = Knowledge, Skills, and Abilities
 LMI = Labor Market Information
 LTAP = Local Technical Assistance Program
 NETWC = Northeast Transportation Workforce Center
 NHI = National Highway Institute
 NOCoE = National Operations Center of Excellence
 NCHRP = National Cooperative Highway Research Program
 NNTW = National Network for the Transportation Workforce
 NTCPI = National Transportation Career Pathways Initiative
 OJT = On-the-Job Training
 PCB = Professional Capacity Building
 PE = Professional Engineer
 ROI = Return on Investment
 RPO = Regional Planning Organization
 SME = Subject Matter Expert
 STEM = Science, Technology, Engineering, Mathematics
 TRB = Transportation Research Board
 TSMO = Transportation Systems Management & Operations
 USDOT = United States Department of Transportation



Transportation Environment

6.2 Citations & Attributions

In-report superscripted citations and/or attributions are expanded below:

- 1) <https://www.fhwa.dot.gov/environment/> (Dec 17, 2018)
- 2) <https://www.transportation.gov/smartcity> (Dec 17, 2018)
- 3) <https://www.mass.gov/orgs/commission-on-the-future-of-transportation> (Dec 17, 2018)
- 4) https://www.newburyportnews.com/news/regional_news/transportation-commission-offers-plan-to-address-congestion-climate-change/article_39858e08-1815-57da-83fa-9971cfc2a755.html (Dec 17, 2018)
- 5) <http://netwc.net/smartcities/> (Dec 17, 2018)
- 6) <http://netwc.net/sharedmobility/> (Dec 17, 2018)
- 7) <https://www.transportation.gov/policy-initiatives/smartcity/smart-city-challenge-lessons-building-cities-future> (Dec 18, 2018)
- 8) <https://economicgraph.linkedin.com/research/linkedin-2018-emerging-jobs-report> (Dec 18, 2018)
- 9) Interviews with Transportation Planners, Southern Maine Planning & Development (Jun 15, 2018)
- 10) https://www.pcb.its.dot.gov/documents/whitepaper_university_pgms_in_ITS.aspx (Dec 18, 2018)
- 11) <https://www.pcb.its.dot.gov/casestudies/default.aspx> (Dec 18, 2018)
- 12) https://www.pcb.its.dot.gov/ITS_Academic_workshops.aspx (Dec 18, 2018)
- 13) <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4326> (Dec 18, 2018)

6.3 Career Pathway Documentation

Each of the transportation environment priority occupations and career pathways detailed in this report have been formally documented for use as a career guidance resource in the deployment of pathway initiatives within the post-secondary education/training continuum. A list of those documents is followed by an instantiation of each on the pages that follow:

Bike Share Systems

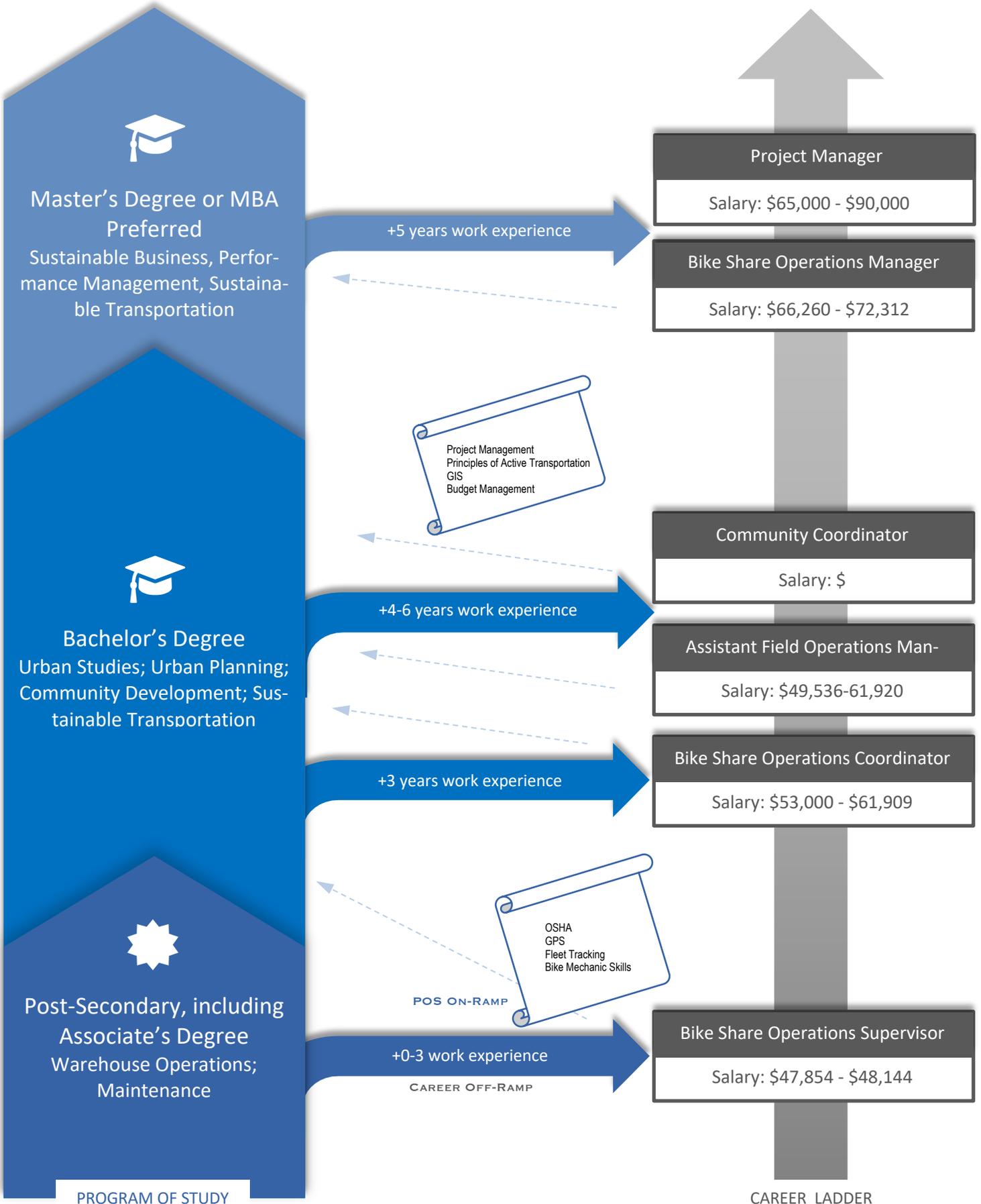
Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

ITS / Smart City

Career Pathway Graphic, Job Description, Program of Study, Program of Study

Sustainable Transportation

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning



Alternative Job Titles

Regional Market Manager, Project Manager, Bike Share City Manager

Job Description

Responsible for coordinating and leading the work of the Bike Share Partnership by supporting and managing tasks completed by the partners and stakeholders. The Program Manager will work closely with the staff of the Office of Transportation and Infrastructure Systems and national partners to build on the successes of the Bike Share Partnership to date; and to identify and foster strategies that make bike sharing a relevant tool to improve the lives of people of color and low income populations. The Program Manager must be passionate about equity and understand the potential that bike share offers to improve the lives of all community members.

- Manage and monitor work completed by a network of local and national partners to meet Bike Share Partnership goals, providing guidance and support as needed.
- Actively engage and energize partner organizations.
- Develop strategic vision for Bike Share Partnership that incorporated a long-term model of equitable bike share and creates strategies for ongoing collaboration and funding.
- Manage deliverables and reporting for multiple grants that support Bike Share work.
- Manage relationships with various funders and communicate successes and challenges in a timely and responsible manner.
- Produce and present program reports for a wide range of partners and stakeholders.
- Develop sustainable funding strategies for Bike Share Partnership including researching and applying for additional grants and alternative funding streams.

Knowledge Requirements

- Project Management
- Budgeting/Financial Analysis
- Communication
- Commitment to diversity, inclusion, and equity in the organization and throughout service delivery

Technical Skills Requirements

- Project Management
- Green Transportation Solutions
- Principles of Shared Mobility
- GPS
- Fleet Tracking
- GIS
- Microsoft Office Applications

Required Skills & Abilities

- Presentations (Public Speaking)
- Written and Oral Communication
- Plan and Coordinate Projects
- Stakeholder Engagement
- Customer Relations
- Management/Supervision
- Prepare/Administer Budgets
- Judgement & Decision-making
- Critical Thinking
- Complex Problem Solving
- Leadership

Typical Salary

- Salaries for these positions cross an extremely wide range. These positions are either newly developing, or transforming existing positions. They are also dependent on the size of the municipality and its location.

Education & Work Experience

- Urban Planning/Sustainable Transportation/Sustainable Communities Master's degree preferred; bachelor's degree accepted for a majority of positions. A combination of education and work experience that fulfill the requirements is acceptable.
- Senior level management experience in Bikes Share Operations, Community Development; Managing complex projects and teams.



Certifications

Beyond attaining a post-secondary degree, student can apply for a variety of additional professional certifications which attest to the attainment of a body of knowledge and capability specific to operations and management of bike share systems. Certifications include, OSHA; GPS; GIS; Fleet Tracking Systems; Bike Mechanic training; Project Management.

Year 5+



Master of Science in Resilient & Communities

Students research regionally specific examples of land-use planning, economic development, energy production, food systems and social justice, while developing skills in leadership, group organization and conflict resolution.

Students learn how to achieve their economic objectives while addressing the needs of the environment, employees, communities, other stakeholders.

Core Courses

Land Use Planning and Policy
Energy and the Environment
Bioregional Approach to Communities
Operations Management & Systems Thinking
Sustainable Organizational Management

Transportation-Related Courses

GIS
Transportation Systems
Topics in Green Design
Emergency Management & Communication

Experiential learning includes case studies and capstone projects.

Year 3-6



BS/BA in Urban Studies & Planning

This program mixes conventional classes with fieldwork and computer-based learning, or senior capstone requirements. Students become deeply engaged with questions of community & neighborhood development, urban policy & design, sustainability, transportation and community development.

GE Courses

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

Transportation-Related Courses

Urban Geography
Transportation History & Policy
Bicycle & Pedestrian Transportation Planning
CAD
Certificate in GIS & Spatial Analysis

Experiential learning includes fieldwork, labs, internships, & research

Year 1-2



Bachelor's Degree in Community Development

Students will complete institutional requirements for the degree sought. The Bachelor's degree in Community Development is a multi-disciplinary, social science program that prepares students for careers in housing, community organizing, transportation and economic development. The hands-on program incorporates significant field research.

General Education Courses

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

Transportation-Related Courses

GIS for Community Development
Urban Planning
Urban Transportation
Information Cities
Community & Built Environment

Experiential learning includes labs, internships, practicum, and fieldwork

Year 0



High School Diploma or G.E.D.

Warehouse or Maintenance, bike mechanic training; OSHA. CTE coursework, if available.

Innovative Strategies for Integrating Bike Share Competencies into Varied Programs of Study

A career pathway in bike share systems involves attaining competencies within various traditional transportation programs of study. In addition to acquiring technical preparedness in bike mechanics, safety, maintenance and warehouse operations, students and incumbent workers on a bike share career pathway will pursue experiential learning, on-the-job training and other work-based or real-world learning experiences focused on community engagement around transportation and shared mobility. Examples of effective integration models are listed that provide curricular and co-curricular value to career preparedness:

Co-Curricular

University Research Partnerships

Research partnerships between university faculty and community and regional entities are proven resources in planning, program development, and transportation 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 multi-modal and/or sustainable transportation research and project development. [The Initiative for Bicycle and Pedestrian Innovation](#) (IBPI) is an excellent example of such a program at Portland State University, offering courses and community continuing education, applied research, and degree concentrations.

Campus Living/Learning

Many US campuses (182 across 45 states as of 2017) are engaged in creating bike-friendly environments (See [League of American Bicyclists'](#) recognition program), and many time of year students their first real interaction with bikeshare (and other types of shared mobility) experience. Students often have an opportunity to play significant roles in planning, design and operation of systems.

Work-Based Learning

In sustainable transportation and planning 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 students have access to and develop skills that are important components of these sustainable transportation fields. From [CTE and apprenticeship programs](#) for bicycle mechanics, to [internships](#) at most bike share companies.

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 community outreach, shared mobility and sustainable transportation course-based projects can serve as a powerful student exposure and recruitment tool to bike share career pathways.

Transportation-Focused Course-Based Learning

Integration of transportation topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of transportation-focused case studies and fieldwork into required coursework; and implementation of assignments that demonstrate understanding of sustainable transportation principles and processes.

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 sustainable transportation. The existence of some industry-driven professional 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

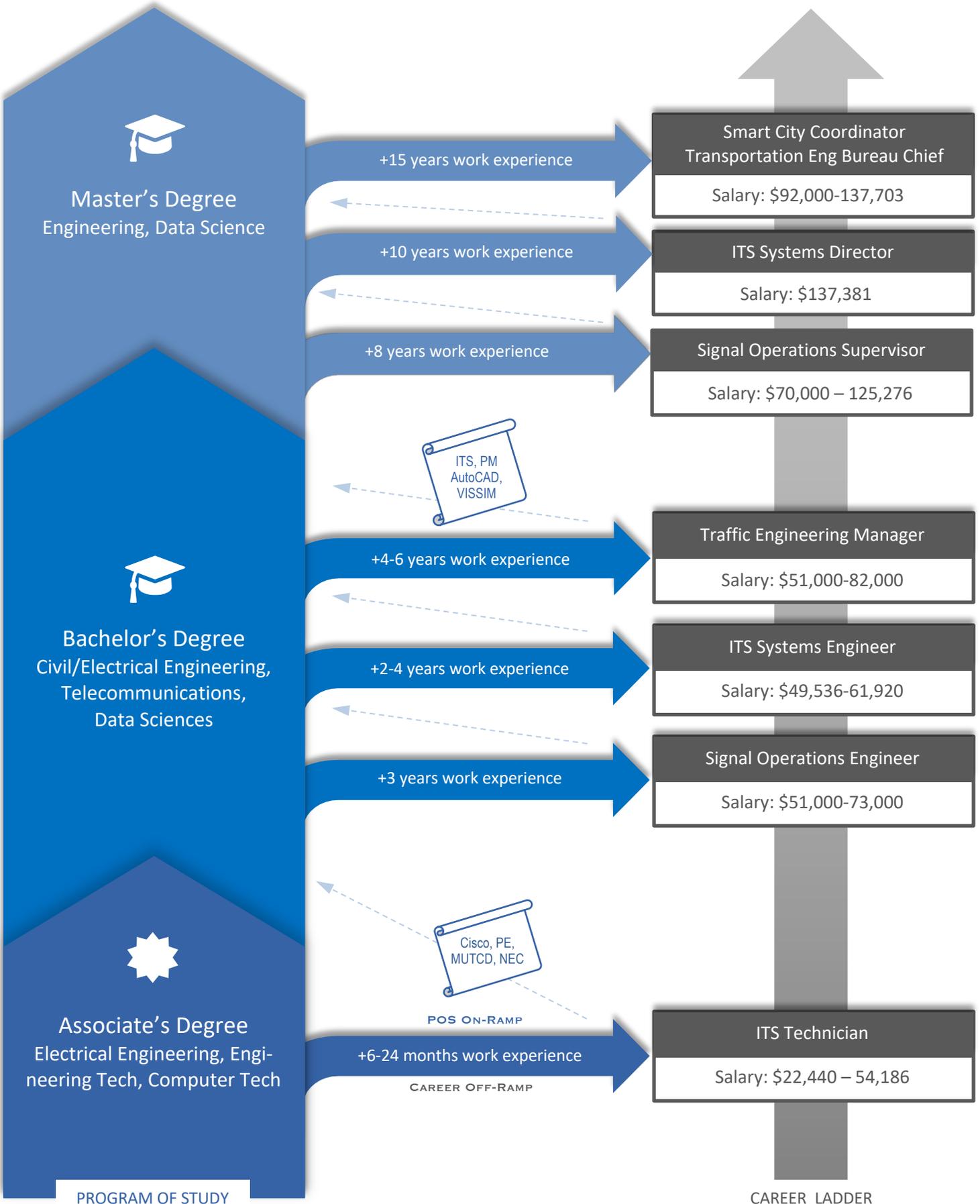
Provide education and training for students and incumbent workers at times and locations convenient to students and employers, rather than instructors or institutions. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

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, fieldwork, and team class projects that are assignments from local employers.



Alternative Job Titles

Senior ITS Engineer, ITS Director, Transportation Engineering and Operations Bureau Chief

Job Description

Responsible for citywide technology governance, strategic planning/policy development to advance Smart City solutions for infrastructure, energy, water and waste management; transportation alternatives, building/properties, and programs that promote technology literacy and public access to government information. Oversee diverse urban multimodal transportation needs critical to supporting ongoing safe/efficient management of a balanced street system that fully accommodates the needs of people who walk, bike, drive, and use transit.

- Collaborate with City departments working to devise Smart City solutions.
- Assist departments in managing, analyzing, interpreting data produced through Smart City implementations.
- Help departments ensure Smart City projects comply with City laws, policies, and standards.
- Work with appropriate IT teams on Smart City projects being proposed/planned.
- Ensure City standards of enterprise architecture, project management, procurement, security, privacy, social equity, data management, and performance are factored into the design of Smart City projects.
- Maintain a high level of education and awareness of developments in the Smart City technology environment.

Knowledge Requirements

- Analysis/Research/Report Methods
- Regulatory environment related to Area
- Transportation Modeling
- Budgeting/Financial Analysis
- Statistical Theory/Methods
- Project Management
- Commitment to diversity, inclusion, and equity in the organization and throughout service delivery

Technical Skills Requirements

- Smart City Technologies & Data Mgt.
- Internet of Things technologies
- AutoCAD Electrical
- MUTCD, IMSA Signal Certification
- National Electric Code
- PE license (for some positions)
- Complete Streets project management
- GIS, Microsoft Office Applications

Required Skills & Abilities

- Presentations (Public Speaking)
- Written and Oral Communication
- Plan and Coordinate Projects
- Stakeholder Engagement
- Customer Relations
- Management/Supervision
- Prepare/Administer Budgets
- Judgement & Decision-making
- Critical Thinking
- Complex Problem Solving
- Leadership

Typical Salary

- Salaries are wide-ranging and dependent on the size of the municipality and its location.

Education & Work Experience

- Master's degree in Transportation Engineering, Urban Planning, or Information & Data Sciences preferred.
- Bachelor's degree accepted for most; education and work experience that fulfill requirements is acceptable.
- Extensive senior-level management experience in Traffic Engineering, Transportation Planning, or Smart City Planning and managing complex projects and teams preferred.



Certifications

Professional Engineering licensure may be required for some positions. In gaining the necessary experience to qualify for these positions it is likely that careerists will have acquired a number of key certifications that attest to the attainment of a body of knowledge and capability specific to transportation and related ITS and smart city technologies. In these fields certifications for applied and process work are essential (e.g., GIS, CISCO, IMSA Traffic Signals, AutoCAD Electrical, MUTCD). The USDOT [ITS Professional Capacity Building Program](#) offers an ITS Standards Training series appropriate for students and practitioners.

Years 5-6



Master's Degree, Civil/Transportation Engineering, Urban Planning, or Sustainability

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

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

Core Courses

Sustainability and Systems Thinking
Problem Solving (to Discipline)
Transportation Systems Planning

Research Methods Courses

Dynamic Modeling/Statistical Modeling
GIS for Planners
Survey Research, Multivariate Statistics

Other Courses

Mitigation, Adaptation, & Resilience
Environmental Ethics & Policy
Sustainability & Enterprise Development
Urban Infrastructure
Communications for Pubic Engagement
Project Management
Environmental Impact Assessment
Traffic Engineering and ITS

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

Years 3-4



Bachelor's Degree, Civil/Transportation Engineering, Urban Planning, or Sustainability

Year 4: Select electives in areas of interest and fulfill internship, fieldwork, or senior capstone. Core transportation & Sustainability/Smart City courses.

Year 3: Take core courses in different areas of Civil Engineering, Urban Planning, or Business, depending on focus.

Year 1-2: In a traditional BS/BA program, students take core distribution courses and select path for Major.

GE Courses

Science, Social Sciences, Humanities, Arts & Foundational Core Courses with emphasis on communications

Sustainability/Smart City Courses

Sustainable Cities
Equity and Sustainability
Dynamic Modeling
Urban Policy and Governance
Sustainable Urbanism

General Transportation Planning & Engineering Courses

Transportation Systems & Planning
Traffic Engineering & ITS
Urban Planning

Other

Required Major courses
Senior Capstone
Internship

Experiential learning includes design labs, internships, clubs, and conferences

Years 1-2



Associate's Degree in Eng/Electrical Tech, Applied Information, Telecom

Year 1 and 2: Course requirements vary by institution. Students will complete institutional The Associate's degree and key certifications will provide students with general education requirements as well as and practical skills and competencies in the chosen field.

General Education Courses

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

Applied Skills Courses

AutoCAD/Engineering Graphics
GIS, Electrical

Specific Field Courses & Certification

Each field has a set curriculum and a set of specific industry or discipline related certificates that can be built into the curriculum.

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

Year 0



High School Diploma or G.E.D.

Computer or Engineering CTE coursework if available.

Innovative Strategies for Integrating ITS/Smart City Competencies into Varied Programs of Study

Programs of study supporting career pathways into careers working with Smart Cities/ITS/Sustainable Communities with a focus on transforming transportation systems as a core focus involves attaining a range of competencies both in traditional transportation engineering or planning programs of study, as well as acquiring academic and technical preparedness in emerging interdisciplinary fields. Sustainability and Smart Cities degree programs are rapidly emerging. In all cases these programs rely heavily on innovative opportunities for students to pursue applied research, experiential learning, other work-based or community service project-based learning experiences focused on preparing students and their communities for transformative transportation systems. Examples of effective models are listed that provide value to student career preparedness:

Co-Curricular

On-Campus Community Design Units

Many campuses partner with transportation agencies, local governments and private employers to provide on-campus internship or community service learning experiences to undergraduate students in around different problem sets. These programs provide students with hands-on design and problem-solving experience and exposure to a variety of organizations that also serves to build a pipeline to future careers.

Work-Based Learning

Many institutions either require or strongly encourage work-based learning experiences for their students through internships. Industry and education institutions can work together to ensure that sustainable transportation-focused experiences and application of related skills are an important component of these student development experiences.

Co-op Programs

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 transportation-focused course-based projects can serve as a powerful student exposure and recruitment tool to sustainable transportation 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—distributed over multiple departments and colleges across the university—utilizing the Educational Partnerships for Innovation in Communities (EPIC) model spearheaded by the University of Oregon (epicn.org).

Course-Based Learning

Integration of safety topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of Smart City and ITS case studies and lab exercises into required coursework; and implementation of assignments that demonstrate understanding of various technologies and processes, through development of ITS and Smart City plans. Job site visits and field trips have also been identified useful tools for promoting student interest.

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 ITS and entry level jobs in deploying smart city technologies and data collection and management systems. Job profiling and the use of "SMEs" should be considered to meet the competency needs of employers. The proliferation of industry-driven professional ITS 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

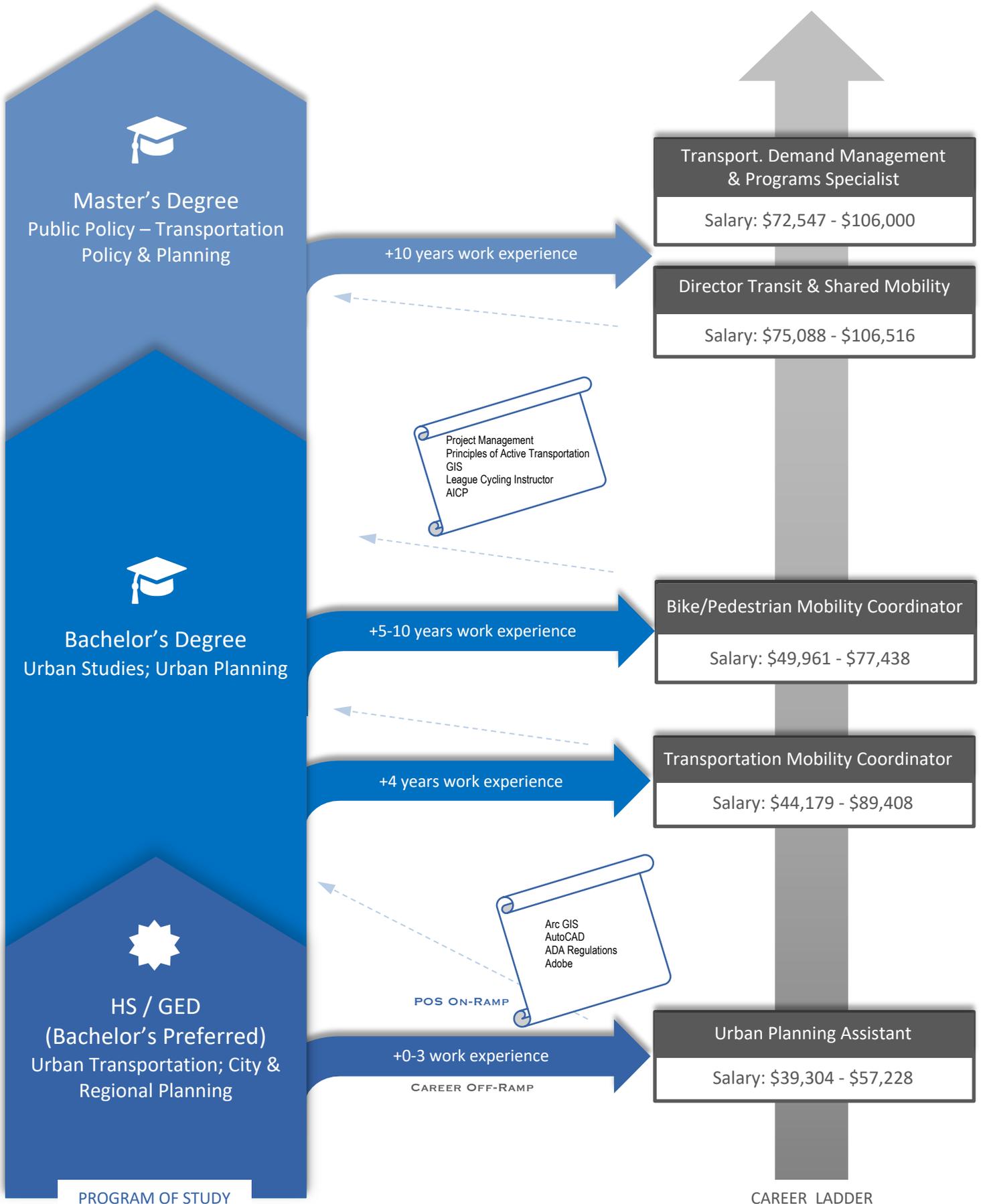
Incorporate opportunities for "learning-by-doing", including internships, co-op work experience, simulations, and team class projects that are assignments from local employers.

Experiential Programs (examples)

- **Northeastern University, MA. Transportation Engineering:** <http://www.civ.neu.edu/civ/research/transportation> Offers a co-op program that provides students the opportunity to work in an engineering practice prior to graduation.
- **US DOT Summer Internship Program for Diverse Groups:** <https://www.fhwa.dot.gov/education/stipdg.cfm> A paid internship program to expose students to transportation industry and prepare them for public service.

Experiential Programs (examples) Continued

- **Mass DOT Engineering Internship:** <https://www.massdot.state.ma.us/Employment/InternshipPrograms.aspx> Opportunities for field-work based internships with a Mass DOT Civil Engineer.
- **Metropolitan Transportation Commission (MTC), San Francisco, CA High School Internship Program:** <http://mtc.ca.gov/about-mtc/careers/high-school-internship-program> Offers internships to high school students to explore the role of public transportation agencies in community, county and regional transportation operations.
- **Volpe: The National Transportation Systems Center:** <https://www.volpe.dot.gov/about-us/careers/student-and-recent-graduate-opportunities> Offers internship programs from high school to graduate level to help resolve real-world transportation problems.
- **ASU ProMod** <https://schoolofsustainability.asu.edu/student-life/student-sustainability-research/promod/>



Alternative Job Titles

Director of Planning, Senior Community Development Specialist, Shared Mobility Program Manger

Job Description

Responsible for:

- Planning, implementing, and evaluating TDM programs: marketing campaigns; media campaigns; bike/pedestrian safety education; employer TDM programs; outreach; walking/biking events; open streets events and Safe Routes to School programs.
- Taking responsibility for every aspect of project management, including managing budgets, schedules, scopes of work, and client service.
- Managing the work of team members (both colleagues and sub-consultants) for a successful outcome.
- Contributing to the development of proposals, statements of work, contract addenda, and scope change.
- Managing the production of materials and incentive items, including content development, managing the client review process, and working with the embedded graphic design team.
- Contributing to blogs, social media, and whitepapers.

Knowledge Requirements

- Project Management
- Budget Management
- Communication
- Commitment to diversity, inclusion, and equity in the organization and throughout service delivery

Technical Skills Requirements

- Experience creating TDM strategic plans
- Principles of Active Transportation
- Experience using Deltek Vision
- League Cycling Instructor Certification
- Creating & editing simple videos
- Social Media
- Microsoft Office Applications

Education & Work Experience

- Master's degree in Urban Planning/Sustainable Transportation with an emphasis on active, non-motorized transportation.
- Senior level management experience; managing complex projects and teams.

Required Skills & Abilities

- Presentations (Public Speaking)
- Written and Oral Communication
- Organizing events
- Stakeholder Engagement
- Customer Relations
- Management/Supervision
- Prepare/Administer Budgets
- Judgement & Decision-making
- Critical Thinking
- Complex Problem Solving
- Leadership

Typical Salary

- Salaries for these positions cross an extremely wide range. These positions are either newly developing, or transforming existing positions. They are also dependent on the size of the municipality and its location.



Certifications

Beyond attaining a post-secondary degree, student can apply for a variety of additional professional certifications which attest to the attainment of a body of knowledge and capability specific to sustainable transportation planning and shared-use mobility. Certifications include, OSHA; GIS; AICP; League Cycling Instructor; Project Management.

Year 5+



Master of Arts in Urban & Regional Planning: Transportation Policy & Planning

Students learn about the current transportation policy and planning issues, and the tools and techniques to analyze them. Many of the course include field visits to meet with transportation experts. The Institute of Transportation Studies offers research opportunities and fellowships to graduate transportation policy & planning students.

Core Courses

Quantitative Analysis
Law and Quality of Urban Life
GIS

Transportation-Related Courses

Transportation Planning
Transportation & Environmental Issues
Traffic Engineering
Transportation Economics
Intro to Transportation Engineering
Travel Behavior Analysis

Experiential learning includes case studies and capstone projects.

Year 4-6



Bachelor of Urban Planning

This is a five-year professional degree program of study that provides an interdisciplinary planning education. It combines conventional classes with planning and design studios, co-op semesters, and senior capstone requirements. The BUP degree qualifies graduates to apply for AICP exam.

GE Courses

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

Transportation and Mobility-Related Courses

Planning Design Graphics
Transportation History & Policy
Urban Environments
Land Use
Certificate in GIS

Experiential learning includes fieldwork, studios, internships, & research

Year 0-3



High School or GED

Students will complete institutional requirements for the degree sought. Students enrolled in CTE courses can develop skills necessary for the occupation of Urban or Regional Planner, or Transportation Management.

General Education Courses

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

Transportation & Mobility-Related Courses

Transportation Systems Management
Logistics Planning
Infrastructure Planning

Experiential learning includes labs, internships, practicum, and fieldwork

Innovative Strategies for Integrating Sustainable Transportation Competencies into Varied Programs of Study

A career pathway in sustainable transportation involves attaining competencies within various planning and transportation programs of study. In addition to acquiring technical preparedness in GIS, AutoCAD, Project Management and American Institute of Certified Planners (AICP) certification, students and incumbent workers on a sustainable transportation career pathway will pursue experiential learning, on-the-job training and other work-based or real-world learning experiences focused on community engagement around transportation, planning and shared-use mobility. Examples of effective integration models are listed that provide curricular and co-curricular value to career preparedness:

Co-Curricular

University Research Partnerships

Research partnerships between university faculty and community and regional entities are proven resources in planning, program development, and professional 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 sustainable transportation and/or professional planning research project development. The Bachelor of Urban Planning at the University of Cincinnati is an excellent example of such a program, offering courses and [specialized certificates](#), [study abroad](#) and [co-op or professional practice](#) opportunities.

Work-Based Learning

In sustainable transportation and planning 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 students have access to and develop skills that are important components of these sustainable transportation fields. By enrolling in the American Institute of Certified Planners [AICP Candidate Pilot Program](#) candidates can take the AICP exam prior to earning professional planning experience. Many cities, towns and regional planning commissions offer internships that can address sustainable transportation issues.

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 community outreach, shared mobility and sustainable transportation course-based projects can serve as a powerful student exposure and recruitment tool to bike share career pathways.

Transportation-Focused Course-Based Learning

Integration of transportation topics and experiential learning into the classroom can be accomplished in various ways, including incorporation of transportation-focused case studies and fieldwork into required coursework; and implementation of assignments that demonstrate understanding of sustainable transportation principles and processes.

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 sustainable transportation. The existence of some industry-driven professional 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, fieldwork, and studio teaching by practice that add a dimension of professional practice to the student's academic studies.

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NTCPI

NATIONAL TRANSPORTATION CAREER PATHWAY INITIATIVE

TRANSPORTATION ENGINEERING

CAREER PATHWAY REPORT

FEBRUARY 2019



**MIDWEST TRANSPORTATION
WORKFORCE CENTER**

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Transportation Engineering

TRANSPORTATION ENGINEERING

SECTION 1.0 CHARACTERIZING THE WORKFORCE

1.1 The Highway Maintenance Workforce

The impetus for a focus on the highway maintenance workforce as a subset of the transportation engineering discipline is tied to the core mission of transportation agencies. In the 1960s, 70s, and early 80s, transportation agencies focused on building and expanding the interstate highway system. Since the mid-1980s and 90s, there has been a gradual shift towards preserving and operating the significant highway and bridge infrastructure built through that earlier investment (Asset Management Primer, 1999).

Today, agencies have a tremendous need for skilled workers to address the challenges of maintaining this system. Additional challenges—from extreme weather events and reduced funding to increased concern over environmental impacts—present complex effects on the competencies needed from highway maintenance workers to keep the nation’s highways in good repair.

This discipline however, has not evolved to a point where training is offered at the community college or university level, making it an “invisible” career option for prospective students. Likewise, parents and guidance counselors remain reasonably unaware of these options as they have gone undocumented in career guides and guidance systems. Many engineers first encounter the maintenance discipline when they begin their agencies’ rotational program.

Within the transportation community, abundant curricula on many aspects of highway maintenance and asset management have been developed in the U.S. Training is available on a nationwide basis from the National Highway Institute (NHI), the American Public Works Association (APWA), and AASHTO (TC3 curriculum).

Organizations like Clear Roads and LTAP programs like Roads Scholar also offer specialized training. State DOTs offer in-house training, and professional associations like the Wisconsin County Highway Association offer professional development to the highway maintenance workforce. Some of these organizations offer certifications, but generally neither the training nor certifications articulate into academic credit.



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With a lack of highway maintenance training through the educational system, the transportation sector has missed out on a most efficient channel for implementing innovations in workforce development. Modern, successful workforce solutions are worker-centric. Demographic shifts in the talent pool are making companies rethink their hiring and retention strategies and are now more likely to retain workers by training them for their next job.

This implementation plan therefore focuses on the skilled highway maintenance worker—the occupation in highest demand among state DOTs—and the skills that every jurisdiction needs to maintain the country’s roads. This plan builds on work the Midwest Transportation Research Center (MTWC) is currently undertaking in developing an apprenticeship for skilled highway maintenance workers. By the end of this plan’s 3-year project timeline, MTWC will have established a career pathway that is visible to students and parents, connected this apprenticeship to Civil Engineering Technician and Highway Maintenance Management programs, and have developed materials to assist employers in building apprenticeships in their own communities to facilitate the emergence of a workforce ready to transition into a sensor-based, AI world.

The highway maintenance and engineering workforce is comprised of occupations that fall all along the educational spectrum, including policy workers, managers, support technicians, and frontline workers. An overview of these occupations is presented below:

Policy Worker: Establish the policies, procedures, and management for how a highway system is maintained within their organization. Most often civil engineers with in-depth, on-the-job experience in managing agency assets (e.g., pavement, bridge, or construction), policy workers decide how to incorporate best practices from a number of other disciplines, such as environmental sustainability, technology, and materials, into maintenance.

Civil engineers are trained at the undergraduate level but receive maintenance and asset management training later in their careers at their organizations, through engineering professional developmental programs offered at universities or professional associations. Master’s degrees in infrastructure/asset management do not exist in the U.S. but are available overseas.

While concepts related to maintenance—such as level-of-service, service life, performance targets, life-cycle cost analysis, cost-benefit analysis, and customer service—are part of university curricula at the undergraduate level, there is no major or minor in maintenance. For entry-level workers, training is predominately provided on an on-the-job basis.

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Managers: There are a variety of management positions within highway maintenance, with backgrounds ranging from civil engineers to urban planners to diesel mechanics. They may manage programs or be experts in fields such as vegetation, invasive species, or fleet.

Support Technicians: Civil engineering techs, GIS techs, and surveying techs all support functions within highway maintenance. The Civil Engineering Technician occupational category encompasses up to fifteen jobs within a state DOT, including: bridge design/inspection, construction inspection, hydraulics/water resources, materials, permits, planning, pre-design, right-of-way, road surface/roadside maintenance, sign maintenance, soils, surveys, and traffic engineering. Community colleges offer civil engineering tech programs, however not all are accredited by the Accreditation Board for Engineering & Technology (ABET), resulting in academic programs that cannot fully transfer to a four-year civil engineering program.

Highway Maintenance Workers: These are the largest category of workers in most state DOTs. Entry-level workers are often trained on the job, which covers safety practices and tools. A “Level 2 Maintenance Worker” usually possesses equipment operation skills and a commercial driver’s license (CDL). Generally, entry-level workers are required to have some related experience in construction or other outdoor work, a high school diploma or G.E.D., and a CDL. Some specialized skills and knowledge are also typically required, such as determining the proper snow maintenance procedure for given weather conditions. Where frontline workers are designated as “skilled”; highway maintenance is considered a “middle-skills” job.

1.2 Priority Occupations

At the outset of this pathways initiative, MTWC researchers interviewed several DOTs and the Highway Maintenance Engineering (HME) Discipline Working Group (DWG) to understand and validate the extent of occupations involved with the highway maintenance function within a state DOT. A data-driven approach to understanding workforce demand was established.

This involved identifying which SOC codes transportation agencies use to submit employment data to BLS, conducting a broad industry literature review, and analyzing real-time employer job listings for related occupations. The results from this effort is shown in Table 1.2.1 below, which lists the occupations considered most critical to supporting highway maintenance.

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Table 1.2.1: Critical Safety Occupations in Transportation

SOC CODE	OCCUPATION	CURRENT # EMPLOYEES, 2016	PROJECTED # EMPLOYEES, 2026	PERCENT CHANGE	MEDIAN SALARY 2016
11-1021	General & Operations Managers	2,263,100	2,468,300	9.10%	\$ 99,310
11-9021	Construction Managers	403,800	448,600	11.10%	\$ 89,300
17-2051	Civil Engineers	303,500	335,700	10.60%	\$ 83,540
17-3022	Civil Engineering Technicians	74,500	81,100	8.80%	\$ 49,980
47-1011	1st-Line Supervisors, Construction Trades & Extraction	602,500	678,300	12.60%	\$ 62,980
47-2061	Construction Laborers	1,216,700	1,367,100	12.40%	\$ 33,430
47-2071	Paving, Surfacing, Tamping Equipment Operators	51,900	58,200	12.10%	\$ 38,970
47-2073	Operating Engineer & Construction Equipment Operator	371,100	416,900	12.30%	\$ 45,890
47-4011	Construction & Building Inspectors	105,100	115,700	10.00%	\$ 58,480
47-4051	Highway Maintenance Workers	149,900	160,200	6.90%	\$ 38,130
53-1031	1st-Line Supervisors, Transp. & Material Moving Machine Operators	204,200	217,700	6.60%	\$ 57,270

These eleven priority occupations represent policy workers, managers, technicians, and front-line workers. MTWC correlated these standard BLS designations to job titles found within the highway maintenance field, shown in the crosswalk below (Figure 1.2.1). They are also represented in the career pathways documentation developed under this initiative.

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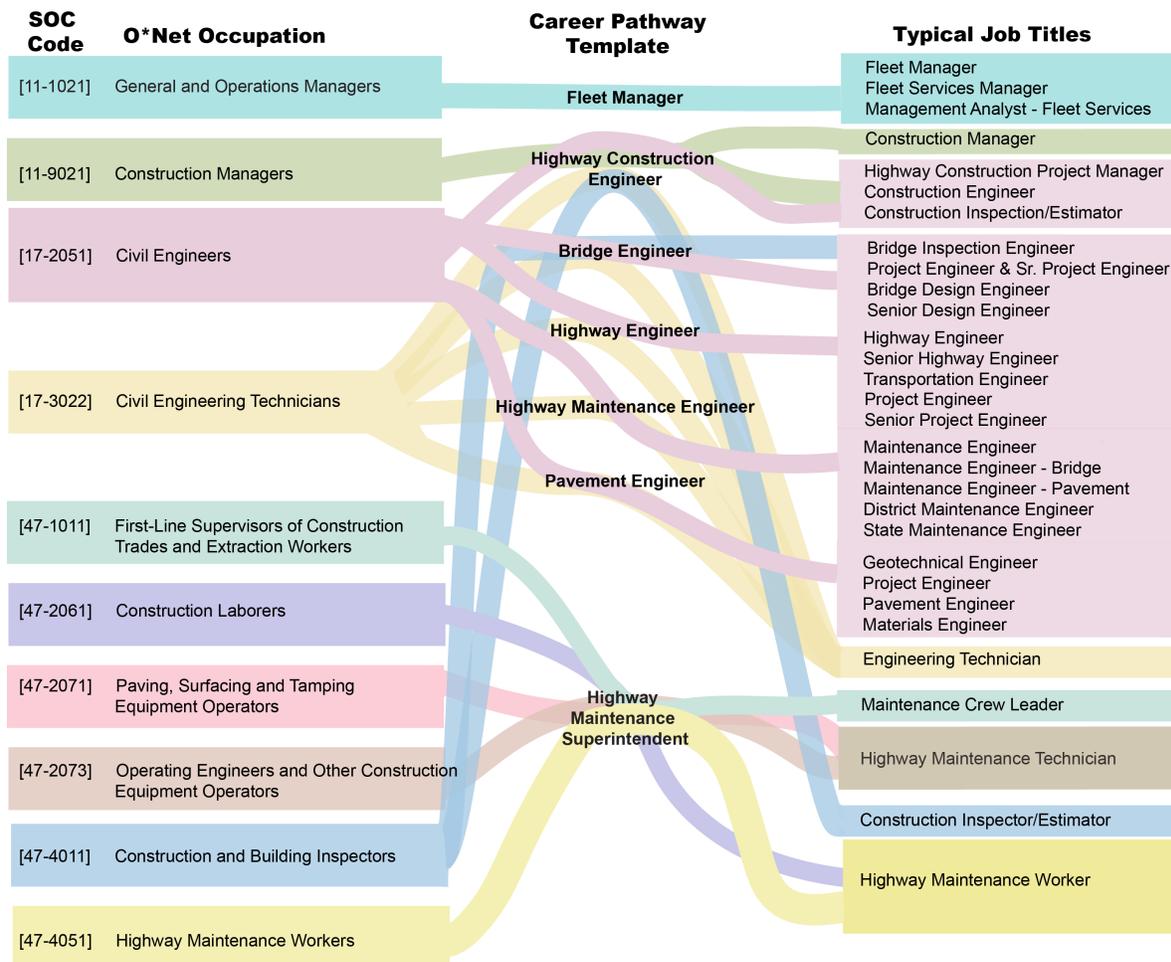


Figure 1.2.1: Occupational Crosswalk of Highway Maintenance Job Priorities

1.3 Critical Workforce Competencies

Highway maintenance workers must have knowledge of the following administrative rules: vegetative rules, private right-of-way usage, use of state highway facilities, regulation of signs, utility installation, building moving permits, temporary closing and special use of state, drainage connections, state highway system connections, and access management. The highway maintenance function is part of an agency's asset management strategy, and engineers and planners must often acquire general management skills in budgeting, finance, and performance measurement. Landscape architects, surveyors, biologists, and environmentalists are also part of the highway maintenance team, along with front-line workers.

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Figure 1.3.1 below illustrates the highway maintenance engineering competency model as a pyramid, following the ETA/DOL standard. It represents broad workforce KSAs at its base and moves up to more specific competency sets, with the top-level listing management competencies and occupation-specific requirements. The competencies listed in this model are meant to represent the KSAs needed across an agency to carry out the highway maintenance function. Many occupations share varying degrees of the listed competencies.

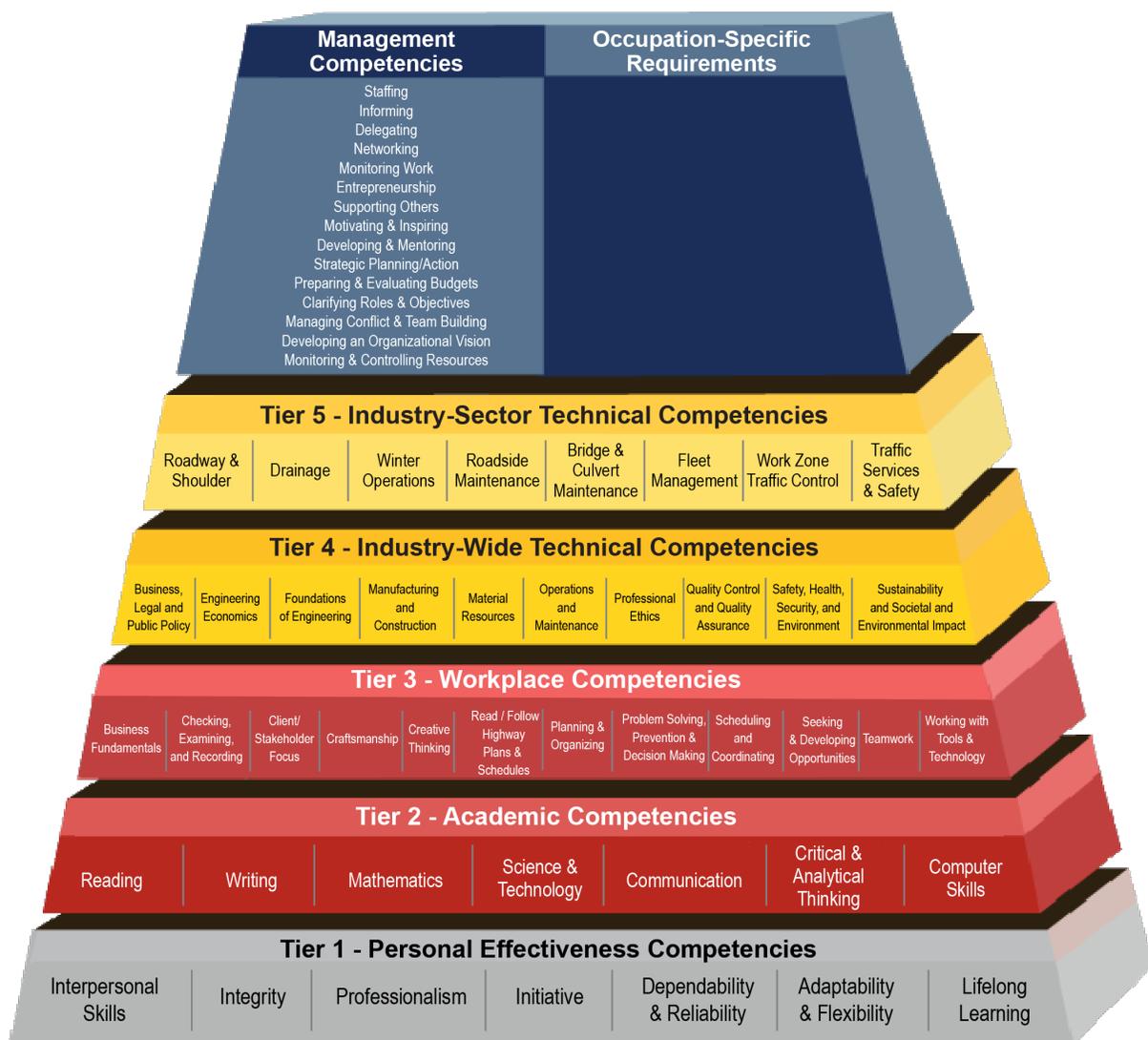


Figure 1.3.1: Highway Maintenance Engineering Competency Model

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Tiers 1-3 are considered foundational competencies essential for all life roles including family, community, and societal member. Tier 1 competencies are essentially “soft skills” that may have been learned at home or in the community and reinforced at school or work. Employers value these skills, but they are sometimes difficult to teach or assess.

Tier 2 represents academic competencies primarily learned in an academic setting, including cognitive functions and thinking styles. These competencies likely to apply to all organizations represented by a single industry or association nationwide and serve as the foundation for occupation and industry specific competencies. These include reading, writing, mathematics, science, technology, communication, critical/analytical thinking, and computer skills.

Tier 3 represents workplace competencies that allow individuals to function in an organizational setting. As with the academic competencies, these are generally applicable to a large number of occupations and industries on a national level.

Tiers 4 and 5 represent industry competencies. In the model shown, Tier 4 identifies the KSAs needed for all occupations within Civil Engineering. Tier 5 competencies identify requirements for highway maintenance, a sub-sector of engineering.

Occupations may require one or more management competencies listed at the top left of the pyramid. These are generic managerial skills often scattered throughout a curriculum or that individuals may attain over a career.

The “Occupation-Specific Requirements” section of this model is blank; its KSAs depend upon the occupation being modeled within highway maintenance. For an entry-level worker, this would identify specific tools or a CDL requirement. For engineer, it might list a Professional Engineer (PE) license or other appropriate certification/KSA.

1.4 State of Workforce Readiness

MTWC identified through a series of interviews, surveys, and meetings, those issues that impact the highway maintenance workforce. Some are geographic or institutional and some relate to individual jobs, that of either the entry-level highway maintenance worker or public works director. Table 1.4.1 below provides an analysis of the data collected.

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Table 1.4.1: Workforce Issues in Highway Maintenance

WORKFORCE ISSUE	MARKET	HUMAN RESOURCES INSTITUTIONAL PRACTICES	HIGHWAY MAINTENANCE WORKER: ENTRY-LEVEL	CIVIL ENGINEER - PUBLIC WORKS DIRECTOR or HIGHWAY COMMISSIONER ROLE
Recruitment	<p>Location. Local economy dictates whether highway maintenance/county maintenance engineer jobs are desirable.</p> <p>Proximity to major urban areas results in more competition for wages.</p>	<p>Lack of partnerships with unions, high schools, and technical college counselors.</p> <p>Use of social media is low. Word of mouth and the organization's website are best means for job posts.</p>	<p>Top barrier to attracting entry-level workers is the cut in benefits by the implementation of Act 10 in Wisconsin. This legislation was enacted in 2011.</p> <p>The consolidation of family farms has resulted in a smaller workforce pool with desired KSAs. Drug issues, lack of clean driving records. Lack of maintenance-related experience in the applicant pool.</p>	<p>Skills levels vary. Both PE and public administration backgrounds are recruited. PE may need to learn budgeting skills. Administrators may need to learn operations skills, such as fleet management.</p>
Retention	<p>Pay is lower than private-sector counterparts for the same skills and experience.</p> <p>Limited opportunities for advancement.</p>		<p>Quality of roads is a reflection of their livelihood. The stigma associated with maintenance. Entry-level duties are boring. Snow plowing demands too much overtime.</p>	
Professional Development	<p>Many vendors (NHI, APWA, TC3, LTAP) but articulation to educational pathways non-existent.</p>		<p>Professional development available but not credentialed or degree-seeking for this level.</p>	<p>No set of standard competencies set for managers. Lack of coursework in the area of asset management is met with professional development coursework.</p>
Credential Attainment	<p>Credentials can be earned, such as Public Works Supervisor or Certified Public Administration. Degree not required to enroll. Credential not articulated to a degree.</p>		<p>CDL is a critical credential. CDL attainment is hampered by a clean driving record.</p>	
Training / Academic	<p>Inconsistent across the state. Some training offered in-house or by contractors, insurance companies, or universities.</p>		<p>Training is largely done in-house.</p>	<p>No master's degree in Asset Management in the US.</p>
Keeping Pace w/ Technology	<p>Adoption rates are slower than private-sector. Institutions generally wait for best practices or pilot demonstration. Limited revenue stream to institute changes at a faster pace.</p>		<p>Some counties are technology adverse.</p> <p>No use of simulators for training purposes.</p>	<p>Adoption rates correlate with a risk-averse workforce.</p>

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SECTION 2.0 CAREER PATHWAY DESIGN

2.1 Pathway Design Methodology

One key criterion in selecting occupations for pathway template development was whether the occupation existed in career information systems. For example, MTWC found that Public Works Directors, Highway Commissioners, and Fleet Managers were occupations not listed in Career Cruising, a national career information systems provider. Public Works Directors are generally civil engineers but could have an educational background in public administration.

A fleet management pathway does not exist and was chosen because (a) fleet expenses are, after salaries, the second highest expenditure of a transportation agency, and (b) the advent of the autonomous vehicle and the implications that may have on agency operations.

Under the priority occupation “Civil Engineer”, there are a set of related occupations that perform an asset management or maintenance function. They are: Bridge Engineer, Highway Engineer, Highway Maintenance Engineer, Highway Construction Engineer, and Pavement Engineer. While “Civil Engineer” is a documented pathway with resources to support it from a national perspective, there is no equivalent support for these sub-specialties. As previously stated, the highway maintenance worker is the occupation in highest demand at state DOTs.

For all these occupations, MTWC reviewed existing credentials, training, and education in the U.S. and abroad, then used job listings to identify KSAs, job descriptions, and alternate titles.

2.2 Pathway Learning Strategies

Career pathways recognize student learning styles and introduce opportunities for experiences that expose students to “real-world” problems or scenarios. Educators recognize that learning needs to be personalized to fit every student. The field of learning science is constantly innovating, especially in the area of game-based learning and discovery.

Games are helping students master subjects like math where they have previously had little success in the domain. Gaming innovation tied to a student’s thinking process is making possible the notion of moving students to technical or engineering positions in the near future.



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MTWC focuses on apprenticeship as a promising learning strategy that could be used at all levels of an organization. Apprenticeship is a work-based learning approach. Apprenticeship programs are post-secondary education where the apprentice learns only a portion of their skills in a traditional classroom; most training is acquired on-the-job working for an employer, being mentored by the employer, and earning a wage. Employment is the primary requirement for an apprenticeship; a job must exist for an apprentice to be trained. Where classroom instruction is provided, it is often through a technical college system.

The U.S. DOL supports the acceleration of apprenticeships beyond traditional trade programs into new industries such as banking and insurance, and to new emerging occupations such as cybersecurity and organic farming. Youth apprenticeships (programs for high school students), are taking new forms and provide dual-credit opportunities.

The adoption of apprenticeship in transportation occupations, other than construction, lags behind other industries. The deployment of this initiative's pathway implementation will accomplish a critical step in advancing the use of apprenticeship in the transportation sector.

Studies have concluded that apprenticeship delivers several benefits, including a high return on investment for employers in terms of recruiting and retaining workers. Apprenticeship is often mentioned as a ticket to the "middle class" and can provide a credential that is recognized across the country—a benefit unavailable to highway maintenance occupations.

Apprentices can represent a target population (minority, disabled, underemployed) to improve community economic development and agency inclusion goals. Two examples of how an apprenticeship could be implemented for transportation workers are as follows.

1. New engineers usually rotate through departments to learn various disciplines. These rotational programs make a good starting point for developing new apprenticeship programs as they provide formalized, consistent training with mentorship opportunities. The apprenticeship would be tied to wage increase and its certificate of completion would articulate to degree programs, making training count toward higher education. Articulation serves personal goals (getting a degree) as well as agency goals, such as having employees who are credentialed, safe, and critical thinkers.

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- Idaho DOT offers a cohort-hired highway maintenance apprenticeship, where cohort performance is measured against agency goals. If met, the entire apprentice cohort advances in job and pay level. This strategy does a better job of connecting worker performance to agency goals, which in turn benefits all workers and encourages tighter teamwork. The Idaho DOT apprenticeships are not registered through DOL, meaning they are unable to provide participants with any formal or accredited credential.

Apprenticeship is considered an experiential learning or learning-by-doing activity, with other examples including internships, externships, rotational programs, co-op work experiences, simulations, and class projects that tackle real-world scenarios from local employers. There are also numerous experiential activities available to transportation students, such as work-study at a state DOT. Many professional organizations offer financial support as a way to engage students around a maintenance career, but few offer opportunities for intern or externships.

Many maintenance worker experiential activities deal with mastery. “Road-eos”, or equipment operation competitions, are held at the local, regional, and national levels.

2.3 Priority Career Pathways

The pathways introduced here encompass a lattice of occupations within the highway maintenance discipline. These occupations are found in both public and private sectors and are impacted by autonomous vehicle technology, advancements in pavement, and trends in environmental stewardship and resilience:

Career Pathway: Highway Maintenance Engineer

Description: This pathway begins with domain experience in the areas of infrastructure (pavement, bridges). Mid-career engineers may be assigned to an area of operation (county, region, district) as an Assistant State Maintenance Engineer to determine cost-effective preventive maintenance treatments, upgrades, and repair strategies to maintain highways, bridges, and roadside facilities. Applies asset management principles to schedule/prioritize work; assesses highway corridors holistically and programs actions through a lens of environmental stewardship, sustainability, safety, and resilience.

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- Priority Occupations: Highway Maintenance Engineer, Engineering Technician.
- Support Occupations: Bridge or Pavement Engineer.
- Education/Training: Civil engineering with PE license. Training at the continuing education level includes budgeting or risk-management to contribute to the asset management efforts of an agency.

Career Pathway: Highway Engineer

- Description: Occupations that prepare plans and specifications for roadway construction/improvement projects, with considerations for safety, parking, traffic calming, pedestrian/bike paths, drainage, highway signs, road markings, signal systems, roadway lighting, impact attenuators, and guide rails. Support or conduct traffic studies, participate in public meetings, write technical reports, and conduct construction analyses.
- Priority Occupations: Road Design / Roadway Engineer, Civil/Transportation Engineer.
- Support Occupations: Engineering/Traffic Technician.
- Education/Training: Civil engineering with specialization in highway engineering.

Career Pathway: Pavement Engineer

- Description: Design, evaluate, and manage asphalt/concrete pavement systems; determines pavement layer thicknesses and material composition required based on traffic load; collects/reviews data on existing pavements to assess deterioration and remaining service life. Understand how external conditions change the rate of pavement degradation over time, while setting immediate/long-term repair and maintenance strategies.
- Priority Occupation: Pavement Engineer, Engineering Technician.
- Support Occupations: Geotechnical Engineer.
- Education/Training: Civil engineering program.

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Career Pathway: Highway Construction Engineer

- Description:** Oversee roadway projects to completion, provide general inspection and project management, work with staff and communicate with clients. Assist in preparing reports, plans, and specifications; research standards/code requirements; and conduct field investigations of design problems. Collaborate with other engineers, technicians, planners, and surveyors.
- Priority Occupations:** Highway Construction Project Manager, Construction Manager, Construction Inspector/Estimator, Engineering Technician.
- Support Occupations:** Construction Engineer.
- Education/Training:** Civil engineering with construction/transportation emphasis.

Career Pathway: Bridge Engineer

- Description:** Conduct structural analysis to ensure strength/safety of highway structures, prepare structural design/contract documents including drawings, specifications, and estimates. Prepare project budget and schedule, participate in client/team meetings, and review structural calculations and contract documents prepared by others. May act as assistant/principal design engineer on a project.
- Priority Occupations:** Bridge Engineer, Project Engineer, Engineering Technician.
- Support Occupations:** Bridge Inspection Engineer.
- Education/Training:** Civil engineering with emphasis on structural engineering.

Career Pathway: Highway Maintenance Superintendent

- Description:** Develop schedules/budgets, set work priorities for maintenance operations, supervise multiple crews tasked with highway/bridge maintenance, repairs, and reconstruction.
- Priority Occupations:** Highway Maintenance Workers I & II, Crew Leader, Highway Maintenance Superintendent.

Transportation Engineering

Support Occupations: Maintenance Crew Leader.

Education/Training: High school diploma or GED.

Career Pathway: Fleet Manager

Description: Oversight of vehicle/heavy equipment repair, maintenance, fueling, record keeping, and vehicle procurement/disposal. Collaborate/coordinate with other departments, divisions, and agencies.

Priority Occupations: Fleet Manager.

Support Occupations: Fleet Management Analyst, Heavy Equipment Technicians.

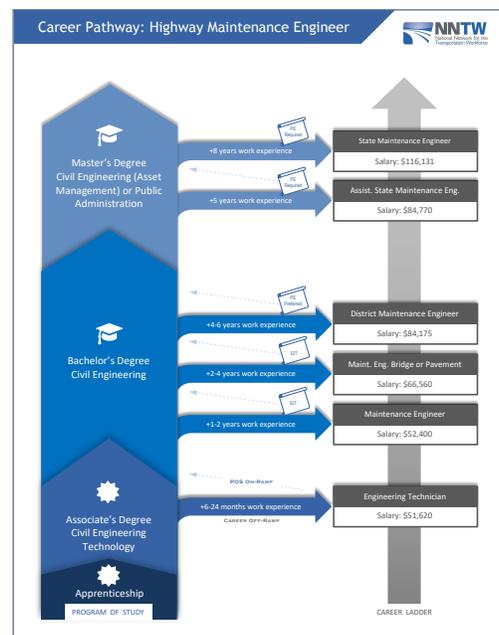
Education/Training: Business administration, work experience, industry certification.

2.3.1 Career Pathway Documentation

All career pathways and priority occupations identified as priorities by this initiative and referenced previously within this report are documented using four standardized templates: a pathway graphic, job description, program of study, and experiential learning aide.

Career Pathway Graphic: This document illustrates the career trajectory for individuals seeking opportunities in an HME-related career. As seen in this Highway Maintenance Engineer example, it denotes the education, certifications, and work experience needed for roles within this space.

On the left side of the graphic are the various levels of degree programs, associate, bachelor's, or master's degree associated with the pathways academic program of study. Arrows denoting years of work experience correlate to sample job titles and typical wage earnings. Certifications or other credentialing are also indicated where preferred or required to advance to the next career ladder position or academic program level.



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Job Description: This document frames priority occupations in terms of their employer-side specifications. Job titles, job description, typical duties and responsibilities, typical skill requirements, typical technical knowledge and tool/software literacy, typical education and work experience necessary to access the position, and a nationally representative salary range.

Salaries vary greatly across the U.S.; data for the example at right was sourced from Glassdoor.com. To finalize this profile, "Education and Work Experience" lists the most common requirements for the Highway Maintenance Engineer position.

Program of Study: For each career path, an idealized program of study is provided. As shown in the example at right, there are three entry points to the highway maintenance engineer position. One is to acquire a master's in civil engineering that will provide the suite of competencies needed for direct entry to the position, if the proper level of work experience is also attained.

For university students considering a career in highway maintenance, this template offers coursework that may be appropriate for the student. The third entry begins at the community or technical college level, by taking courses that provide the mathematical background to transfer to a four-year civil engineering program.

For professional development, the top of the page also lists licensure/credentialing commonly requested for careers in this pathway.

Job Description: Highway Maintenance Engineer



Alternative Job Titles

State Maintenance Engineer, Road Maintenance Engineer, County Engineer, Public Works Director, Highway Maintenance Administrator, Director of Maintenance

Job Description

A Highway Maintenance Engineer is responsible for determining cost-effective preventive maintenance treatments, upgrade, and repair strategies to maintain highways, bridges and roadside facilities within an assigned area of operation. This position follows state department of transportation standards and applies asset management principles to schedule and prioritize work. This position assesses highway corridors holistically and programs actions through a lens of environmental stewardship, sustainability, safety, and resilience. Other duties include:

- Develops and monitors maintenance budget.
- Oversees selection and maintenance of major roadway maintenance equipment.
- Responsible for landscape and vegetation management along roadways.
- Responsible for emergency response preparedness for maintenance.
- Responsible for the development, preparation, and letting of maintenance contracts for the district.
- Works with governmental officials and the public to set maintenance program goals and expectations.
- Administers and inspects contracted maintenance activities.

Knowledge Requirements

- Principles of asset management
- Construction engineering procedures
- Government programs and operations
- Roadside maintenance procedures
- Materials for highway/bridge maintenance
- Roadway/shoulder maintenance practices
- Drainage/bridge/culvert maintenance
- Preventive maintenance Procedures
- Safety and incident management
- Fleet & Traffic services
- Inventory management
- Budgeting, life-cycle costing
- Environmental laws and regulations

Required Skills and Abilities

- Engineering principles, practices, methods
- Prioritization and organization
- Management/supervision
- Logic/reasoning/decision-making
- Communicate effectively with the public
- Teamwork
- Organizing, scheduling and coordinating
- Written and oral communication
- Customer service
- Leadership

Technical Skills Requirements

- Standard Microsoft Office applications
- Maintenance management software

Typical Salary

• \$52,600 – \$116,000
Source: AAJITD salary information

Education and Work Experience

- Bachelor's degree in Civil Engineering or related field with four (4) years of professional experience in highway construction and maintenance with one (1) of those years in a supervisory capacity.
- Licensed Professional Engineer (P.E.)

Program of Study: Highway Maintenance Engineer



PE – Professional Engineer

While each state licensing board has its own laws regarding engineering licensure, there is a general three-step process for licensure candidates. PE candidates must possess a degree accredited by EAC or ABET. They must take two exams: the Fundamentals of Engineering (FE) exam and the Principles and Practice of Engineering (PE) exam. Most states require four years of acceptable, progressive, and verifiable work experience in the industry. Once students pass the FE exam, they earn an Engineering in Training certificate or an Engineering Intern (EI) certificate depending on the certifying organization.

Year 5-6

Master's Degree in Civil Engineering (Infrastructure or Asset Management Emphasis)

Year 6: Students choose specific maintenance, sustainability or management electives to round out their skill set. Examples include public works administration, environmental impacts, engineering, and public health.

Year 5: During the first year, students take core courses.

Asset Management Courses
 Strategic Asset Management
 Asset Maintenance Technologies
 Sustainability Eng. & Management
 Work Planning & Scheduling
 Condition Monitoring & Diagnostics
 Maintenance Analysis & Optimization
 Research Methods
 Health, Safety and the Environment
 Reliability Centered Maintenance

Project Management
 Total Quality Management
 Federal, State and Local Governments
 Public Works Final Project
 Life Cycle Cost Analysis
 Transportation Policy and Economics

Experiential learning includes: Internship, externship, co-ops and fieldwork

Year 3-4

Bachelor's Degree in Civil Engineering

Year 3 & 4: Students fulfill internship or co-op and fieldwork requirements. Elective courses complement the highway maintenance focus such as construction management, vegetation, sustainability, resilience, public policy, invasive species, solar technology, public health.

Year 1 & 2: Students take a number of engineering courses to build a strong technical background.

GE Courses
 Calculus, Differential Equations, Statistics, Liberal Arts, and Communications

CE-Related Courses
 Fluid Mechanics
 Structural Analysis
 Civil Engineering Graphics
 Environmental Impacts
 Fieldwork/Internship
 Senior Capstone Design

HME-Related Courses
 Hydroscience & Soil Mechanics
 Transportation Engineering
 Materials for Construction Facilities
 Construction Project Management
 Introduction to Asset Management
 Advanced Pavement Design
 Highway Bridges
 Reliability Centered Maintenance
 Engineering Economics

Experiential learning includes: Internship, externship, co-ops and fieldwork

Year 1-2

Associate's Degree in Civil Engineering Technology

Year 2: Students continue to take general education courses and technical courses that can prepare them for a position as a technologist. Those intending to transfer to a 4-year program will take additional mathematics courses.

Year 1: Students are required to take general education courses interspersed with technical coursework. Certifications are built into the curriculum.

GE Courses
 English Composition and Oral Communication
 Intro to Psychology/Business Ethics
 Trig/Algebra w/ Physics, Statics
 American, State and Local Governments

Highway Maintenance-Related Courses
 Introduction to Asset Management
 Highway Safety
 Surveying-Intro, Station, Highway
 Soils & Stone Work Management
 GPS and GIS Fundamentals

Commoned Aggregate Mixtures
 Construction Estimating & Management
 Inspection
 Sustainability & Resilience
 Pavement & Invasive Species
 Technology in Transportation Systems
 Civil Engineering Project Capstone

Experiential learning includes: Internship, externship, co-ops and fieldwork

Year 0

High School Diploma

Transportation-related career academies.

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Experiential Learning: A listing of career-relevant experiential learning programs and pathway-relevant innovative learning strategies round-out the recommendations and findings of this career path initiative. The resources listed are grouped by type of program. National-level organizations are listed along with those programs that can regionally replicated. Because many of the pathways in HME are related, the programs and resources recommended in the example at the right may be similar across all pathways.

Similarly, strategies to improve student learning efficiency reflect current thought in learning science and are therefore also relevant across most all HME academic paths.

Experiential & Innovative Learning: HME



Experiential Learning Programs for Highway Maintenance Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

HIGHWAY MAINTENANCE ENGINEERING RESOURCES

American Society of Civil Engineers (ASCE) Student Chapter

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. They also have access to publications, eBooks, and educational resources. An example of training offered by ASCE is the Geographic Information Systems for Asset Management Certificate Program. Scholarships are available for undergraduates at ASCE certified schools. Fellowships are available for graduate students.

Roadway Maintenance Training and Demo Day

The Roadway Maintenance Training and Demo Day is a one-day event that rotates throughout the state of Minnesota annually. The event offers a half-day of classroom roadway maintenance training, followed by a half day of outdoor maintenance activity demonstrations. LTAP, Minnesota Local Road Research Board, Minnesota DOT and the APWA-MN Chapter sponsor this event. Maintenance operators, supervisors, and transportation and research implementation personnel from township, local, city, county, and state agencies attend seeking continual education and knowledge-building opportunities.

INTERNSHIP/CO-OP/EXTENSIVE OPPORTUNITIES

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 underclassmen, graduate students, and students pursuing a technical degree or apprenticeship. Opportunities such as job shadowing and career fairs are available through state AGC chapters.

Maintenance Superintendent Associations/Highway Commissioners Associations/County Road Associations

Many states have associations that support professional development for Highway Superintendents and Commissioners of Public Works and are good sources for job postings or internships. These organizations may be affiliates of the National Association of County Engineers as well as partners with APWA state chapters. Some may offer certificate programs as well as scholarship opportunities.

Municipal Public Works Departments

County and other 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 network-

ing, 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 related 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 air roadside rest facilities, and flagging. Some training is provided on the job. DOTs offer vicarious programs to entry-level engineers so that they experience different business areas within the organization before selecting a permanent assignment.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its [Onsite Road Internship/Transportation Education Program](#) to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

CO-CURRICULAR OPPORTUNITIES

American Association of State Transportation Highway Officials (AASTHO)

While students are not eligible for AASTHO membership, the website offers an email subscription to the Daily Transportation Update of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 30s segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASTHO provides a strong social media presence communicating issues, projects, and announcements.

American Public Works Association (APWA)

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering social work, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students in this field.

Engineers Without Borders USA

Engineers Without Borders provides service-learning opportunities for students at the local and international levels. The national organization offers internships, while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

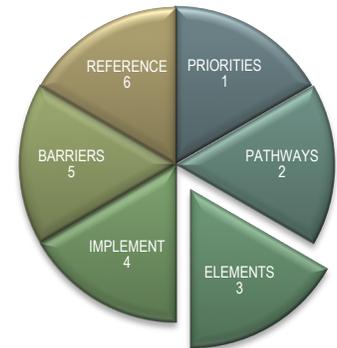
National Society of Professional Engineers (NSPE)

Students can be members of NSPE and attend student chap-

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SECTION 3.0 THE SIX ELEMENTS OF PATHWAY DEVELOPMENT

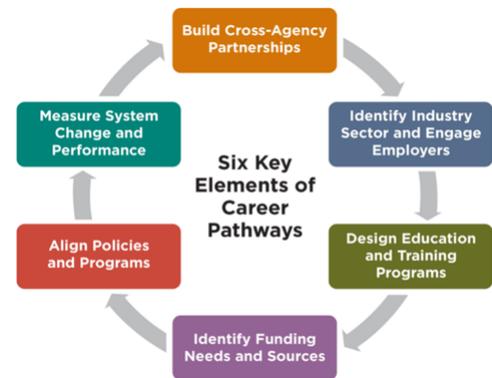
All NNTW implementation plans follow the six key elements of career pathway development, established by the Employment Training Association (ETA) of the Department of Labor (DOL), which are designed to guide state and local workforce development teams through the steps necessary for developing a comprehensive 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 Highway Maintenance workforce—and an implementation plan for deploying those pathways into the post-secondary educational continuum, the MTWC team approached this ETA system using the following strategies:



3.1 Build Cross-Agency Partnerships & Clarify Roles

Career Pathways are sector-based efforts, meaning that industry drives their development. MTWC's role is that of an intermediary—connecting employers to workforce/educational systems and serving as a transportation expert to partnering agencies—and will engage agencies that will help scale this implementation plan.

MTWC has also already built relationships with the U.S. DOT and Colorado DOT (two future partners in articulating a highway maintenance apprenticeship to other post-secondary programs), the NHI, APWA, AASHTO, and TRB committees involved in highway maintenance.

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3.2 Identify Industry Sectors & Engage Employers

MTWC engages industry employers through a combination of targeted communication, in-person presentation, and the use of survey tools. To facilitate implementation deployment, a database from the Wisconsin League of Municipalities and Wisconsin DOT of over 500 highway maintenance stakeholders will be used, and target stakeholder meetings will be attended.

To gauge industry issues regarding worker retention and recruitment, MTWC developed the Wisconsin Highway Maintenance survey that was validated by Minnesota DOT HR staff with expertise in highway maintenance issues and the President of the Wisconsin Chapter of APWA. This survey can serve as a tool and be modified for other employers wishing to develop documentation to approach their state departments of labor or community college systems.

3.3 Design Education & Training Programs

MTWC is spearheading the development of a highway maintenance apprenticeship that is the foundation of this implementation plan. One major outcome is to provide college credit for existing training programs to allow workers to advance within the transportation sector.

3.4 Identify Funding Needs & Sources

MTWC will investigate the availability of funding from employers, U.S. Departments of Labor and Education, and private foundations. DOTs can be approached to determine if pooled funding is an option to scale activities proposed under this plan.

3.5 Align Policies & Programs

In Wisconsin, the workforce system and the Wisconsin Technical College System are aligned with the local job market, meaning an institutionalized process exists for the development of an apprenticeship with a corresponding articulation to the community college system (and as a result of this implementation plan, to an HME career pathway). This employer-led system requires industry to approach workforce development and college entities to begin the process of establishing an apprenticeship or new degree program. Not all locations have this coordinated alignment in place. MTWC, through this implementation plan, will bring the knowledge of alignment as it scales the apprenticeship to other locations in the U.S.

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3.6 Measure System Change & Performance

An example of transformational outcome is a change of policy or shift in opinion. One item found lacking from earlier pathway research was knowledge of the processes and benefits of an apprenticeship program. MTWC will periodically survey national stakeholders to determine whether an apprenticeship is being adopted and if institutional changes are taking place.

It will be important to keep metrics on the dissemination of materials, presentations and follow-up meetings of parties interested in starting their own apprenticeship programs and establishing articulation to an academic degree.

MTWC will determine if highway maintenance employers are partnering with the educational systems and providing pathways for their highway maintenance workers. Another longitudinal aspect that can be monitored is the number of students in “Project Lead the Way” that culminate in an asset management career.

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SECTION 4.0 CAREER PATHWAY IMPLEMENTATION

4.1 Project Title

“Advancing Apprenticeship in Highway Maintenance & Engineering”

4.2 Workforce Priority

Across the country, state DOTs cite filling highway maintenance positions as their biggest workforce challenge. In the Fall of 2017, the MTWC surveyed Wisconsin municipalities to learn about the highway maintenance workforce in Wisconsin, to get the background needed to develop a career pathway and credentialed training, and to assess opportunities to establish a “middle-skills” apprenticeship program. The U.S. DOL has provided states with funding to accelerate the adoption of apprenticeship beyond traditional trade programs into new industries like banking and insurance, and studies have concluded that apprenticeships deliver a high ROI for employers in terms of recruiting and retaining workers.

MTWC’s survey documented more than just issues with work retention and recruitment, but also a lack of formal training and an industry sector with little knowledge of basic or innovative workforce development practices. As a result of this discovery, the Bureau of Apprenticeship Standards (BAS) at the Wisconsin Department of Workforce Development (DWD) have partnered with MTWC to inform employers of the apprenticeship model and to determine their interest in pursuing a statewide apprenticeship in highway maintenance. The results so far are positive; employers see an apprenticeship in highway maintenance as the first step in delivering “consistent training across Wisconsin”.

4.3 Project Description

MTWC will address the biggest workforce challenge facing state DOTs by focusing on apprenticeship as a vehicle to connect highway maintenance workers to post-secondary education.

In its intermediary role, MTWC will have (by this project’s start date) partnered in establishing a statewide apprenticeship in Wisconsin, educated employers on the apprenticeship model, recruited subject matter experts, coordinated and funded a DACUM occupational analysis, and participated in the development process of setting-up a new apprenticeship.



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By the end of this implementation plan's third year, there will also be a career pathway that connects this apprenticeship to civil engineering technician and highway maintenance management programs and materials that will assist employers in building apprenticeships in their own communities to facilitate the emergence of a new and prepared maintenance workforce ready to navigate the transition to a sensor-based, artificial intelligence workplace.

This plan's deployment activities are listed here and discussed in detail below.

- Document the implementation of a highway maintenance apprenticeship.
- Articulate the apprenticeship to other post-secondary programs.
- Increase awareness of highway maintenance occupations.
- Embed maintenance concepts in youth apprenticeship.
- Scale the highway maintenance apprenticeship.

Document Implementation of Highway Maintenance Apprenticeship (HMA)

A documented process will help scale the HMA project and serve as a model for the development of other transportation apprenticeships. It will also facilitate replication across other FHWA regional centers, private employers, state associations, or state DOTs.

MTWC will take on the role of facilitator and will engage with employers, most likely through an apprentice mentor or other employee following apprentice progress or who understands the institutional impact of the apprenticeship. MTWC will build a Community of Practice (CoP) by convening regular meetings, provide a means of member communication, allow the group to set the agenda, and address all institutional impacts through-out the year. Topics for CoP discussion include recruitment issues, organizational impacts, curriculum changes, and wrap-around services needed to support apprentices. An annual apprenticeship advisory meeting will be an opportunity to hear from the apprenticeship educators on the challenges they encountered. CoP members may also belong to the apprenticeship advisory group.

Community of Practice

A group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. CoPs meet as often as needed to solve problems. In theory, the CoP emerges as an organic expression of a group's needs and is meant to exist as long as the group needs it to last, sometimes transforming into other CoPs to solve new problems.

MTWC will develop metrics for evaluation of the HMA, based on discussion and data gathering during CoP meetings. The final documentation will be written from an employer perspective to help scale the statewide apprenticeship to other municipalities, a focus of Years 2 & 3.

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Articulate Apprenticeship to Post-Secondary Programs

There are currently many training programs and credentials relevant to highway maintenance, however they are not linked to post-secondary systems. MTWC found that only the NAFA Fleet Management Association offered college credit for certification.

In order to articulate the HMA, MTWC will ensure the apprenticeship becomes registered with DOL, then work with two community college programs to establish articulation agreements.

At one WTCS college, apprentices receive a certificate of completion that provides up to 39 credits toward an associate degree in Journeywork (the number of credits depends on the length of the apprenticeship). The remaining 21 or more credits required for a Journeywork Associate of Applied Science (AAS) degree typically come from general education coursework. An AAS in Journeywork does not articulate to an AAS in Civil Engineering Technology or a civil engineering program. WTCS will work with MTWC to ensure that HMA articulates to an associate degree that will transfer to an engineering degree, providing greater flexibility and academic efficiency for students pursuing other career paths.

MTWC will then work with one of the RACC colleges, Front Range Community College (FRCC) in Colorado, to articulate the HMA to its two-year AAS in Highway Maintenance Management (HMM) program. The HMM program combines existing online courses with a comprehensive process for granting credit for prior learning. Scheduled for launch in August 2019, HMM is designed to help employees meet the demands of the future while earning post-secondary credentials and is targeted at highway maintenance supervisors or those wishing to advance in the organization or to be better prepared for supervisory positions.

While some workers may not be interested in pursuing higher education, survey responses from maintenance professionals in Wisconsin often regretted not acquiring a college. By facilitating post-secondary education, we can help move workers into technical fields and improve the talent pipeline for transportation agencies.

During this implementation, FRCC will work with MTWC on three fronts: articulate the HMA to their HMM degree, pilot a prior learning assessment for HMA participants, and determine what training—offered through the University of Wisconsin at Madison, Engineering Professional Development—would articulate to an HMM degree.

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FRCC’s HMM degree is relevant to state, county, and municipal public works agencies as well as companies in the private sector involved in the maintenance of roads and bridges. It features general education, management, highway maintenance, and operations courses. General education and management courses will be available online for learning flexibility, supporting participation from a national audience. Students will have the option to complete coursework by attending an FRCC campus located in three counties in Colorado.

A graphic showing the proposed progression of articulations is shown in Figure 4.3.1:

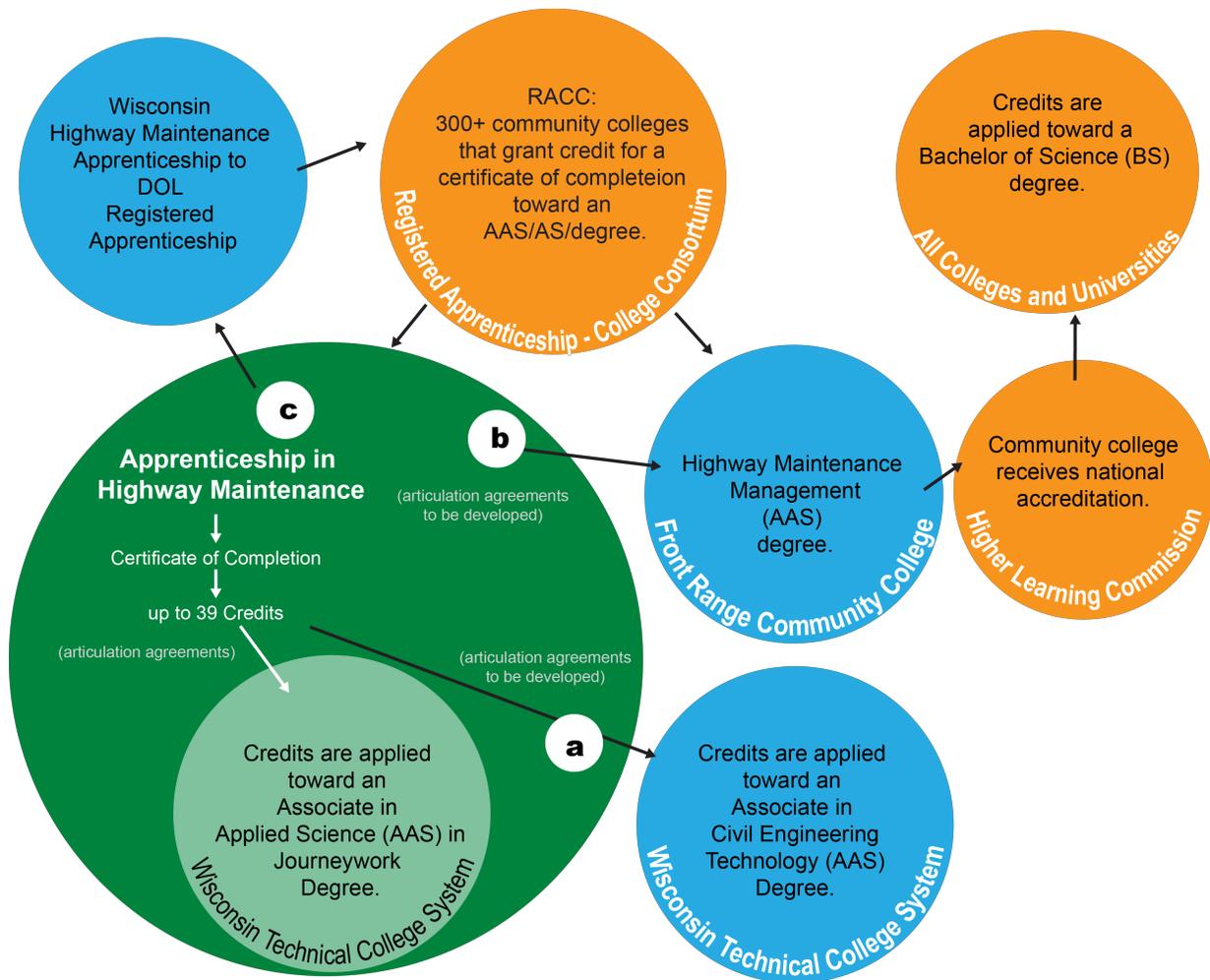


Figure 4.3.1: How an Apprentice Can Obtain a Degree

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Increase Awareness of Highway Maintenance Occupations

To improve awareness of the highway maintenance field, MTWC will embed its career package of seven priority occupations into career information systems used in Wisconsin, to establish an online presence for students and workers. Some of these systems have national reach:

[Career Cruising in Wisconsin](#)

[Wisconsin Job Centers](#)

[Wisconsin Career Readiness Pathways](#)

[BLS K-12 Career Information](#)

[CTE Programs of Study](#)

[Military Career Guide](#)

[Student Career Info](#)

Career Cruising is the career information system vendor for Wisconsin. In 2018, Wisconsin implemented academic career planning in grades 5–12, requiring all students to review careers within Career Cruising and to meet with their guidance counselor and families to review careers of interest. Career Cruising includes the INSPIRE module which connects employers to students through a number of experiential programs.

Embed Maintenance Concepts in Youth Apprenticeship

The U.S. DOL and Project Lead the Way (PLTW) have partnered to launch a pilot youth apprenticeship program in engineering in the Fall of 2018. This pilot offers two pathways to meet the needs of students with different career goals.

The first, an Engineering Assistant program, is geared toward students planning to pursue a four-year engineering degree. The second, an Engineering Technician program, is geared for students looking to start their careers early by offering a hands-on apprenticeship experience with a chance to get an associate degree.

PLTW is a nonprofit organization that provides experiential learning experiences and curricula for K-12 students and teachers. The group helps students develop in-demand, transportable skills through the exploration of real-world challenges. They offer pathways in computer science, engineering, and biomedical science. They also provide teachers with training, resources, and support.

Approximately 11,500 elementary, middle, and high schools in all 50 states and the District of Columbia offer PLTW programs.

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MTWC will work with PLTW to include highway maintenance and asset management concepts in its youth engineering apprenticeships and civil engineering K-12 programs. In Wisconsin, MTWC will work with the Bureau of Apprenticeship to ensure that these concepts are included in the STEM Skill Standards Checklist, a youth apprenticeship covering civil engineering topics.

Scale the Highway Maintenance Apprenticeship

MTWC will ensure the HMA becomes a DOL Registered Apprenticeship and offers a certificate of completion that is portable and recognized all over the U.S. Any employer across the country can use the HMA blueprint as a starting point for their own needs.

MTWC will facilitate employer outreach to 72 counties in Wisconsin, to encourage that they hire apprentices. Outside Wisconsin, MTWC will contact state DOT HR departments plus over 1,000 national stakeholders, to provide information on the benefits and lessons-learned from employers who hire apprentices during the first year of plan deployment. MTWC will also provide a “system” view of how an apprentice can earn a degree while being employed.

4.4 Implementation Partners

The organizations below have committed time and resources to the successful deployment of the Wisconsin Highway Maintenance Apprenticeship. They will continue to be partners in the articulation of the apprenticeship to other degree programs.

Wisconsin Department of Workforce Development (DWD). The Bureau of Apprenticeship Standards ([BAS](#)) at DWD is a national leader that serves as a model in developing innovative apprenticeships for workers and youth. BAS will provide staff time to attend highway maintenance events offered by APWA and the Wisconsin County Highway Association to educate the transportation sector on apprenticeship—a necessary step for project scaling.



Wisconsin Technical College System (WTCS). WTCS consists of 16 public technical colleges that offer over 500 programs awarding two-year associate degrees, one/two-year technical diplomas, and short-term technical diplomas certificates. It is the major provider of customized instruction and technical assistance for Wisconsin employers and apprenticeships.



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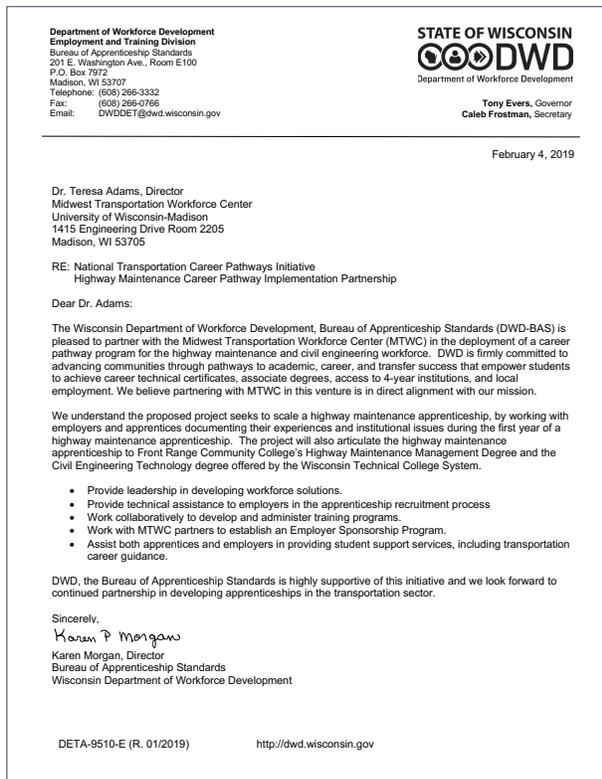
WTCS will attend and participate in planning and working group meetings, provide guidance on career pathway models, connect the project to potential resources within WTCS, and provide guidance on creating pathways to the WTCS Civil Engineering Technology AAS degree.

Employer Partners. To be identified at a later date, these employers will be part of a Community of Practice and provide employee subject matter experts for the HMA project.

Future Partners. Eventually, MTWC looks to partner with FRCC, PTLW, the Registered Apprenticeship College Consortium, and broad industry representatives such as AASHTO.

4.5 Partner Commitments

In an expression of their commitment to the deployment and mission of this implementation plan, MTWC partners have “signed-on” as key contributors of time, expertise, and resources, through the authorized letters of agreement presented below. It is this level of engagement that makes the HMA program both achievable and scalable.



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4.6 Project Outcomes

MTWC believes this project's greatest impact will be a sea-change on how transportation agencies think about their workers. By facilitating access to post-secondary education, it will help produce workers who are more technical, innovative, and trained to think holistically, thus improving the talent pipeline for transportation agencies.

Documenting the HMA process will result in the following outcomes, some of which are transformational. Metrics will be developed to measure these outcomes.

1. Greater transparency of the apprenticeship development process in Wisconsin.
2. Awareness in municipalities of contemporary workforce development strategies.
3. A comprehensive guide for replication.
4. List of best practices.
5. Use of common metrics across municipalities to measure collective impact.

4.7 Project Timeline

Each of the major activities for this project are listed below, along with a schedule of their basic deployment. A first year workplan for the demonstration project is also included.

Document Implementation of HMA

- | | |
|-------------------------------------|--------------------|
| 1. Engage Employers and Apprentices | July – August 2019 |
| 2. Conduct CoP Meetings | Monthly |
| 3. Develop Metrics | January 2020 |
| 4. Draft Final Report | August 2020 |
| 5. Develop State/National Campaign | August 2020 |
| 6. Attend Conferences | Fall 2020 |
| 7. Quarterly Reports | Quarterly |

Articulate HMA to Post-Secondary Programs

- | | |
|------------------------------------|---------------|
| 1. Ensure HMA is Registered by DOL | January 2020 |
| 2. Meet with WTCS, FRCC, DOL | February 2020 |
| 3. Initiate Articulation | March 2020 |
| 4. Create Promotional Campaign | March 2020 |
| 5. Develop Metrics | March 2020 |
| 6. Draft Report | June 2020 |

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Increase Awareness of Highway Maintenance Occupations

- | | |
|--|-----------------------|
| 1. Conduct Workshop Meeting with Stakeholders | January 2020 |
| 2. Determine Timeline for Implementation | May 2020 |
| 3. Develop Campaign to Inform Educators & Counselors | September 2021 |
| 4. Develop Metrics | September 2021 |
| 5. Implement Campaign | September – June 2022 |

Embed Maintenance Concepts in Youth Apprenticeship

- | | |
|--|---------------|
| 1. Meet with Stakeholders | August 2020 |
| 2. Develop Curriculum | October 2021 |
| 3. Pilot Curriculum | March 2021 |
| 4. Adjust Apprenticeship Standards | January 2022 |
| 5. Develop Marketing Campaign | February 2022 |
| 6. Deploy Campaign to Inform Educators | March 2022 |
| 7. Draft Report | May 2022 |

Embed Maintenance Concepts in Youth Apprenticeship

- | | |
|---------------------------------|-------------------------|
| 1. Develop Marketing Strategy | October 2020 |
| 2. Build Databases | October – December 2020 |
| 3. Develop Metrics | October 2020 |
| 4. Implement Marketing Strategy | Ongoing |
| 5. Draft Final Report | May 2021 |

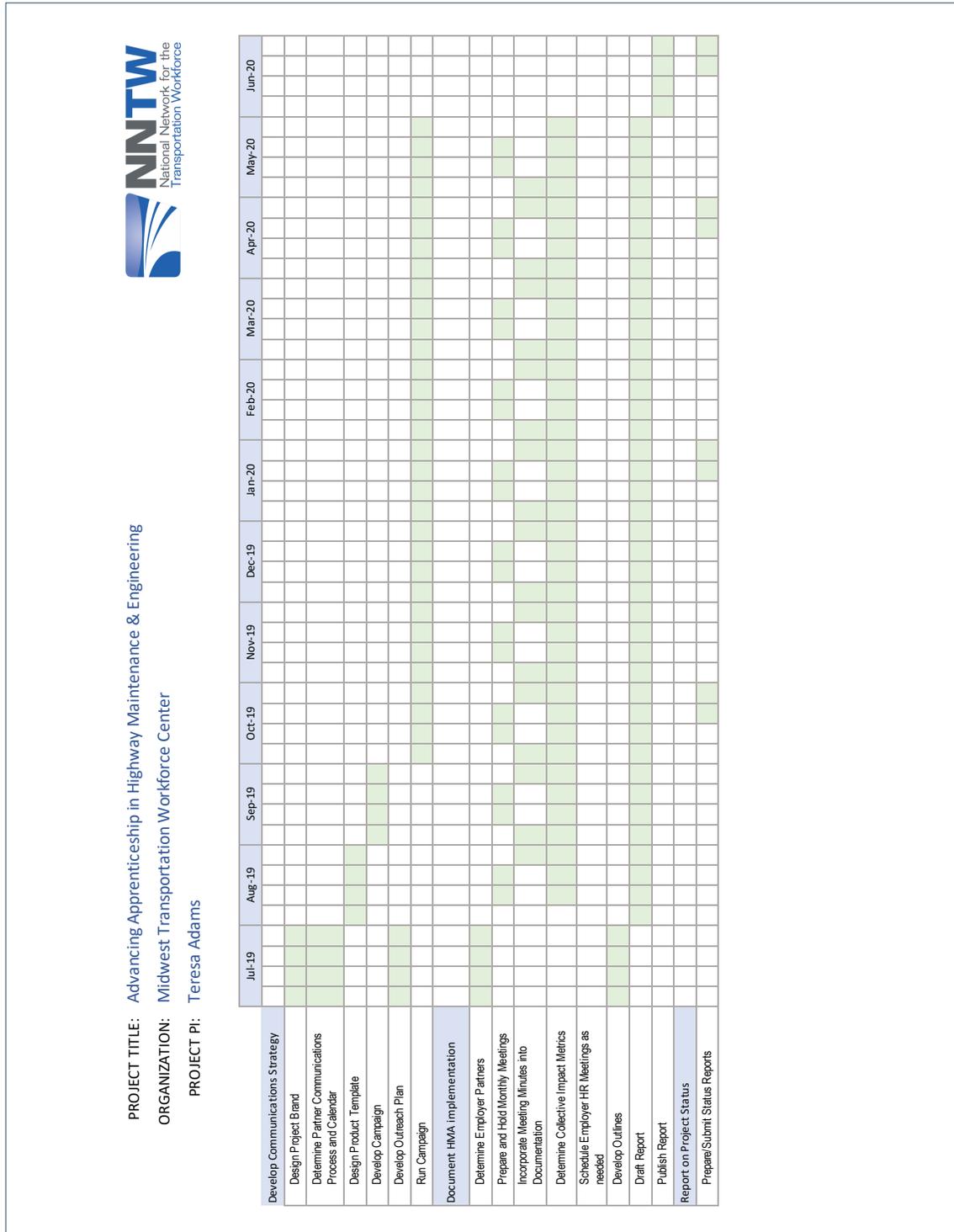
4.8 Project Budget

The first-year budget for this deployment allocates the personnel, travel, and material needs listed below. Successive annual budget requirements are projected to be similar.

Budget Item	Annual Costs	Match	Total Budget
Personnel	\$54,000	\$15,000	\$69,000
Fringe Benefits	\$17,982	\$4,995	\$22,977
Travel & Per Diem	\$5,000	\$0	\$5,000
Supplies & Materials	\$3,000	\$0	\$3,000
Professional Services	\$0	\$0	\$0
Facilities & Administration (F&A Rate 36%)	\$28,793	\$7,198	\$35,991
	-----	-----	-----
Annual Totals:	\$108,775	\$27,193	\$135,968

Transportation Engineering

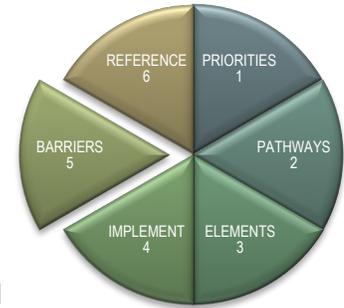
4.9 First Year Workplan



Transportation Engineering

SECTION 5.0 BARRIERS TO DEPLOYMENT

Many of the barriers to deployment depend on the geographic location of the career pathway project. Of most importance is to learn the systems that each potential partner operates in. Fundamentally, a career pathways system is about the coordination of people and resources. Within education, this includes aligning the nation's K–12 and post-secondary education systems and in particular, the career and technical education services provided within and across program providers.



Partner Alignment: The timescale for deploying a career pathway is about three years. That can be much longer if partners are not well aligned or have not institutionalized a system for working together. In the case of a new career, it is sometimes necessary for employers to create a collaborative to come up with enough demand to justify a new educational program. This process of getting employers on board can extend the development of a new career pathway to around 8 years, as was evidenced by the energy sector's work in Michigan. It is recommended that potential partners meet early and understand the systems that are in place.

Funding: Funding is often an important first conversation with workforce partners. In Wisconsin, apprenticeship development is well aligned so costs are distributed through staff responsibilities and wages. Consultant payments, if required, should be inquired to determine fiscal responsibilities. Most employers are ready to invest some funding to improve their workforce, but virtually all are unaware of DOL grant opportunities offering to fund upskill training, create new occupations, or deliver quick-action attempts to close the middle-skills gap.

Deadlines for grant submissions should be considered a major milestone in work plans and employers are recommended to consider their level of investment in a pathway or apprenticeship in order to determine overall ROI and to use as leverage for public workforce funding.

Credit for Prior Learning: The process of establishing credit for prior learning is lengthy and few organizations have pursued this option for their workers. They should, as a worker-centric activity, facilitate the documentation needed for educational systems to award credit.

Transportation Engineering

SECTION 6.0 REFERENCES & DOCUMENTATION

6.1 Acronyms & Abbreviations

AASHTO = American Association of State Hwy & Transportation Officials

ABET = Accreditation Board for Engineering & Technology

APWA = American Public Works Association

BLS = Bureau of Labor Statistics

CDL = Commercial Driver's License

CoP = Community of Practice

CTE = Career Technical Education

CTWD = Center for Workforce Development

DWD = Department of Development

DACUM = Developing a Curriculum

DOL = Department of Labor

DOT = Department of Transportation

DWG = Discipline Working Group

FHWA = Federal Highway Administration

EPIC = Educational Partnerships for Innovation in Communities

ETA = Employment Training Association

FRCC = Front Range Community College

GED = General Education Development

GIS = Geographic Information Systems

HMA = Highway Maintenance Apprenticeship

HME = Highway Maintenance Engineering

HMM = Highway Maintenance Management

ITE = Institute of Transportation Engineers

ITS = Intelligent Transportation Systems

KSA = Knowledge, Skills, and Abilities

LMI = Labor Market Information

LTAP = Local Technical Assistance Program

MTWC = Midwest Transportation Workforce Center

NAFA = National Association of Fleet Administrators

NHI = National Highway Institute

NNTW = National Network for the Transportation Workforce

NTCPI = National Transportation Career Pathways Initiative

OJT = On-the-Job Training

PCB = Professional Capacity Building

PE = Professional Engineer



Transportation Engineering

PLTW = Project Lead the Way

SME = Subject Matter Expert

STEM = Science, Technology, Engineering, Mathematics

TC3 = Transportation Curriculum Coordination Council

TRB = Transportation Research Board

WTCS = Wisconsin Technical College System

6.2 Career Pathway Documentation

Each of the highway maintenance priority occupations and career pathways detailed in this report have been formally documented for use as a career guidance resource in the deployment of pathway initiatives within the post-secondary education/training continuum. A list of those documents is followed by an instantiation of each on the pages that follow:

Bridge Engineer

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Fleet Manager

Career Pathway Graphic, Job Description, Program of Study, Program of Study

Highway Construction Engineer

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Highway Engineer

Career Pathway Graphic, Job Description, Program of Study, Program of Study

Highway Maintenance Engineer

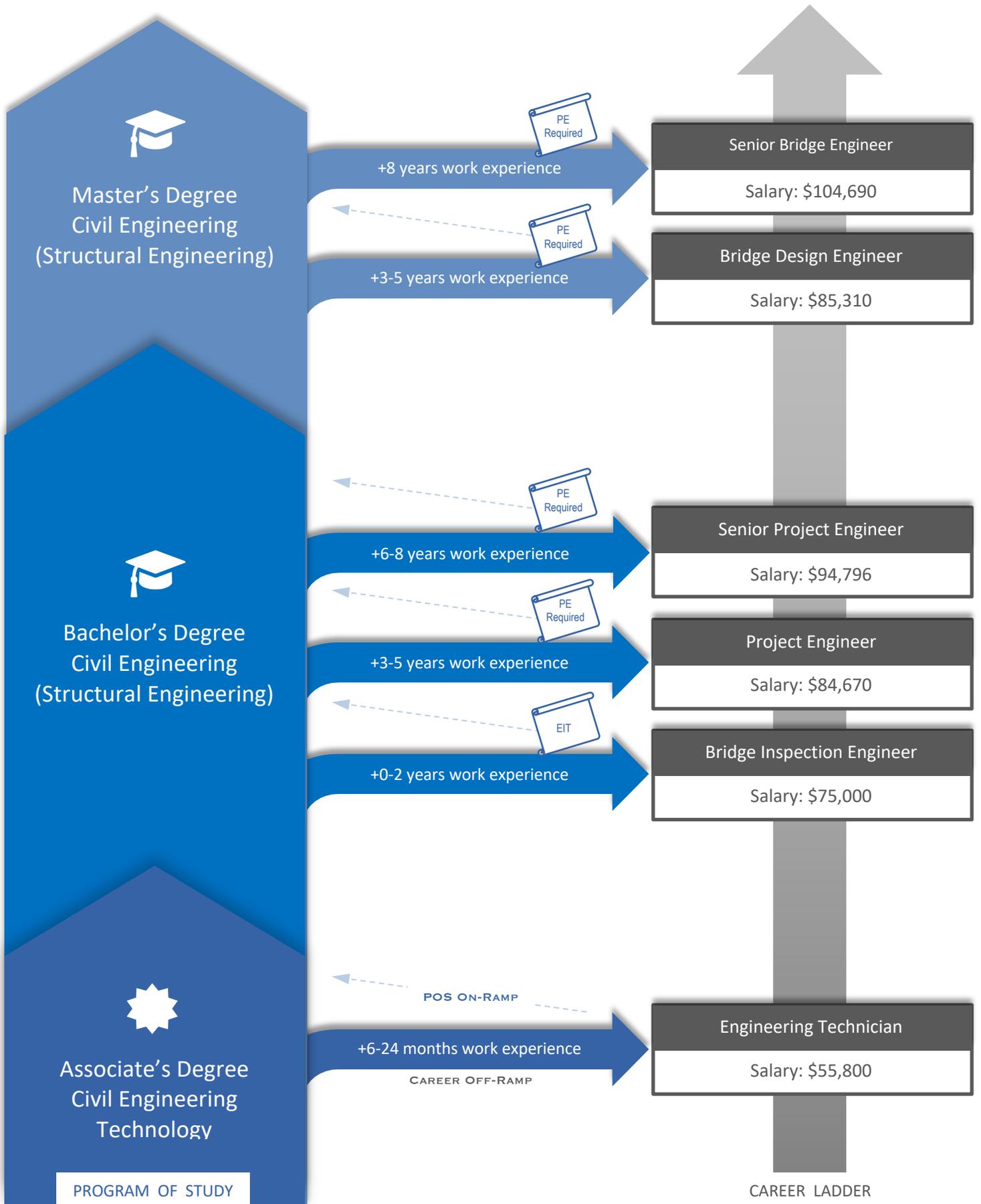
Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Highway Maintenance Superintendent

Career Pathway Graphic, Job Description, Program of Study, Program of Study

Pavement Engineer

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning



Alternative Job Titles

Structural Engineer, Structural Design Engineer, Civil Engineer, Senior Bridge Design Engineer, Lead Bridge Design Engineer

Job Description

A Bridge Design Engineer conducts structural analysis to ensure the strength and safety of highway structures, prepares structural design and contract documents including drawings, specifications, and estimates, participates in preparing the project budget and schedule, participates in meetings with clients and project team members, and reviews the structural calculations and contract documents prepared by others. A Bridge Design Engineer may be the principal design engineer on a project or the assistant design engineer on large, complex projects. Other duties include:

- Develop designs for other highway structures such as sign bridges and lighting supports.
- Analyze damaged bridges.
- Assess structural adequacy of existing bridges to withstand stresses due to oversized or overweight truck stresses to prevent damage or a bridge collapse.
- Prepare designs to upgrade an existing bridge by widening the deck, raising the deck, or strengthening the structure.
- Assess design related construction problems and erection schemes.
- Update bridge standards.
- Carry out design investigations of cranes, hoists, and similar apparatus used on bridge and highway maintenance to ensure structural stability and safety of operators.

Knowledge Requirements

- Civil and structural engineering
- Procedures of design and construction
- Mechanics of materials
- Soil mechanics
- Geotechnics
- Structural Failure Analysis
- Highway Design
- Hydraulics
- Economics and Life-cycle Costing
- Risk Management
- Warranty & Performance Guarantees

Required Skills and Abilities

- Develop and implement plans, policies, programs and procedures
- Materials specification
- Finite element analysis
- Cost estimation
- Public interaction
- Teamwork
- Organizing, scheduling and coordinating
- Written and oral communication
- Initiative and technical ingenuity in solving design problems

Technical Skills Requirements

- Computer-aided engineering analysis, design, and drafting software, such as AutoCAD Civil 3D, Geopak, SAP, STAAD, and Microstation

Typical Salary

- \$75,000 – \$104,700

**Sources: Burning Glass Labor Insights for salaries by experience and Glassdoor for upper and lower salary bounds.*

Education and Work Experience

- Bachelor's degree in civil engineering, with specialization in structural engineering, supplemented by three to five (3 to 5) years of engineering experience in structural design.
Licensed Professional Engineer (P.E.)

PE – Professional Engineer

While each state licensing board has its own laws regarding engineering licensure, there is a general three-step process for licensure candidates. PE candidates must possess a degree accredited by EAC or ABET. They must take two exams, the Fundamentals of Engineering (FE) exam and the Principles and Practice of Engineering (PE) exam. Most states require four years of acceptable, progressive, and verifiable work experience in the industry. Once students pass the FE exam, they earn an Engineering in Training certificate or an Engineering Intern (EI) certificate depending on the certifying organization.

Year 5-6

Master's Degree in Civil Engineering (Structural Engineering Emphasis)

Year 6: Students choose specific transportation engineering electives to round out their skill set. Examples include traffic operations, intelligent transportation systems, queuing theory, project management, and environmental impacts.

Year 5: During the first year, students take core courses.

Structural Design Courses

Bridge Design
Soil-structure and fluid-solid interaction
Structural Reliability and Safety
Inelastic Behavior
Earthquake Engineer
Finite Element Analysis
Composite Structures
Cost-Benefit Analysis

Project Management
Bridge and Highway Infrastructure Management
Structural Dynamics
Wind and Turbulent Flow

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

Year 3-4

Bachelor's Degree in Civil Engineering (Structural Engineering Emphasis)

Year 3 & 4: Students fulfill internship or co-op and fieldwork requirements. Elective courses that complement bridge design include construction management, geometric design, pavement materials, traffic operations, and environmental impacts of transportation.

Year 1 & 2: Students take several engineering courses to build a strong technical background.

GE Courses

Chemistry, Geology, Calculus, Differential Equations, Statistics, Liberal Arts, and Communications

Civil Engineering Required Courses

Fluid Mechanics, Environmental Engineering, Soil Mechanics, Internship, and Senior Capstone Design

Bridge Design-Related Courses

Structural Analysis
Steel Bridge Design

Reinforced Concrete Design
Structural Mechanics
Load Resistance Factor Design (LFRD)
Materials for Constructed Facilities
Construction Project Management
Pavement Design
Bridge Engineering
Engineering Economics
Foundation Design

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

Year 1-2

Associate's Degree in Civil Engineering Technology

Year 2: Students continue to take GE courses and technical courses that can prepare them for a position as a technologist. Those intending to transfer to a 4-year program will take additional mathematics courses.

Year 1: Students are required to take general education courses interspersed with technical coursework. Certifications are built into the curriculum.

GE Courses

English Composition and Oral Comm., Intro to Psychology/Conflict Resolution, Trigonometry & Algebra w/Applications, Physics, Statics, and Economics

Design-Related Courses

Intro to Civil Engineering & Architecture
Building Material & Construction Method
AutoCAD for Construction Science
Soil and Materials Testing

Structural Mechanics
Construction Project Management
3D CAD: Digital Terrain Modeling
3D CAD: Building Information Modeling
Surveying and GPS Fundamentals
Geographical Information Systems
Civil Engineering Drafting
Construction Estimating
Surveying–Construction/Route/Highway
3D Modeling and Virtualization
Sewer & Storm Water Management
Capstone: CET–Highway Technology

Year 0

High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Bridge Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

BRIDGE ENGINEERING RESOURCES

[American Institute of Steel Construction \(AISC\)](#)

AISC offers complimentary memberships to full-time students enrolled in two- and four-year engineering programs. AISC also provides scholarships and an internship job board. AISC sponsors the [National Steel Bridge Competition](#). In this inter-collegiate challenge, civil engineering students design, fabricate and construct a steel bridge. Student teams participate in one of 18 regional events, and the top teams in each region move on to compete in the national finals, typically held in May.

[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.

One competition of interest to Bridge Engineers is the [National Concrete Canoe Competition](#). Students attend regional conferences to compete and to present technical papers.

[NACE International](#)

The [University Student Design and Applied Student Competition](#) is open to university and military academy students. The competition gives students a platform to showcase their engineering design and problem-solving skills when presented with a corrosion-related problem they would encounter in their professional careers. The national conference also features a collegiate poster competition.

INTERNSHIP/CO-OP/EXTERNSHIP OPPORTUNITIES

[Association of General Contractors \(AGC\)](#)

Student chapters of AGC 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.

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.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its [Dwight David Eisenhower Transportation Fellowship Program](#) to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

CO-CURRICULAR OPPORTUNITIES

[American Association of State Transportation Highway Officials \(AASHTO\)](#)

While students are not eligible for AASHTO membership, the website offers an email subscription to the *Daily Transportation Update* of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

American Public Works Association (APWA)

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field.

[Engineers Without Borders USA](#)

Engineers Without Borders provides service-learning opportunities for students at the local and international levels. The national organization offers internships while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

[Institute of Transportation Engineers \(ITE\)](#)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation planning and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

[National Society of Black Engineers \(NSBE\)](#)

NSBE offers resources to students across the entire educational spectrum including retention, scholarships, leadership, and soft skills training through local networks and regional conferences. NSBE provides community STEM training for individuals who may want to mentor younger students.

[National Society of Professional Engineers \(NSPE\)](#)

Students can be members of NSPE and attend student chapters or local chapters to learn more about licensing and to network with professionals. The website offers a job board that can be filtered by internship opportunities. Students can log in to experience the virtual Professional Engineers Day event to learn more about the Professional Engineering (PE) license and to hear about the work PEs do from practitioners in the field.

[Society of Hispanic Professional Engineers \(SHPE\)](#)

SHPE programs offer support and development to increase degree persistence and attainment as well as aid undergraduates in professional development for a transition into either a STEM career or pursuit of a graduate degree.

[Society of Women Engineers \(SWE\)](#)

Open to all genders, SWE chapters exist in many institutions of higher education. Chapter activities range from mentoring, K-12 outreach, career and industry presentations, and opportunities for technical competitions, scholarships and national conference attendance.

[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. For example, the New York LTAP offers the *Cornell Asset Management Program (CAMP)*. This program offers hands-on experience in implementing a pavement management system. Summer interns input data into a GIS mapping program, inventory drainage facilities and sidewalks, flag traffic, work as laborers on a highway crew, and operate equipment on construction sites.

[The Association for Unmanned Vehicle Systems International \(AUVSI\)](#)

Students involved in an AUVSI Student Chapter, gain experience in the industry and receive guidance from professionals in the chapter. Drones are emerging as a safer method for bridge inspection.

[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 a number of scholarships for post-secondary students and women at the undergraduate or graduate level.

Innovative Learning Strategies for a Bridge Engineer Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within an engineering program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

Modularized Curriculum

Structured/sequenced curriculum in modules tied to jobs with multiple entry and exit points and multiple levels of industry-recognized credentials built into the sequenced pathway.

Asynchronous Learning

Education/training for students and incumbent workers provided at times and locations convenient to students and employers. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Instruction that helps students benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs,

co-op work experiences, simulations, and class projects that are assignments from local employers.

Tinkering is the first step in the experiential learning continuum. Students pursue self-led, hands-on practice as a precursor to being involved in more significant activities. Tinkering projects are a great way to build a foundation for future engineering endeavors. Universities are offering Tinkering or Makerspace Design Studios equipped with tools and software to reverse engineer or build new products.

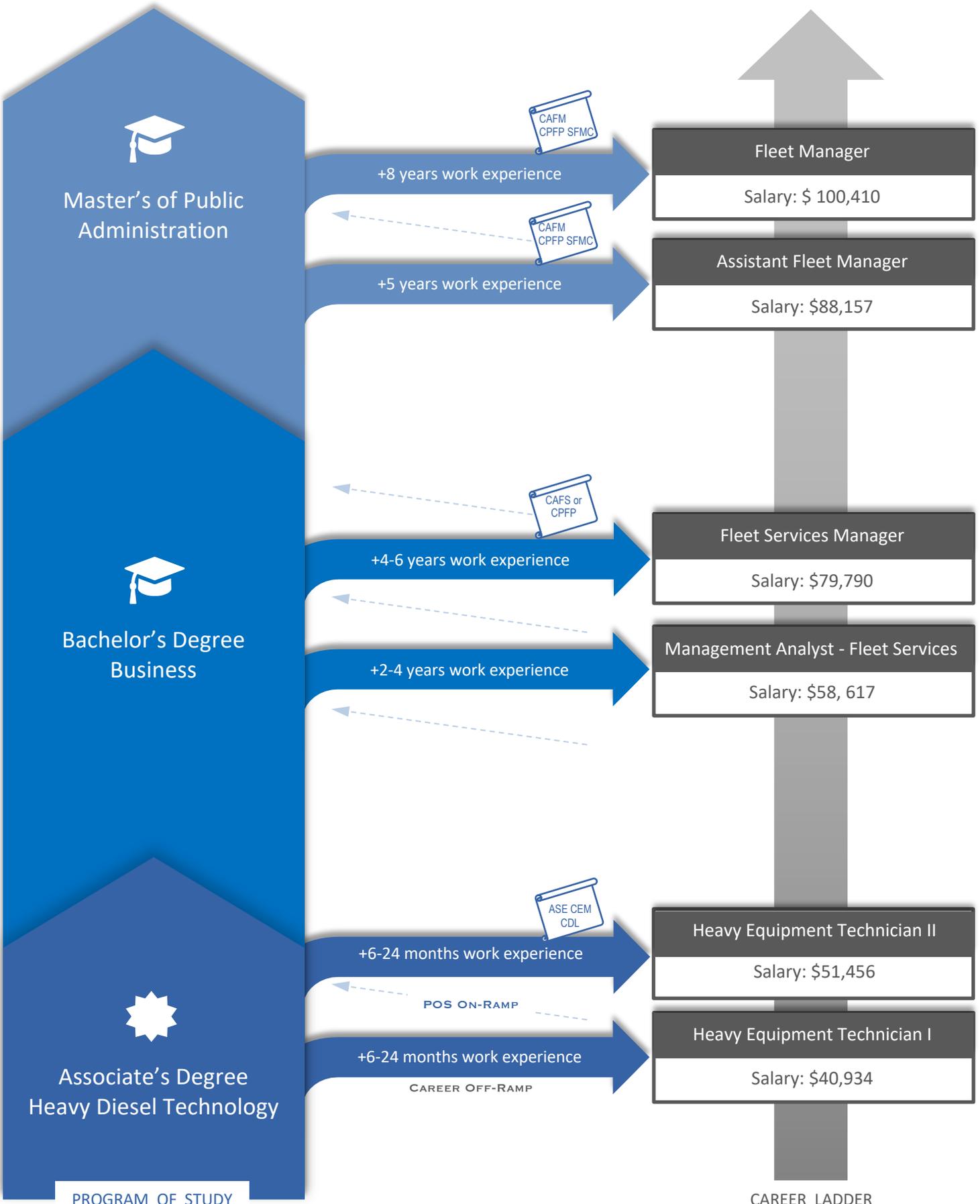
Context-Based Learning

Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.





Alternative Job Titles

Fleet Superintendent, Fleet Maintenance Manager, Automotive Pool Manager, Motor Vehicle Operations Manager, Equipment Manager, Director of Transportation Operations, Fleet Maintenance Supervisor

Job Description

A Fleet Manager plans, organizes, implements, directs, and leads the activities of the Fleet Services Division of a Department of Public Works or a State Department of Transportation. Duties include oversight of vehicle and heavy equipment repair, maintenance, fueling, record keeping, and vehicle procurement/disposal. The Fleet Manager collaborates and coordinates with other departments and divisions and other governmental agencies. Other duties include:

- Determines whether equipment needs can be met.
- Buys or researches and recommends equipment for specific activities.
- Identifies and integrates new technologies into departmental operations.
- Ensures personnel safety through effective use of training, performance management, and communication.
- Participates in outside community and professional groups and committees.
- Mentors staff and provides training programs for equipment operators and other subordinates.
- Sets and monitors productivity measures.

Knowledge Requirements

- Specifications
- Preventive maintenance
- Inventory management
- Life-cycle costing
- Equipment maintenance practices
- Procurement and acquisition
- Outsourcing
- Parts management
- Environmental laws and regulations
- Safety
- Financial management and budgeting
- Risk management
- Warranty and performance guarantees

Technical Skills Requirements

- Fleet management software, Telematics
- Standard Microsoft Office applications

Education & Work Experience

- Bachelor's degree in Business Administration or related field and five (5) years of increasingly responsible supervisory experience in vehicle and equipment maintenance. A combination of education, training, and experience is acceptable.
- Any of the following certifications are acceptable: APWA Certified Public Fleet Professional, NAFA Certified Automotive Fleet Manager, or NAFA Certified Automotive Fleet Specialist.

Required Skills & Abilities

- Develop and implement plans, policies, programs, and procedures
- Shop and facility management
- Diagnose and address operational problems
- Communicate effectively with the public
- Organizing, scheduling and coordinating
- Written and oral communication
- Hazardous waste disposal
- Emissions
- Read, interpret, and analyze technical codes, regulations, and data
- Strategic mindset
- Customer service
- Complex problem solving and negotiation
- Supervisory/leadership

Typical Salary

- \$58,600 – \$100,400

**Sources: Burning Glass Labor Insights for salaries by experience and Glassdoor for upper and lower salary bounds.*



CAFM – Certified Automotive Fleet Manager, CAFS – Certified Automotive Fleet Specialist, CPFP – Certified Public Fleet Professional, CSM/E – Certified Supervisor of Maintenance/Equipment, CFMO – Certified Fleet Management Operation, EMS – Equipment Management Specialist, Sustainable Fleet Management, CDM/E – Certified Director of Maintenance/Equipment, ASE Certifications

Certifications exist through the following organizations: NAFA - Fleet Management Association, American Public Works Association, Association of Equipment Management Professionals, North American Transportation Institute in partnership with the American Trucking Association, Government Fleet Management Alliance, and the National Institute for Automotive Service Excellence.

Year 5-6



Master's of Public Administration

Year 6: Students may concentrate on courses in Public Works or Fleet, Transportation Management and Policy in the form of a specialization or certificate.

Year 5: Core courses spanning the broad skills needed for public-sector management are covered.

Core Courses

The Legislative Process
Public Finance and Budgeting
Fundamentals of Public Administration
Decision Analytics
Ethics and Leadership
Strategic Policy Environment
Intergovernmental Relations
Regulatory Policy
Public Policy

Fleet, Transportation Management and Policy Courses

Asset Management
Transportation Automation, Technologies and Impacts on Fleet
Artificial Intelligence in Delivery of Public Services
Data Science/Fleet Telematics
Sustainability and Resilience Practices
Capstone Project

Experiential learning includes internship and NAFA membership

Year 3-4



Bachelor's Degree in Business–Supply Chain, Fleet Management Minor or Certificate

Year 3 & 4: Students take senior-level courses and fulfill internship and field-work requirements. A certificate or a minor in Fleet Management can be completed, or students may take courses from NAFA for articulation credit.

Year 1 & 2: Students take specialized courses in core business functions.

GE Courses

Accounting, Economics, Ethics, Finance, Statistics, Marketing, Applied Management, Contract and Sales, and Organizational Behavior

Fleet Management Minor

Planned Maintenance Systems
Fleet Management
Legal Environment of Business

Data Science/Fleet Telematics Management Metrics & Decision-making
Foundations of Risk Management & Insurance
Transportation Automation, Technologies and Impacts on Fleet
Internship/Co-op

Experiential learning includes internship, NAFA and ASE Chapter membership

Year 1-2



Associate Degree in Automotive or Highway Equipment Technology

Year 2: Students concentrate on technical expertise in the diagnosing and repair of heavy equipment. Students will need to obtain a CDL to drive trucks. Students take part in industry competitions and intern with educational partners

Year 1: Students are required to take general education courses mixed with technical coursework.

GE Courses

English
Industrial and Career Writing
Algebra
Concepts in Physics
Culture Competency Course
Self and Society Competency Course

Heavy Equipment Courses

Maintenance Fundamentals
Engine Technology
Electronics Fundamentals

Fluid Power Fundamentals
Diesel Fuel Systems
Planned Maintenance Systems
Power Transfer Tech
Transport Refrigeration Systems
Trouble Shooting Strategies
Internship
Brakes and Suspension Systems

Related

Introduction to Welding

Year 0



High School Diploma

Youth apprenticeship in fleet-related occupations.

Experiential Learning Programs for Fleet Management Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

FLEET MANAGEMENT RESOURCES

[American Association of State Transportation Highway Officials \(AASHTO\)](#)

While students are not eligible for AASHTO membership, the website offers an email subscription to the Daily Transportation Update of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

Fleet Professionals can join the Equipment Management Technical Services Program which provides networking opportunities for state DOT fleet managers.

[NAFA Fleet Management Association](#)

Any full-time two- or four-year degree student in a relevant course of study may join as a student member. Students gain insight on what “being a fleet manager” entails and have access to database and research tools and internships.

[Clean Cities Network Coalition](#)

There are almost 100 local Clean Cities organizations working in communities across the country to implement alternative fuels and advanced vehicle technologies. Student membership provides networking and service opportunities. For example, in Wisconsin, students can get involved by serving on the Board of Directors and committees.

[Technology & Maintenance Council’s National Student Technician Competition \(Future Tech\)](#)

This council is part of the American Trucking Association. Post-secondary students (age 18 or older) currently enrolled in a diesel technician training program or working as a professional technician but having graduated less than six months ago from a diesel technician training program can participate in this competition.

[Skills USA](#)

Contestants cycle through fourteen stations testing and troubleshooting engines, electrical and electronics systems, and powertrain systems including chassis, transmissions, and carriers. Contestants also demonstrate skills in hydraulic systems, vehicle inspections, fundamental failure analysis, brake systems, air-conditioning systems, and general shop skills. Contestants also perform a job interview and complete a written test.

[National Conference of State Fleet Administrators](#)

This organization provides a community of practice for Fleet Managers at universities and state agencies.

INTERNSHIP/CO-OP/EXTERNSHIP OPPORTUNITIES

Industry Partners

Many diesel technician programs have partnered with industry to build their labs. Schools have a direct pipeline to local industry for internships and jobs.

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.

[Public Works Academy Grand Rapids Community College. \(Grand Rapids MI\)](#)

This 84-hour, 7-week program provides a hands-on, active learning experience and exposes students to occupations in the public works sector. Graduates of the Public Works Academy receive interviews with two of the community partners for possible seasonal or internship positions at public works facilities in West Michigan. This program is intended to connect vulnerable populations to careers in public works.

[Public Works Cadet Academy \(Pinellas Technical College, St. Petersburg, FL\)](#)

This 195-hour program exposes students to 14 public works occupations via classroom instruction and internship.

CO-CURRICULAR OPPORTUNITIES

American Public Works Association (APWA)

APWA student membership connects students to a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate’s, bachelor’s or advanced degree programs in engineering, public administration, planning, construction, or, other public works-related coursework. 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. 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.

[The Association for Unmanned Vehicle Systems International \(AUVSI\)](#)

Students involved in an AUVSI Student Chapter gain experience in the industry and receive guidance from professionals in the Chapter.

Innovative Learning Strategies for a Fleet Management Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within a highway maintenance program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

Modularized Curriculum

Structured and sequenced curriculum in modules tied to jobs with multiple entry and exit points and multiple levels of industry-recognized credentials built into the sequenced pathway.

Asynchronous Learning

Education and training for students and incumbent workers provided at times and locations convenient to students and employers. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Instruction that helps students who benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs, co-op work experiences, simulations, and class projects that are assignments from local employers.

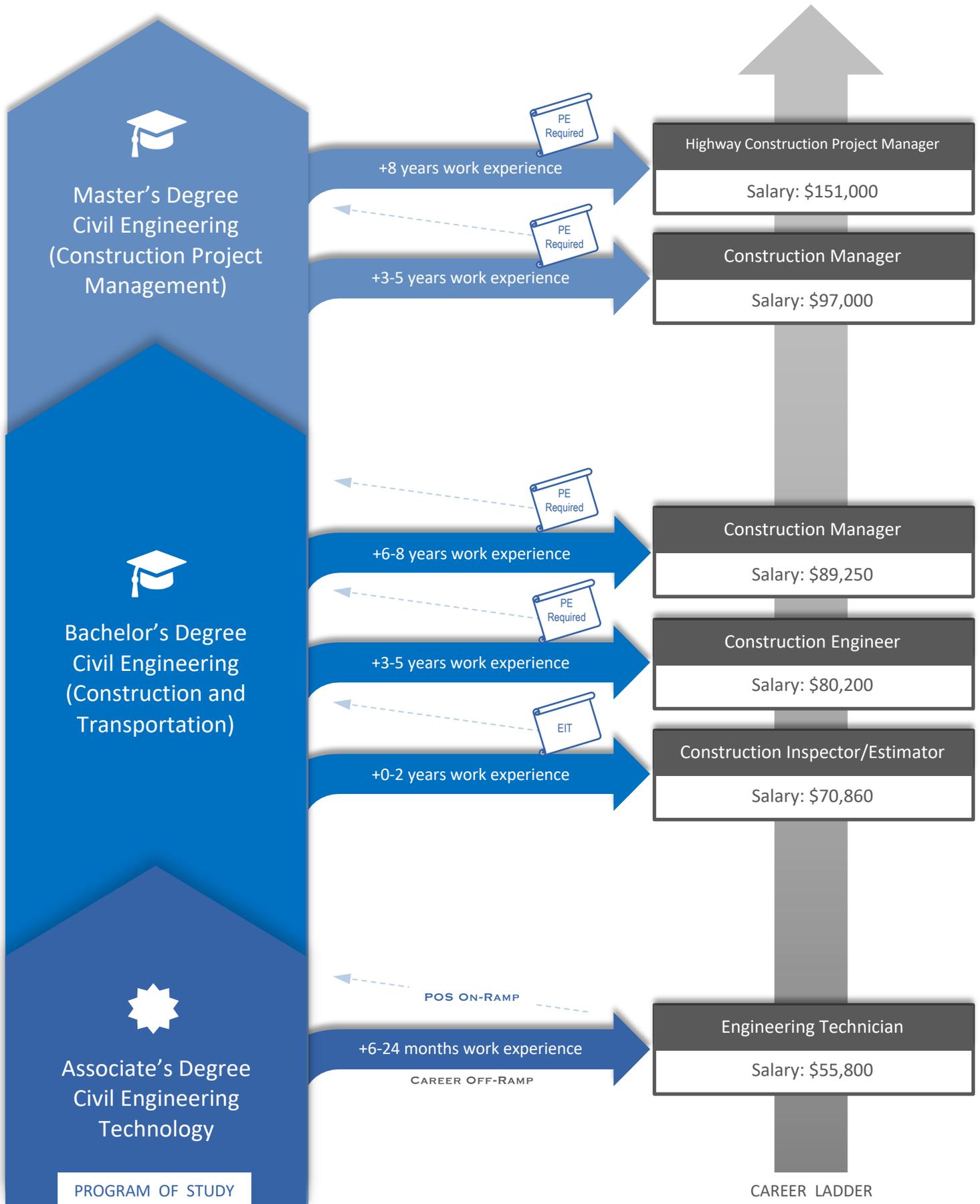
Tinkering is the first step in the experiential learning continuum. Students pursue self-led, hands-on practice as a precursor to being involved in more significant activities. Tinkering projects are a great way to build a foundation for future engineering endeavors. Universities are offering Tinkering or Makerspace Design Studios equipped with tools and software to reverse engineer or build new products.

Context-Based Learning

Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.



Alternative Job Titles

Construction Engineer, Construction Project Manager, Roadway Project Engineer

Job Description

A Highway Construction Engineer is responsible for overseeing roadway projects to completion, on time and within budget. Duties include field layout of projects, general inspection, project management, working with staff, and communicating with clients. The Engineer may be called upon to assist in design engineering duties including: preparing reports, plans, and specifications; researching design standards and code requirements; and conducting field investigations of design problems. The Engineer collaborates with other engineers, technicians, planners, and surveyors. Other duties include:

- Control and/or review all project forecasts, schedules, cost estimates, and reports.
- Prepare construction cost estimates, project budgets, schedules, or specifications for labor or materials.
- Prepare reports and conduct studies of engineering methods, codes, processes, and materials.
- Participate in contract bidding, negotiation, or administration.
- Responsible for quality control. Investigate or test construction materials to determine compliance with specifications or standards including environmental standards.
- Inspect completed transportation projects to ensure safety or compliance with applicable standards or regulations including environmental regulations.
- Confer with contractors, utility companies, and the public.
- Conduct feasibility and operating studies aimed at evaluating alternative innovative designs.
- Develop plans to deconstruct damaged or obsolete roadways or other transportation structures.

Knowledge Requirements

- Road and bridge construction processes
- Construction equipment operations
- Project development process
- Project management
- Estimating and scheduling
- Contract management
- Quality assurance and control
- Occupational safety and health

Required Skills & Abilities

- Ability to deal with construction contractors
- Conflict resolution
- Building effective relationships
- Problem-solving
- Time management
- Self-starter
- Teamwork/collaboration
- Organizing, scheduling, and coordinating
- Written and oral communication

Technical Skills Requirements

- Engineering software such as Primavera and Microsoft Project, FieldManager, Civil3D, MicroStation, and InRoads
- Augmented reality and virtual reality applications such as Microsoft HoloLens

Typical Salary

- \$70,900 – \$151,000

**Sources: Burning Glass Labor Insights for salaries by experience and Glassdoor for upper and lower salary bounds*

Education & Work Experience

- Bachelor's degree in civil engineering with emphasis on transportation or construction.
- Three to five (3 to 5) years of construction engineering experience on roads and/or bridges.
- Licensed Professional Engineer (P.E.)

PE – Professional Engineer

While each state licensing board has its own laws regarding engineering licensure, there is a general three-step process for licensure candidates. PE candidates must possess a degree accredited by EAC or ABET. They must take two exams, the Fundamentals of Engineering (FE) exam and the Principles and Practice of Engineering (PE) exam. Most states require four years of acceptable, progressive, and verifiable work experience in the industry. Once students pass the FE exam, they earn an Engineering in Training certificate or an Engineering Intern (EI) certificate depending on the certifying organization.

Year 5-6

Master's Degree in Civil Engineering (Construction Project Management Emphasis)

Year 6: Students choose specific transportation engineering electives to round out their skill set. Examples include project management, contract management, safety management, and cost management.

Year 5: During the first year, students take core courses.

Structural Design Courses

Operating and Managing a Construction Organization
Negotiation & Dispute Resolution
Legal Principles & Practices
Construction Financial & Cost Control
Project Management
Construction Safety Management

Construction Equipment

Construction Productivity Analysis
Construction Contract Management
Linear Scheduling
Project Management
Labor Management
Occupational Health and Safety

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

Year 3-4

Bachelor's Degree in Civil Engineering (Construction and Transportation Emphasis)

Year 3 & 4: Students fulfill internship or co-op and fieldwork requirements. Elective courses that complement construction engineering include quality assurance, estimating and scheduling, electrical and mechanical systems, construction management, and construction operations analysis.

Year 1 & 2: Students take several engineering courses to build a strong technical background.

GE Courses

Chemistry, Geology, Calculus, Differential Equations, Statistics, Liberal Arts, and Communications

Civil Engineering Required Courses

Fluid Mechanics, Environmental Engineering, Soil Mechanics, Internship, and Senior Capstone Design

Construction-Related Courses

Structural Analysis
Foundation Design
Quality Assurance
Estimating and Scheduling
Materials for Constructed Facilities
Construction Project Management
Electrical and Mechanical Systems
Construction Operations Analysis

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

Year 1-2

Associate Degree in Civil Engineering Technology

Year 2: Students continue to take general education courses and technical courses that can prepare them for a position as a technologist. Those intending to transfer to a 4-year program will take additional mathematics courses.

Year 1: Students are required to take general education courses interspersed with technical coursework. Certifications are built into the curriculum.

GE Courses

English Composition and Oral Comm.
Intro to Psychology/Conflict Resolution
Trigonometry & Algebra w/Applications
Physics
Statics
Economics

Construction-Related Courses

Construction Planning and Scheduling
Materials & Construction Method
Construction Documentation

Construction Estimating & Bidding

Sustainable Construction Practices
AutoCAD for Construction Science
Soil and Materials Testing
Introduction to Structural Design
Construction Project Management
3D CAD: Digital Terrain Modeling
3D CAD: Building Information Modeling
Surveying and GPS Fundamentals
Surveying—Construction/Route/Highway
Capstone: CET—Highway Technology

Year 0

High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Highway Construction Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

CONSTRUCTION ENGINEERING RESOURCES

[American Institute of Steel Construction \(AISC\)](#)

AISC offers complimentary memberships to full-time students enrolled in two- and four-year engineering programs. AISC also provides scholarships and an internship job board. AISC sponsors the [National Steel Bridge Competition](#). In this inter-collegiate challenge, civil engineering students design, fabricate and construct a steel bridge. Student teams participate in one of 18 regional events, and the top teams in each region move on to compete in the national finals, typically held in May.

[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 a number of scholarships for post-secondary students and women at the undergraduate or graduate level.

INTERNSHIP/CO-OP/EXTERNSHIP OPPORTUNITIES

[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.

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.

[US DOT Federal Highway Administration \(FHWA\)](#)

FHWA offers internships and financial support through its [Dwight David Eisenhower Transportation Fellowship Program](#) to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

CO-CURRICULAR OPPORTUNITIES

[American Association State Trans. Hwy Officials \(AASHTO\)](#)

While students are not eligible for AASHTO membership, the website offers an email subscription to the *Daily Transportation Update* of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

[American Public Works Association \(APWA\)](#)

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field.

[Engineers Without Borders USA](#)

Provides service-learning opportunities for students at the local and international levels. The national organization offers internships while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

[Institute of Transportation Engineers \(ITE\)](#)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation planning and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

[National Society of Black Engineers \(NSBE\)](#)

NSBE offers resources to students across the entire educational spectrum including retention, scholarships, leadership, and soft skills training through local networks and regional conferences. NSBE provides community STEM training for individuals who may want to mentor younger students.

[National Society of Professional Engineers \(NSPE\)](#)

Students can be members of NSPE and attend student chapters or local chapters to learn more about licensing and to network with professionals. The website offers a job board that can be filtered by internship opportunities. Students can log in to experience the virtual Professional Engineers Day event to learn more about the Professional Engineering (PE) license and to hear about the work PEs do from practitioners in the field.

[Society of Hispanic Professional Engineers \(SHPE\)](#)

SHPE programs offer support and development to increase degree persistence and attainment as well as aid undergraduates

in professional development for a transition into either a STEM career or pursuit of a graduate degree.

[Society of Women Engineers \(SWE\)](#)

Open to all genders, SWE chapters exist in many institutions of higher education. Chapter activities range from mentoring, K-12 outreach, career and industry presentations, and opportunities for technical competitions, scholarships and national conference attendance.

[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. For example, the New York LTAP offers the *Cornell Asset Management Program (CAMP)*. This program offers hands-on experience in implementing a pavement management system. Summer interns input data into a GIS mapping program, inventory drainage facilities and sidewalks, flag traffic, work as laborers on a highway crew, and operate equipment on construction sites.

[The Association for Unmanned Vehicle Systems International \(AUVSI\)](#)

Students involved in an AUVSI Student Chapter, gain experience in the industry and receive guidance from professionals in the chapter. Drones are emerging as a safer method for construction inspection.

Innovative Learning Strategies for a Highway Construction Engineer Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within an engineering program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

Modularized Curriculum

Structured/sequenced curriculum in modules tied to jobs with multiple entry and exit points and multiple levels of industry-recognized credentials built into the sequenced pathway.

Asynchronous Learning

Education/training for students and incumbent workers provided at times and locations convenient to students and employers. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Instruction that helps students benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs,

co-op work experiences, simulations, and class projects that are assignments from local employers.

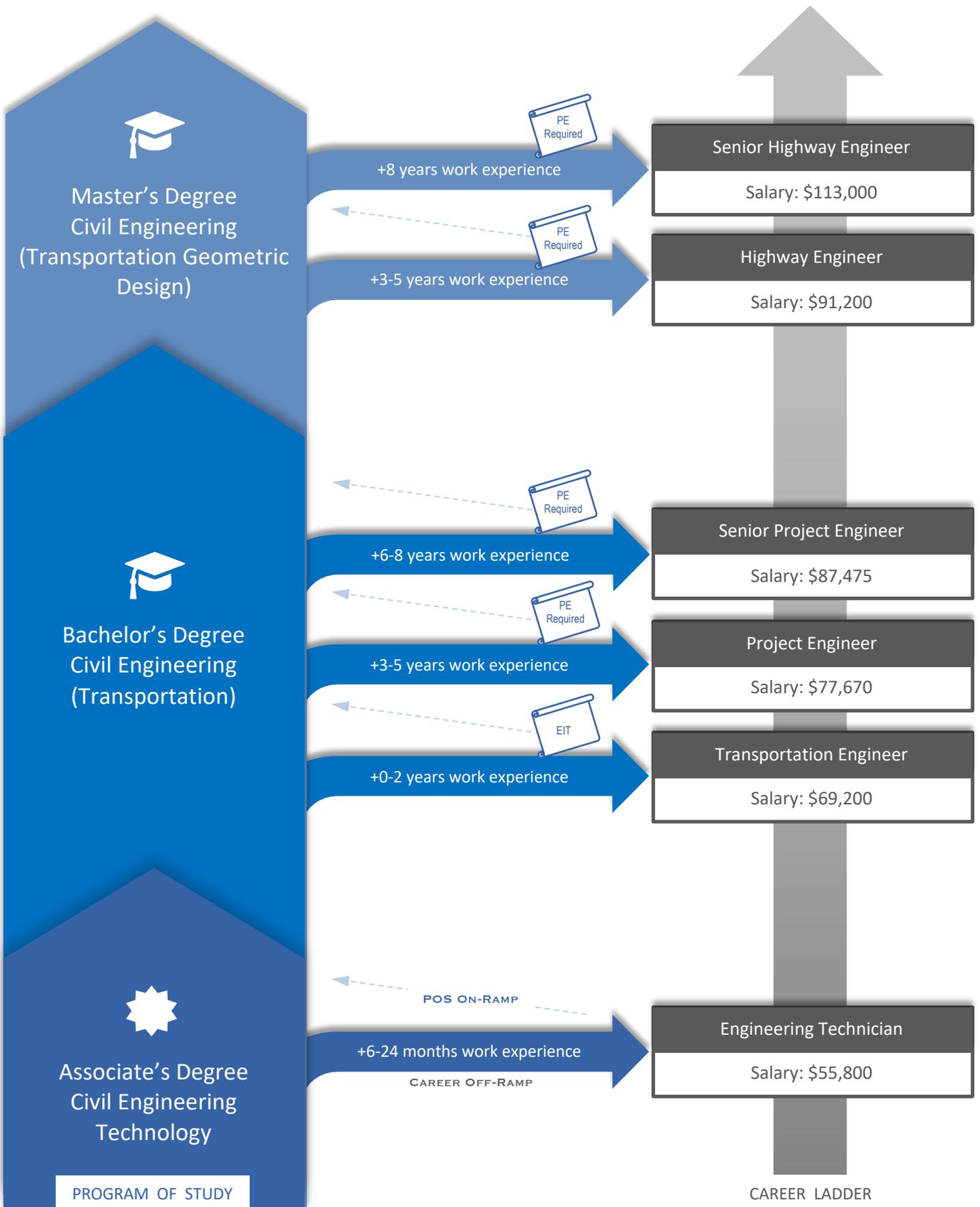
Tinkering is the first step in the experiential learning continuum. Students pursue self-led, hands-on practice as a precursor to being involved in more significant activities. Tinkering projects are a great way to build a foundation for future engineering endeavors. Universities are offering Tinkering or Makerspace Design Studios equipped with tools and software to reverse engineer or build new products.

Context-Based Learning

Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.



Alternative Job Titles

Road Design Engineer, Roadway Engineer, Civil Engineer, Transportation Engineer

Job Description

The Roadway Design Engineer prepares plans and specifications for roadway construction and improvement projects. Before a road structure can be designed, the Engineer must determine the exact route the road will take, how many lanes are needed, how this road interfaces with other roads, and how the flow of traffic will be maintained. Design of the roadway system involves many considerations including safety, parking, traffic calming, pedestrian and bike paths, drainage, highway signs, road markings, signal systems, roadway lighting, impact attenuators, and guide rails. The Roadway Design Engineer conducts traffic studies, participates in public meetings, writes technical reports, and conducts construction analyses. Other duties include:

- Perform roadway geometric design for horizontal and vertical alignment from preliminary to final design.
- Prepare technical designs in accordance with design standards using roadway design software.
- Prepare plan and specification documents including base sheet, details, quantities, special provisions, and estimates.
- Coordinate design with other disciplines and affected third parties.
- Coordinate with reviewers to ensure accuracy and quality of work.
- Manage and maintain project documentation.
- Design systems or structures using sustainable materials, such as porous pavement or bioretention structures.
- Prepare design for drainage and runoff.
- Prepare designs that do not damage natural plant and wildlife environments.

Knowledge Requirements

- Civil and structural engineering
- Procedures of design and construction
- Mechanics of materials
- Soil mechanics and geotechnics
- Vertical and horizontal geometric design
- Vehicle dynamics
- Drainage and hydrology
- Economics and life-cycle costing
- Transportation safety, mobility and access

Required Skills and Abilities

- Cost estimation
- Public interaction
- Teamwork
- Attention to detail
- Organizing, scheduling, and coordinating
- Written and oral communication
- Exercise independent engineering judgement and provide innovative solutions to engineering problems

Technical Skills Requirements

- AASHTO and State DOT criteria and standards
- Roadway design and engineering software such as Civil3D, MicroStation, and InRoads

Typical Salary

- \$69,200 – \$113,000

**Sources: Burning Glass Labor Insights for salaries by experience and Glassdoor for upper and lower salary bounds.*

Education and Work Experience

- Bachelor's degree in civil engineering, with specialization highway engineering.
- Three to five (3 to 5) years of engineering experience preferably with state or other transportation agency. Licensed Professional Engineer (P.E.)



PE – Professional Engineer

While each state licensing board has its own laws regarding engineering licensure, there is a general three-step process for licensure candidates. PE candidates must possess a degree accredited by EAC or ABET. They must take two exams, the Fundamentals of Engineering (FE) exam and the Principles and Practice of Engineering (PE) exam. Most states require four years of acceptable, progressive, and verifiable work experience in the industry. Once students pass the FE exam, they earn an Engineering in Training certificate or an Engineering Intern (EI) certificate depending on the certifying organization.

Year 5-6



Master's Degree in Civil Engineering (Transportation Geometric Design Emphasis)

Year 6: Students choose specific transportation engineering electives to round out their skill set. Examples include traffic operations, intelligent transportation systems, queuing theory, project management, or environmental impacts.

Year 5: During the first year, students take core courses.

Highway Engineering Courses

Infrastructure Management
Intelligent Transportation Systems
Highway Traffic Operations
Intersection Design
Environmental Planning & Regulation
Analysis of Transportation Data
Transportation Theory and Modeling
Traffic Safety and Injury Prevention

Transportation and Land Use Planning
Signals and Systems
Queueing Theory
Network Flows and Graphs
Cost-Benefit Analysis
Project Management
Transportation Policy and Economics
Emergency Response and Evacuation

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

Year 3-4



Bachelor's Degree in Civil Engineering (Transportation Emphasis)

Year 3 & 4: Students fulfill internship or co-op and fieldwork requirements. Elective courses complement highway design, such as construction management, geometric design, pavement materials, traffic operations, and environmental impacts of transportation.

Year 1 & 2: Students take several engineering courses to build a strong technical background.

GE Courses

Chemistry, Geology, Calculus, Differential Equations, Statistics, Liberal Arts, and Communications

Civil Engineering Required Courses

Fluid Mechanics, Structural Analysis, Environmental Engineering, Soil Mechanics, Internship, and Senior Capstone Design

Highway-Related Courses

Construction Management

Geometric Design and Route Planning
Transportation Systems Engineering
Materials for Constructed Facilities
Construction Project Management
Traffic Operations
Pavement Design
Bridge Engineering
Engineering Economics
Environmental Impacts of Transportation

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

Year 1-2



Associate Degree in Civil Engineering Technology

Year 2: Students continue to take general education courses and technical courses that can prepare them for a position as a technologist. Those intending to transfer to a 4-year program will take additional mathematics courses.

Year 1: Students are required to take general education courses interspersed with technical coursework. Certifications are built into the curriculum.

GE Courses

English Composition and Oral Comm.
Intro to Psychology/Conflict Resolution
Trigonometry & Algebra w/Applications
Physics
Statics
Economic

Highway Design-Related Courses

Intro to Civil Engineering & Architecture
Building Material & Construction Method
AutoCAD for Construction Science

Soil and Materials Testing
Structural Mechanics
Construction Project Management
3D CAD: Digital Terrain Modeling
3D CAD: Building Information Modeling
Surveying and GPS Fundamentals
Geographical Information Systems
Civil Engineering Drafting
Construction Estimating
Surveying–Construction/Route/Highway
3D Modeling and Virtualization
Sewer & Storm Water Management
Capstone: CET–Highway Technology

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Highway Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

HIGHWAY ENGINEERING RESOURCES

[American Institute of Steel Construction \(AISC\)](#)

AISC offers complimentary memberships to full-time students enrolled in two- and four-year engineering programs. AISC also provides scholarships and an internship job board. AISC sponsors the [National Steel Bridge Competition](#). In this inter-collegiate challenge, civil engineering students design, fabricate and construct a steel bridge. Student teams participate in one of 18 regional events, and the top teams in each region move on to compete in the national finals, typically held in May.

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[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.

Hyperloop Competitions

Students self-organize in interdisciplinary teams to fund, market, learn and design components of a future transportation system and compete at a worldwide level.

[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 a number of scholarships for post-secondary students and women at the undergraduate or graduate level.

INTERNSHIP/CO-OP/EXTERNSHIP OPPORTUNITIES

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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 Foun-

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FHWA offers internships and financial support through its [Dwight David Eisenhower Transportation Fellowship Program](#) to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

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While students are not eligible for AASHTO membership, the website offers an email subscription to the *Daily Transportation Update* of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

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nities for students at the local and international levels. The national organization offers internships while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

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Modularized Curriculum

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Asynchronous Learning

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Problem-Based Learning

Instruction that helps students benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs,

co-op work experiences, simulations, and class projects that are assignments from local employers.

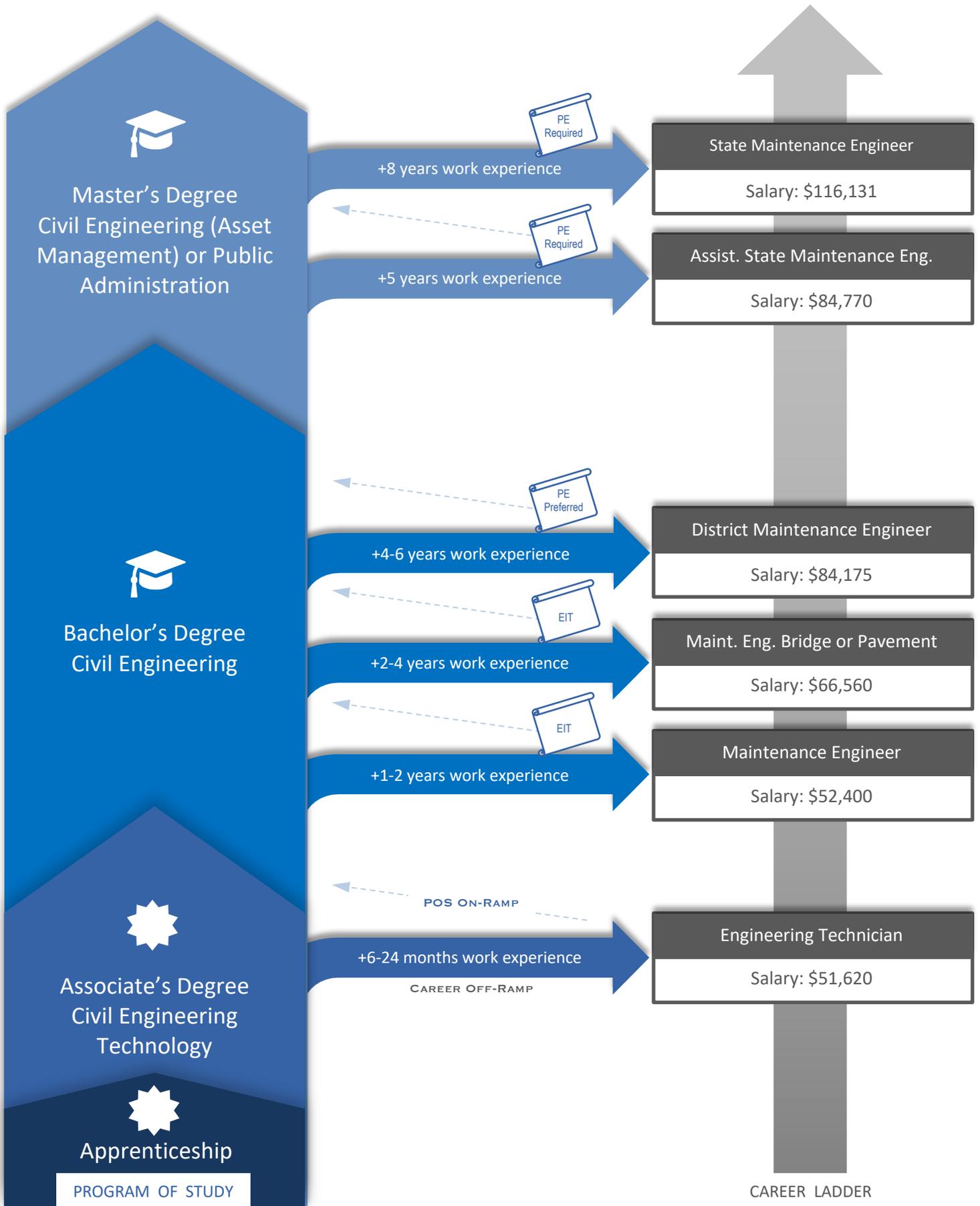
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Context-Based Learning

Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.



Alternative Job Titles

State Maintenance Engineer, Road Maintenance Engineer, County Engineer, Public Works Director, Highway Maintenance Administrator, Director of Maintenance

Job Description

A Highway Maintenance Engineer is responsible for determining cost-effective preventive maintenance treatments, upgrade, and repair strategies to maintain highways, bridges and roadside facilities within an assigned area of operation. This position follows state department of transportation standards and applies asset management principles to schedule and prioritize work. This position assesses highway corridors holistically and programs actions through a lens of environmental stewardship, sustainability, safety, and resilience. Other duties include:

- Develops and monitors maintenance budget.
- Oversees selection and maintenance of major roadway maintenance equipment.
- Responsible for landscape and vegetation management along roadways.
- Responsible for emergency response preparedness for maintenance.
- Responsible for the development, preparation, and letting of maintenance contracts for the district.
- Works with governmental officials and the public to set maintenance program goals and expectations.
- Administers and inspects contracted maintenance activities.

Knowledge Requirements

- Principles of asset management
- Construction engineering procedures
- Government programs and operations
- Roadside maintenance procedures
- Materials for highway/bridge maintenance
- Roadway/shoulder maintenance practices
- Drainage/bridge/culvert maintenance
- Preventive maintenance Procedures
- Safety and incident management
- Fleet & Traffic services
- Inventory management
- Budgeting, Life-cycle costing
- Environmental laws and regulations

Required Skills and Abilities

- Engineering principles, practices, methods
- Prioritizes and organizes
- Management/supervision
- Logic/reasoning/decision-making
- Communicate effectively with the public
- Teamwork
- Organizing, scheduling and coordinating
- Written and oral communication
- Customer service
- Leadership

Technical Skills Requirements

- Standard Microsoft Office applications
- Maintenance management software

Typical Salary

- \$52,600 – \$116,000

**Source: AASHTO salary information*

Education and Work Experience

- Bachelor's degree in Civil Engineering or related field with four (4) years of professional experience in highway construction and maintenance with one (1) of those years in a supervisory capacity.
- Licensed Professional Engineer (P.E.)



PE – Professional Engineer

While each state licensing board has its own laws regarding engineering licensure, there is a general three-step process for licensure candidates. PE candidates must possess a degree accredited by EAC or ABET. They must take two exams, the Fundamentals of Engineering (FE) exam and the Principles and Practice of Engineering (PE) exam. Most states require four years of acceptable, progressive, and verifiable work experience in the industry. Once students pass the FE exam, they earn an Engineering in Training certificate or an Engineering Intern (EI) certificate depending on the certifying organization.

Year 5-6



Master's Degree in Civil Engineering (Infrastructure or Asset Management Emphasis)

Year 6: Students choose specific maintenance, sustainability or management electives to round out their skill set. Examples include public works administration, environmental impacts, engineering, and public health.

Year 5: During the first year, students take core courses.

Asset Management Courses

Strategic Asset Management
 Asset Maintenance Technologies
 Maintainability Eng. & Management
 Work Planning & Scheduling
 Condition Monitoring & Diagnostics
 Maintenance Analysis & Optimization
 Research Methods
 Health, Safety and the Environment
 Reliability Centered Maintenance

Project Management

Total Quality Management
 Federal, State and Local Governments
 Public Works Final Project
 Life Cycle Cost Analysis
 Transportation Policy and Economics

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

Year 3-4



Bachelor's Degree in Civil Engineering

Year 3 & 4: Students fulfill internship or co-op and fieldwork requirements. Elective courses complement the highway maintenance focus such as construction management, vegetation, sustainability, resilience, public policy, invasive species, solar technology, public health.

Year 1 & 2: Students take a number of engineering course to build a strong technical background.

GE Courses

Calculus, Differential Equations, Statistics, Liberal Arts, and Communications

Civil Engineering Required Courses

Fluid Mechanics
 Structural Analysis
 Civil Engineering Graphics
 Environmental Impacts
 Fieldwork/Internship
 Senior Capstone Design

HME-Related Courses

Hydroscience & Soil Mechanics
 Transportation Engineering
 Materials for Constructed Facilities
 Construction Project Management
 Introduction to Asset Management
 Advanced Pavement Design
 Highway Bridges
 Reliability Centered Maintenance
 Engineering Economics

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

Year 1-2



Associate's Degree in Civil Engineering Technology

Year 2: Students continue to take general education courses and technical courses that can prepare them for a position as a technologist. Those intending to transfer to a 4-year program will take additional mathematics courses.

Year 1: Students are required to take general education courses interspersed with technical coursework. Certifications are built into the curriculum.

GE Courses

English Composition and Oral Comm.
 Intro to Psychology/Business Ethics
 Trig/Algebra w/ Physics, Statics
 American, State and Local Governments

Highway Maintenance-Related Courses

Introduction to Asset Management
 Highway Safety
 Surveying-Intro, Station, Highway
 Soils & Storm Water Management
 GPS and GIS Fundamentals

Cemented Aggregate Mixtures

Construction Estimating & Management
 Inspection
 Sustainability & Resilience
 Pollinators & Invasive Species
 Technology in Transportation Systems
 Civil Engineering Project Capstone

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Highway Maintenance Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

HIGHWAY MAINTENANCE ENGINEERING RESOURCES

[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. They also have access to publications, eBooks, and educational resources. An example of training offered by ASCE is the Geographic Information Systems for Asset Management Certificate Program. Scholarships are available for undergraduates at ABET certified schools. Fellowships are available for graduate students.

[Roadway Maintenance Training and Demo Day](#)

The Roadway Maintenance Training and Demo Day is a one-day event that rotates throughout the state of Minnesota annually. The event offers a half-day of classroom roadway maintenance training, followed by a half-day of outdoor maintenance activity demonstrations. LTAP, Minnesota Local Road Research Board, Minnesota DOT and the APWA-MN Chapter sponsor this event. Maintenance operators, supervisors, and transportation and research implementation personnel from township, tribal, city, county, and state agencies attend seeking continued education and knowledge-building opportunities.

INTERNSHIP/CO-OP/EXTERNSHIP OPPORTUNITIES

[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.

[Maintenance Superintendent Associations/Highway Commissioners Associations/County Road Associations](#)

Many states have associations that support professional development for Highway Superintendents and Commissioners of Public Works and are good sources for job postings or internships. These organizations may be affiliates of the National Association of County Engineers as well as partners with APWA state chapters. Some may offer certificate programs as well as scholarship opportunities.

[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 network-

ing, 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.

[US DOT Federal Highway Administration \(FHWA\)](#)

FHWA offers internships and financial support through its [Dwight David Eisenhower Transportation Fellowship Program](#) to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

CO-CURRICULAR OPPORTUNITIES

[American Association of State Transportation Highway Officials \(AASHTO\)](#)

While students are not eligible for AASHTO membership, the website offers an email subscription to the *Daily Transportation Update* of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

[American Public Works Association \(APWA\)](#)

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field.

[Engineers Without Borders USA](#)

Engineers Without Borders provides service-learning opportunities for students at the local and international levels. The national organization offers internships while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

[National Society of Professional Engineers \(NSPE\)](#)

Students can be members of NSPE and attend student chap-

ters or local chapters to learn more about licensing and to network with professionals. The website offers a job board that can be filtered by internship opportunities. Students can log in to experience the virtual Professional Engineers Day event to learn more about the Professional Engineering (PE) license and to hear about the work PEs do from practitioners in the field.

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. For example, the New York LTAP offers the *Cornell Asset Management Program (CAMP)*. This program offers hands-on experience in implementing a pavement management system. Summer interns input data into a GIS mapping program, inventory drainage facilities and sidewalks, flag traffic, work as laborers on a highway crew, and operate equipment on construction sites.

The Association for Unmanned Vehicle Systems International (AUVSI)

Students involved in an AUVSI Student Chapter, gain experience in the industry and receive guidance from professionals in the chapter.

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 a number of scholarships for post-secondary students and women at the undergraduate or graduate level.

Innovative Learning Strategies for a Highway Maintenance Engineering Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within a highway maintenance engineering program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

Modularized Curriculum

Structured and sequenced curriculum in modules tied to jobs with multiple entry and exit points and multiple levels of industry-recognized credentials built into the sequenced pathway.

Asynchronous Learning

Education and training for students and incumbent workers provided at times and locations convenient to students and employers. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Instruction that helps students who benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs, co-op work experiences, simulations, and class projects that are assignments from local employers.

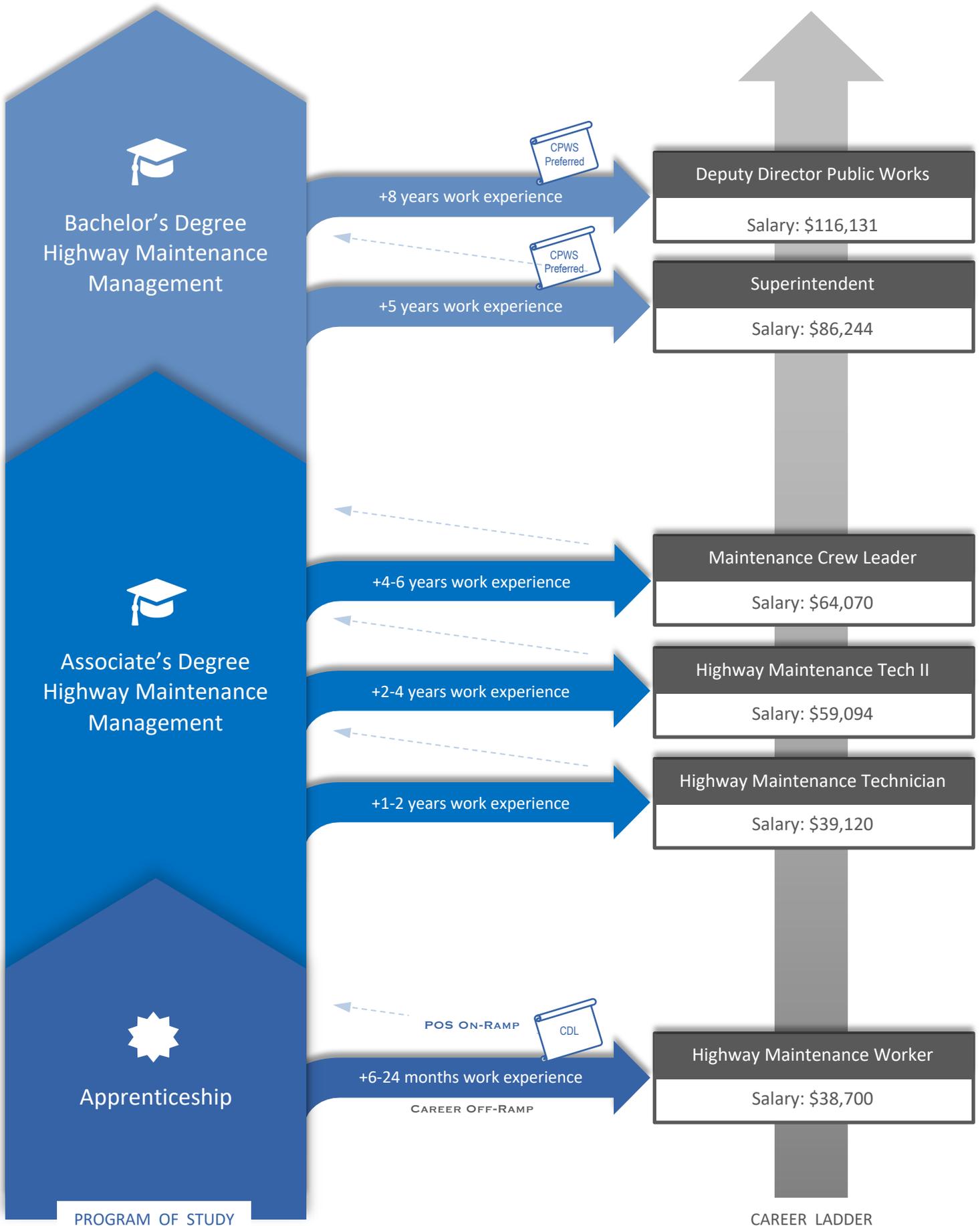
Tinkering is the first step in the experiential learning continuum. Students pursue self-led, hands-on practice as a precursor to being involved in more significant activities. Tinkering projects are a great way to build a foundation for future engineering endeavors. Universities are offering Tinkering or Makerspace Design Studios equipped with tools and software to reverse engineer or build new products.

Context-Based Learning

Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.



Alternative Job Titles

Highway Field Operations Supervisor, Transportation Maintenance Superintendent, Area Maintenance Supervisor, Highway Maintenance Manager, Highway Operations Technician Supervisor, Highway Patrol Foreman, Roadway Operations Manager, Highway Maintenance Supervisor

Job Description

A Highway Maintenance Superintendent is a top-level supervisor. The Superintendent develops schedules and budgets and sets work priorities for maintenance operations. The Superintendent supervises multiple crews tasked with highway and bridge maintenance, repairs, and reconstruction. This person is often assisted by a Senior Highway Maintenance Worker. Other duties include:

- Accounting for all equipment issued to subordinates or self, such as hand tools, road building tools, materials, plows and sanders, and trucks and heavy equipment.
- Assists with management of the area's emergency operations and safety programs to include work-zone traffic controls and setup and developing and monitoring individual training programs.
- Works with governmental officials and the public.
- Administers and inspects contracted maintenance activities.

Knowledge Requirements

- Asset Management: life-cycle costing, budgeting, and inventory management
- Roadside maintenance procedures
- Preventive & predictive maintenance procedures
- Highway and bridge materials
- Roadway and shoulder maintenance best practices including management of water, vegetation, animal habitat, and herbicide usage
- Drainage
- Winter maintenance
- Bridge and culvert maintenance
- Traffic services including pavement markings, guardrails, MUTCD
- Equipment maintenance practices
- Environmental laws and regulations

Technical Skills Requirements

- Maintenance management software
- Standard Microsoft Office applications

Education & Work Experience

- Bachelor's degree not required.
- For entry-level positions, between 1-2 years of work experience is commonly desired.
- A combination of education and work experience that fulfill the requirements is acceptable.

Required Skills & Abilities

- Supervisory experience providing technical direction and guidance to a variety of skilled, semi-skilled, and manual laborers.
- Read/interpret road and bridge plans and sketches
- Develop and implement plans, policies, programs, and procedures
- Communicate effectively with the public
- Teamwork
- Organizing, scheduling and coordinating
- Written and oral communication
- Customer service
- Leadership
- Ability to work in inclement weather
- Commercial Driver's License (CDL)

Typical Salary

- \$39,100 – \$116,000

**Sources: Burning Glass Labor Insights for salaries by experience and Glassdoor for upper and lower salary bounds.*

Year 5-6



CPWS - Certified Public Works Supervisor



Bachelor's degree in Highway Maintenance Management

Year 3 & 4: Curriculum is multi-disciplinary and taught through a resiliency, environmental and sustainability lens. Certificates available in engineering or business.

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

Core Courses

Introduction to Asset Management
Sustainability in Highway Maintenance
Highway Maintenance Management Information Systems
Regenerative Corridors: Solar Highways & Electrical Vehicle Charging Systems
Resiliency of Transportation Corridors
Pavement Types and Culverts
Emergency Management
Fleet Management and Robotics

Stewardship, Conservation & Environmental Impacts of Transportation Systems

Management Courses

Human Resources
Project Management
Principles of Management
Predictive Maintenance and Data Visualization

Experiential learning includes labs, internships and fieldwork

Year 3-4



Associate's Degree in Highway Maintenance Management

Apprenticeship to Associate Degree

Completion of an Apprenticeship provides 39 credit towards a degree at Registered Apprenticeship - College Consortium colleges. Students must complete 21 hours in the following manner:

- Communications 6 credits
- Social Science 3 credits
- Behavioral Science 3 credits
- Math and/or Science 3 credits
- Additional General Education 6 credits

Associate Degree w/o Apprenticeship

GE Courses

English Composition and Oral Comm.
Intro to Psychology/Business Ethics
Trigonometry & Algebra w/Applications
Physics, Statistics
American, State & Local Governments

Highway Maintenance Courses

Introduction to Highway Maintenance
Highway Safety
Surveying-Intro, Station, Highway
Soils and Storm Water Management
GPS and GIS Fundamentals
Construction Estimating & Management
Inspection

Cemented Aggregate Mixtures

Sustainability & Resiliency
Vegetation, Pollinators & Invasive Species
Technology in Transportation Systems: Drones, ITS, Vehicle Automation

Management Courses

Human Resources
Asset Management
Project Management
Principles of Management
Civil Engineering Capstone

Experiential learning includes internships and fieldwork

Year 1-2



Apprenticeship or Work-Based Learning

Year 2 Technician: Equipment operations skills 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 by working in the field. Coursework supplements the on-the-job portion and embeds certifications.

Apprenticeship provides 39 credits toward associate degree with 400 hours of paid related instruction.

Highway Maintenance Courses

Incident Command System or National Incident Management System
Weapons of Mass Destruction
HAZMAT Awareness
Hazard Communication
Trenching & Shoring Awareness
Confined Space Entry
Defensive Driving
Blood Borne Pathogens
Promoting Workplace Safety
OSHA Standards Part 1926
Work Zone Traffic Certification
Work Zone Flagging Certification
Personal Protective Equipment

Technical Mathematics

Hand Tools and Equipment Operation
Basic/Intermediate Street Repair and Maintenance Including Snow Removal
First Aid/CPR Certification
Blueprint Reading
Introduction to Asset Management
Technology in Transportation Systems

Year 0



High School Diploma

Transportation/Public Works-related career academies.

Experiential Learning Programs for Highway Maintenance Superintendent Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

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Many states have associations that support professional development for Highway Superintendents and Commissioners of Public Works and are good sources for job postings or internships. These organizations may be affiliates of the National Association of County Engineers as well as partners with APWA state chapters. Some may offer certificate programs as well as scholarship opportunities.

[Public Works Academy Grand Rapids Community College. \(Grand Rapids MI\)](#)

This 84-hour, 7-week program provides a hands-on, active learning experience and exposes students to occupations in the public works sector. Graduates of the Public Works Academy receive interviews with two of the community partners

for possible seasonal or internship positions at public works facilities in West Michigan. This program is intended to connect vulnerable populations to careers in public works.

[Roadway Maintenance Training and Demo Day](#)

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[Public Works Cadet Academy \(Pinellas Technical College, St. Petersburg, FL\)](#)

This 195-hour program exposes students to 14 public works occupations via classroom instruction and internship. Once graduates find employment, their training continues in the form of a two-year apprenticeship program. The Roadway Technician Apprenticeship is one of the options.

[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.

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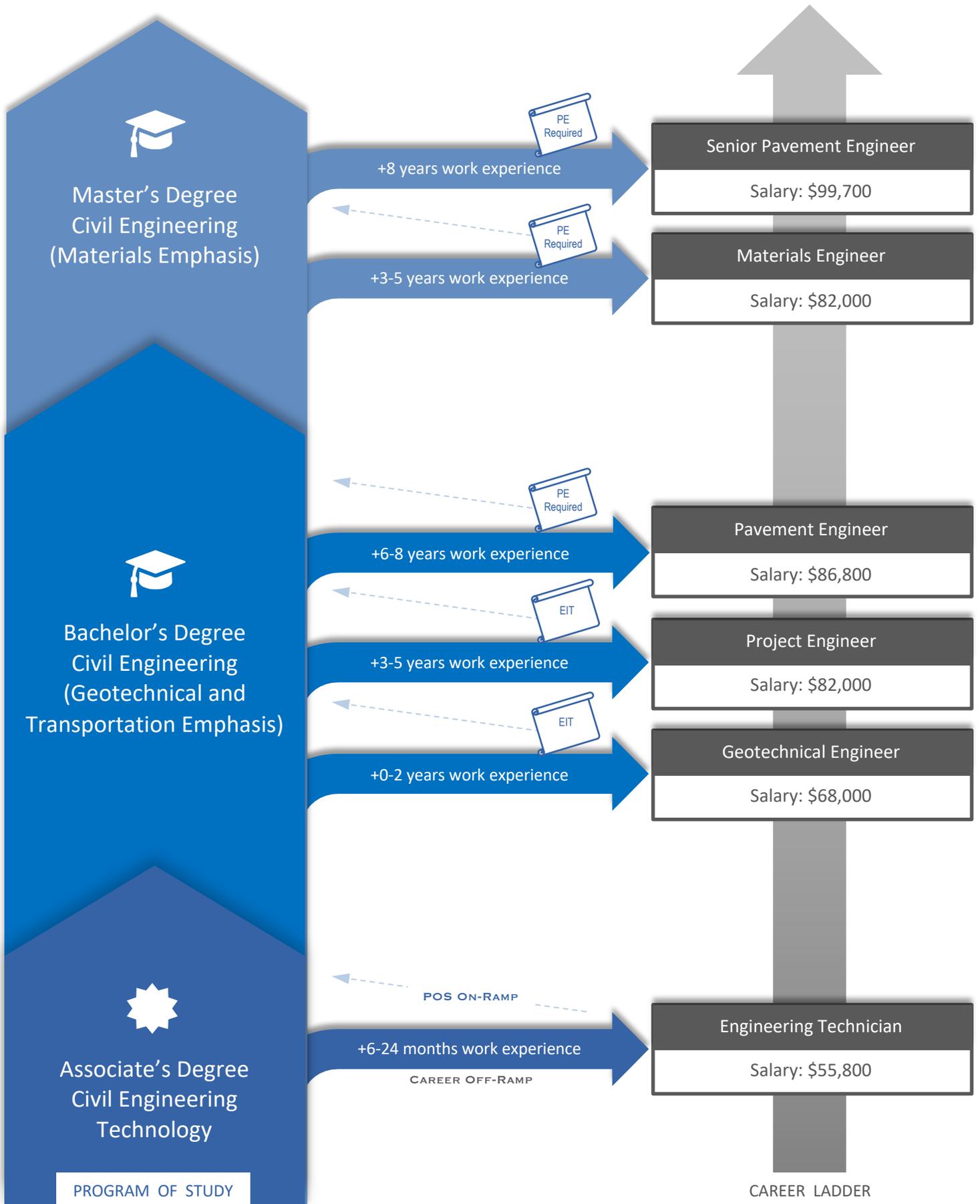
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Alternative Job Titles

Materials Engineer, Highway Materials Engineer, Geotechnical Engineer

Job Description

A Pavement Engineer designs, evaluates and manages asphalt and concrete pavement systems. The Engineer determines the pavement layer thicknesses and material composition required based on the traffic load. The Engineer collects and reviews data on existing pavements to assess deterioration and remaining service life. They understand how external conditions change the rate of pavement degradation over time. The Pavement Engineer sets the immediate and long-term repair and maintenance strategies. Other duties include:

- Design pavements according to the AASHTO Mechanistic-Empirical Pavement Design Guide (MEPDG).
- Develop specifications for pavement construction projects.
- Observe pavement construction and collect material samples for quality testing.
- Test pavement materials to determine compliance to specifications or standards.
- Inspect completed roadways to ensure safety and compliance with applicable standards or regulations.
- Analyze nondestructive falling weight deflectometer (FWD) deflection measurements.
- Work with others to develop pavement rehabilitation plans and designs.
- Work with others to implement a pavement management system.
- Reviewing concrete and asphalt Superpave mix design data.
- Design drainage, erosion, or sedimentation control systems for transportation projects.
- Develop plans to deconstruct damaged or obsolete roadways or other transportation structures in a manner that is environmentally sound or prepares the land for sustainable development.

Knowledge Requirements

- Civil and structural engineering
- Pavement mix design
- Pavement construction and equipment
- Mechanics of materials
- Quality assurance and control analysis
- Hydraulics
- Highway design
- Geotechnical engineering
- Laboratory testing
- Life-cycle Cost Analysis (LCCA)
- Life-cycle Analysis (LCA)

Required Skills and Abilities

- Project planning and development
- Analyze pavement profiles
- Interpret quality and process-control data
- Materials specification
- Cost estimation
- Detail oriented
- Written and oral communication
- Technical ingenuity in solving design problems
- Work independently and as part of a team
- Adapt to new challenges and learn new concepts

Technical Skills Requirements

- Pavement Condition Index (PCI)
- Operate manual and automated condition surveys tools such as for deflection and friction testing

Typical Salary

- \$68,000 – \$99,700

**Sources: Burning Glass Labor Insights for salaries by experience and Glassdoor for upper and lower salary bounds.*

Education and Work Experience

- Master's degree with emphasis in pavements and transportation materials.
- Three to five (3 to 5) years of engineering experience in pavement design.
- Licensed Professional Engineer (P.E.)



PE – Professional Engineer

While each state licensing board has its own laws regarding engineering licensure, there is a general three-step process for licensure candidates. PE candidates must possess a degree accredited by EAC or ABET. They must take two exams, the Fundamentals of Engineering (FE) exam and the Principles and Practice of Engineering (PE) exam. Most states require four years of acceptable, progressive, and verifiable work experience in the industry. Once students pass the FE exam, they earn an Engineering in Training certificate or an Engineering Intern (EI) certificate depending on the certifying organization.

Year 5-6



Master's Degree in Civil Engineering (Materials Emphasis)

Year 6: Students choose specific transportation engineering electives to round out their skill set. Examples include traffic operations, intelligent transportation systems, queuing theory, project management, or environmental impacts.

Year 5: During the first year, students take core courses.

Pavement Engineering Courses

Flexible and Rigid Pavement Analysis
Construction Materials Deterioration
Repair of Civil Infrastructure
Pavement Evaluation and Rehabilitation
Soil Mechanics
Slope and Soil Stabilization
Material Characterization
Concrete and Asphalt Mix Design

Mechanistic Design for New & Rehabilitated Pavements
Infrastructure Management

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

Year 3-4



Bachelor's Degree in Civil Engineering (Geotechnical and Transportation Emphasis)

Year 3 & 4: Students fulfill internship or co-op and fieldwork requirements. Elective courses provide knowledge of engineering behavior of soil, aggregates, and paving materials, the production of these materials, and how they will deteriorate under the combined effects of traffic and the environment.

Year 1 & 2: Students take several engineering courses to build a strong technical background.

GE Courses

Chemistry, Geology, Calculus, Differential Equations, Statistics, Liberal Arts, and Communications

Civil Engineering Required Courses

Fluid Mechanics, Structural Analysis, Environmental Engineering, Soil Mechanics, Internship, Senior Capstone Design

Pavement Engineering-Related Courses

Materials for Constructed Facilities
Pavement Design and Analysis
Non-Destructive Testing & Evaluation
Geosynthetics
Geometric Design and Route Planning
Construction Project Management

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

Year 1-2



Associate Degree in Civil Engineering Technology

Year 2: Students continue to take GE courses and technical courses that can prepare them for a position as a technologist. Those intending to transfer to a 4-year program will take additional mathematics coursework.

Year 1: Students are required to take general education courses interspersed with technical coursework. Certifications are built into the curriculum.

GE Courses

English Composition and Oral Comm.
Intro to Psychology
Trigonometry & Algebra w/Applications
Physics
Statics
Economics

Pavement Related Courses

Intro to Civil Engineering & Architecture
Building Material & Construction Method
Conflict Resolution
AutoCAD for Construction Science

Soil and Materials Testing
Structural Mechanics
Construction Project Management
3D CAD: Digital Terrain Modeling
3D CAD: Building Information Modeling
Surveying and GPS Fundamentals
Geographical Information Systems
Civil Engineering Drafting
Construction Estimating
Survey-Construction/Route/Highway
3D Modeling and Virtualization
Sewer & Storm Water Management
Capstone: CET-Highway Technology

Year 0



High School Diploma

Transportation-related career academies.

Experiential Learning Programs for Pavement Engineering Students

In addition to academic and technical preparedness, on-the-job training and other work-based learning experiences are critical components of worker readiness programs. These national programs provide co-curricular value to student career preparedness:

PAVEMENT ENGINEERING RESOURCES

[American Concrete Institute \(ACI\)](#)

The ACI Foundation Fellowship is an opportunity for students enrolled in college or trades programs to receive financial support. Students are expected to complete a 10- to 12-week internship prior to the award year.

[American Concrete Pavement Association \(ACPA\)](#)

Students may join ACPA to access industry research on pavement as well as networking opportunities with the concrete paving community: contractors, consultants, suppliers, academia, and transportation officials. Some states may have chapters with additional student support or activities. ACPA in partnership with the Innovative Pavement Research Foundation provides internship opportunities through its Interns of the Future program.

[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. Competitions of interest to Pavement Engineers include the [National Concrete Canoe Competition](#) and [International Contest on Long-Term Pavement Performance Data Analysis](#). Students attend regional conferences to compete and to present technical papers.

[International Society for Concrete Pavements \(ISCP\)](#)

Students may join this organization for free and gain access to literature and a network of concrete professionals.

INTERNSHIP/CO-OP/EXTERNSHIP OPPORTUNITIES

[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.

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.

US DOT Federal Highway Administration (FHWA)

FHWA offers internships and financial support through its [Dwight David Eisenhower Transportation Fellowship Program](#) to students pursuing transportation-related occupations. Two hundred students are placed annually in interest-related assignments throughout the agency.

CO-CURRICULAR OPPORTUNITIES

[American Association State Trans. Hwy Officials \(AASHTO\)](#)

While students are not eligible for AASHTO membership, the website offers an email subscription to the *Daily Transportation Update* of transportation news from across the country. Transportation TV provides information on new publications, initiatives, and other news. This section also incorporates Transportation 101 segments—brief videocasts of topics. Other videos feature CEOs and other leaders in the transportation world. AASHTO provides a strong social media presence communicating issues, projects, and announcements.

American Public Works Association (APWA)

APWA student members connect with a network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field.

[Engineers Without Borders USA](#)

Engineers Without Borders provides service-learning opportunities for students at the local and international levels. The national organization offers internships while student chapters offer opportunities for developing leadership, working on infrastructure projects, and making connections with professionals who provide mentorship. Many projects are public works projects. Opportunities exist for students, recent graduates, and professionals.

[Institute of Transportation Engineers \(ITE\)](#)

The ITE Student Leadership Summit is entirely planned by students, for students. Through the promotion of leadership and professional development, these events aim to guide future transportation professionals. The Traffic Bowl, another competition, tests students in topics such as transportation planning and engineering. State and local chapters provide opportunities for students to meet professionals and to learn about the latest in engineering practices in their communities.

[National Society of Black Engineers \(NSBE\)](#)

NSBE offers resources to students across the entire educational spectrum including retention, scholarships, leadership, and soft skills training through local networks and regional conferences. NSBE provides community STEM training for individuals who may want to mentor younger students.

[National Society of Professional Engineers \(NSPE\)](#)

Students can be members of NSPE and attend student chapters or local chapters to learn more about licensing and to network with professionals. The website offers a job board that can be filtered by internship opportunities. Students can log in to experience the virtual Professional Engineers Day event to learn more about the Professional Engineering (PE) license and to hear about the work PEs do from practitioners in the field.

[Society of Hispanic Professional Engineers \(SHPE\)](#)

SHPE programs offer support and development to increase degree persistence and attainment as well as aid undergraduates in professional development for a transition into either a STEM career or pursuit of a graduate degree.

[Society of Women Engineers \(SWE\)](#)

Open to all genders, SWE chapters exist in many institutions of higher education. Chapter activities range from mentoring, K-12 outreach, career and industry presentations, and opportunities for technical competitions, scholarships and national conference attendance.

[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. For example, the New York LTAP offers the *Cornell Asset Management Program (CAMP)*. This program offers hands-on experience in implementing a pavement management system. Summer interns input data into a GIS mapping program, inventory drainage facilities and sidewalks, flag traffic, work as laborers on a highway crew, and operate equipment on construction sites.

[The Association for Unmanned Vehicle Systems International \(AUVSI\)](#)

Students involved in an AUVSI Student Chapter, gain experience in the industry and receive guidance from professionals in the chapter. Drones are emerging as a safer method for bridge inspection.

[Transportation Development Foundation of the American Road Transportation 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 a number of scholarships for post-secondary students and women at the undergraduate or graduate level.

Innovative Learning Strategies for a Bridge Engineer Program of Study

To establish curricular lessons and activities that incorporate the latest strategies for increasing student learning effectiveness and retention, a review of practices deployed by workforce and CTE practitioners reveals several approaches that would benefit students within an engineering program of study. These learning strategies include:

Competency-Based Curriculum

Curriculum that meets academic and quality standards, is designed and organized by competencies required for jobs, and is cross-walked with industry skill standards and certifications, where applicable. Job profiling and the use of subject matter experts (SMEs) should be considered to meet the competency needs of business.

Modularized Curriculum

Structured and sequenced curriculum in modules tied to jobs with multiple entry and exit points and multiple levels of industry-recognized credentials built into the pathway.

Asynchronous Learning

Education/training for students and incumbent workers provided at times and locations convenient to students and employers. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

Problem-Based Learning

Instruction that helps students benefit from hands-on learning foster team-building skills while solving real-life problems.

Experiential Learning

Opportunities for "learning-by-doing." Examples include apprenticeships, internships, externships, rotational programs,

co-op work experiences, simulations, and class projects that are assignments from local employers. Tinkering is the first step in the experiential learning continuum. Students pursue self-led, hands-on practice as a precursor to being involved in more significant activities. Tinkering projects are a great way to build a foundation for future engineering endeavors. Universities are offering Tinkering or Makerspace Design Studios equipped with tools and software to reverse engineer or build new products.

Context-Based Learning

Instruction that fosters interpretation of new information in the context or place of where and when it occurs. By relating new information to what the student already knows, the student comes to understand its relevance and meaning.

Individual Learning

Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class. It's important that practices and processes help teachers engage each student where they are.

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NTCPI

NATIONAL TRANSPORTATION CAREER PATHWAY INITIATIVE

TRANSPORTATION SAFETY

CAREER PATHWAY REPORT

FEBRUARY 2019



WEST REGION
**Transportation
Workforce Center**

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Transportation Safety

TRANSPORTATION SAFETY

SECTION 1.0 CHARACTERIZING THE WORKFORCE

1.1 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 risk¹. 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. These numbers are predicted to increase as focus on data-driven safety outcomes grows at local, state, and federal levels².

MAP-21, for instance, established a performance and outcomes-based highway investment program to include reductions in traffic fatalities and injuries on public roads³. Vision Zero has helped push safety as a policy, planning, and budgetary priority down to local levels. Legislative efforts at both state and national levels have mandated improved integration of safety measures/outcomes into transportation planning, design, and operations. The Highway Safety Improvement Program 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 abilities 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.

Substantial progress has been made on developing textbooks, courses, degree programs, and professional certifications dedicated to transportation safety.



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 transportation safety career pathways, this implementation plan concentrates on two components of this workforce. First, by focusing 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 “safety mentors to the larger workforce.”⁵ Second, the proposed 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. They have the ability to detect safety issues at a local site (or even systemically), then implement appropriate mitigation measures can produce significant safety improvements for both workers and road users.

1.2 Priority Occupations

The transportation safety career pathway implementation plan focuses on eight critical occupations within two career cluster areas:

- Transportation Safety Planning, Engineering, Design & Analysis
- Infrastructure Construction & Maintenance Safety

Transportation Safety Planning, Engineering, Design & Analysis encompasses occupations responsible for roadway and vehicle design, traffic engineering/operations, transportation planning, human factors and behavioral research, and safety data analysis. Priority occupations in this cluster include Civil/Transportation Engineers, Engineering Technicians, Human Factors Engineers, Transportation/Urban & Regional Planners, and Computer & Mathematical Occupations (e.g. statisticians, data analysts, data scientists, computer scientists).

Infrastructure Construction & Maintenance Safety covers the priority occupations 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 of these priority transportation safety occupations is provided in the Table 1.2.1 below.

Transportation Safety

Table 1.2.1: Priority Safety Occupations in Transportation

SOC CODE	OCCUPATION	CURRENT # EMPLOYEES, 2016	PROJECTED # EMPLOYEES, 2026	PERCENT CHANGE	MEDIAN SALARY 2016
11-9021	Construction Managers	403,800	448,600	11.1%	\$89,300
15-0000	Computer & Mathematical	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 & Regional Planners	36,000	40,600	12.8%	\$70,020
47-1011	First-Line Supervisors, Const 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 clusters and priority occupations is represented in Figure 1.2.1 below. 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 1.2.1: Conceptual Framework for Safety Occupational Clusters

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1.3 Critical Workforce 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 lead to on-the-ground tools and techniques that can be implemented in safety planning, roadway design, transportation operations, and road construction/maintenance activities. Road safety professionals must possess foundational knowledge of road safety as a distinct field, while correspondingly applying road safety techniques and tools to their everyday occupational job tasks. Over the past decade, considerable effort has been expended on defining road safety competencies⁶. To facilitate integration of safety competencies into multi-disciplinary coursework, this 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 occupation-specific. They represent fundamental cross-occupational knowledge, skills, and abilities (KSAs) expected of a road safety professional. Attainment of these competencies will help new career entrants achieve career flexibility, allowing them to pursue multiple career paths into safety-related careers.

- ✓ *Awareness of the importance of safety. Ability to communicate importance to broader audience in 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, interpret various data/information sources and analytical tools to (a) identify and assess safety risks, (b) identify appropriate countermeasures to mitigate risks, and (c) assess effectiveness of safety measures.*
- ✓ *Ability to effectively develop and/or implement a safety plan.*
- ✓ *Ability to communicate/collaborate with multiple stakeholders and to lead/navigate change.*
- ✓ *Ability to recognize capabilities and limitations of different road users in terms of behavior choices, reactions to transportation systems, and capacity to survive a crash.*

Transportation Safety

These core safety competencies provide a foundation for both career clusters and priority occupations within transportation safety. Recognizing differing safety job functions and levels of specialization between the two safety clusters, separate competency models were developed that focus on safety-specific KSAs. Additional competencies specific to individual academic disciplines and occupations, like planning or civil engineering, are clearly required for job seekers, however these are well-documented in this report.

For the purposes of career pathway implementation, these models focus on safety-specific KSAs to facilitate alignment of training and education development efforts and to fill gaps.

Career Cluster: Transportation Safety Planning, Engineering, Design & Analysis

Figure 1.3.1 illustrates the high-level competency model for this career cluster:

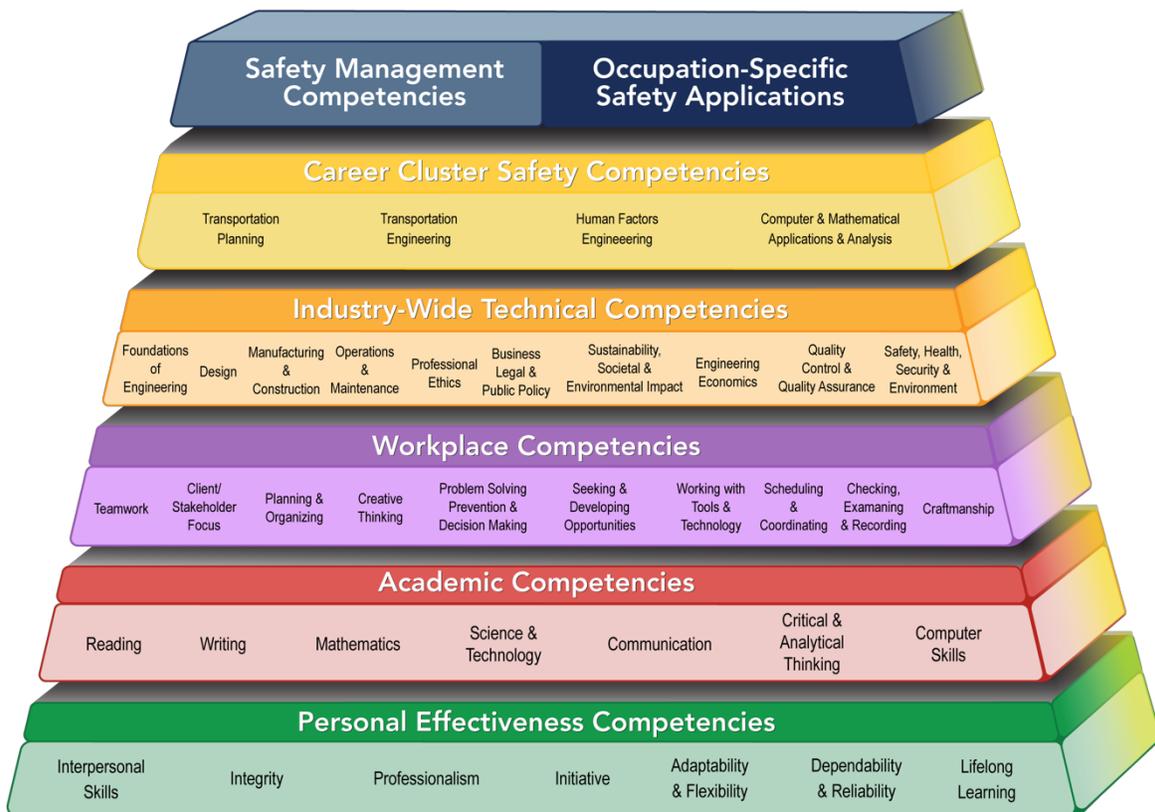


Figure 1.3.1: Transportation Planning, Engineering, Design & Analysis Competency Model

Transportation Safety

Baseline personal effectiveness, academic, workplace, and industry-wide technical competencies are drawn from the DOL's industry model for Engineering⁷. 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:

1. **Career Cluster Safety Competencies** focus on core KSAs common to all priority occupations within the cluster and are based on road safety science principles and techniques. Depth of knowledge, level of competence with analytical tools and techniques, and applications of skillsets will vary between the different occupational groupings. However, baseline safety KSAs are cross-disciplinary and cross-occupational, as shown in Table 1.3.1 below.

Table 1.3.1: Core Knowledge/Skills — 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.	Able to interpret crash data and other safety-related data.
Understand and communicate comprehensive costs of transportation system crashes, injuries, fatalities to society.	Able to assess different factors contributing to highway crashes, injuries, fatalities and how those 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, communications technologies, vehicle design features, and the roadside environment.	Able to assess the appropriateness of different analytical methods used for identifying safety problems and evaluating the effectiveness of safety countermeasures.
Understand potential safety impacts of different roadway designs, particularly on vulnerable road users, and how demographic trends impact safety management outcomes.	Able to use GIS or other spatial data analysis and visualization tools to identify transportation safety issues.
Understand classification system of roadway elements, highway crash / injury severity factors and interactions.	Understand and utilize predictive methods for analyzing systemic safety issues.
Familiar with transportation safety aspects of major legislation, tort liability, and risk management.	Able to apply modeling/simulation skills and appropriate qualitative/quantitative research methodologies to transportation safety problems to develop solutions.
Understand safety research and methods employed to achieve improvements in transportation safety.	Understand myriad environmental, cultural, other factors that influence behavior, to develop effective plan to promote behavior change and enhanced safety culture.

Transportation Safety

2. **Safety Management Competencies** focus on specific management abilities for the attainment of safety leadership positions. These competencies are listed below:

Table 1.3.2: Core Mgmt. Abilities —Transportation Planning, Engineering, Design & Analysis

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

Competency models for these pathways highlight the commonalities between occupations within each career cluster, with the primary distinction being the application of job competencies in day-to-day job activities and in products/outcomes produced (e.g. vehicle safety technologies, highway geometric designs, long-range safety improvement plans).

Each occupation has additional competency requirements that are well-documented in career paths for other disciplines like engineering and planning. For the purposes of these safety career pathways, these competency models focus specifically on the additional requirements necessary to function effectively as a leader in transportation safety.

3. **Occupation-Specific Safety Applications** highlight the differences in job tasks and underline safety functions for specific occupations within the cluster. Examples of how safety competencies may apply within the job specification for a priority occupation is shown 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.

Transportation Safety

- 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/targeting high risk groups to plan effective safety programs at the national, state, and local levels.

“Transportation Safety Engineer” applies safety KSAs to:

- Incorporate quantitative safety performance measures/outcomes into transportation operations, roadway design processes, and 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, evaluate effective systemic safety improvements and counter-measures.

“Human Factors Engineer” applies safety KSAs to:

- Integrate human performance/factors-related data/knowledge into transportation systems or vehicle engineering/design activities to improve safety.
- Assess contributing factors to crashes and develop solutions based on user considerations, such as visual/sensory systems, cognitive loads/distractions, situational awareness, decision-making, and information processing.
- Improve understanding of safety impacts of behavioral decision-making to improve mitigation measures, utilizing psychological and other research methods based on scientific principles related to human behavior/performance; individual differences in ability, personality, and interests; and learning or 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/analysis tasks to assess transportation safety problems and develop evidence-based solutions. Tasks may include developing/implementing novel computational approaches, statistical methods, simulation models, graphic/spatial data analysis/representation, and developing new software tools or other technologies to support safety research goals.
- Perform validation/testing of models, programs or databases; review existing or in-coming data for currency, accuracy, usefulness, quality, or completeness of documentation. Collaborate with other organizations to support interoperability of systems, and safety data sharing/analysis.
- Manage data systems and implement security measures to safeguard data. Facilitate access/use of safety data for stakeholders.

Transportation Safety

Career Cluster: Transportation Infrastructure Construction & Maintenance Safety

Figure 1.3.2 illustrates the high-level competency model for this career cluster:



Figure 1.3.2: Transportation Infrastructure Const. & Maintenance Safety Competency Model

Baseline personal effectiveness, academic, workplace, and industry-wide technical competencies are drawn from DOL's industry model for Heavy Highway Civil Construction⁷. 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:

1. **Career Cluster Safety Competencies** focus on core KSAs common to all priority occupations within the cluster, and depth of knowledge and applications of skillsets will vary between different occupational groupings. However, baseline safety KSAs are cross-disciplinary and cross-occupational and are outlined for the career cluster in Table 1.3.3 below.

Transportation Safety

Table 1.3.3: Core Knowledge/Skills — Transportation Infrastructure Const. & Maintenance Safety

CORE SAFETY KNOWLEDGE	CORE SAFETY SKILLS
Understand road safety as a discipline devoted to the avoidance/mitigation of fatalities, injuries, and crashes.	Able to assess contributing factors to highway crashes, injuries, fatalities and how crash factors interact.
Understand the goals, process, and contributors to highway/road safety management.	Able to identify, implement, and evaluate roadside and jobsite countermeasures for safety.
Understand steps in safety analysis and differences in approach for systematic, systemic, individual site concerns.	Able to assess safety of different roadway components by observing potential safety issues (“reading the road”).
Understand how road user decisions/safety are influenced by road design, maintenance activities, traffic control elements, roadside environment, other operational conditions.	Understand myriad environmental, cultural, other factors that influence behavior to develop effective plan to promote behavior change and enhanced safety culture.
Understand safety impacts of different road designs, signage, maint. practices, particularly on vulnerable road users.	Able to locate, use, interpret various information sources to assess risks and identify appropriate countermeasures.
Understand classification system of roadway elements and different safety concerns for each (e.g., low volume roads).	Able to use appropriate data/analytical tools to evaluate effectiveness of safety plans and safety mitigations.
Understand transportation safety aspects of major legislation, tort liability, risk management; safety regs/policies governing maint/construction activities to ensure compliance.	Able to utilize safety and incident management techniques to identify/remediate risk.
Understand purpose of Manual on Uniform Traffic Control Devices (MUTCD) and how its tenants apply to safety.	Able to implement range of project safety plans, including: confined space, fall prevention, excavation, equipment, incident management, and emergency response.
Understand differences between mobile, short, long-term work zone traffic control reqs and how to implement them.	Able to use/maintain proper flagging techniques and traffic control devices; manage work zone safety.

2. Safety Management Competencies focus on specific management abilities for the attainment of safety leadership positions. These competencies are listed below:

Table 1.3.4: Core Mgmt. Abilities — Transportation Infrastructure Const. & Maintenance Safety

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

Transportation Safety

3. **Occupation-Specific Safety Applications** highlight the differences in job tasks and underline safety functions for specific occupations within the cluster. Examples of how safety competencies may apply within maintenance/construction job specs are provided below:

“Highway/Road Maintenance Worker” applies safety KSAs to:

- Assess safety of different roadway components and roadway environment; determine appropriate maintenance countermeasures to improve safety as needed; implement mitigation measures on systemic or individual site basis as appropriate.
- Implement maintenance activities with aim of improving safety, such as vegetation control, signs and supports, guardrails, drainage, or other roadside features maintenance.
- 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 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 and 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/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, including big data and predictive analytics, cybersecurity techniques, computer programming, and algorithm development.

Transportation Safety

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 this new environment⁸.

1.4 State of 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 employers, job seekers, and education providers. On one hand, job seekers and education/training institutions responsible for preparing incoming workers do not see any explicit “demand for persons trained in road-safety⁹” within the labor market.

As a result, degree-level road safety curriculum remains sparse and dependent on faculty interest¹⁰. While construction degree programs 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-design¹¹.

Research indicates most construction safety course content is currently related to personal and job-site safety (e.g. OSHA topics), with less class time devoted to risk mitigation, evaluation of safety measures, and safety planning and design¹².

Lack of evident workforce demand leads to an unproductive cycle characterized by a lack of well-trained safety professionals emerging from the education system. Reinforcing the workforce preparatory issue is a reluctance on the part of employers to write specific safety KSAs into job qualification requirements, with the assumption that these needed skills are too difficult to find in typical applicant pools and will prevent successful completion of the hiring process. Safety engineers at state and local agencies expect to train new staff on safety-related topics because it is rare to find applicants with these skill-sets. This results in an initial period of training for new hires to get “up to speed” on fundamental safety competencies.

However, identifying training courses to cover core safety topics and develop required skillsets for specific positions can be a challenge. A study on safety training utilization by four state

Transportation Safety

DOTs found that “training is being addressed on an ad-hoc basis depending on availability and staff needs.”¹³ A structured transportation safety education and training curricula would benefit both employers and future and incumbent transportation professionals.

Safety career paths that begin at 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 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 ensure emerging workers in a variety of entry-level fields (roadway design, traffic operations, planning, etc.) have foundational safety knowledge/skills.

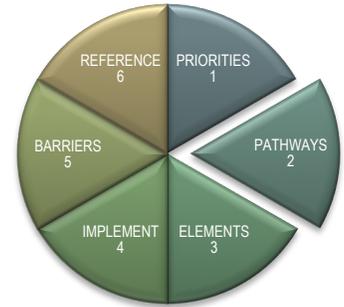
It also provides a conduit to cross-disciplinary learning opportunities for students, allowing them to develop competencies in emerging areas like big data analytics that are expected to be increasingly in demand by transportation employers.

Transportation Safety

SECTION 2.0 CAREER PATHWAY DESIGN

2.1 Pathway Design Methodology

The design of 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 career path represents a position that works full-time on road safety—that “safety mentors to the larger workforce,”¹⁴ while also incorporating 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 were identified in an iterative process involving an extensive literature review, stakeholder interviews, LMI data analysis, and advisement from subject matter experts serving on the Safety DWG. Selection of priority occupations was further supported by efforts to develop professional certification programs in transportation safety, based on extensive national outreach to determine industry demand. A scan of education/training offerings was also completed to identify gaps in workplace competency delivery.

Transportation safety pathway models bring safety competencies front-and-center at each stage of the career ladder, highlighting opportunities for safety-focused cross-disciplinary coursework and experiential learning.

2.2 Pathway Learning Strategies

Significant institutional barriers exist that can impede the implementation of new course-work or degree programs at education institutions. Nevertheless, integration of road safety competencies into programs of study can be successfully accomplished through the implementation

Transportation Safety

of experiential or problem-based learning strategies focused on applying technical and problem-solving skills that address transportation safety issues. These strategies can be curricular (integrated into coursework or classroom projects) or co-curricular (experiences supplemental to degree work, such as research or internships). Examples proven successful in attracting and preparing students for safety careers are highlighted below:

Transportation Agency / University Research Partnerships: Research partnerships between university faculty and state DOTs are proven sources for safety workforce development when they (a) are implemented over the long-term and (b) actively involve faculty, undergraduate, and graduate multi-disciplinary students in the implementation of safety research and project development.

As an example, Utah DOT contracts with Brigham Young University to develop safety countermeasure improvements, develop/improve safety models (crash prediction, crash severity, intersection crash prediction), analyze current safety data, and identify countermeasures. Project development is collaborative between the university and DOT, allowing for progressive improvements as partners jointly identify next steps. Since this collaboration began, over 25 student participants have since entered safety-focused careers.

Safety-Focused Work-Based Learning: Particularly in construction programs, many institutions require or strongly encourage work-based learning for their students via 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 done in various ways. These include incorporating 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. Jobsite visits and field trips are also useful for engaging student interest. Senior design courses, industry-led challenge projects, and service-learning projects offer opportunities for employers to engage with educational institutions to help build safety competencies by engaging students on real-world projects.

Transportation Safety

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/recruitment tool to safety career pathways.

For instance, the Idaho Transportation Department 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 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.¹⁵ This model provides a powerful tool for gaining access to multidisciplinary students and expertise to solve transportation safety problems.

Competency-Based Curriculum: For incumbent workers, pursuing an academic program 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 workers to obtain academic credit by demonstrating knowledge/skills acquired on-the-job), can help workers achieve degrees to advance their careers.

Colorado DOT and Front Range Community College are currently utilizing this model to implement an associate degree in Highway Maintenance Management.

In each of these cases, the transportation industry should play a proactive role in fostering experiential learning opportunities for students to develop safety competencies, by offering exposure to safety topics and allowing them to develop problem-solving skills and apply safety tools and techniques 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.

Transportation Safety

2.3 Priority Career Pathways

Transportation safety career pathways are presented here for each of the priority occupations identified within two career clusters. The four pathways documented under the “Transportation Safety Planning, Engineering, Design & Analysis” career cluster are as follows:

Career Pathway: Transportation Safety Planning

Description:	Provides guidance for transportation planners to obtain additional competencies needed to integrate safety into transportation planning documents and processes, including knowledge of systemic safety issues, demographic and human factors associated with safety risk, and safety data analysis techniques.
Priority Occupations:	Transportation Planner, Urban & Regional Planner.
Support Occupations:	Planning Aide.
Education/Training:	Urban & Regional or Transportation Planning program.

Career Pathway: Transportation Safety Engineering

Description:	Provides guidance for transportation engineers to obtain the competencies needed to integrate safety into transportation planning, design, operations, and investment decision-making processes. This includes 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 Occupations:	Engineering/Traffic Technician.
Education/Training:	Civil Engineering program.

Transportation Safety

Career Pathway: Human Factors Engineering

Description:	Provides guidance for human factors engineers to obtain the additional competencies needed to integrate safety into vehicle and transportation system design, including knowledge of road user limitations and 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.
Support Occupations:	n/a
Education/Training:	Industrial Engineering or Human Factors Engineering Program.

Career Pathway: Transportation Safety Data Analysis

Description:	Provides guidance for those pursuing careers in computer/mathematical occupations to obtain competencies needed to support data-driven transportation system improvements and investment decisions, including knowledge of road safety science principles, analytical tools/techniques, and ability to apply analytical/modeling/simulation skills to identify issues and develop safety solutions.
Priority Occupations:	Computer & Information Research Scientist, Research Scientist/Mathematician.
Support Occupations:	Database Administrator, Computer Systems Analyst, Statistician, GIS Scientist/Technologist.
Education/Training:	Computer Science, Data Science, GIS, Mathematics, or Statistics.

The two pathways documented under the “Transportation Infrastructure Construction & Maintenance Safety” career cluster are as follows:

Transportation Safety

Career Pathway: Road Construction Safety Management

- Description:** 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, to implement effective on-site safety plans and traffic control, and to identify risks and implement/evaluate safety countermeasures.
- Priority Occupations:** Construction Manager, Project Engineer.
- Support Occupations:** Front-line Construction Supervisor, Construction Equipment Operator, Construction Laborer.
- Education/Training:** Civil or Construction Engineering program.

Career Pathway: Highway Maintenance Safety Management

- Description:** 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. Includes ability to assess road conditions and roadway environment to identify safety issues; implement maintenance activities to improve road user safety.
- Priority Occupations:** Highway Maintenance Manager.
- Support Occupations:** Highway Maintenance Worker.
- Education/Training:** On-the-job training; Civil or Construction Engineering.

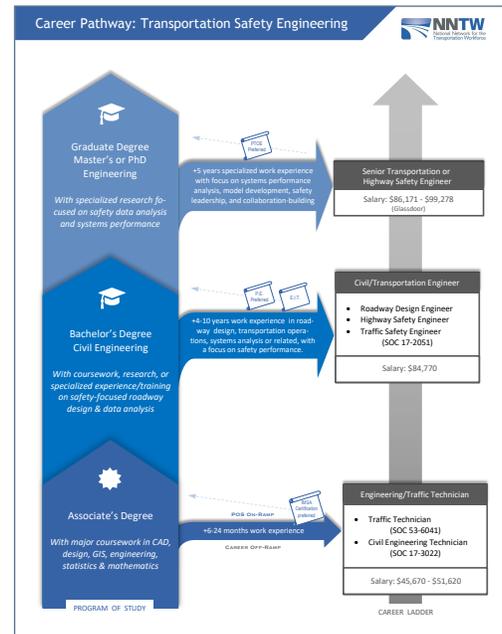
2.3.1 Career Pathway Documentation

All career pathways and priority occupations identified as priorities by this initiative and referenced previously within this report are documented using four standardized templates: a pathway graphic, job description, program of study, and experiential learning aide.

Transportation Safety

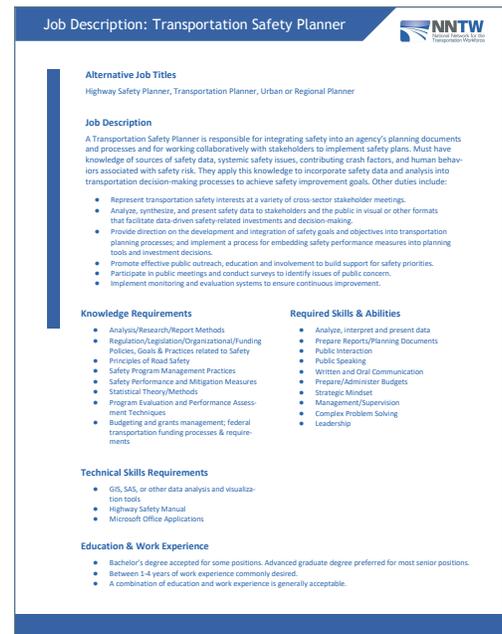
Career Pathway Graphic: Identifies entry/exit points between academic coursework and corresponding occupations and pay scales along a career continuum. Examples of coursework, research, or experiential learning focus specifically on opportunities to develop safety competencies, which in many cases require coursework from disciplines outside a student's major.

Industry credentials are identified as preferred or required for specific occupations along the career path, with additional information provided in the accompanying program of study. For occupations that align with an SOC, median annual national salaries from BLS (2017) are listed. For titles not represented by an SOC, senior-level salaries were captured from Glassdoor.com, while maintenance positions came from AASHTO's salary survey.



Job Description: These priority occupation descriptions, like the Transportation Safety Planner shown at the right, provide 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 and platforms.

For safety career pathways, these job descriptions focus on safety-related responsibilities for the occupation and the KSAs required to effectively implement the safety functions of the position.



Transportation Safety

Program of Study: This document presents an academic plan for a career pathway. Programs of study offer multiple entry/exit points. Some students may pursue graduate degree completion directly after high school without interruption, while others may leave academics to gain work experience then return to school at a later date to pursue enhanced degrees or credentials.

Either course can result in a positive career experiences and is at the discretion of the student. Minimum education requirements for specific occupations guide appropriate off-ramps from programs of study into careers.

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 multidisciplinary, so coursework outside a primary degree program is emphasized.

Experiential Learning: This document presents 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.

Many academic institutions either require or strongly encourage work-based learning experiences for degree program 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.

NNTW
NORTON NORTHWEST TECHNICAL COLLEGE

Program of Study: Human Factors Engineering

Year 5-8

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.

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

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 Eng., including experimental design, engineering statistics, mechanics, engineering psychology, and user-centered design.

Year 1-2

Bachelor's Degree in Progress or Associate's Degree in Pre-Engineering
Year 1 and 2: Course requirements vary by institution. Students wishing to transfer into a 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.

Year 0

High School Diploma or G.E.D.
Engineering or Computer Science CTE coursework if available.

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: Equipment Design & Analysis, Regression Analysis
Psychology: Cognitive Psychology, Research Methods, Behavior Management
Human Factors: Research Methods

Human Factors Courses
Design & Analysis of Info Systems
Systems Modeling & Simulation
Human-Computer Systems Design
Engineering Psychology
Computational Methods

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

Transportation Safety-Related Courses
Transportation Safety
Risk Assessment

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

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

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

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

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NNTW
NORTON NORTHWEST TECHNICAL COLLEGE

Experiential & Innovative Learning: Maintenance Safety

Experiential Learning & Professional Development Opportunities
Professional associations provide professional development and networking opportunities for 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)
Within NACE does not offer student membership, they provide education and training events to county engineers, road managers, and related professionals across the US.

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. NACE 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 training 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 meeting, and National Work Zone Awareness Week activities.

American Public Works Association (APWA)
APWA student membership connects students to a

network of professionals. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field. Public Works conferences or expos often include an Equipment Roadshow competition for technicians in a number of maintenance occupations to show their skills troubleshooting mechanical issues or maintaining equipment in various weather conditions. Local winners advance to regional and national Roadshows. 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.

Public Agencies and Transportation Organizations
Cities and counties as well as state transportation agencies provide opportunities for paid internships, co-ops, externships and on-the-job training in the maintenance field.

State Local Technical Assistance Programs (SLTAP)
These FHWA-funded centers offer training and coordination for local Road Programs or Road Scholar Programs. Opportunities for students vary by state.

Federal Highway Administration (FHWA) EOP Program
FHWA's Emergency Transportation Operations program provides tools, guidance, capacity building and good practices that aid local and State DOTs with their efforts to improve transportation network efficiency and public response to safety when a non-recurring event either interrupts or overwhelms transportation operations.

Federal Highway Administration (FHWA) ITM Program
The Federal Highway Administration has training for safer, faster, stronger, more integrated incident response through National Traffic Incident Management Response Training Program. This program includes web-based training, a communication 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 comprising the public safety and transportation communities to coordinate experience, knowledge, practices, and ideas to improve incident management practices.

Traffic Incident Management Network (TIMN)
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.

NATIONAL TRANSPORTATION
CAREER PATHWAYS INITIATIVE

FINAL PROJECT REPORT, PAGE 275
FHWA AWARD #DTFH6116H00030

Transportation Safety

SECTION 3.0 THE SIX ELEMENTS OF PATHWAY DEVELOPMENT

All NNTW implementation plans follow 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:

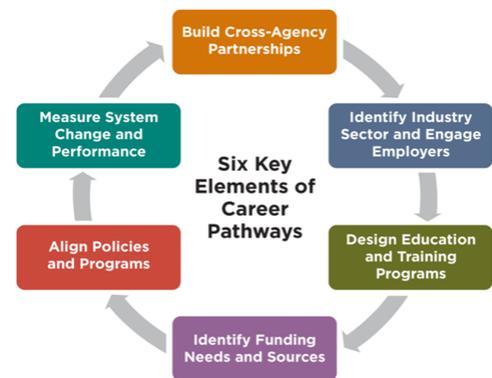
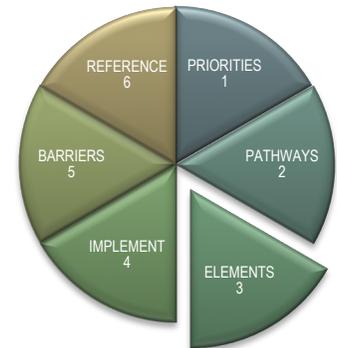
1. Build Cross-Agency Partnerships & Clarify Roles
2. Identify Industry Sectors & Engage Employers
3. Design Education & Training Programs
4. Identify Funding Needs & Sources
5. Align Policies & Programs
6. Measure System Change & Performance

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 WRTWC team approached this ETA system using the following strategies:

3.1 Build Cross-Agency Partnerships & Clarify Roles

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, 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



Transportation Safety

to disseminate training information to staff and to incentivize employee participation through employee recognition programs or career advancement opportunities. WRTWC will work with the Front Range Community College (FRCC) Highway Maintenance Management program and other post-secondary 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.

3.2 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. 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 membership's safety training goals. NACE will disseminate information about the program through its membership. Curriculum will be packaged to facilitate blended delivery either online or in-person by local technical assistance providers (LTAPs) or other local training/education providers. Montana LTAP will lead the first pilot demonstration of curriculum focused on construction and maintenance personnel, work with NLTAPA and other national training associations to expand the pilot nationally, and 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. WRTWC will work with professional associations like AASHTO and directly with state/local 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.

Transportation Safety

3.3 Design Education & Training Programs

Safety curriculum for local roads personnel will be designed based on the NTCPI's safety competency models, on current/past efforts to identify safety training needs and resources¹⁶, and on a scan of existing safety trainings¹⁷. 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 industry training providers.

Gaps in current training will be addressed through the development of new safety training modules, primarily in partnership with the National Center for Rural Road Safety. WRTWC will work with colleges like FRCC that award course credit through prior learning assessments to make academic credit available for training participants through articulation agreements.

At the university level, implementation focuses on integration of safety experiential and project-based learning experiences into existing coursework versus new curriculum development. In this way, 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 safety education will not become static, but instead keep pace with changes in industry as new issues, techniques, and tools emerge. This approach also avoids institutional challenges like curriculum review for new degree coursework or program development.

3.4 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 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.

Transportation Safety

Long-term program sustainability is built into pathway program design. Local roads safety curriculum is designed to facilitate utilization/adaptation by multiple entities (technical assistance providers, professional associations, community colleges) 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.

3.5 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.

3.6 Measure System Change & Performance

System change measures will focus on industry engagement with safety career pathways, to include (a) increased university-agency research and engaged scholarship partnerships focused on safety, and (b) new-hire/promotion practices or employee incentives to reward or recognize staff with safety competencies. Multidisciplinary university students will gain project-based safety experience through industry engagement. The development of a comprehensive safety training curriculum for local roads personnel will provide incumbent workers an opportunity for accelerated contextualized safety skillset development. Performance measures will focus on participant results within the pathway, including number of students exposed to road safety topics, number of workers with industry recognized safety credentials, and evidence of participant career advancement (job placement, increased wages, promotion).

Transportation Safety

SECTION 4.0 CAREER PATHWAY IMPLEMENTATION

4.1 Project Title

“Career Pathways to Safer Transportation Systems”

4.2 Workforce Priority

Research indicates that over 100,000 professionals have responsibilities that impact road safety. Yet remarkably, there is a 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 infrastructure construction/maintenance personnel and transportation engineering, design, and analysis—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 an applicant’s past learning and experience. However, for those interested in obtaining industry-recognized safety credentials, 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 courses include some safety-focused content, they are scattered across training providers, organizations, delivery modes, and target audiences, making it difficult for staff to easily identify. Degree-level road safety curriculum is sparse and dependent on individual faculty or department interest.

Further complicating this picture is the challenge future/incumbent transportation professionals face in assessing 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.



Transportation Safety

4.3 Project Description

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, using a two-fold approach:

1. Deploy a pilot demonstration of a Local Road Safety Scholars recognition program.
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 curriculum.

The purpose and expectations for this pathway implementation include:

- Highlight and disseminate industry-identified safety competencies (NTCPI research outcomes) to education/training providers to enhance curriculum.
- Provide a structured mechanism for incumbent/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 path.
- Provide adaptable models for integrating road safety awareness and problem-based learning experiences into existing training/education programs to build awareness, interest, knowledge, and technical skills related to road safety.
- 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.

Local Road Safety Scholar Recognition Program

NACE is pursuing the development of a comprehensive safety training curriculum and certificate program for local roads personnel, to include road supervisors, engineers, construction, and maintenance personnel. Their goal 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.”

Transportation Safety

NACE has partnered with the National Center for Rural Road Safety (Safety Center) to begin laying the framework for a training program. This includes identifying leadership and safety training modules, core safety competencies appropriate for all occupations, and specialized training requirements 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.

WRTWC's implementation plan leverages these ongoing partnership efforts and will coordinate with NACE and the Safety Center to deploy a pilot safety demonstration training program focused on frontline construction and maintenance personnel in Montana. This pilot will focus on implementing core safety training modules identified by WRTWC, NACE, and the Safety Center for all career pathways, plus specialized safety training courses targeted specifically to road construction and maintenance personnel.

Safety courses will be bundled into a program of study and integrated into the MT LTAP 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 "Road Scholar" and "Road Master" levels. The Road Scholar program is both well-established and well-known by employers and employees. Implementation of a Road Safety Scholar program within this existing framework will facilitate program information dissemination and employee/employer buy-in for safety-focused programming.

MT LTAP will be the in-person training provider for this pilot deployment, and its curriculum will include options for on-line training through the Safety Center or other national training providers, providing access flexibility for full-time professionals. While MT LTAP offers non-credit coursework, WRTWC will identify community colleges where articulation agreements can be established to provide college credit to pathway participants for training completed.

WRTWC will work closely with FRCC—set to launch an online Highway Maintenance Management associate degree in 2019—to align safety training courses with eligible academic credit options for their degree. WRTWC's role in this pilot demonstration is to establish resources and processes that will enable national expansion and long-term viability of the program.

Transportation Safety

Where initiative year one will be dominated with start-up and pilot activities (detailed in the Section 4.8 First Year Workplan), the overall multi-year deployment effort includes:

- Assessment of employer buy-in; development of effective industry outreach materials.
- Development of program assessment tools targeted to participants and employers.
- Project outcomes evaluation (short-term).
- Funding identification / proposal development for 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/roadmaps 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.

MT LTAP expects to offer 3-5 safety trainings to local roads personnel each year of the program. By the end of this 3-year pilot demonstration, an estimated 90-375 transportation staff are expected to complete safety training. This will provide adequate data to evaluate safety learning outcomes, recommend program revisions, and identify next steps for program expansion. Letters of agreement from pilot project partners (NACE, Safety Center, MT LTAP) are included in Section 6 of this plan report.

Transportation Agency / University Partnerships for Engaged Scholarship

Critical occupations in the “Transportation Safety Planning, Engineering, Design & Analysis” career cluster require completion of four-year or graduate-level degrees. Safety job specifica-

Transportation Safety

tions 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 academic institutions 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/program development—is through the integration of project-based learning into existing courseware. 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. WRTWC will act as a facilitator to identify at least two university and transportation agencies and provide them with the support and resources needed to implement productive safety project partnerships.

Partnerships that involve multidisciplinary students. Initial deployment will focus on curricular partnerships: integrating project-based learning into degree coursework. Years two and three of this implementation will focus on “stacking” safety career development experiences through the addition of co-curricular research project partnerships.

The primary partner for this initiative of the implementation project is the Educational Partnerships for Innovation in Communities Network (EPIC-N). 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 on a large scale.

This network is made up of universities nationwide that 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 will be engaged to partner with transportation agencies on safety-focused projects.

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.

Transportation Safety

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.

While the first year of this initiative deployment are well documented in the Section 4.8 work-plan, initiative goals and objectives for years two and three include:

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

At the end of this three-year pilot, over 300 students from various degree programs will have been exposed to road safety as a discipline and a career and will have gained experience applying various tools/techniques to real-world transportation safety issues. The goal is for an additional 25 students at participating institutions to gain more intensive project experience on agency-sponsored safety research projects.

WRTWC will evaluate the impact these experiences have on student 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 will be used to develop a guidebook for universities and agencies nationwide to facilitate national expansion of safety career pathways.

Transportation Safety

4.4 Implementation Partners

WRTWC thanks its partners for their continued engagement, contribution, and commitment to developing workforce solutions that positively impact the lives of students and the incumbent workforce. In their support of this career pathway pilot implementation for the transportation planning discipline, each of these valued partners have agreed to participate as key contributors to this plan's deployment, success, and long-term sustainability. WRTWC's partner organizations, including their roles and responsibilities, are presented below:

National Center for Rural Road Safety. The Safety Center will assist in defining learning objectives for core safety training courses, provide support to develop new training, work with training providers to pilot new courses, and coordinate with NACE. Long-term, the content/process of the Local Roads Safety Scholar Program will be integrated into a scaled-up national deployment of a Local Road Safety Certificate Program, which NACE will lead.



National Association of County Engineers. 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 WRTWC and the Safety Center to create a cohesive training curriculum that addresses the core safety competencies identified by the safety career pathways initiative, 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. MT LTAP will coordinate with WRTWC to adapt existing training and integrate new content that meets targeted safety learning objectives, into its on-site/blended training program. MT LTAP will assist WRTWC with outreach to employers, employees, and professional associations to market the program and encourage participation.



MT LTAP will lead in-person training, track participation, assist with program evaluation, coordinate participant recognition awards, and work with FRCC in Colorado to develop articulation agreements to provide a path for training participants to obtain college credit and advance towards an associate degree in Highway Maintenance Management.

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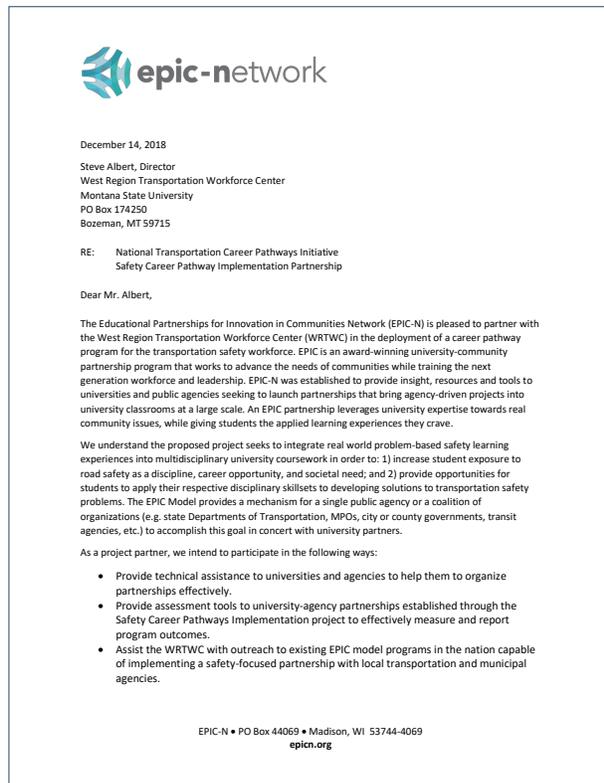
Educational Partnerships for Innovation in Communities Network.



EPIC-N is 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, thus transforming higher education into an arena where students learn through real-life problem solving. WRTWC will continue to work with EPIC-N and transportation agencies to foster partnerships that provide students with exposure to transportation safety problems, projects, and solution-building, through peer-to-peer networking, collaboration forums, and technical support.

4.5 Partner Commitments

In an expression of their commitment to the deployment and mission of this implementation plan, WRTWC partners have “signed-on” as key contributors of time, expertise, resources, and in some cases funding, through the authorized letters of agreement presented below. It is this level of engagement that makes a program of this scale possible.



Transportation Safety



December 2, 2018

Steve Albert, Director
West Region Transportation Workforce Center
Montana State University
PO Box 174250
Bozeman, MT 59715

RE: National Transportation Career Pathways Initiative
Safety Career Pathway Implementation Partnership

Local Technical Assistance Program

Dear Mr. Albert,

The Montana Local Technical Assistance Program (MT LTAP) is pleased to partner with the West Region Transportation Workforce Center (WRTWC) in the deployment of a career pathway program for the transportation safety workforce. LTAP is committed to serving the needs of local transportation providers through training and technical assistance. LTAP trainers provide in-person training to transportation personnel across the state and also serves as a resource to identify online training and other professional development materials that may be beneficial to our customers.

Montana LTAP additionally administers the Montana Roads Scholar program, which provides an incentive for city and county road personnel to pursue professional development, much of it focused on safety of both workers and roadways. The WRTWC's plan to implement training and career pathways for local road safety supports LTAP's mission of fostering a safe, efficient, and environmentally sound transportation system by improving the skills and knowledge of local transportation providers.

We understand the proposed project seeks to elevate professional practice in the local road safety field by developing and implementing a comprehensive training curriculum that provides career advancement incentives for local roads personnel to obtain core safety competencies. The project will provide a mechanism for employers to incentivize road safety professional development for staff, and it will provide formal recognition to personnel completing the training. In this way, it is very similar to the Montana LTAP Road Scholar program.

P.O. Box 173950
Bozeman, MT 59717-3950

Tel (406) 994-6300
Tel (800) 543-6671
Fax (406) 994-5333
E-mail mtlap@coe.montana.edu




As a lead project partner, we intend to participate in the following ways:

- Act as the primary in-person training source in the state of Montana for a pilot demonstration project of the road safety recognition program.
- Provide information on and facilitate access to other training sources (blended/online) that can be used to obtain safety recognition through the program.
- Participate in the development process for new training curricula.
- Act as a focal point for statewide outreach to local, city, and county transportation staff and organizations to disseminate information about the safety recognition program.
- Track training participation and provide certificates of completion.
- Work with the project team to evaluate the pilot implementation project and to identify opportunities to expand nationally.

Local Technical Assistance Program

Montana LTAP supports this initiative as an important component in ensuring that local roads maintenance and engineering staff possess the necessary road safety competencies to enhance statewide transportation safety. We look forward to assisting as training providers for the pilot demonstration project in Montana.

Sincerely,



Matthew A. Ulberg, PE
Director, Montana LTAP

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National Association of County Engineers
THE VOICE OF COUNTY ROAD OFFICIALS

December 7, 2018

Steve Albert, Director
West Region Transportation Workforce Center
Montana State University
PO Box 174250
Bozeman, MT 59715

RE: National Transportation Career Pathways Initiative
Safety Career Pathway Implementation Partnership

Dear Mr. Albert,

The National Association of County Engineers (NACE) is pleased to partner with the West Region Transportation Workforce Center (WRTWC) in the deployment of a career pathway program for the transportation safety workforce. NACE is committed to serving the needs of local roads maintenance and engineering staff and to advancing professional practice through the development of professional capacity building opportunities. The WRTWC's plan to implement training and career pathways for local road safety directly aligns with NACE's vision of eliminating fatal and serious crashes from public roads.

We understand the proposed project seeks to elevate professional practice in the local road safety field by developing and implementing a comprehensive training curriculum that covers core safety competencies for local roads personnel. After the pilot period we also understand the goal is that any organization (NLTAPA, NACE, etc.) would be able to freely use/deliver the materials locally.

The project will provide a mechanism for employers to incentivize road safety professional development for staff, and it will provide formal recognition to personnel completing the training. The project will create additional opportunities for educational and career pathway advancement by making connections to degree-granting programs and to industry-recognized professional certification programs, which attest to the attainment of core road safety knowledge, skills, and abilities.

As a lead project partner, we intend to participate in the following ways:

- Provide leadership in developing workforce solutions.
- Identify existing training and partners and participate in the review and development process for new training curricula.
- Work with membership to identify graduated learning levels based upon need and to design a modular format for training.
- Provide outreach to NACE membership to disseminate information about the program.
- Work with the project team to evaluate the pilot implementation project and to identify opportunities to expand nationally.

President
Richard Sanders, PE
County Engineer
Fisk County, Minnesota

President Elect
Timothy Hines, PE
County Engineer
Cattaraugus County, New York

Secretary/Treasurer
Scott McGeehan
Public Works Director
Santa Barbara County, California

Immediate Past President
Brian P. Anderson, PE
County Engineer
Buchanan County, Iowa

Northeast Region Vice President
Kane Rowell, PE
Highway Director
Harrison County, Indiana

Southeast Region Vice President
Chris Chapman, PE
County Engineer
Henry County, Alabama

North Central Region Vice President
Jeff Blaw, PE
County Engineer
Champaign County, Illinois

South Central Region Vice President
Todd Hines, PE
County Engineer
Clinton County, Iowa

Western Region Vice President
Mark Stone
Public Works Director
Albany County, Washington

National Association of Counties Director
Richard Jones, PE
Chief Engineer & Operations Officer
Clatsop County, Oregon

Executive Director
Kevan P. Stone

660 North Capitol St. NW, Suite 420 • Washington, DC 20001
T 202-393-5041 • E nace@nace.org • www.countyengineers.org

NACE is highly supportive of this initiative and we look forward to providing our members with opportunities to increase road safety competencies and professional practice, as well with career advancement opportunities.

Sincerely,



Kevan Stone
Executive Director

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Transportation Safety



December 20, 2018

Steve Albert, Director
West Region Transportation Workforce Center
Montana State University
PO Box 174250
Bozeman, MT 59715

RE: National Transportation Career Pathways Initiative
Safety Career Pathway Implementation Partnership

Dear Mr. Albert,

As you are aware, the mission of the National Center for Rural Road Safety (Safety Center) is to provide coordinated, multidisciplinary, scalable, and accessible safety resources in order to empower rural road users to accelerate road safety improvements and save lives. The Safety Center is therefore pleased to partner with the West Region Transportation Workforce Center (WRTWC) in the development and deployment of a safety-focused career pathway program for the transportation workforce focused on local roads personnel. We understand the proposed project seeks to elevate professional practice in the local road safety field by developing and implementing a comprehensive training curriculum that provides career advancement incentives for local roads personnel to obtain core safety competencies. The project will provide a mechanism for employers to incentivize road safety professional development for staff, and it will provide formal recognition to personnel completing the training.

The Safety Center has devoted considerable resources to identifying local roads safety training needs, outlining a potential recognition program for local transportation professionals, and developing training modules to fill gaps in available professional development opportunities in this area. The WRTWC and Safety Center's plan to implement a demonstration pilot project that will disseminate this training program widely while offering career advancement incentives and recognition to local transportation providers who complete the safety training program provides an excellent opportunity for the two FHWA-supported Centers to leverage resources and expertise to the benefit of local transportation providers and the safety of transportation system users.

As a lead project partner, we intend to participate in the following ways:

- Assist in the framework creation for the pilot project.
- Act as the primary liaison to other collaborating national organizations, particularly NACE to ensure that the training program meets their needs.
- Identify and/or provide training resources (blended/online) that can be used to obtain safety recognition through the program.

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jaimer@ruralsafetycenter.org

(844) 330 2200

Page 1



- Support the development of 2-4 new training modules focused on safety competencies to fill gaps.
- Provide national outreach to disseminate information about the program nationally and support expansion of the pilot.

The National Center for Rural Road Safety supports this initiative as a mechanism to ensure that local roads maintenance and engineering staff possess the necessary road safety competencies to enhance transportation safety on rural roads. We look forward to assisting as a training developer and provider for the pilot demonstration project in Montana and as an outreach partner in supporting the expansion of the pilot nationally.

Sincerely,

Jaime L. Sullivan
Center Manager
National Center for Rural Road Safety

Your trusted "safety sidekick" to make rural road travel safer!

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jaimer@ruralsafetycenter.org

(844) 330 2200

Page 2

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4.6 Project Outcomes

During the first year of deployment, WRTWC and its implementation partners will deliver the following project outcomes:

1. MT LTAP and its training partners will offer 3-5 core safety trainings to local roads maintenance, construction, and engineering personnel in Montana over the first year of the pilot deployment, affecting an estimated 30-125 participants.
2. Develop/assess the effectiveness of recruitment and employer outreach.
3. Track participation in the Safety Scholars program and gather evaluation data on safety competency learning outcomes.
4. Develop a long-term plan for assessing training impact on participant career paths and on-the-job safety performance.
5. All training courses identified/created will be shared with NACE and other national training organizations to facilitate national-level implementation.
6. Coordinate with degree-granting institutions to develop articulation agreements to award course credit for training completion.
7. Identify two universities to partner with transportation organizations to provide multi-disciplinary students with a course-based road safety problem-based learning experience. All project deliverables, course learning objectives, and partner MOUs will be completed for course implementation in academic year 2020-2021.

Additional long-term workforce impact includes:

- 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 continue to increase.
- Safety performance outcomes for state/local roads will improve under the care of a well-trained safety workforce.

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4.7 Project Timeline

Major milestones are listed below for the first-year of the pilot deployment. A project work-plan (Gantt chart) is also attached below for Year 1. Additional details on the full three-year deployment are provided in Section 4.3 of this implementation plan.

Deployment: Safety Scholars Program

1. Develop program of study through MT LTAP	July – September 2019
2. Develop/disseminate recruitment materials	August – October 2019
3. Develop participant tracking & course eval tools	August – October 2019
4. Begin Safety Scholars Recognition program	November 2019 – June 2020
5. Track participants; evaluate learning outcomes	November 2019 – June 2020
6. Plan to develop/modify preparatory curriculum	April 2020
7. Report on project status	Quarterly
8. Meet with DWG	Quarterly

Deployment: Higher Ed Project-Based Learning

1. Continue networking/collaboration with EPIC-N	July 2019 – June 2020
2. Identify university partners (road safety project)	July – August 2019
3. Est. university/agency MOUs; identify courses/faculty	Fall 2019
4. Faculty/agencies define SOW, SLOs, & evaluations	Spring/Summer 2020
5. Project kick-off scheduled; courses begin Fall 2020	Spring/Summer 2020

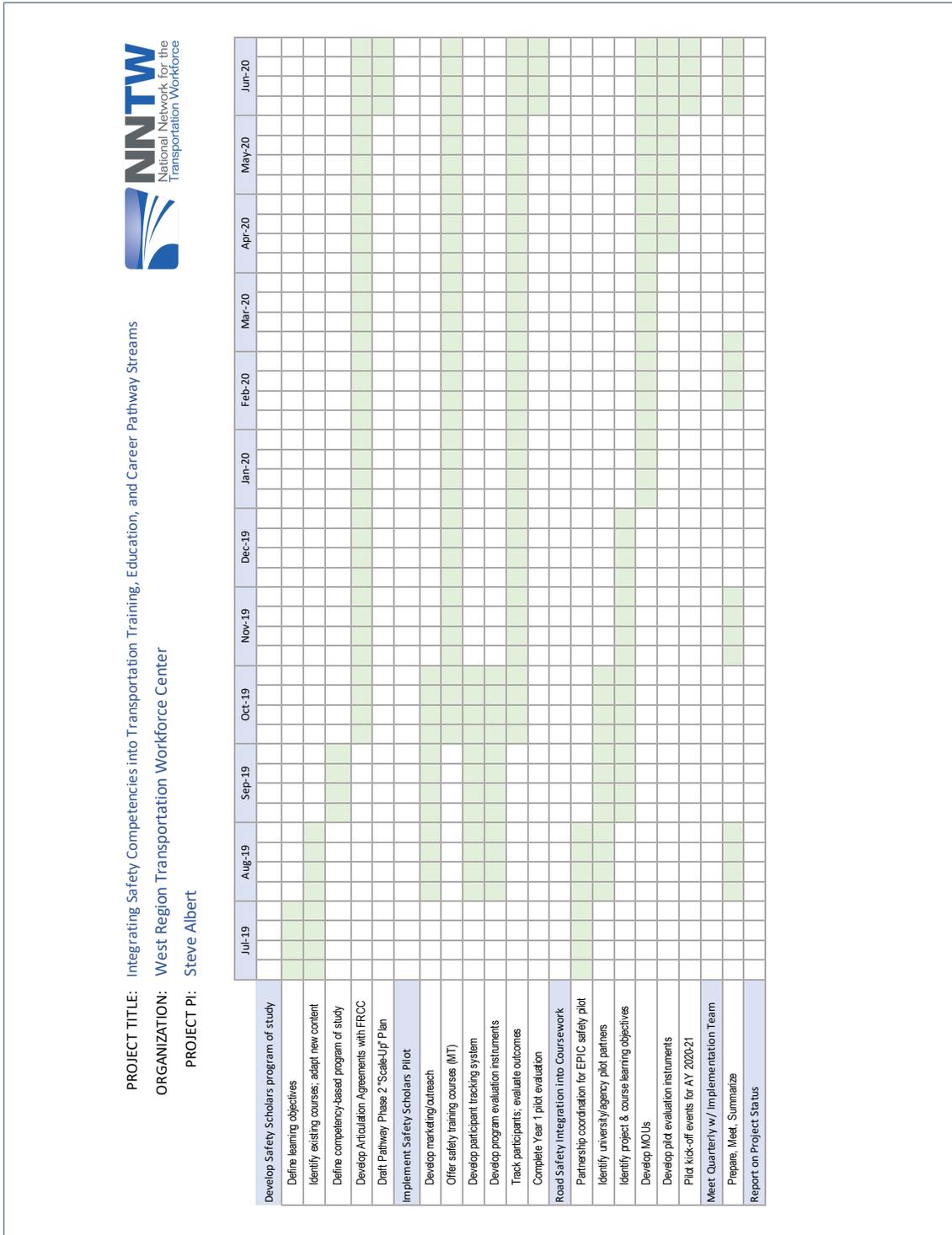
4.8 Project Budget

The first-year budget for this deployment allocates the personnel, travel, and material needs listed below. Successive annual budget requirements are projected to be similar.

Budget Item	Annual Costs	Match	Total Budget
Personnel	\$60,000	\$18,500	\$78,500
Fringe Benefits	\$22,200	\$6,845	\$29,045
Travel & Per Diem	\$6,000	\$0	\$6,000
Supplies & Materials	\$3,000	\$0	\$3,000
Professional Services	\$10,000	\$0	\$10,000
Facilities & Administration (F&A Rate 34.5%)	\$32,000	\$8,744	\$43,658
	-----	-----	-----
Annual Totals:	\$136,114	\$34,089	\$170,203

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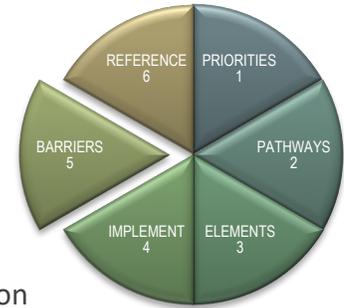
4.9 First Year Workplan



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SECTION 5.0 BARRIERS TO DEPLOYMENT

This pathway 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 time and financial support to pursue safety training opportunities.
- Invest in employee safety training incentives, such as formal employee recognition programs, pay grade increases, or job advancement opportunities.
- Investment staff time and organizational resources to support safety project-based learning experiences, integrate safety topics and skillset development into education programs, and demonstrate 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 agency abilities to hire/promote individuals with specific skillsets.

Some state DOTs, for instance, have promotion policies in place that focus primarily on years of service. Agency leadership should review whether human resource practices promote or undermine career pathway development for staff, and how those policies 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 providing a low-cost mechanism for employees to participate in safety training and their employers to track that participation, this implementation

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plan reduces the burden on limited agency staff time to identify training opportunities on an ad-hoc basis and promotes tracking 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. This implementation avoids this barrier by working within the context of existing coursework rather than attempting to implement new courseware or programs.

Course projects identified by transportation agencies will likewise constitute existing work within an agency workplan. The value of 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.

Transportation Safety

SECTION 6.0 REFERENCES & DOCUMENTATION

6.1 Acronyms & Abbreviations

AASHTO = American Association of State Hwy & Transportation Officials
 BLS = Bureau of Labor Statistics
 CTE = Career & Technical Education
 CTWD = Center for Workforce Development
 DOL = Department of Labor
 DOT = Department of Transportation
 DWG = Discipline Working Group
 FHWA = Federal Highway Administration
 EPIC-N = Educational Partnerships for Innovation in Communities Network
 ETA = Employment Training Association
 FRCC = Front Range Community College
 GIS = Geographic Information Systems
 ITE = Institute of Transportation Engineers
 ITS = Intelligent Transportation Systems
 KSA = Knowledge, Skills, and Abilities
 LMI = Labor Market Information
 LTAP = Local Technical Assistance Program
 MAP-21 = Moving Ahead for Progress in the 21st Century Act
 MBA = Master of Business Administration
 NACE = National Association of County Engineers
 NHI = National Highway Institute
 NLTAPA = National Local Technical Assistance Program Association
 NNTW = National Network for the Transportation Workforce
 NTCPI = National Transportation Career Pathways Initiative
 OJT = On-the-Job Training
 OSHA = Occupational Safety and Health Administration
 PCB = Professional Capacity Building
 PE = Professional Engineer
 ROI = Return on Investment
 RPO = Regional Planning Organization
 SME = Subject Matter Expert
 SOC = Standard Occupational Classification
 STEM = Science, Technology, Engineering, Mathematics
 TRB = Transportation Research Board
 WRTWC = West Region Transportation Workforce Center



Transportation Safety

6.2 Citations & Attributions

In-report superscripted citations and/or attributions are expanded below:

- 1) US DOT FHWA. (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 Study of Supply & Demand for Highway Safety Professionals in Public Sector (2007). Building the Road Safety Profession in the Public Sector: Special Report 289 (Vol. 289). TRB.
- 3) <https://www.fhwa.dot.gov/map21/factsheets/pm.cfm>
- 4) Committee for Study of Supply & Demand for Highway Safety Professionals in Public Sector (2007). Building the Road Safety Profession in the Public Sector: Special Report 289 (Vol. 289). TRB.
- 5) Ibid.
- 6) Jovanis, P. and F. Gross. (2006) Core Competencies for Highway Safety Professionals. NCHRP. Research Results Digest 302. TRB, Washington, D.C.

Bahar, G. (2011). Highway Safety Training Synthesis/Roadmap (NCHRP Project 20-07, Task 290), NCHRP, TRB, Washington, D.C.

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/>

US DOL, ETA, O*NET Online: <https://www.onetonline.org/>

U.S. DOT, FHWA Safety Program. Guide for State DOT Safety Data Business Planning. FHWA-SA-17-047. July 2017.

Campbell, J. et. al. (2012). NCHRP Report 600: Human Factors Guidelines for Road Systems. TRB, Washington, D.C.

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

ARTBA Safety Certification for Transportation Project Professionals™ Candidate Handbook. Online: https://www.artba.org/wp-content/uploads/SCTPP/SCTPP_Candidate_Handbook.pdf

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

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- 7) Pyramid Tiers 1-4 are adapted from CareerOneStop's industry competency models for Engineering and Heavy Highway Civil Construction. Toolkit is available online through U.S. DOL, ETA support: <https://www.careeronestop.org/CompetencyModel/competency-models/pyramid-home.aspx>
- 8) Based on a survey of 95 transportation safety professionals on the expected workforce impacts of transformational technologies; conducted by the WRTWC in December 2017.
- 9) 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.
- 10) 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.
- 11) Gambatese, J. A. (2003). Safety emphasis in university engineering and construction programs. Construction safety education and training—A global perspective.
- 12) 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>
- 13) 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.
- 14) Committee for Study of Supply & Demand for Highway Safety Professionals in Public Sector. (2007). Building the Road Safety Profession in the Public Sector: Special Report 289 (Vol. 289). TRB.
- 15) Model, spearheaded by University of Oregon, since implemented by universities nationwide. Now constitutes network of institutions utilizing the EPIC model (<http://www.epicn.org/>).
- 16) 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.

National Center for Rural Road Safety (2017). Development Materials for a Local Maintenance Personnel Rural Road Safety Recognition Program. Prepared for U.S. DOT FHWA. Available online: <https://ruralsafetycenter.org/resources/list/development-materials-for-a-local-maintenance-personnel-rural-road-safety-recognition-program/>

Bahar, G. (2011). Highway Safety Training Synthesis/Roadmap (NCHRP Project 20-07, Task 290), NCHRP, TRB, Washington, D.C.

Cambridge Systematics. (2010). Model Curriculum for Highway Safety Core Competencies NCHRP Report 667, NCHRP, TRB, Washington, DC.
- 17) Training scan completed by National Center for Rural Road Safety; updated by WRTWC in 2018.

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6.3 Career Pathway Documentation

Each of the transportation environment priority occupations and career pathways detailed in this report have been formally documented for use as a career guidance resource in the deployment of pathway initiatives within the post-secondary education/training continuum. A list of those documents is followed by an instantiation of each on the pages that follow:

Construction Safety Management (5 pages)

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Safety Data Analysis & Management (5 pages)

Career Pathway Graphic, Job Description, Program of Study, Program of Study

Transportation Safety Engineering (5 pages)

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Human Factors Engineering (5 pages)

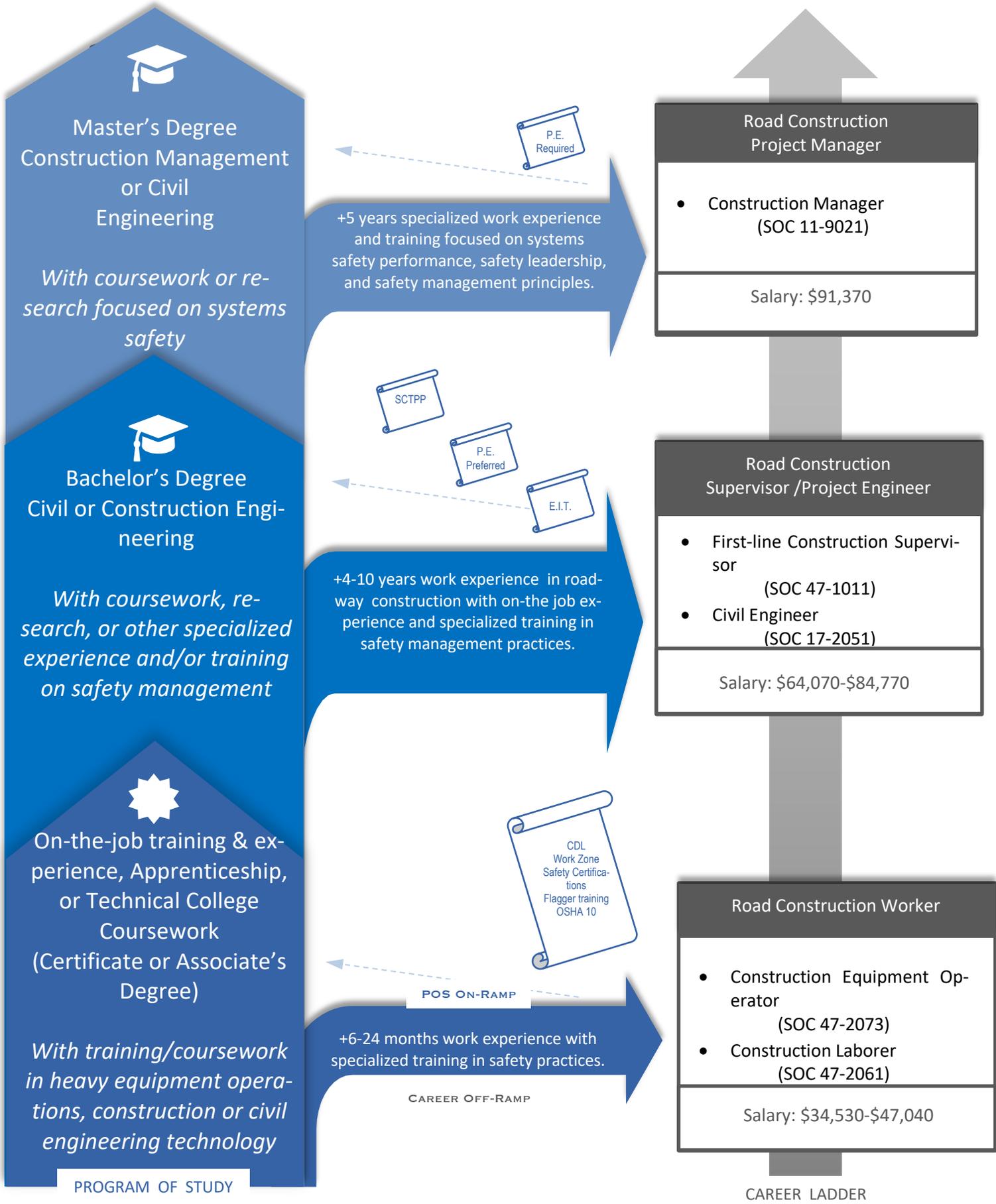
Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Highway Maintenance Safety Management (5 pages)

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

Transportation Safety Planning (5 pages)

Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning



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

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).



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 Const. Health & Safety

Experiential learning includes planning studios / labs, internship, and field-

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 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.

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging coursework 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.





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



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

PROGRAM OF STUDY

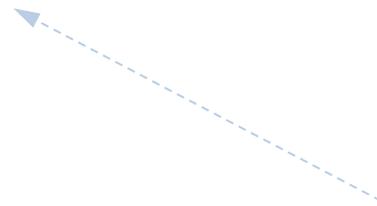
+2-5 years specialized research or work experience focused on transportation safety



Transportation Safety Researcher

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

Salary: \$103,010 - \$114,520



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

CAREER LADDER

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.



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

Interdisciplinary Research Methods

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

Core Transportation Courses

Transportation Safety
Traffic Simulation & Modeling

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

Data Analytics Courses

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

Transportation Safety-Related Courses

Transportation Safety
Human Factors

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.

Data Structures
Computer Programming
Probability and Statistics

Major Coursework

Information Systems
Database Management
Network and Security

Experiential learning includes design projects, internships, co-ops

Year 0



High School Diploma or G.E.D.

Computer Science CTE coursework if available.

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging coursework 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:

[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.

[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.

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

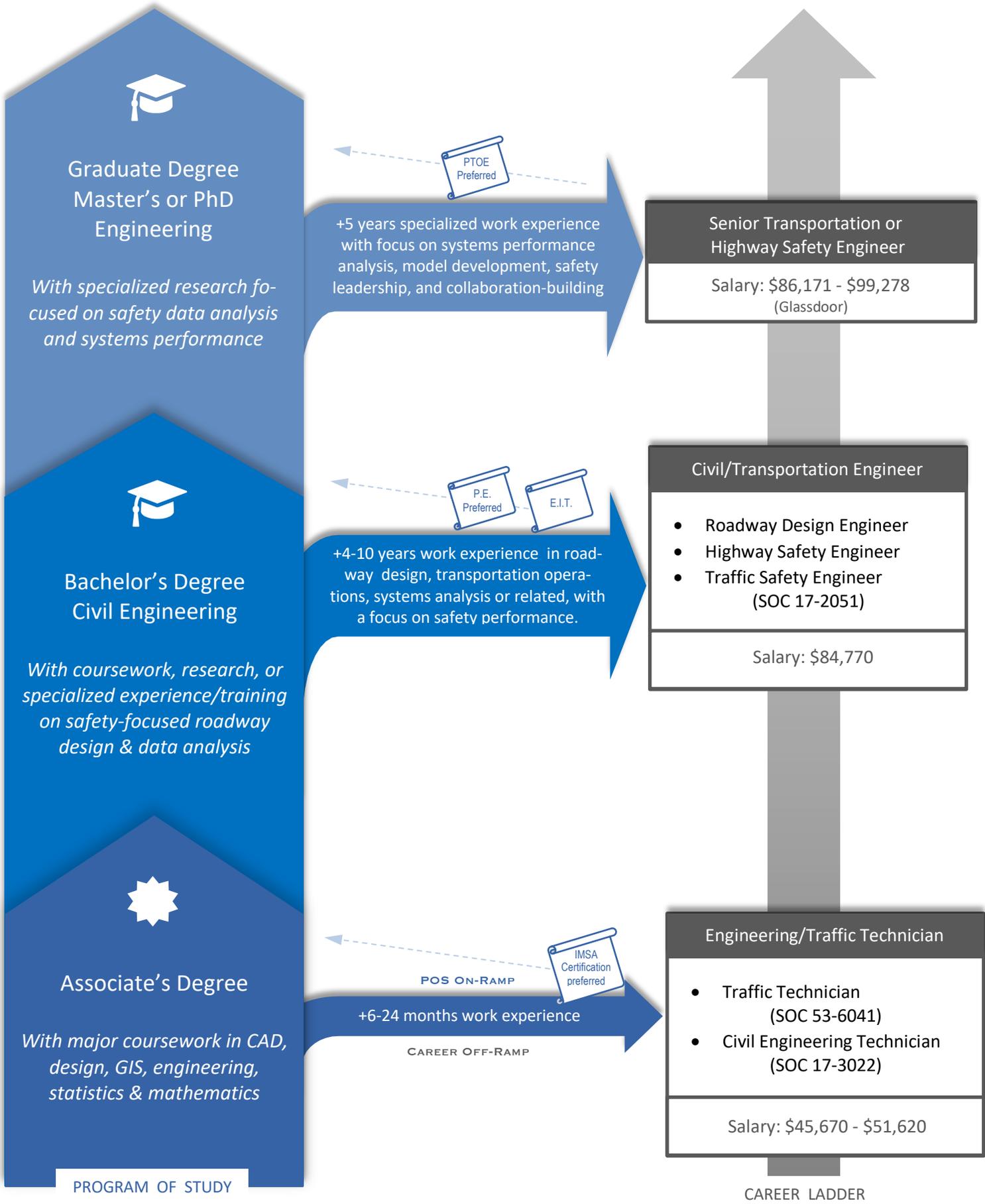
Provide education and training for students and incumbent workers at times and locations convenient to students and employers, rather than instructors or institutions. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

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.



Graduate Degree Master's or PhD Engineering

With specialized research focused on safety data analysis and systems performance

Bachelor's Degree Civil Engineering

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

Associate's Degree

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

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

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

+6-24 months work experience

Senior Transportation or Highway Safety Engineer

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

Civil/Transportation Engineer

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

Salary: \$84,770

Engineering/Traffic Technician

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

Salary: \$45,670 - \$51,620

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.



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
Adv. Geometric Design & Hwy Safety

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

Year 3-4



Bachelor's Degree in Civil Engineering

Year 4: Students select electives in specific areas of interest and fulfill internship, fieldwork, or senior capstone requirements. Core transportation courses 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, 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 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 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 course-work if available.

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging coursework 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 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.

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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.





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



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



POS ON-RAMP

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

CAREER OFF-RAMP



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

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.



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

Interdisciplinary Research Methods

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

Core Transportation Courses

Transportation Safety
Transportation Systems Planning
Traffic Flow Modeling

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 Eng., including 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

Design & Analysis of Info Systems
Systems Modeling & Simulation
Human-Centered Systems Design
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.

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging coursework 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.

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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

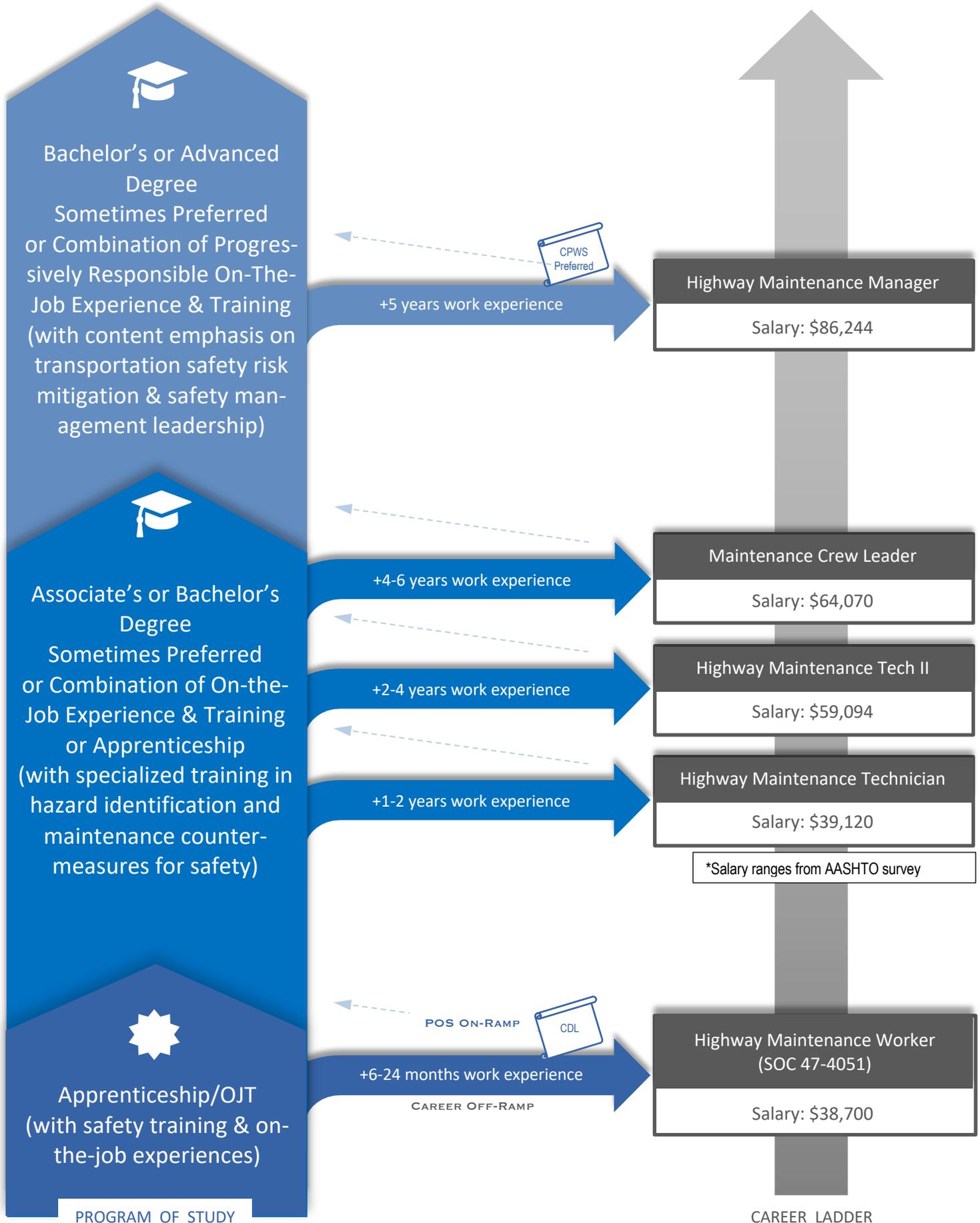
Provide education and training for students and incumbent workers at times and locations convenient to students and employers, rather than instructors or institutions. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

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.



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)

Year 3+



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



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 Regis-

tered 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.

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 \(NACE\)](#)

While NACE does not offer student membership, they provide education and training events to county engineers, road managers, and related professionals across the US.

[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. Membership is available to anyone enrolled in at least nine credit hours per semester at an accredited college, university, junior college or community college offering associate's, bachelor's or advanced degree programs in engineering, public administration, planning, construction, or other public works-related coursework. State chapters provide scholarships as a way to attract students to this field. Public Works conferences or expos often include an Equipment Rodeo—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 Rodeos. 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.

Public Agencies and Transportation Organizations

Cities and counties as well as state transportation agencies provide opportunities for paid internships, co-ops, externships and on-the-job training in the maintenance field.

[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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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.

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Asynchronous Learning

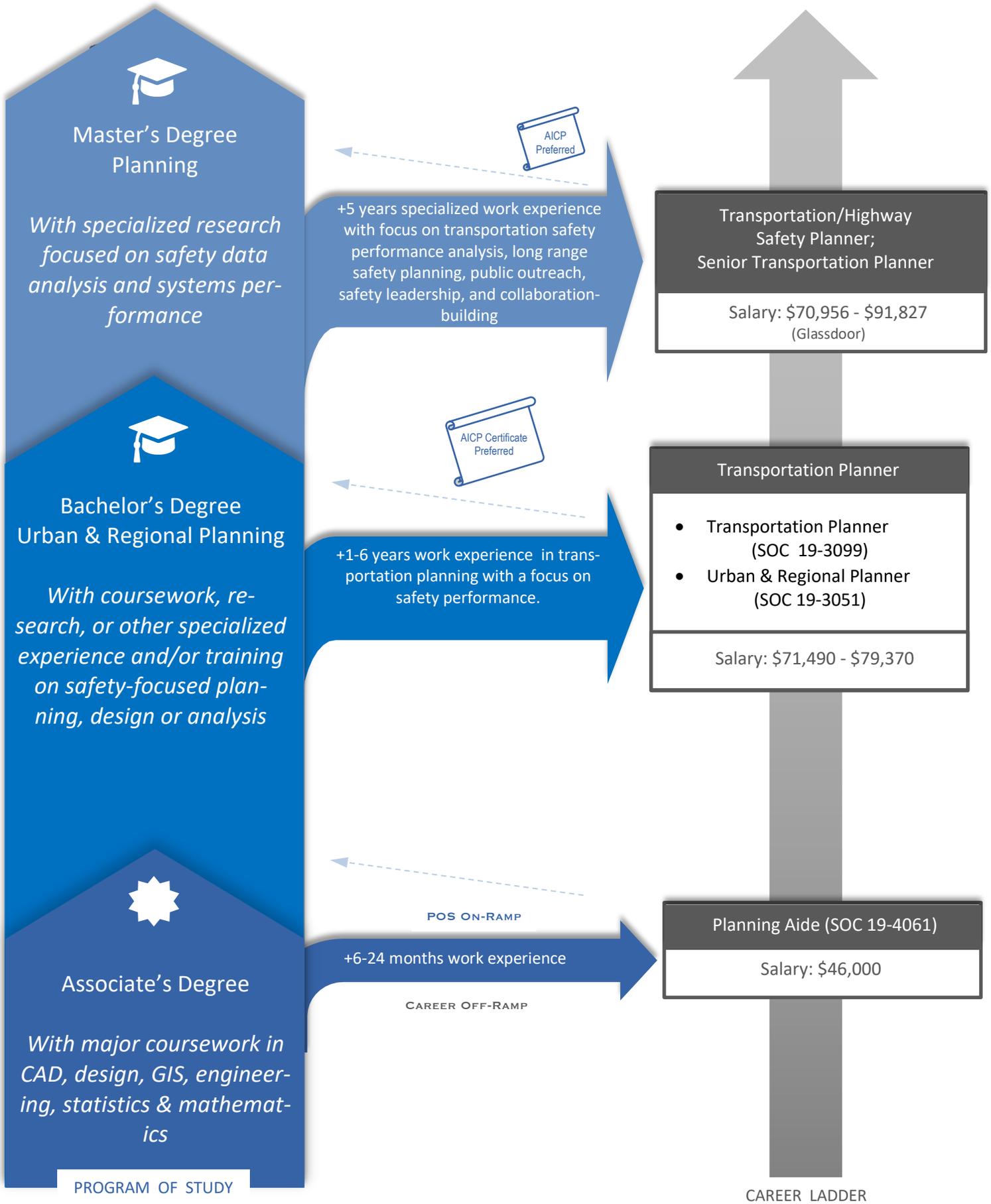
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Work-Based and Experiential Learning

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



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 stakeholders to implement safety plans. 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. Advanced graduate degree preferred for most senior positions.
- Between 1-4 years of work experience commonly desired.
- A combination of education and work experience is generally acceptable.



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 & Regional Planning or Related

Years 3-4: Students complete major coursework and select electives in specific areas of interest. Core transportation courses 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 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.

Experiential Learning & Professional Development Opportunities

Student professional associations provide professional development and networking opportunities to students, bridging coursework 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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