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National Transportation Career Pathway Initiative: Environment Career

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NTCPI

NATIONAL TRANSPORTATION CAREER PATHWAY INITIATIVE

TRANSPORTATION ENVIRONMENT

CAREER PATHWAY REPORT

FEBRUARY 2019



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The University of Vermont



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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



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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

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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)

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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:

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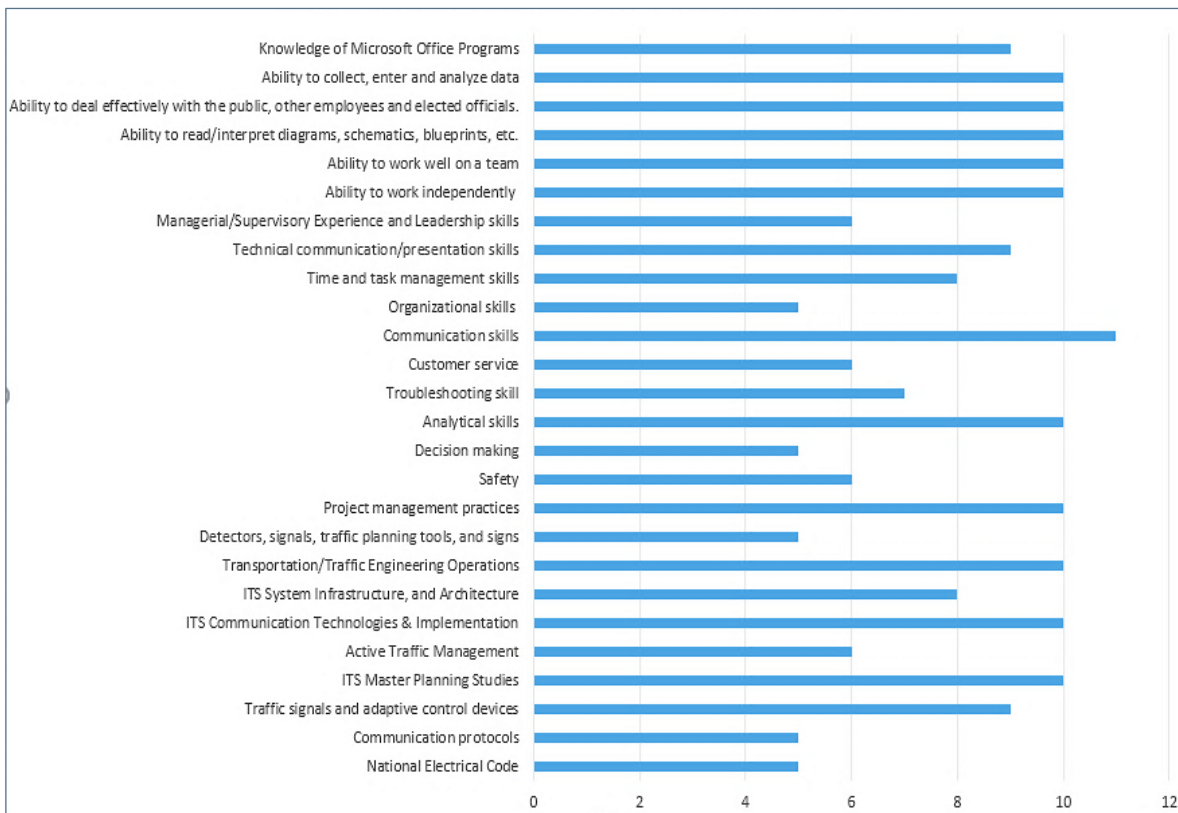


Figure 1.3.1: Key Competencies for ITS / Smart City Occupations

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.

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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.

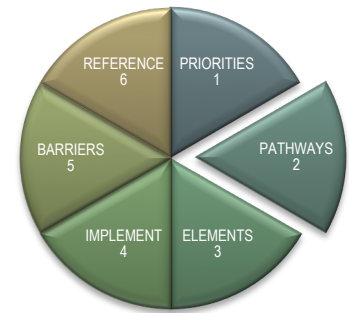
The challenge and opportunity to deploying an ITS/Smart-City career pathway is to contribute to a broader uniformity so that this field can be better identified, attract new entrants, and provide a better-defined education and training pathway.

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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.

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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.

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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.

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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.

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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.

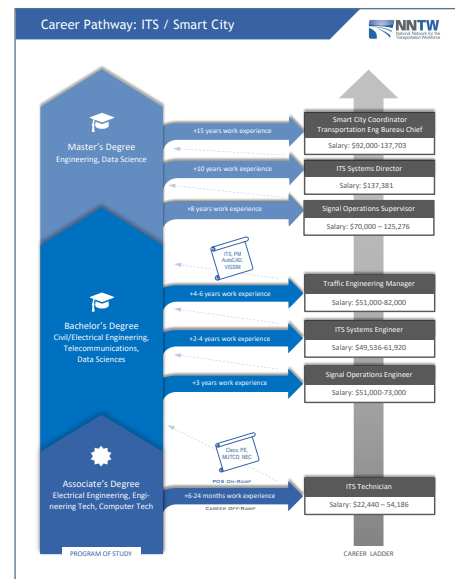
Education/Training: MS/BS in Public Policy, Urban Planning, Communications.

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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.

Job Description: ITS / Smart City Director

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 safety/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

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

Technical Skills Requirements

- Smart City Technologies & Data Mgt.
- Internet of Things/Technologies
- AutoCAD Electrical
- MUTCD, NEMA Signal Certification
- National Electric Code
- PE License (for some positions)
- Complete Streets project management
- GIS, Microsoft Office Applications

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.

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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.

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, CMAA, NHTSA Traffic Signals, AutoCAD Electrical, MATCOE, THE L3000 IT5 Studies, Social 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 (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
 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 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
 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, 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.
 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.

This material is based upon work supported by the Federal Highway Administration under Agreement No. D17H0119001. The program, design, and content are those of the author(s) and do not necessarily reflect the views of the Federal Highway Administration.

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 conventional STEM efforts have produced in other fields.

Experiential & Innovative Learning: ITS / Smart City

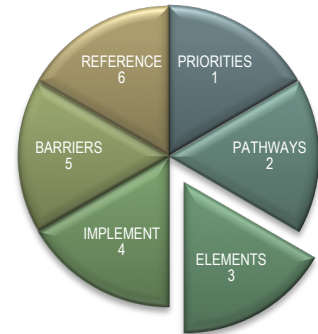
Innovative Strategies for Integrating ITS/Smart City Competencies into Varied Programs of Study
 Programs of study supporting career pathways into careers working with Smart Cities (SCs) include collaborations with a focus on transferring transportation systems as a core focus involves creating a range 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 internships or community service learning experiences to undergraduate students in various different 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
Co-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 seek 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 replacement 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 their own pace and on their own terms. This may include evening or weekend, blended or "hybrid" delivery models, and delivery of 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 use engagements from local employers.
Experiential Programs (examples)
 • **Northwestern University, MA, Transportation Engineering** <https://www.nyu.edu/about/prospectus/transportation>
 • **UMass Lowell** 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/interior/transportation-city-and-interiorship-programs> to expose students to transportation industry and prepare them for public service.

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SECTION 3.0 THE SIX ELEMENTS OF PATHWAY DEVELOPMENT

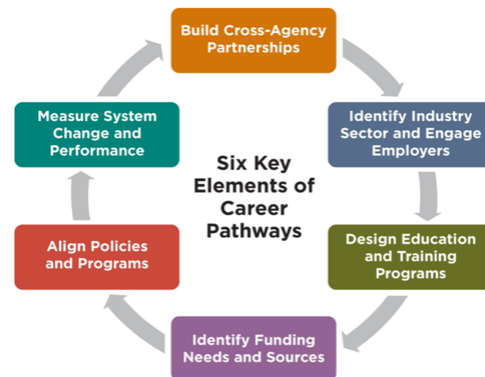
All NNTW implementation plans follow the six key elements of career pathway development, established by the Employment Training Association (ETA) of the Department of Labor (DOL), which are designed to guide state and local workforce development teams through the steps necessary for developing a comprehensive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

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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.

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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?

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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.



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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.

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- 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.

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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)

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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.

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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

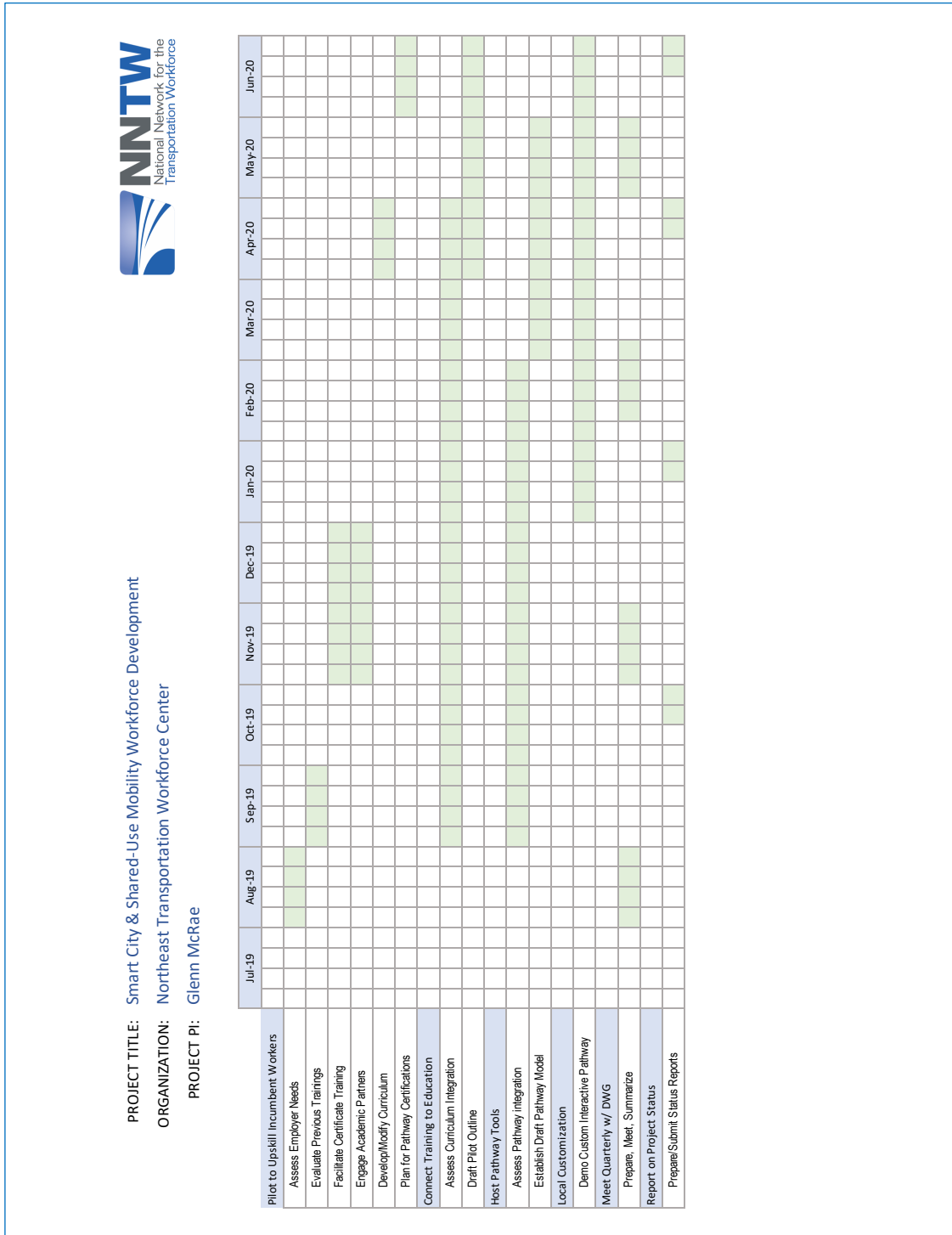
- | | |
|-----------------------------------|--------------------------------|
| 1. Pathway integration assessment | September 2019 – February 2020 |
| 2. Establish draft pathway model | March – May 2020 |

Local Customization

- | | |
|--|---------------------|
| 1. Custom demonstration of interactive pathway | January – June 2020 |
|--|---------------------|

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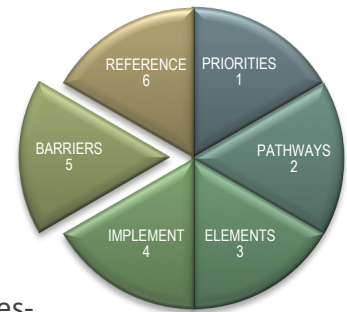
4.7 First Year Workplan



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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.

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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



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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

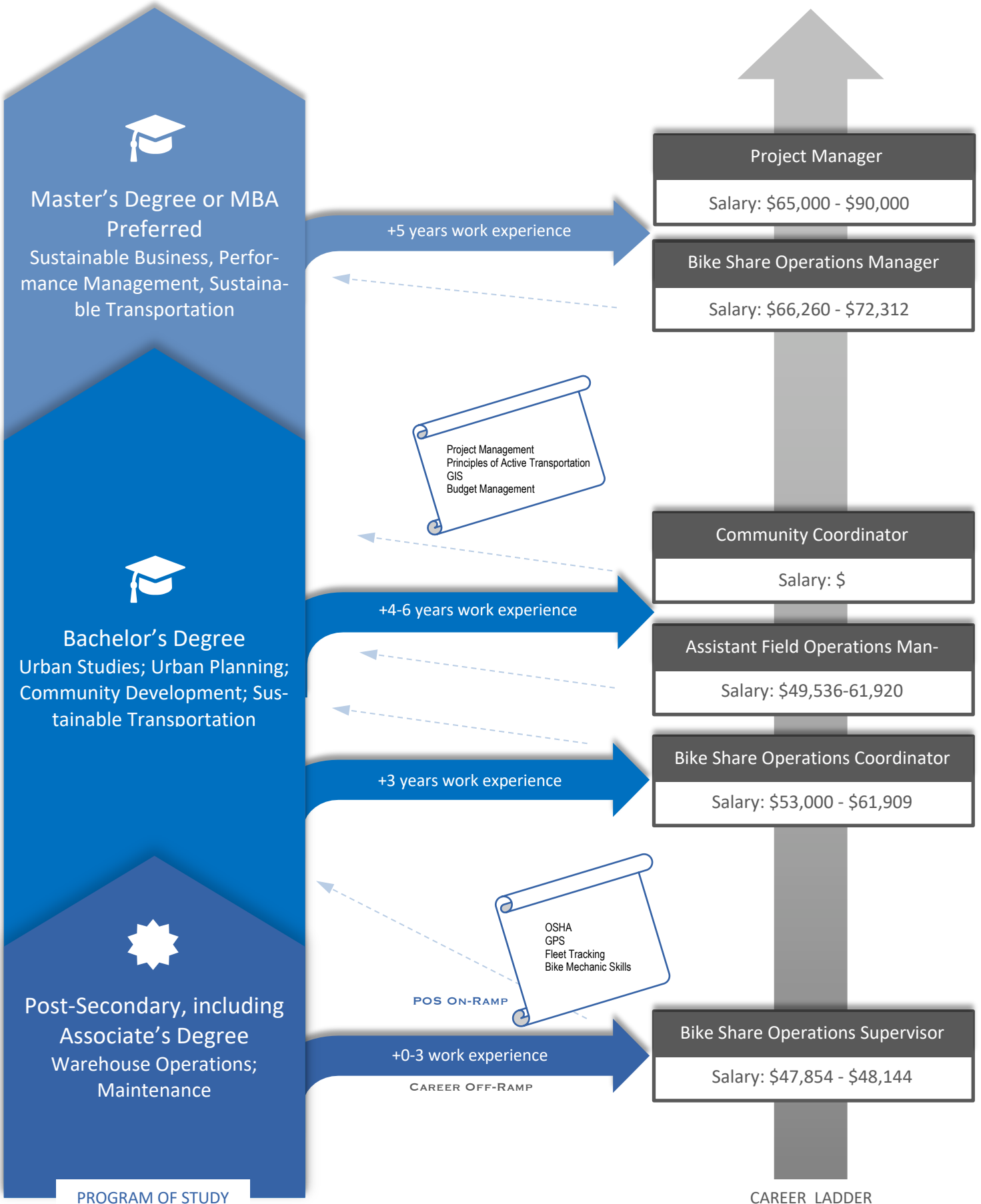
Career Pathway Graphic, Job Description, Program of Study, Experiential & Innovative Learning

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

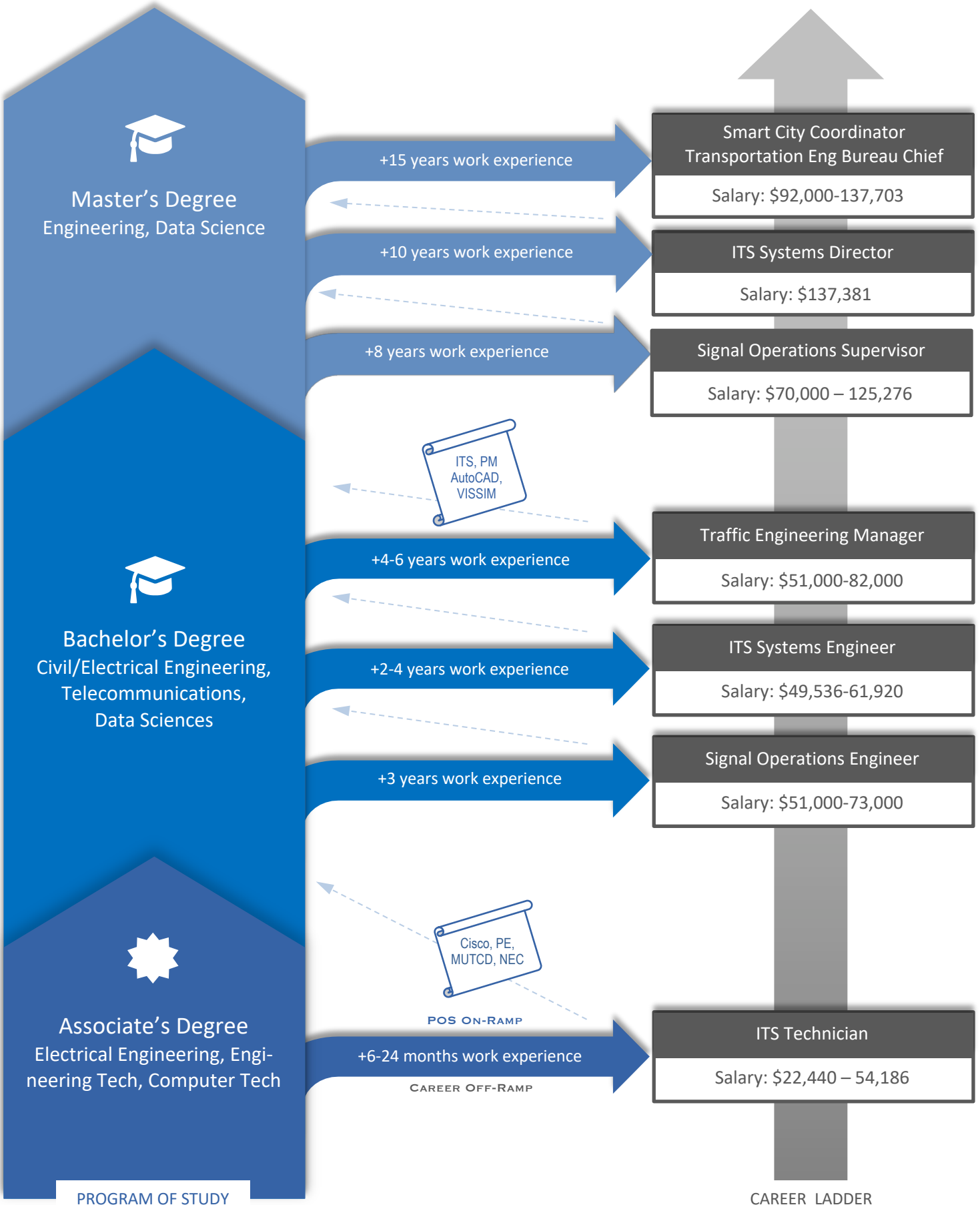
Provide education and training for students and incumbent workers at times and locations convenient to students and employers, rather than instructors or institutions. This may include evenings or weekends, blended or "hybrid" delivery models, and delivery at off-campus locations.

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

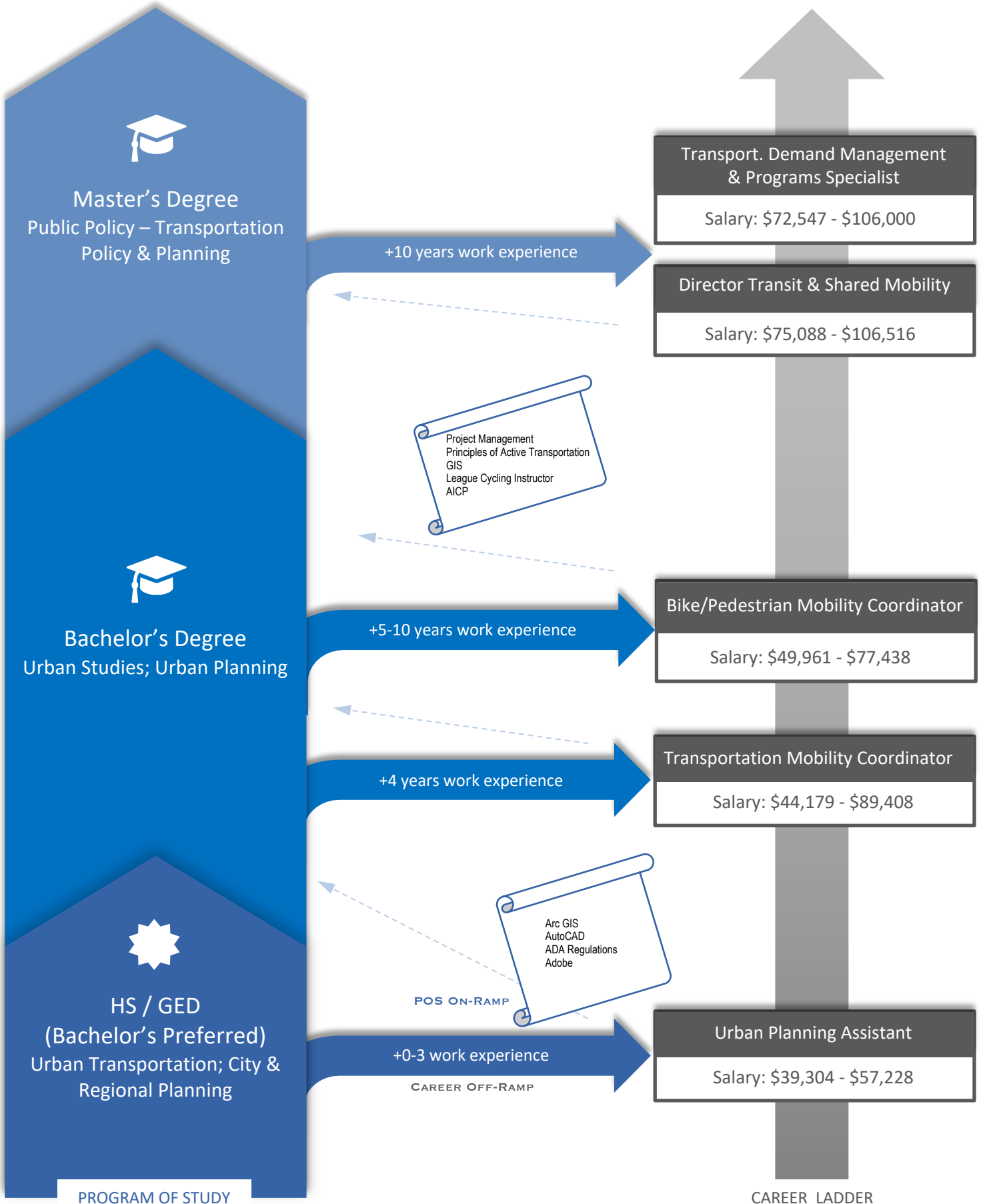
Incorporate opportunities for "learning-by-doing", including internships, co-op work experience, simulations, and team class projects that are assignments from local employers.

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/>



PROGRAM OF STUDY

CAREER LADDER

Master's Degree
Public Policy – Transportation
Policy & Planning

+10 years work experience

Transport. Demand Management
& Programs Specialist

Salary: \$72,547 - \$106,000

Director Transit & Shared Mobility

Salary: \$75,088 - \$106,516

Project Management
Principles of Active Transportation
GIS
League Cycling Instructor
AICP

Bachelor's Degree
Urban Studies; Urban Planning

+5-10 years work experience

Bike/Pedestrian Mobility Coordinator

Salary: \$49,961 - \$77,438

Transportation Mobility Coordinator

+4 years work experience

Salary: \$44,179 - \$89,408

HS / GED
(Bachelor's Preferred)
Urban Transportation; City &
Regional Planning

+0-3 work experience

CAREER OFF-RAMP

Arc GIS
AutoCAD
ADA Regulations
Adobe

Urban Planning Assistant

Salary: \$39,304 - \$57,228

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.

Endnote

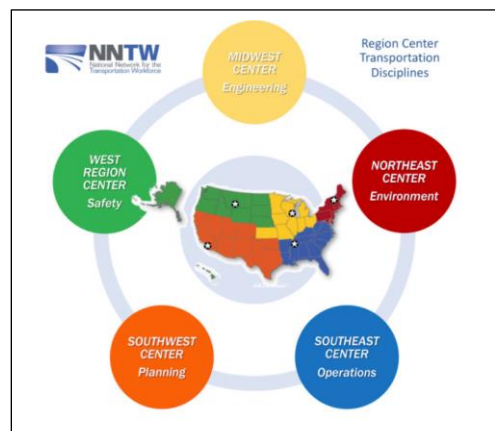
National Transportation Career Pathway Initiative (NTCPI): Environment Career Paths (2019)

This is one of five Career Pathway reports produced as part of the National Transportation Career Pathway Initiative, funding by FHWA, and managed by the SW Transportation Workforce Center for the National Network for the Transportation Workforce (NNTW).

This strategic initiative sought to establish a set of five transportation discipline-focused career pathways that could be deployed within post-secondary education/training institutions nationwide, in order to begin the development of forward-looking, technology-infused workforce pipelines that would lead students and job seekers into critical occupations within the highway transportation sector.

The disciplinary reports include:

- Safety
- Engineering
- Planning
- Operations
- Environment



In its execution of this research effort, an abiding goal for the NNTW has been to develop a multidisciplinary roster of transportation career pathways and related implementation plans that best support FHWA's strategic goal of "*keeping the nation's highway system safe, reliable, effective, and sustainably mobile for all users.*" Each of its Regional Centers worked collaboratively with leaders from transportation, education, and workforce development to establish a body of research that challenges traditional approaches to job classification, occupational forecasting, and career pathway development.

All reports can be accessed at: <https://www.nntw.org/workforce-initiatives/ntcpi/>