

**DEVELOPMENT OF PACTRANS
WORKFORCE DEVELOPMENT INSTITUTE
Year 1 – Year 3**

FINAL PROJECT REPORT

by

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University of Washington

Sponsorship
PacTrans and WSDOT

for

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16. Abstract With the emergence of technology and applications in transportation practice, the demand for continuing education and workforce development is growing. As the Northwest regional transportation research center, PacTrans carries responsibility for transportation workforce development for Federal Region 10. To fulfill this task and address regional workforce development challenges, PacTrans saw a clear need to develop an institute to provide professional training and continuing education for Region 10's transportation professionals. Bringing together decades of collective experience in educational research and continuing education, the research team established the PacTrans Workforce Development Institute (WDI) to address increasing workforce development needs. Each university has its own strengths in transportation research and education and thus makes unique and meaningful contributions to this project. To better accommodate working professionals' busy schedules, the PacTrans WDI offers demand-responsive and flexible training services in both on-site and online settings. Through survey and outreach activities, the research team identified the gaps between workforce training needs and existing training opportunities, and it developed training courses to fill these gaps. Specifically, the WDI has developed and delivered several training courses, such as Understanding and Applying the Manual on Uniform Traffic Control Devices, Incorporating Human Factors into Roadway Design and Crash Diagnostics, Project Management and Key Skill Capability Building. In addition, the WDI has scheduled the delivery of several training courses, such as Data Analytics and Tools, Geospatial Analysis for Transportation Planners and Practitioners, and An Introduction to School Zone Safety.					
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m ²
yd ²	square yard	0.836	square meters	m ²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³
NOTE: volumes greater than 1000 L shall be shown in m ³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in ²	poundforce per square inch	6.89	kilopascals	kPa
APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm ²	square millimeters	0.0016	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	yd ²
ha	hectares	2.47	acres	ac
km ²	square kilometers	0.386	square miles	mi ²
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m ³	cubic meters	35.314	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yards	yd ³
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in ²

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LIST OF ABBREVIATIONS

AASHTO: American Association of State Highway and Transportation Officials
ASCE: American Society of Civil Engineers
ATSSA: American Traffic Safety Services Association
CAIT: Center for Advanced Infrastructure and Transportation
CED: Continuing Education and Development, Inc.
CEU: Continuing education unit
CHSC: Center for Health & Safety Culture
CITE: Consortium for Innovative Transportation Education
CTS: Center for Transportation Safety
CVSA: Commercial Vehicle Safety Alliance
FHWA: Federal Highway Administration
FMCSA: Federal Motor Carrier Safety Administration
HCM (6th Edition): Highway Capacity Manual
HDM: Highway Design Manual
HSM: Highway Safety Manual
IRF: International Road Federation
ITE: Institute of Transportation Engineers
ITSA: Intelligent Transportation Society of America
ITS PCB: ITS Professional Capacity Building Program
LMS: Learning management system
LTAP Local Technical Assistance Program
MUTCD: *Manual on Uniform Traffic Control Devices*
NHI: National Highway Institute
NHTSA: National Highway Traffic Safety Administration
NITC: National Institute for Transportation and Communities
NoCoE: National Operations Center for Excellence
NSC: National Safety Council
NTSB: National Transportation Safety Board
OSU: Oregon State University
PacTrans: Pacific Northwest Transportation Consortium

PDH: Professional development hours
RSI: Roadway Safety Institute
TSI: Transportation Safety Institute
T2: Technology transfer
TTA: Transportation Training Academy
TTAP: Tribal Technical Assistance Program
UI: University of Idaho (UI)
UW: University of Washington
WSU: Washington State University
WDI: Workforce Development Institute
WSDOT: Washington State Department of Transportation
WRTWC: West Region Surface Transportation Workforce Center

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EXECUTIVE SUMMARY

Transportation plays a critical role for our nation's economy. With increased transportation activities and reduced highway trust funds, however, our transportation system faces numerous challenges. Among them, the use of new technologies to enhance the efficiency and reliability of existing transportation infrastructure is quite remarkable. Their use requires not simply learning to use a mature technology but also processing large quantities of data and other information to develop optimal operational strategies, as well as use of supporting tools to address emerging issues. Obviously, the knowledge learned through college education may not be sufficient to address the challenges posed by such quickly evolving technologies. Transportation professionals need access to professional and continuing education courses and training to help them keep up with new knowledge and technology developments.

As the Northwest regional transportation research center, PacTrans has responsibility for the task of transportation workforce development for Federal Region 10. To fulfill this task and address regional workforce development challenges, PacTrans saw a clear need to develop an institute that would provide professional training and continuing education for Region 10's transportation professionals. Bringing together decades of collective experience in educational research and continuing education, the research team established the PacTrans Workforce Development Institute (WDI) to address increasing workforce development needs. Each university has its own strengths in transportation research and education and thus makes unique and meaningful contributions to this project.

To better accommodate working professionals' busy schedules, the PacTrans WDI offers demand-responsive and flexible training services in both on-site and online settings. Through survey and outreach activities, the research team identified the gaps between workforce training needs and existing training opportunities and developed training courses to fill those gaps.

Specifically, the WDI developed and delivered several training courses, such as Understanding and Applying the Manual on Uniform Traffic Control Devices, Incorporating Human Factors into Roadway Design and Crash Diagnostics, Project Management and Key Skill Capability Building, and more. In addition, the WDI has scheduled the delivery of several training courses, such as Data Analytics and Tools, Geospatial Analysis for Transportation Planners and Practitioners, and An Introduction to School Zone Safety.

CHAPTER 1. INTRODUCTION

1.1. Research Background

With support from WSDOT and other transportation agencies, the Civil and Environmental Engineering (CEE) Department at the University of Washington (UW) operated a very popular continuing education program called TRANSPEED until 2010. Administered through the UW's Professional and Continuing Education (PCE) programs, TRANSPEED brought transportation engineering professional training and continuing education to governmental agencies and private firms. It conducted 50 workshops annually that served over 1,400 students. Figure 1.1 shows an example course advertisement in 2004. The offered courses were all short-term and delivered at different locations—such as Seattle, Bellevue, Vancouver, and Lacey in Washington—to make it convenient for working professionals to participate. Figure 1.2 shows a snapshot of a TRANSPEED training session, in which students had hands-on experience at such training sessions.

Instructors of the TRANSPEED courses were typically working professionals with real-world experience. Each course was designed to address some specific challenges in engineering practice. Figure 1.3 shows a brief description of an example training course: the Traffic Signal Timing and Operations.

The TRANSPEED program at the University of Washington is pleased to announce its Winter/Spring schedule of courses. TRANSPEED is a professional development program of the Civil and Environmental Engineering Department at the University of Washington. .
Upcoming TRANSPEED Courses

To view specific course descriptions and faculty check the TRANSPEED website at: <http://www.engr.washington.edu/epp/transpeed/>
For questions please contact: Christy Roop Pack
Program Manager
University of Washington
Engineering Professional Programs
10303 Meridian Ave N #301
Seattle, WA 98133
206-543-5539 or 1-866-791-1275 (Toll Free)
206-543-2352 FAX
croop@u.washington.edu

Roadway Safety, Analysis, Evaluation and Programming January 5-6, 2004 Seattle	Basic Highway Capacity for Engineers and Planners January 7-9, 2004 Seattle
Determining Contract Working Days January 29, 2004 Seattle, March 9, 2004 Seattle	Managing Consultants February 3, 2004 Seattle, May 11, 2004 Lacey
Concrete Bridge Design February 10-12, 2004 Seattle	Work Zone Traffic Control Plan (TCP) Design February 18-20, 2004 Seattle
Traffic Signal Timing and Operations February 23-25, 2004 Lacey	Techniques of Pavement Rehabilitation February 24-26, 2004 Seattle
Urban Street Design March 1-3, 2004 Seattle	Work Zone Traffic Control Plan (TCP) Design March 23-25, 2004 Lacey, June 14-16, 2004 Spokane
Fundamentals of Traffic Engineering March 17-19, 2004 Seattle	Legal Liability for Transportation Professionals April 5-6, 2004 Wenatchee, April 8-9, 2004 Seattle
Managing Scope, Schedule and Budget March 31-April 2, 2004 Seattle	Manual on Uniform Traffic Control Devices (MUTCD) April 14-16, 2004 Seattle
Stormwater Engineering for Transportation Professionals April 20-22, 2004 Seattle	Technical Communication for Transportation Professionals April 27-28, 2004 Seattle
Traffic Calming: Techniques and Management May 3-5, 2004 Seattle	Traffic Engineering Operations June 9-11, 2004 Lacey
Traffic Signal Design May 26-28, 2004 Lacey	

Figure 1.1 An example TRANSPEED course advertisement in 2004



Figure 1.2 A snapshot of a TRANSPEED training session



Figure 1.3 An example TRANSPEED course introduction

1.2. Problem Statement

Transportation plays a critical role in our nation's economy. With increased transportation activities and reduced highway trust funds, however, our transportation system

faces numerous challenges. Among them, the use of new technologies to enhance the efficiency and reliability of existing transportation infrastructure is quite remarkable. Their use requires not simply learning to use a mature technology but also processing large quantities of data and other information to develop optimal operational strategies, as well as use of supporting tools to address emerging issues. Obviously, the knowledge learned through college education may not be sufficient to address the challenges posed by such quickly evolving technologies.

Transportation professionals need access to professional and continuing education courses and training to help them keep up with the new knowledge and technology developments.

1.2.1. Workforce Deficiency in Transportation

Published by WSDOT, the Gray Notebook (WSDOT 2018a) highlighted that, agency-wide, there is a limited annual increase rate of permanent full-time employees (4 percent), and 42 percent of WSDOT employees may retire by the year 2022. Meanwhile, WSDOT also set a goal of providing leadership training to 500 employees by June 2019 to support the agency's Talent Development Strategy (WSDOT 2018b). Training included the utilization of available tools at WSDOT such as the Learning Management System, Skill Soft, and the Performance Management System to support staff's growth and development. Clearly, a critical need to prepare a qualified workforce in the state DOT was identified. Both newly employed and existing working professionals need to be trained so that WSDOT can better deal with the inevitability of future retirements. The "2017 Washington State Employee Engagement Survey, Employer of choice" (2017) also stressed the value of offering responsive training for "targeted continuing education and personal growth at work" for recruiting and retaining good employees. That conclusion was based on poor responses to the questions: "*I have opportunities at work to learn and grow*" and "*I am encouraged to come up with better ways to do things.*"

1.2.2. *Insufficient Training Availability for Working Professionals*

New employees have high expectations for advancement. Yet existing training opportunities seem insufficient to help prepare employees for new and changing conditions related to the demand for transportation and associated technological advances. An online survey¹ of transportation working professionals from Region 10 revealed that in comparison to internal training opportunities provided by various organizations, chances for transportation professionals to get external training are quite limited, for both managers and engineers (Table 3 in appendix). Within WSDOT, the internal training program offers several types of training opportunities for current employees, but those courses mainly concentrate on soft skill or specific project training. The WSDOT Learning Management System² offers mandatory training, leadership development training, and consultant services from LEAN. One example of an external training program is the WSDOT local technical assistance programs (LTAP). These programs are mainly geared toward the national level or state-based organizations. Programs such as LTAP tend to be fairly generalized and do not always meet all the needs of all trainees who work with varied state or regional terms, rules, and even regulations. Therefore, more localized workforce development training programs are in high demand.

Commented [A01]: Where is this?

1.2.3. *Understanding Gaps in Existing Training Supplies and Demands*

A recent deep investigation (by PacTrans 2018)³ of existing transportation workforce development training organizations, with broad coverage including federal and state agencies, associates, and non-profit institutes, as well as university-affiliated training, found that there are

¹ Online internet survey conducted by PacTrans to explore the training needs of working professionals in Region 10, for detail please refer to the summary in the appendix.

² Learning Management System. (Accessed on Nov.11, 2018 at <https://www.wsdot.wa.gov/employment/workforce-development/talent-development.htm>)

³ Literature review conducted by PacTrans to summaries 28 existing training organizations/institutes and organizations with 135 courses on transportation workforce development in the USA. For more details, please refer to the appendix.

some big understanding gaps between current training opportunities and demand from potential trainees. Specifically, even though various on-demand courses are offered (some course offerings are duplicated), in many training institutes, working professionals' training needs are currently not well satisfied. For most participants, location and cost tend to drive training decisions. If travel is involved or if costs are too high, training opportunities decrease. Therefore, the easy availability of in-demand training courses significantly influences training opportunities for working professionals. For that reason, a demand-responsive and flexible training program is a much more effective platform for delivering advances and context sensitive courses.

Although the TRANSPEED program was popular and far-reaching, it was badly hit by the most recent financial crisis. After WSDOT and other agencies stopped their funding support, TRANSPEED closed in 2010. Since then, working professionals have lost easy access to continuing education, and local need for workforce development has accumulated. With the recent emergence of technology and applications in transportation practice, such as connected and autonomous vehicles (CAVs) and smart cities technologies, the demand for continuing education and workforce development is growing.

As the regional transportation research center, the Pacific Northwest Transportation Consortium (PacTrans) also has responsibility for transportation workforce development for Federal Region 10, which comprises Washington, Oregon, Idaho, and Alaska. In 2016, a new dialog started between transportation agencies and PacTrans to re-establish a new workforce development program to address the increasing workforce development needs of transportation agencies and companies in the Pacific Northwest. PacTrans set out to develop a workforce development institute to support professional training and continuing education for Region 10 transportation professionals.

1.3. Research Objectives

The objective of this project was to develop a demand responsive and flexible program, namely, the PacTrans Workforce Development Institute (WDI), for transportation workforce development in Washington state. This new program is not a simple re-establishment of the TRANSPEED program. In addition to the proven advantages of TRANSPEED, it also takes advantage of new e-learning technology to make training accessible online and available at trainees' own paces and schedules. This is not a degree program. Instead, it is a program central to addressing WSDOT's workforce development needs by delivering a collection of demand-responsive, short-term training courses and workshops. Deliverables of this project include the following:

- Design of the PacTrans WDI, including its administrative structure, funding sources, and business model.
- Certificates of continuing education and courses for each certificate program.
- Curriculum and candidate instructors for each training course.
- A full set of course materials, including lecture notes, assignments, projects, and exams, for each training course.
- An official website for the PacTrans WDI for promotion, course schedules, registration, and more.
- A final research report of this project.

The workforce development program will benefit transportation working professionals in the following three ways:

- It allows busy working professionals to access desired training materials and courses at their convenient times and locations, and at their own pace.

- It provides a forum for working professionals and university researchers to jointly investigate challenges and opportunities associated with new technologies, such as connected and autonomous vehicles (CAVs), and their potential impacts so that transportation agencies and companies can be proactive in incorporating the new technologies into practice.
- It directly addresses the continuing education needs of transportation agencies and companies and thus is critical for enhancing their organizational strength.

CHAPTER 2. LITERATURE AND STATE OF PRACTICE REVIEW

2.1. Background

Employee training supports the collective knowledge base of an agency or company and ensures that staff are educated and equipped with the latest or most pertinent information needed to complete a project or activity. This training, which falls under the broad umbrella of workforce development or continuing education, includes topics that range from discipline-specific in nature to those that focus on organizational dynamics, and they can be presented in a wide variety of formats, such as in-person presentations, hardcopy materials, and online offerings.

Individual employees are faced with the responsibilities of completing day-to-day tasks, managing assignments, and assuring that their knowledge base is current. The challenge of identifying and understanding new information and requirements can be significant to the employee. Larger organizations must recognize that the provision of training balances training needs with each agency's priorities. When and how frequently should an employee be offered training opportunities? How does the agency recover its investment? What are the agency's philosophies and overall budget allocation with regard to training? What are the philosophies of individual managers and supervisors? (Chang, 2015)

For civil (and transportation) engineers, there is added recognition that "civil engineers must learn and apply new technologies that (may not have been) included in a traditional (academic) curriculum. (Lipinski, 2005) This idea is becoming more true as intelligent transportation systems and the evolution of autonomous and connected vehicles increasingly connect the learning pathways of civil engineering, computer science and engineering, and human psychology. The lack of workforce development to support "improved systems operational management is becoming a more serious constraint to improving mobility ... and the

demand of new technologies on staff capabilities has also been recognized in ongoing professional capacity building efforts at the United States Department of Transportation and in some university curricula.” (Lockwood and Euler, 2016)

As recently as March 2017, the American Society of Civil Engineers’ Board of Direction (ASCE) adopted a new policy statement suggesting that student learning at the college level should be expanded. “ASCE supports the attainment of the Civil Engineering Body of Knowledge for entry into the practice of civil engineering at the professional level (i.e., practicing professional engineer) through appropriate engineering education and experience, and validation by passing the licensure examinations. To that end, ASCE supports an increase in the amount of engineering education, such that the requirements for licensure would comprise a combination of:

- “A baccalaureate degree in civil engineering;
- “A Master's degree in engineering, or no less than 30 graduate or upper level undergraduate technical and/or professional practice credits or the equivalent agency/organization/professional society courses which have been reviewed and approved as providing equal academic quality and rigor with at least 50 percent being engineering in nature; and
- “Appropriate experience based upon broad technical and professional practice guidelines which provide sufficient flexibility for a wide range of roles in engineering practice.

“ASCE encourages institutions of higher education, governments, employers, engineers, and other appropriate organizations to endorse, support, promote, and implement the attainment of an

appropriate engineering body of knowledge for individual engineers.” (ASCE, Denver, CO October 12-15, 2018)

The Transportation Education Council of the Institute of Transportation Engineers one year earlier undertook a complementary effort to identify employers’ opinions of the expectations and desires for a transportation engineering degree program. This effort involved conducting an initial assessment to identify key characteristics that employers are looking for in new graduates entering the transportation engineering field, with “willingness to learn” identified as the highest-ranked item. People skills, writing skills, and general analytical skills were also listed as important characteristics. When queried on exposure to technical subject matter taught at universities, practitioners highlighted two topics: familiarity with the MUTCD (Manual on Uniform Traffic Control Devices) and intersection capacity and level of service analysis. Other topics rated as medium to high importance included but were not limited to the following: familiarity with the Highway Capacity Manual (HCM), pedestrians and bicycles (complete streets), traffic signal phasing and timing, and horizontal and vertical roadway design. (Hawkins and Chang, 2016)

These examples highlight the importance of making certain that young professionals are exposed, in terms of both breadth and depth, to essential technical competencies and, when appropriate, additional learning in the form of workforce development training or continuing education. It is also important to note that workforce development consists of not only increased knowledge but also mentorship and other professional-related opportunities. (Martin and Glenn, 2002)

In terms of training delivery methods, a broad range of offerings is available, and with the advent of technology, opportunities to “bring” the training to the employee is becoming

much more prevalent. Table 2-1 presents a list of common methods. Each method offers its own advantages and disadvantages, and each is generally influenced by costs associated with travel or staff time, the timeliness of the information provided, the expertise provided by the individual or individuals leading the training, and the resulting learning format, which may or may not be conducive to a particular individual. (Chang, 2015)

Table 2-1 Advantages and disadvantages of specific training delivery methods

Method	Advantages	Disadvantages
Presentations (live and virtual)	Opportunity for interaction and discussion; affords participants the flexibility to ask questions and clarify understanding	Presenters must be able to effectively communicate and provide useful information; requires travel by participants (live presentations)
(Hands-on) Training	Opportunity for interaction; allows participants to ask questions; opportunity for attendees to learn; environment creates knowledgeable staff and workforce	Schedule conflicts; can be difficult to establish balanced training across all staff members; details much match need; can be expensive
Webinars	Reduces or eliminates travel time; can reach a larger audience; recorded or archived presentations can be reviewed; duration can be flexible	Lack of interaction between presenter and audience; typically requires an internet connection and software application; difficult to implement hands-on activities
Videos	Can be viewed at the discretion of the user; content to be accessed by a large audience (i.e., YouTube); more lively than written documents	May not necessarily be relatable to user; content and perspectives can become outdated over time; production costs could be significant
Handbooks	Comprehensive; can be used as a reference guide; contains useful information provided in a detailed manner	Printing costs (for hardcopies); may not be used regularly; exhaustive to read; bulk can be intimidating
Decision-Support Tools	Provides information that is conducive to making an informed decision; allows users to apply knowledge developed from past experiences at a broad level	May require extensive use of technology and learning; reliance on good data can be restrictive; larger systems can be cost-prohibitive
Community of Practice Support	Participants share common interest; team-oriented environment; multiple opportunities for networking and interaction	Participants may lack the necessary skills and background; organizations must develop a clear understanding of how knowledge will be applied in practice

Note that among the methods listed in table 2-1, online programs require program development and long-term commitment that are often expensive and cost-prohibitive despite the programs' increasing popularity. (Mason, 2003) For example, the Global Road Safety course at the University of Iowa had found success as an in-person, academic credit-based course. However, when consideration was given to developing an online interactive version open to parties outside of the university, costs (associated with registration) and scheduling challenges grounded the effort. For these reasons, a short-course format was ultimately “found to be much more successful in attracting participants.” (Hamann and Peek-Asa, 2017) A separate study noted that “some of the most important considerations of successful online training programs (for staff at a state department of transportation) are (a) the inclusion of interactive components within the training modules to keep participants engaged, (b) a short duration for each of the training modules to retain participants' attentiveness, and (c) the provision of quizzes to assess participants' understanding of the material.” (Islam, 2017)

This study further acknowledged that an effective online training program can “develop the skillset of personnel both efficiently and effectively, and help facilitate capacity building of transportation professionals.” A majority of the DOTs that were interviewed acknowledged that online training was required of their employees, suggesting that DOTs were “making online training programs as a part of their capability building efforts.” (Islam, 2017)

To address workforce development needs, particularly in regard to transportation-related topics, the Federal Highway Administration, in partnership with the U.S. Departments of Labor and Education, has established five regional transportation workforce centers to enhance transportation workforce development more strategically and efficiently. Establishment of these centers arguably represents one of the first concerted efforts to consolidate and prioritize the

need for such training opportunities. These centers are designed to “create, coordinate, and facilitate partnerships with state departments of transportation and education, industry, and other public and private stakeholders to enhance transportation workforce development throughout the education continuum,” and these centers also “facilitate middle school and high school activities, training in technical schools and community colleges, universities, and post-graduate programs, and professional development services for incumbent transportation workers.” (Martin, 2015) The Pacific Northwest is served by the West Region Surface Transportation Workforce Center (WRTWC) at the Western Transportation Institute at Montana State University in partnership with the Upper Great Plains Transportation Institute.

The WRTWC is not alone in offering training. In fact, within the transportation (safety) domain, there are a plethora of entities that currently offer training in a wide range of topics. Below are listed federal agencies, state-level agencies, associations and non-profits, university-affiliated centers and programs, and other entities. Although this summary is not an exhaustive list, the breadth of offerings available is evident and suggests that workforce development and continuing education opportunities are indeed plentiful to the interested consumer.

2.1.1. Federal Agencies

National Operations Center for Excellence

Website: transportationops.org

The National Operations Center for Excellence (NOCoE) is a partnership of the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the Intelligent Transportation Society of America (ITSA), with support from the Federal Highway Administration (FHWA). The NOCoE features an Operations Technical Services Program, funded through contributions from state

transportation agencies and FHWA, to provide peer exchange webinars, training, capacity building programs, and practice area forums.

National Center for Rural Road Safety

Website: ruralsafetycenter.org

The National Center for Rural Road Safety, or Safety Center, was “created to identify the most effective current and emerging road safety improvements and deploy them on rural roads.” The Safety Center currently hosts a free webinar each month; topics include Creating a Rural Transportation Planning Organization and Sharing the Road with Slow Moving Vehicles. A lengthy list of archived webinars is available for viewing, and the center sends out a weekly email about traffic safety events available through other organizations.

National Transportation Safety Board Training Center

Website: www.nts.gov/Training_Center/Pages/TrainingCenter.aspx

The National Transportation Safety Board (NTSB) Training Center “provides training for NTSB investigators and others from the transportation community to improve their practice of accident investigation techniques.” Attendance is primarily limited to parties related to NTSB investigations, safety and law enforcement members, and members of the academic community working on relevant research projects. Courses range in length from one day to as long as two weeks.

Transportation Safety Institute (U.S. Department of Transportation)

Website: www.transportation.gov/transportation-safety-institute

The Transportation Safety Institute (TSI), which is part of the U.S. Department of Transportation, provides training to “safety professionals in federal, state and local government agencies and private industry.” Offerings include face-to-face courses, live online courses, and general online courses. TSI courses cover all major modes of transportation, including general automobile, bus, rail, and aviation for both passenger and freight hauling. Note that the National

Highway Traffic Safety Administration (NHTSA) training center is folded under the TSI's Highway Safety Division. Training is offered in several different forms and includes online classes on topics such as Milestones of Highway Safety, History of Impaired Driving, and History of Speed Program Management. NHTSA also has a dedicated website that provides short articles on various safety topics such as teen driving, pedestrian and bicycle safety, and motorcycle safety.

National Highway Institute

Website: www.nhi.fhwa.dot.gov/about-nhi

The National Highway Institute (NHI), which represents the training and education branch of the Federal Highway Administration (FHWA), was established in 1970 and seeks to improve the “conditions and safety of our nation's roads, highways, and bridges [by] continuously building on the skills of highway professionals and enhancing job performance in the transportation industry across the country.” The program offers courses in eighteen transportation industry program areas; course examples include Roadside Safety Design (instructor-led training) and the safe and effective use of law enforcement personnel in work zones (web-based training).

Federal Motor Carrier Safety Administration

Website: www.fmcsa.dot.gov/

The Federal Motor Carrier Safety Administration (FMCSA) was established within the U.S. Department of Transportation in 2000. The mission of the FMCSA is to prevent commercial motor vehicle-related fatalities and injuries; activities include increasing safety awareness. The FMCSA works with federal, state, and local enforcement agencies, the motor carrier industry, and labor and safety interest groups. The majority of courses are not oriented to driver training but are designed to serve law enforcement officers.

Intelligent Transportation Systems (USDOT)

Website: www.pcb.its.dot.gov/default.aspx

The Intelligent Transportation Systems Joint Program Office offers the ITS Professional Capacity Building Program (ITS PCB) to provide the ITS workforce with “flexible, accessible ITS learning through training, technical assistance and educational resources. The program assists transportation professionals by developing their knowledge, skills, and abilities to build technical proficiency while furthering their career paths.” The ITS PCB hosts training courses and features an archive of nearly 200 online webinars on topics such as automated and connected vehicles and other transportation technology.

*2.1.2. State-Level Agencies***T2 Center**

Website: www.techtransfer.ce.ufl.edu/t2ctt/default.asp

The Florida Transportation Technology Transfer (T2) Center is part of the University of Florida Transportation Institute (UFTI). The T2 Center provides training, technical assistance, technology transfer services, and safety information to transportation, public works and safety professionals, and the general public. Its mission is to “transform engineering research and technology into common practice and to foster a safe, efficient, environmentally sound transportation system by improving skills and knowledge.” Program offerings include its Local Technical Assistance Program (LTAP), Pedestrian & Bicycling Safety Resource Center (SRC), Florida Occupant Protection Resource Center (OPRC), and Technology Transfer Support.

Minnesota DOT

Website: www.dot.state.mn.us/trafficeng/education/index.html

As a state-level example, the Office of Traffic, Safety and Technology in the State of Minnesota “establishes guidelines and procedures [by building] relationships between state, county and city engineering staff to resolve questions about engineering and roadway safety.” The Minnesota Department of Transportation provides technical leadership and works closely with professionals to identify professional continuing education needs. An online database is dedicated to traffic engineering, with webinars (mostly free) and learning modules that are divided into specialty areas ranging from basic road work safety to traffic management plans.

Minnesota LTAP

Website: www.mnltap.umn.edu/training/online/

The mission of the Minnesota Local Technical Assistance Program (LTAP), in partnership with the University of Minnesota, is to “improve the skills and knowledge of local transportation agencies through training, technical assistance, and technology transfer.” The LTAP provides both online training and workshop opportunities. Course topics range from work-zone traffic control, to sign maintenance and management, to gravel road maintenance and design.

Technology Transfer Program

Website: www.techtransfer.berkeley.edu

The Technology Transfer Program is the California transportation community's source for professional training, expert assistance, and information resources and is a division of the Institute of Transportation Studies at the University of California, Berkeley. The program “provides training, workshops, conferences, and technical assistance in the transportation-related areas of planning and policy, traffic engineering, project development, infrastructure design and

maintenance, safety, environmental issues, complete streets, multimodal transportation, railroad and aviation.”

Transportation Training Academy

Website: uva-tta.net

The University of Virginia’s Transportation Training Academy (TTA) provides local transportation professionals across Virginia with knowledge to design safe and efficient transportation systems. The TTA offers “informative, innovative, and affordable training and professional development programs tailored to meet the workforce development needs of Virginia’s state and local government agencies in order to improve the level of transportation services provided to the traveling public.” The vast majority of TTA’s events are on-site training, but it also provides limited availability of online materials, webinars, and training videos.

2.1.3. Associations or Non-Profits

American Society of Civil Engineers

Website: www.asce.org/education_and_careers/

The American Society of Civil Engineers (ASCE) is a “leading provider of technical and professional conferences and continuing education, the world’s largest publisher of civil engineering content, and an authoritative source for codes and standards that protect the public.” Training opportunities are provided in four different forms: webinars, seminars, guided online courses, and on-site training. Most courses broadly focus on civil engineering-related topics as opposed to exclusively focusing on transportation or traffic. Specific examples include 90-minute webinars, one- to three-day long seminars, and guided online courses six to twelve weeks long featuring video lectures, interactive exercises, case studies, live webinars, and weekly discussion topics.

Institute of Transportation Engineers

Website: www.pathlms.com/ite/

The Institute of Transportation Engineers (ITE) is “an international membership association of transportation professionals who work to improve mobility and safety for all transportation system users and help build smart and livable communities. Through its products and services, ITE promotes professional development and career advancement for its members, supports and encourages education, identifies necessary research, develops technical resources including standards and recommended practices, develops public awareness programs, and serves as a conduit for the exchange of professional information.” Many of its webinars are tailored to transportation engineers or an engineering audience.

American Traffic Safety Services Association

Website: www.atssa.com/TuesdayTopics

The core purpose of the American Traffic Safety Services Association (ATSSA) is to advance roadway safety. Its members “accomplish the advancement of roadway safety through the design, manufacture, and installation of road safety and traffic control devices,” and the association “brings together members, road safety experts, and public agencies to identify and solve road safety issues. [Its] primary focus is to move Toward Zero Deaths on our nation’s roads.” ATSSA offers many transportation-related courses, ranging from certification to training to webinars, and online training ranges from flagger training to an introduction to the MUTCD. One particular training opportunity, Tuesday Topics, offers 30- minute webinars that are focused on the roadway safety industry, traffic control, and innovative technologies, among other subjects.

ITS America

Website: www.itsa.org

The members of ITS America are “leading the technological modernization of our transportation system by supporting the research, deployment, and public policy for the future of intelligent transportation systems. Collaboration [exists] between private companies, public agencies, research institutions and academia while educating the public about the importance of intelligent transportation systems.” The mission of ITS America is to “create a policy environment that drives ITS and Internet of Things development and deepens industry engagement.” ITS America’s annual showcase event is its annual meeting, which features presentations on vehicle connectivity, electrified vehicles, and other topics. Through its Knowledge Center, webinars, reports, and a technology scan and assessments are available.

National Safety Council

Website: www.nsc.org/learn/Safety-Training/Pages/defensive-driving-driver-safety-training.aspx

The National Safety Council (NSC) is a nonprofit, safety advocacy organization with the mission of “eliminating preventable deaths at work, in homes and communities, and on the road through leadership, research, education and advocacy.” The NSC focuses on preventing injuries and deaths at work, in homes and communities, and on the road. With regard to roadways, NSC focuses on distracted driving, teen driving, and driver training. The NSC pioneered defensive driver education and trains many drivers each year to become safer drivers. The Council leads Road to Zero, the national initiative aimed at eliminating traffic fatalities within 30 years.

Commercial Vehicle Safety Alliance

Website: cvsa.org/eventpage/events/cvsa-workshop/

The Commercial Vehicle Safety Alliance (CVSA) is a nonprofit association that comprises local, state, provincial, territorial, and federal commercial motor vehicle safety officials and industry representatives. The Alliance seeks to “achieve uniformity, compatibility

and reciprocity of commercial motor vehicle inspections and enforcement by certified inspectors dedicated to driver and vehicle safety.” CVSA oversees several programs aimed at educating inspectors and improving the safety of commercial vehicles in areas such as air brake effectiveness and unsafe driving behaviors.

International Road Federation Global

Website: www.irf.global

The International Road Federation (IRF) is an international non-profit group based in Washington D.C. The IRF assists countries in “progressing toward better, safer and smarter road systems” by developing and delivering knowledge resources, advocacy services, and continuing education programs. Its Global Training Curriculum provides technical expertise in classroom and practical settings where attendees learn from and have direct access to seasoned professionals.

Tribal Safety

Website: tribalsafety.org

The tribalsafety.org website represents an online clearinghouse for practitioners. It was developed by the Alaska Tribal Technical Assistance Program (TTAP) in partnership with participating tribes, federal and state partners, and TTAP Centers. Although the Tribal Transportation Safety Management System Steering Committee uses the site to share information with members, a variety of resources, ranging in topics from safety planning and data to impaired driving and roadway departure, are provided to the public. Links to archived webinars and regional safety summits are also shared.

Safety Fest Boise

Website: safetyfest-boise.org

Safety Fest is an example of an annual regional event that provides free safety and health training to workers, supervisors, and managers. The event enables many of the Pacific

Northwest’s “frontline workers” to learn methods to reduce hazards that can cause workplace fatalities, injuries, and illnesses. Attendee topics range from construction to general industry to mine safety and health.

2.1.4. University-Affiliated Organizations

University of Maryland

Website: www.citeconsortium.org

The Consortium for Innovative Transportation Education (CITE) was established in 1998 to provide “transportation engineering students and professionals with an integrated curriculum covering the technologies and management subjects associated with Intelligent Transportation Systems (ITS).” The curriculum broadly focuses on information technology, transportation engineering, project management, performance management, systems engineering, and ITS technology. CITE offers training in three different formats: blended (instructor-led), self-paced (independent study), and full semester.

Portland State University

Website: nitc.trec.pdx.edu

The National Institute for Transportation and Communities (NITC) is currently one of five U.S. Department of Transportation national university transportation centers (UTC). As a national UTC, the NITC hosts frequent online webinars that are archived on the website and available for any user to view for free. These webinars cover a variety of transportation topics, including shared streets and bicycle/pedestrian accessibility and safety; its existing archive features over 500 such resources.

University of Minnesota

Website: www.roadwaysafety.umn.edu

The Roadway Safety Institute (RSI) is a regional university transportation center that “conducts activities to advance domestic technology and expertise in the many disciplines that

make up transportation through education, research, and technology transfer activities at university-based centers of excellence.” RSI activities focus on user-centered transportation safety systems with an overarching goal of preventing crashes to reduce fatalities and life-changing injuries. Its research incorporates both engineering and social sciences, and a majority of RSI’s seminars incorporate some type of safety topic.

Rutgers University

Website: cait.rutgers.edu

The Center for Advanced Infrastructure and Transportation (CAIT) is another national university transportation center and hosts periodic courses on transportation topics such as asphalt design, traffic regulations, and bridge maintenance. CAIT activities seek to advance the “safe, efficient, economical, and environmentally sound movement of people and goods in our nation and beyond,” with the majority of its work focusing on the USDOT strategic areas of state of good repair, economic competitiveness, and safety.

Montana State University

Website: chsculture.org

The Center for Health & Safety Culture (CHSC), which is part of the Western Transportation Institute at Montana State University, is an “interdisciplinary center serving communities and organizations through research, training, and support services to cultivate healthy and safe cultures. The Center is dedicated to applying research to develop sustainable solutions to complex social problems, and its research focuses on understanding how culture impacts behavior—especially behavior associated with health and safety.” Current research projects include addressing substance abuse, traffic safety, child maltreatment, and violence. CHSC holds an annual symposium on how a positive culture can help promote a healthy society.

2.1.5. *Other Entities*

Lifesavers Conference

Website: lifesaversconference.org

The annual Lifesavers Conference represents “the largest gathering of highway safety professionals in the United States” and “brings together a unique combination of public health and safety professionals, researchers, advocates, practitioners and students committed to sharing best practices, research, and policy initiatives that are proven to work.” The Conference covers a variety of transportation safety topics, including distracted motorists and pedestrians, drugged driving, driving under the influence, and autonomous vehicles.

360training.com

Website: www.360training.com/environmental-health-safety/transportation-safety-training

360training.com offers and has developed a safety training course for drivers of large trucks and buses and a similar course for drivers of cars, vans, and small trucks. 360training.com’s courses are aimed at companies that would buy the training in a package for multiple employees. In addition to driver safety training, 360training.com offers a DOT supervisor training course on how to determine whether employees are sufficiently exhibiting safe behavior while operating vehicles.

National Safety Compliance

Website: www.osha-safety-training.net

National Safety Compliance offers a variety of safety-related training. Although its primary focus area relates to Occupational Safety and Health Administration (OSHA) compliance, some of its training resources and materials (i.e., accident investigation, driving safety, powered industrial trucks) tangentially relate to transportation safety.

OHSA.com Transportation Safety Courses

Website: www.osha.com/courses/transportation.html

OHSA.com offers online OSHA training (and on-demand training) that is tailored for drivers or employees. Its transportation safety training programs are created for safety managers, safety trainers, construction employees, employees who deal with safety hazards or environmental hazards, and general workforce employees. They are designed “for drivers to improve their driving skills and learn the rules and laws when on the road.” These courses target commercial vehicle drivers to “enhance their skills and make them sharper and more aware when on the road.”

IMPROV

Website: www.myimprov.com

Interactive Education Concepts (IEC), under the trade name Traffic School by Improv, Improv Traffic School, and Driver License Direct by Improv, has been providing behavior-based driver education, traffic school, and defensive driving programs to students for 20 years. Improv has “won numerous awards from the media and other organizations over the years for its unique curriculum that is written by professional Hollywood writers and based on humor.” As an example, Improv offers an Idaho-approved, 30-minute-long defensive driving course for \$28.

CED Engineering

Website: www.cedengineering.com

Continuing Education and Development, Inc. (CED) provides “online engineering continuing education courses, video presentations and live webinars to licensed professional engineers to enhance their engineering knowledge and competence as well as to assist them in fulfilling their Continuing Professional Competency (CPC) requirements by earning their professional development hours (PDH) and continuing education unit (CEU) credits mandated by their respective state licensing boards.” CED offers a large selection of transportation

engineering courses featuring topics such as bicycle planning and safety and identifying optimum intersection lane configuration and signal phasing.

Center for Transportation Safety

Website: centerfortransportationsafety.com

The Center for Transportation Safety (CTS) is part of Driving Dynamics, Inc. Driving Dynamics is a “leading provider of advanced performance driver safety training and fleet risk management services throughout North America.” CTS offers behind-the-wheel driver education, simulator-based training, online learning, and driver risk management to help fleet-based organizations reduce potential crash rates.

2.2. Current Offerings

To capture the breadth of transportation and traffic safety-related offerings actively available to practitioners and members of the general public, a snapshot of current offerings was compiled during the last two weeks of January 2018. Course offerings were compiled by topic, host organization, format, length, and cost, based on available information. An abbreviated summary, alphabetized by offering title, is shown in tables 2-2, 2-3, and 2-4.

Table 2-2 Review list of transportation-related training opportunities (part I)

TOPIC	HOST	FORMAT	LENGTH	COST
Access Management	CED Engineering	online course		\$96
Accessible Approach to Shared Streets	National Institute for Transportation & Communities	Online Webinar	60 minutes	free
Achieving Safety Results by Addressing Behavioral Issues	National Center for Rural Road Safety	webinar	90 minutes	free
Adaptive Traffic Control Systems as a Way to Measure Performance of Arterial Streets	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Aircraft Accident Investigation	National Transportation Safety Board (NTSB)		12 days	\$3,970; \$4,070 Late
Aircraft Accident Investigation for Aviation Professionals	National Transportation Safety Board (NTSB)		2 days	\$1034 Early, \$1134 Late
Application of Clear Zones for Roadway Departures	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Are Autonomous Vehicles Safe? What's Already Here & What Needs to Happen	Intelligent Transportation Systems (USDOT)	Online Webinar	60 minutes	free
Automated Driving	Institute of Transportation Engineers	Online Podcast	31 minutes	free
Avoiding Roundabout Design Failures	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Basic Road Work Safety- Temporary Traffic Control	Minnesota DOT	online tutorial		free
Basic Rotorcraft Accident Investigation	Transportation Safety Institute (USDOT)	In-Person Seminar Series	56 hours	\$2,854
Bike Planning and Safety	CED Engineering	online course		\$96
Biochemecanics of High Impact Injury	National Transportation Safety Board (NTSB)			TBD
Cargo/Tank Truck Rollover Prevention	Federal Motor Carrier Safety Administration	Online Video	17 minutes	free
Child Safety Restrain Systems on School Buses	NHTSA	Online Video Series	27 minutes	free
Cognitive Interviewing Series	National Transportation Safety Board (NTSB)		2 days	\$1034 Early, \$1134 Late
Collaborating with Law Enforcement to Reach Zero	National Center for Rural Road Safety	webinar	90 minutes	free
Complete Streets	ATSSA	live webinar	30 minutes	free for members
Conversation with Sam Schwartz: Future of Transportation	Institute of Transportation Engineers	Online Podcast	26 minutes	free
Countermeasures for reducing collisions at Pedestrian Crossings	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Crash Risk Factors for Low-Volume Roads: an ODOT Case Study	National Center for Rural Road Safety	webinar	90 minutes	free
Critical Aspects of Timing Traffic Signals to Maximize Road User Safety	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
CSA Driver Compliance	OHSA.com	online video	5 hours	79
CVSA Workshop: Commercial Vehicle Safety	Commercial Vehicle Safety Alliance	In-Person Conference	5 days	\$550-\$750
Defensive Driving/Driving Safety	National Safety Council	Online Webinar OR In Person	20-240 minutes	\$25-\$41
Defining the Future for Safe Rural Transportation in Rural America	National Center for Rural Road Safety	webinar	90 minutes	free
Designing In-Vehicle Systems for High-Risk Drivers for Teens and Older Drivers	Roadway Safety Institute	Online Webinar	57 minutes	free
Designing Safer Roads for Pedestrians and Bicyclists	UF	live webinar	8 hours	Public 125, Private 175
Driver Safety Course for Cars, Vans & Small Trucks	OHSA.com	online	6 hours	220
Driver Safety Course for Large Trucks and Buses	OHSA.com	online	4 hours	160
Driver Safety Resources for Drivers	Federal Motor Carrier Safety Administration	Website		free
Driving Safety Game	National Safety Compliance	DVD disc		129
Effectively Managing Transit Emergencies	Transportation Safety Institute (USDOT)	In-Person Seminar Series	29.5 hours	\$60
Effects of Traffic Calming Measures on Pedestrians and Motorists	CED Engineering	online course		\$48
Engineering Countermeasures to Reduce Red-Light Running	CED Engineering	online course		\$168
Engineering Treatments and Design Development Strategies for Creating Safe Routes to Schools	ASCE	webinar	60 minutes	M99, NM 129; Group M199 NM 299
Enhanced work zone safety and reliability through connected automation technologies	National Operations Center of Excellence	webinar		free
Examination of Supplemental Driver Training & Online Basic Driver Education	NHTSA	Online PDF	152 pages	free
FHWA Road Safety Audit Guidelines	National Highway Institute	online document		free
FHWA Safety Data & Analysis Toolbox	National Center for Rural Road Safety	webinar	90 minutes	free
FHWA Speed Management ePrimer for Rural Transition Zones & Town Centers	Institute of Transportation Engineers	Online Webinar	90 minutes	free
Finding the Right Tool for the Job – A Safety Data and Analysis Toolbox	Institute of Transportation Engineers	Online Webinar	90 minutes	\$49 M; \$99 NM
Fundamentals of Bus Collision Investigation	Transportation Safety Institute (USDOT)	In-Person Seminar Series	38 hours	\$85
General Hazardous Materials Inspection	Federal Motor Carrier Safety Administration	In-Person Course	5 days	
Helicopter Accident Investigation	National Transportation Safety Board (NTSB)		5 days	\$2100 Early, \$2200 Late
High and Street Safety On-Demand Webinar Package	ASCE	webinar package	16 hours	M 540, NM 740
Highway Crash Investigation	National Transportation Safety Board (NTSB)		8.5 hours	\$250 Early, \$350 Late
Highway Safety Data Systems	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Highway Safety Features	UF	online video	3 hours	free
Highway Safety Priorities	Lifesavers Conference	In-Person Conference	3 days	\$350-\$500 (\$100 Students)
How to Address Roadway Safety Issues for ATVs and Other Off-Road Vehicles	National Center for Rural Road Safety	webinar	90 minutes	free
Idaho Approved Defensive Driving Course	IMPROV Safety	online	30 minutes	27.95
Impaired Driving Law Enforcement Training	NHTSA	In-Person Course	1-5 days	
Implementing Connected Vehicle Technology and Strategies	Institute of Transportation Engineers	Online Webinar	90 minutes	free

Table 2-3 Review list of transportation-related training opportunities (part II)

TOPIC	HOST	FORMAT	LENGTH	COST
Improving Highway Safety with ITS	CITE	online course	8 hours	\$250
Improving Highway Safety: An Overview of 9 Proven Crash Countermeasures	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Improving the Safety of Railroad Crossings & Light Rail Systems	Tech Transfer	live online	4 hours	CA Public 145, Others 290
Incorporating Safety Data Into the Planning Process at the Rural Level	National Center for Rural Road Safety	webinar	90 minutes	free
Increasing Freeway Capacity by Using Safety Lanes as Travel Lanes	CED Engineering	online course		\$168
Instructor Development (Traffic Safety)	NHTSA	In-Person Seminar Series	38.5 hours	\$0
Instructors Course for Transit Trainers	Transportation Safety Institute (USDOT)	In-Person Seminar Series	40 hours	\$140
Intermodal Accident Site Photography	National Transportation Safety Board (NTSB)		3 days	\$1198 Early, \$1248 Late
Intersection Safety	CED Engineering	online course		\$96
Investigating Human Fatigue Factors	National Transportation Safety Board (NTSB)		2 days	\$1034 Early, \$1134 Late
Investigative Safety Analysis	Federal Motor Carrier Safety Administration	In-Person Course	12 days	
ITE Vision Zero Virtual Toolbox	National Center for Rural Road Safety	webinar	90 minutes	free
Lagging Left-Turn Arrow Safety and Operation	Institute of Transportation Engineers	Online Webinar	90 minutes	\$149 M, \$199 NM
Large Truck and Bus Traffic Enforcement	Federal Motor Carrier Safety Administration	Online Videos, PDF's	2 hours	
Law Enforcement & Commercial Driver Training	Federal Motor Carrier Safety Administration			
Linking Safety and Operations	National Operations Center of Excellence	photo/video		free
Low Cost Treatments for Horizontal Curve Safety	CED Engineering	online course		\$96
Managing Communications During an Aircraft Accident or Incident	National Transportation Safety Board (NTSB)		2 days	\$1034 Early, \$1134 Late
Managing Communications Following a Major Transportation Accident	National Transportation Safety Board (NTSB)			
Managing Pedestrian Safety Programs	NHTSA	In-Person Course	2 days	
Managing Speed: Self-Enforcing Roadway Concepts	Institute of Transportation Engineers	Online Webinar	90 minutes	\$49 M, \$99 NM
Marine Accident Investigation	National Transportation Safety Board (NTSB)			TBD
Modern Transportation Tech, Autonomous Vehicles, Electrification	ITS Detroit	In-Person Conference	4 days	
Moving People - Steady, Slower, Smarter, and Safer	Institute of Transportation Engineers	On-Demand Recording	90 minutes	\$49 M, \$99 NM
New Entrant Safety Audit Course	Federal Motor Carrier Safety Administration	In-Person Course	12 days	
North American Standard Commercial Vehicle Inspection	Federal Motor Carrier Safety Administration	In-Person Course	5 days	
Orientation to Work Zone Safety	U of Minnesota	online tutorial		free
Passenger Vehicle Inspection	Federal Motor Carrier Safety Administration	In-Person Course	3 days	
Pedestrian and Bicycle Safety Assessment Studies	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Pedestrian and Bicyclist Safety and Mobility	CED Engineering	online course		\$120
Pedestrian Safety	CED Engineering	online course		\$96
Pedestrian Treatments for Uncontrolled Locations	National Center for Rural Road Safety	webinar	90 minutes	free
Pilot/Escort Vehicle Operators Best Practices Guidelines	Federal Highway Administration (FHA)	Online Document		free
Prevent Accidents and Traffic Delays, by Improving Signal Timing	ASCE	live webinar	60 minutes	M99, NM 129; Group M199 NM 299
Preventing Wrong-Way Driving on Freeways	CED Engineering	online course		\$144
Primer on the Joint Use of the HSM and the HFG for Road Systems	National Center for Rural Road Safety	Online Webinar	90 minutes	free
Promoting Bicycle Commuter Safety	CED Engineering	online course		\$216
Protected Bikeway Design: a 6-Part Series	Institute of Transportation Engineers	Online Webinar	90 minutes	\$149 M, \$199 NM
Proven Safety Countermeasures Webinar	Tribal Safety	Online Webinar		
Public Health Perspective to Rural Transportation Safety	National Center for Rural Road Safety	webinar	90 minutes	free
Rail Accident Investigation Orientation	National Transportation Safety Board (NTSB)		2 days	\$1034 Early, \$1134 Late
Reducing Collisions at High Crash Locations	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Reducing Safety at Railroad Highway Grade Crossings	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Relationship Between Public Perceptions of Speed, Speed Laws, and Safety	Roadway Safety Institute	Online Webinar	60 minutes	free
Road Safety Adits: Case Studies	National Highway Institute	online document		free
Road Safety and Signage Audit: Proactive Roadway Safety in 21st Century	ASCE	live webinar	60 minutes	M99, NM 129; Group M199 NM 299
Road to Zero Coalition	Institute of Transportation Engineers	Online Podcast	29 minutes	free
Roadway Geometric Design for Improved Safety and Operations	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Safe Transportation for Every Pedestrian (STEP)	UVA Transportation Training Academy	In-Person Course	6.8 Hours	\$75-\$300
Safe, Multimodal, Integrated Transportation Services	Institute of Transportation Engineers	Online Podcast	24 minutes	free
Safer Roads by Design: Road Safety Audit	International Road Federation (IRF) Global	In-Person Conference	3 days	\$1,500 Member, \$2,000 Regular
Safety and Health training for Workers, Supervisors, and Managers	Safety Fest of the Great Northwest Boise	In-Person Courses	4 days	
Safety Effects of Roadway Design	UVA Transportation Training Academy	In-Person Course	6.8 Hours	\$75-\$300
Safety Fundamentals: A 9-Part ITE Learning Hub Webinar Series	Institute of Transportation Engineers	Online Webinar Series	90 minutes	\$99 M, \$149 NM
Safety Toolkit for Improving Roads and Intersection	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349

Table 2-4 Review list of transportation-related training opportunities (part III)

TOPIC	HOST	FORMAT	LENGTH	COST
School Bus Driver In-Service Safety Series	NHTSA	Online PDF and Misc. Docs		free
School Zones: A Comprehensive Look, Markings, and Safety Programs	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Setting and Managing Speed Zones	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Seven Steps for Safety at Highway-Rail Grade Crossings	Federal Motor Carrier Safety Administration	Online Brochure		free
Shared Mobility	Institute of Transportation Engineers	Online Podcast	25 minutes	free
Shoulder Treatments: Rumble Strips	CED Engineering	online course		\$72
Sight Distance	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
SMS Principles for Transit	Transportation Safety Institute (USDOT)	In-Person Seminar Series	21 hours	\$55
Survival Factors in Aviation Accidents	National Transportation Safety Board (NTSB)			TBD
The Culture of Swedish Vision Zero	National Center for Rural Road Safety	webinar	90 minutes	free
The Next Step in Auto Safety: Vehicle to Vehicle Communications	CED Engineering	online course		\$96
Toolbox of Countermeasures & their Potential Effectiveness for Intersection Crashes	National Highway Institute	online document		free
Toolbox of Countermeasures & their Potential Effectiveness for Pedestrian Crashes	National Highway Institute	online document		free
Toolbox of Countermeasures & their Potential Effectiveness for Roadway Crashes	National Highway Institute	online document		free
Toward Minimalistic and Learning-Enabled Autonomous Navigation	Roadway Safety Institute	Online Webinar	59 minutes	free
Toward Vision Zero: Tools and Tips for Achieving Target Speeds in Your Community	Institute of Transportation Engineers	Online Webinar	90 minutes	\$49 M; \$99 NM
Toward Zero Deaths- Proactive Steps for Your Community	National Center for Rural Road Safety	webinar	90 minutes	free
Toward Zero Deaths through Improved Transportation Systems Management and Operations	National Center for Rural Road Safety	webinar	90 minutes	free
Traffic Calming	Center for Advanced Infrastructure & Transportation	In-Person Conference	7 hours	free
Traffic Calming	UVA Transportation Training Academy	In-Person Course	6.8 Hours	\$75-\$300
Traffic Calming: The Lumps and the Bumps	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Traffic Occupant Protection Strategies, Seat Belts Use and Enforcement	Transportation Safety Institute (USDOT)	Online E-Learning Course	8.5 hours	
Traffic Safety, Substance Abuse, other misc. topics	Center for Health & Safety Culture	In-Person Conference	2.5 days	\$675
Transit Rail Incident Investigation	Transportation Safety Institute (USDOT)	In-Person Seminar Series	33 hours	\$95
Unpaved Road Safety	National Center for Rural Road Safety	webinar	90 minutes	free
usRAP: An Innovation in Data Driven Safety Analysis	National Center for Rural Road Safety	webinar	90 minutes	free
Vision Zero for All Users: Lessons Learned and New Strategies	Institute of Transportation Engineers	Online Webinar	90 minutes	\$149 M; \$199 NM
Vision Zero in Sweden	Institute of Transportation Engineers	Online Podcast	22 minutes	free
What Legal Professionals Need to Know in Transportation Accident Investigation	National Transportation Safety Board (NTSB)			TBD
Work Zone Safety Awareness Workshop	Center for Advanced Infrastructure & Transportation	In-Person Conference	5 hours	\$95

CHAPTER 3. REGION 10 WORKFORCE DEVELOPMENT NEEDS SURVEY AND ANALYSIS

The goal of this task was to gain a better understanding of the existing training or professional development needs within Region 10 (i.e., Idaho, Alaska, Oregon, and Washington). To complete the task, Pactrans and researchers from Oregon State University and the University of Idaho collaborated to design and implement a workforce development study. This study contained two major components: interviews with local transportation offices and the development and distribution of an online survey. Below are a description of the empirical approaches used to conduct interviews and develop the survey; the findings from our data collection efforts; and a discussion of major themes that emerged from a descriptive analysis of workforce development needs.

3.1. Background and Research Approach

The research presented herein can be best described as a sequential, exploratory, mixed-methods project (Creswell, 2013). More specifically, the research design took place across two distinct phases. During the first phase, qualitative data (e.g., interviews) were collected and analyzed. These findings were then used to inform the development and execution of the second, quantitative phase (e.g., survey development). This research approach is particularly useful in cases where relatively little is known about the topic of interest, and in which initial open-ended perspectives can provide direct insight into subsequent research. Given the goal of exploring perspectives regarding services that do not yet exist, a sequential, exploratory, mixed-methods design suited the project well.

3.2. Collection, Analysis, and Results

3.2.1. Phase 1

3.2.1.1 Structured Telephone Interviews

During the first phase of the research, we conducted structured, qualitative interviews with transportation engineering managers, practitioners, and learning coordinators across Region 10. Participants were recruited through personal contacts among the research teams at Oregon State University (OSU), the University of Idaho (UI), Washington State University (WSU), and the University of Washington (UW), as well as Internet directory searches through each state's transportation website (e.g., Oregon Department of Transportation). Researchers also implemented snowball sampling, in which current participants helped to identify additional candidates to interview. In total, 17 participants were interviewed, including three from Washington, one from Idaho, eleven from Oregon, and two from Alaska. Interview questions asked participants to talk about three major topics: 1) their access to or awareness of training opportunities; 2) the factors that affect whether to attend training; and 3) any perceived urgent or compelling needs within transportation engineering training. Interviews lasted approximately 15 minutes each and were conducted over the phone. They were not audio recorded, but a researcher took field notes as they were conducted for later analysis.

3.2.1.2 Awareness and Access

Participants were asked to describe a typical training experience, including the means through which they heard about the training. In general, participants tended to find out about most training opportunities through some form of email listserv. As individuals began to attend training and/or join various professional societies, the opportunities to find out about training

opportunities increased. Some participants also noted conducting Google searches or reaching out to training coordinators, but such actions were often in response to a specific training need.

3.2.1.3 Factors Affecting Training Decisions

A wide range of factors was noted as influential to the choice to attend training (or in the case of managers, to send an employee to training). For most participants, location and cost tended to drive training decisions. If travel was involved or if costs were too high, training opportunities might be more challenging. Another salient factor was the relevance of the training to current workplace needs. If a training program or upcoming webinar was related to a project in the near future, the training was seen as more valuable.

In addition to the timeliness of the training, participants noted the importance of being able to gain practical skills that they could apply in their jobs. Hands-on training was seen as especially valuable, in contrast to programs that educated on theories or rules or information that was seen as less directly applicable to current work. Put simply, congruence between training and upcoming work was a key driver in decision making related to attendance.

Beyond the content of the particular training program, participants noted the importance of the presenter or organization conducting the training. Participants noted that some people or organizations had stronger reputations than others, and so when making choices about training, it was helpful to inquire about the skills or reputation of the presenter.

3.2.1.4 Current Training Topic Needs

The final portion of the structured interview asked participants to think of topic areas or content for which training would be helpful but training does not currently exist. Most participants reiterated the importance of alignment of training topic area with current workplace demands, but some larger categories emerged from the discussion. In particular, there seem to be

persistent training needs related to safety, operations, and maintenance. As laws, rules, and regulations shift, it is important that engineers and managers are up-to-date on the changes. As technology becomes more ubiquitous in traffic engineering, including the use of software, big data, and other applications, ensuring employee competence with these new advances is essential.

3.2.2. Phase 2

3.2.2.1 Survey Development and Distribution

Following the interviews, the researchers used the descriptive analysis to inform the development of items and response choices. By leveraging our first qualitative phase to inform the second phase, our results were empirically grounded in responses from practitioners. The survey was again distributed on the basis of the personal contacts of the researchers in the four collaborative universities noted above, as well as the managers who had participated in the qualitative interviews. The full results, separated by managers and engineers, is provided in the appendix. The following sections provide some highlights across the two groups. Important to note about the following results is that not all respondents completed the survey entirely or responded to all the questions. There were also questions for which respondents could select several choices. In some cases, total responses to particular items may have slightly different overall totals.

3.2.2.2 Demographics

As of April 30, 2018, 184 individuals had responded to the survey, including 63 managers and 121 practitioners. Table 3-1 provides a breakdown of the states from which respondents came.

Table 3-1 Participant locations

	<i>Alaska</i>	<i>Oregon</i>	<i>Washington</i>	<i>Idaho</i>	<i>Other</i>
<i>Managers</i>	42	7	12	0	2 (CA)
<i>Engineers</i>	45	46	23	3	2 (CA, Norway)

Table 3-2 provides an overview of the amount of experience reported by both managers and practitioners. All managers reported more than five years of experience in transportation engineering, broadly, while there was a wider range of experience with their current positions. Engineers tended to have less experience, both in transportation in general as well as their current jobs in particular.

Table 3-2 Participant experience overview

	<i>Experience in Transportation (yrs)</i>				<i>Experience in current job (yrs)</i>			
	<i><1</i>	<i>1-2</i>	<i>3-5</i>	<i>5+</i>	<i><1</i>	<i>1-2</i>	<i>3-5</i>	<i>5+</i>
<i>Managers</i>	0	0	2	63	7	11	12	3
<i>Engineers</i>	5	9	12	93	27	22	20	51

In terms of disciplines represented within transportation engineering, results suggested a relatively diverse group of concentrations in specific fields. Table 3-3 provides an overview of the fields reported by managers and engineers. In this case, respondents could select several responses at the same time, depending on the nature of their work. Notable here is the high proportion of “Design” as a discipline, suggesting that such activities might be common across other areas of focus. In terms of responses to “Other,” participants tended to note more specific subdisciplines of transportation engineering, such as right-of-way or hydraulics or bridges.

Table 3-3 Overview of discipline areas for managers and engineers

	<i>Traffic</i>	<i>Highway</i>	<i>Safety</i>	<i>Construction</i>	<i>Design</i>	<i>Consulting</i>	<i>Other</i>
<i>Managers</i>	26	27	16	20	32	19	15
<i>Engineers</i>	38	53	30	34	56	18	32

3.2.2.3 *Awareness and Access*

On the basis of our findings from interview data we developed the following questions to more broadly explore transportation engineers’ awareness of and access to different training opportunities. First, we wanted to gain a better understanding of the frequencies with which transportation engineers and managers attend training or professional development. Table 3-4 provides a summary of the frequencies with which managers and engineers attended internal and external training programs within a given year. Important to note here is that managers were asked how many times their average employee attended training, whereas engineers were asked how many times they, specifically, attended training. As can be seen in table 3-4, internal training opportunities appeared much more common than external training.

Table 3-4 Training frequency comparison across managers and engineers

	<i>Internal Training (times/year)</i>					<i>External Training (times/year)</i>				
	0-1	2	3	4	5+	0-1	2	3	4	5+
<i>Managers</i>	12 (19%)	10 (16%)	14 (22%)	7 (11%)	20 (32%)	36 (57%)	20 (32%)	4 (6%)	3 (5%)	0 (0%)
<i>Engineers</i>	27 (22%)	28 (23%)	21 (17%)	17 (14%)	31 (25%)	71 (57%)	28 (23%)	10 (8%)	4 (3%)	11 (9%)

We also explored how individuals find out about training opportunities. Informed by our interviews, we developed questions to probe for the ways respondents learned about training opportunities or programs (table 3-5). Notable about table 3-5 are the strong similarities in how

training was discovered, suggesting similarities in the ways these individuals received information about training. Although the responses developed in the survey captured most of the modes of dissemination, some participants noted periodically checking different websites for training events.

Table 3-5 Frequency and percentage of methods of discovering training opportunities

	<i>Internal Comm</i>	<i>Email listserv</i>	<i>Word of mouth</i>	<i>Online ads</i>	<i>Professional societies</i>	<i>Other</i>
<i>Manager</i>	50 (34%)	25 (17%)	23 (15%)	16 (11%)	28 (19 %)	7 (5%)
<i>Engineer</i>	98 (38%)	52 (20%)	39 (15%)	22 (8%)	45 (17%)	5 (2%)

Also important for understanding access is to explore barriers to training. To do so, we developed questions that probed for participants’ criteria for making decisions about training. The responses were informed by interviews with managers, which suggested that some of the most influential factors for deciding to attend training are related to cost, location (which is related to cost), and timeliness of training.

To explore barriers to and criteria for training, we asked a series of questions. First, we asked participants to respond to Likert-type questions regarding the importance of various factors, such as location cost, topic area, etc. Figure 3-1 illustrates the importance of different criteria for managers and engineers. The quantitative findings here echoed and corroborated findings from Phase 1: some of the most important aspects of choosing training are related to location, cost, and timeliness. These trends appeared similar across managers as well as practicing engineers.

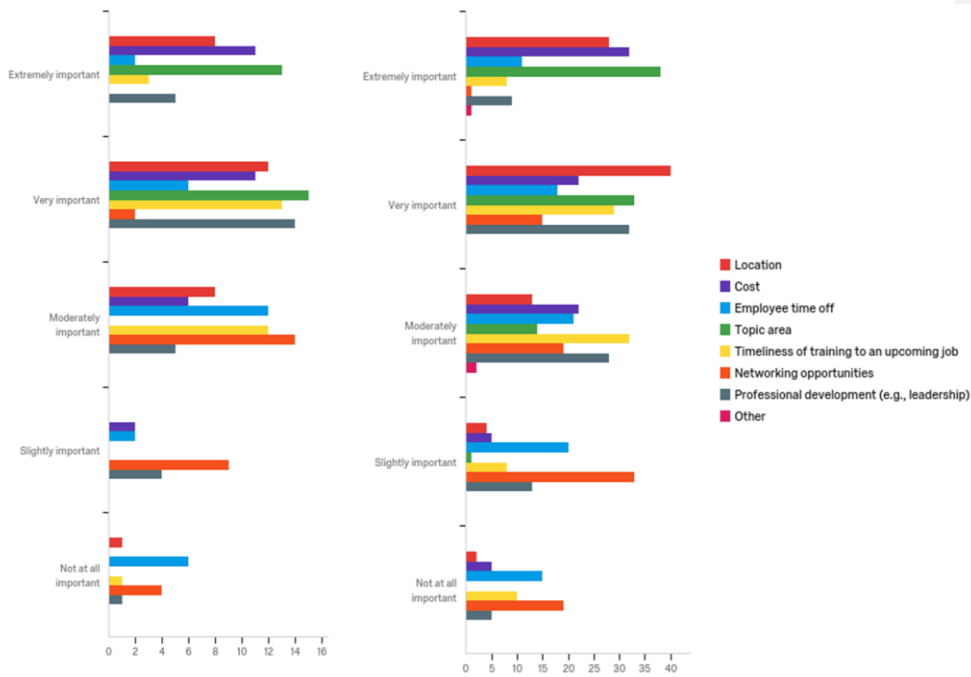


Figure 3.1 Manager (left) and engineer (right) responses to “How important are the following factors when deciding to attend training?”

3.2.2.4 Current Training Needs

On the basis of our interviews, we developed survey items to query transportation managers and engineers regarding topics and content areas in need of development. The categories from Phase 1 interviews were distilled into seven overarching categories, and participants were asked to rate the importance of various topics in terms of timeliness of training needs. Figure 3-2 details the manager and engineer responses, respectively (for full frequencies and descriptions, please see the appendix). In this data set, engineers and their managers were in general agreement regarding the importance and timeliness on a range of different topics, and

those topics primarily concerned issues of accessibility (or ADA compliance), changes in technology, and design.

Finally, we asked survey respondents to list topics for which they would like training but training is not available or personally accessible. For this question, responses were open ended, and participants could provide any text they wanted. Although responses were optional and the possibility existed that there were no topics for which training was unavailable, 12 managers and 31 engineers provided responses. Table 3-6 provides a brief overview of some key areas, and a full list is provided in the appendix. Interesting to note here is that within table 3-6, there are some topics that appear to be available based on findings from Task 2 from the University of Idaho. This particular finding suggests that although training may be available on some topics, some engineers and managers may not be aware of some of the resources.

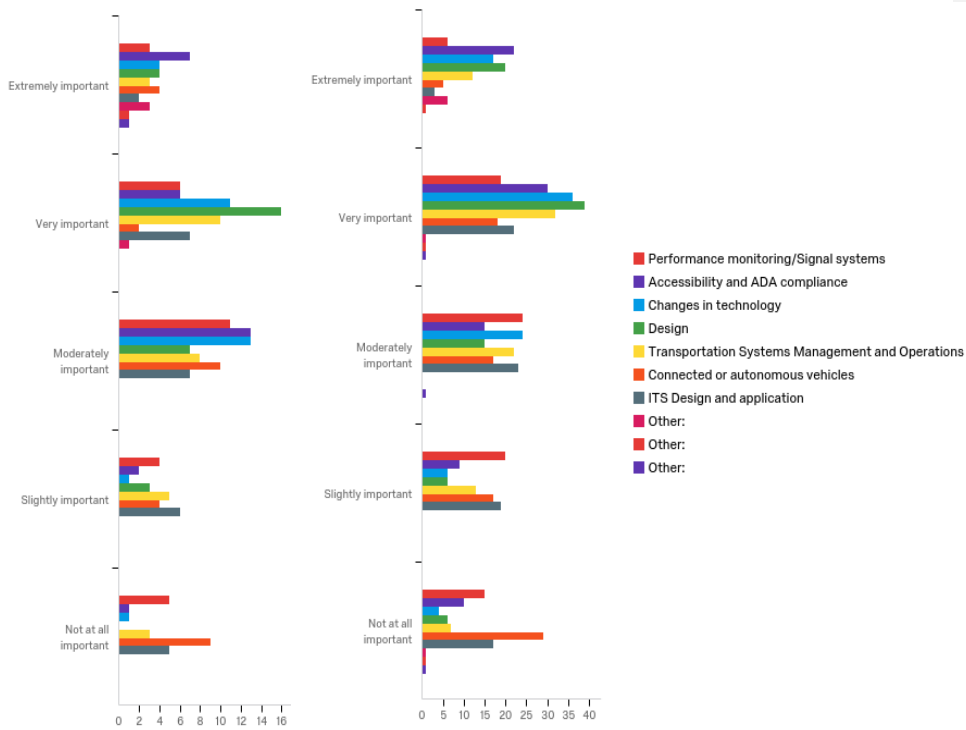


Figure 3.2 Manager (left) and engineer (right) ranking of importance of various possible training topics.

Table 3-6 Examples of topics for which managers and engineers perceive a need for training but training is not currently available.

Managers	Engineers
Data storytelling	Right of way
Professional (soft skills)	GIS training
Skip tracing and archive research	Team building and change management
System Operations	ADA compliance
Aviation base training	PE and FE exam workshops

3.3. Conclusion

The purpose of the research was to gain insight into existing training needs and potential gaps in professional development within transportation engineering fields. To address this goal, researchers developed an exploratory, mixed-method project. In Phase one, we created qualitative, structured interview protocols; conducted interviews with transportation engineers, managers, and learning coordinators; and synthesized our findings to generate an online survey tool for broader distribution. The survey was then distributed to engineers, managers, and learning coordinators across Region 10 (i.e., Oregon, Washington, Idaho, and Alaska).

The results from the survey provided triangulation and corroboration for findings from Phase 1 (interviews) and also pointed to some potentially interesting trends. For instance, the most important criteria for determining whether someone will attend training often come down to cost and location but are also driven by the relevance of the training topic to an upcoming project or job. That is, most respondents did not think about training needs on broad scales or in terms of larger trajectories of the field but instead made choices related to the immediacy of a need for training or a specific type of competence or certification. These findings emerged from both interviews and survey responses, providing compelling evidence of their validity.

Furthermore, in most cases, engineers and managers appeared aligned in terms of their preferences for training, perceptions of topics needed, and criteria for decision making. When seeking training, managers and engineers often utilized the same sources and prioritized training in similar ways. However, some gaps did exist across engineers and managers in terms of desired training that was not available. Table 3-6, as well as questions 17 and 35 in the appendix, show that managers and engineers might perceive different kinds of training needs with respect to professional development. Where managers emphasized professional development related to

leadership or management or training, practitioners often linked their perceived training needs to more specific kinds of skills or tasks (e.g., software, design for particular kinds of roads, etc.).

On the basis of the training needs identified, a proposal was created for new transportation program development, in which three training courses with two skill development streams could be provided interactively and delivered through a collection of short-term (1~3 days) training seminars/workshops. Specifically, the three training courses with specific transportation topics (table 3-7) would include Americans with Disabilities Act (ADA), advanced technology applications for transportation systems management and operations (TSMO), and a series of courses on updates of rules and regulations, e.g. HCM (6th Edition), Highway Safety Manual (HSM), Highway Design Manual (HDM), etc.

Additionally, specific transportation-related courses from each program could be mixed and matched with courses related to advanced technology skills (focused on software and modeling techniques) and soft skills (focused on management and communication techniques) (as shown in figure 3.3). Trainees in these offerings could also be given more opportunities to meet each individual’s personalized needs. However, at the beginning stage of the organization development, a set choice of available courses in software, modeling techniques, management, and communication techniques are proposed based on the preferences revealed in the survey results.

Table 3-7 Proposed programs of training on transportation topics

Programs	Specific transportation topics
Americans with Disabilities Act (ADA)	Practical ADA in transportation (general introduction of standard application of ADA design in transportation, and exceptions to standard situation)
	ADA and transportation facilities: management and control
	ADA Design for Temporary Traffic Control

	Advanced ADA design for future transportation management, advanced ITS technology assistance
Advanced technology applications for transportation systems management and operations (TSMO)	Multimodal transportation systems
	Complete street: active transportation and demand management
	Emergency transportation operations
	Smart city neighborhood design with CAVs, SAVs, and electric assisted vehicles
Series courses on manual updates, e.g. HCM (6th Edition), HSM, HDM, etc.	Geometric design for urban transportation systems
	Rural transportation system design
	Highway transportation design (based on the Highway Capacity Manual)
	Safety management and risk evaluation in design

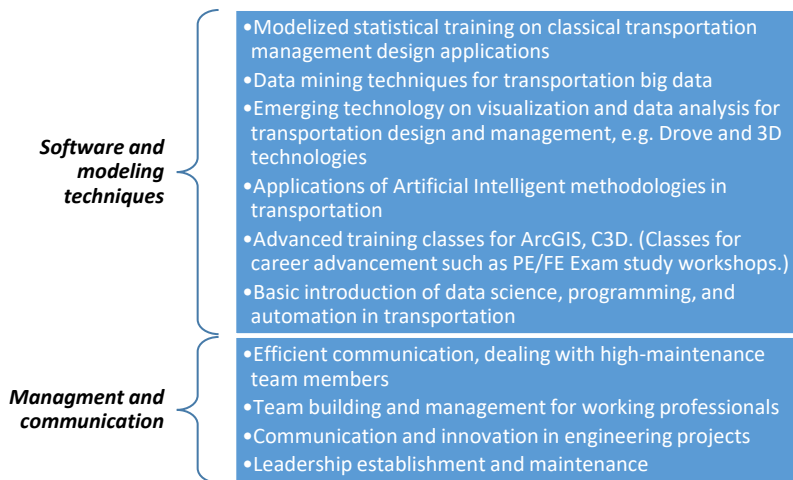


Figure 3.3 Technology and soft skills training topics

CHAPTER 4. WORKFORCE DEVELOPMENT INSTITUTE

4.1. Mission

The PacTrans Workforce Development Institute (WDI) is a demand responsive and flexible program to provide training services to working professionals in the Pacific Northwest, including Alaska, Idaho, Oregon, and Washington. The WDI focuses on short-term training about transportation-specific topics, emerging technologies, management and communication skills, software and modeling, and more.

The PacTrans WDI aims to benefit PacTrans and Region 10 in the following three ways:

1. It allows Region 10's busy working professionals to access desired training materials and courses at their convenient times and locations, and at their own pace.
2. It provides a forum for working professionals and university researchers to jointly investigate the challenges and opportunities associated with the new technologies, such as connected and autonomous vehicles (CAVs), and their potential impacts so that transportation agencies and companies can be proactive in incorporating the new technologies into practice.
3. It directly addresses the continuing education needs of Region 10's working professionals and thus is critical for enhancing local transportation agencies' organizational strengths and local companies' competitiveness.



Figure 4.1 PacTrans WDI logo

4.2. Administrative Structure and Business Model

The research team designed the following administrative structure to ensure the sustainability, efficiency, and quality of the PacTrans WDI:

- PacTrans owns the program. PacTrans owns the PacTrans WDI and is responsible for the overall operations of the institute, such as training, promotion and outreach activities, instructor hiring, course development and delivery, etc.
- Each university runs a sub-institute. Each partner university in PacTrans runs a sub-institute to identify local training needs with transportation agencies and companies.

In order to address the training needs in Region 10, the PacTrans WDI aims to provide the following training services:

- A focus on short-term training for
 - Employees from transportation agencies
 - Students/practitioners looking for transportation engineering-related jobs
 - K-12 transportation-related training webinars/workshops.
- A flexible training format

- Onsite when the demand bar is met
- Online learning otherwise.
- A flexible schedule
 - Self-paced, pre-recorded, interactive
 - Group-based, real-time, instructor-lead.

The PacTrans WDI is not intended to make a profit, although it needs to be financially sustainable. In addition to onsite training, the PacTrans WDI also offers online access to the courses and training materials and thus creates a new revenue source through online learning. The initial costs for new course development are high. They require funding support from agencies or companies . PacTrans will definitely be a reliable funding source during the UTC grant’s active period. PacTrans funds can be used to match agencies/companies’ funds to develop new courses and certificate programs. Those established courses and certificate programs should generate enough money to cover the operational and update costs to ensure this new program’s sustainability.

4.3. Online Training Platform

The research team developed the PacTrans WDI website (<https://pactranswdi.org/>) as the online training platform for marketing and outreach activities, training schedules, and payments and registration (see figures 4.2 and 4.3).

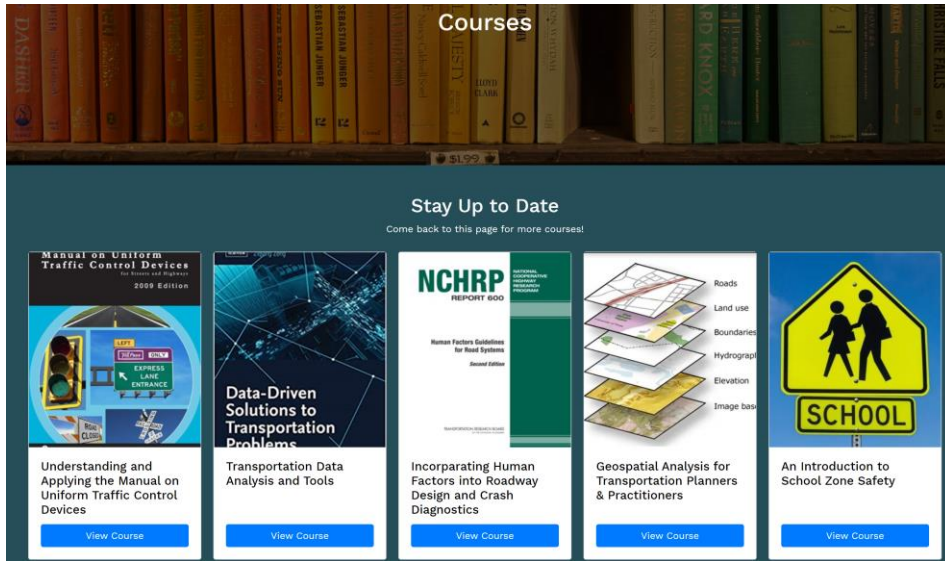
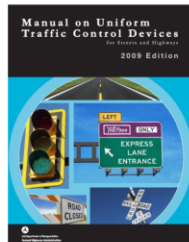


Figure 4.2 PacTrans WDI website

Manual on Uniform Traffic Control Devices

Home / PacTrans WDI / Manual on Uniform Traffic Control Devices



Course Description

Today's transportation planning and engineering professionals face the responsibility of managing a wide variety of surface transportation systems that serve humans, vehicles, and even machine vision systems. The principal resource for designing the information systems of roadway systems and trail systems in the United States is a regulatory document, the Manual on Uniform Traffic Control Devices. Successful application of the standards, guidance, options, and support in this document requires an understanding of how the MUTCD is developed, the principles that underlie its primary assumptions and target audience, and a grasp of the emerging technologies that will drive changes to MUTCD content and applicability in the future. In this course, participants will gain an understanding of the influence of human factors and contemporary research on the performance of traffic control devices for both human operators and increasingly-common machine vision systems that handle portions of the driving task.

Content outline

Module 0 Course Introduction

- Course Launch
- Introductions
- Background Information

Module 1 Core Concepts

- Conceptual Framework Introduction
- Introduction to Human Factors
- Machine Vision Primer
- Designing for People and Logic

Module 2 Signing, Markings, and Signals

- MUTCD Resources
- Traffic Signing Fundamentals
- Regulatory Signs
- Warning Signs
- Guide and Motorist Information Signing
- Pavement Markings and Delineation
- Traffic Signals
- Changeable Message Signs

Module 3 Applications of TCDs in Various Settings

Figure 4.3 Online course registration

4.4. E-Learning Capabilities

For transportation practitioners who prefer online training, the PacTrans WDI has e-learning capabilities to offer high quality and flexible training services.

The UW PacTrans workforce development team has proven experience in developing and operating online continuing education programs. For example, Dr. Yinhai Wang was on the original teaching team for the first UW online Master's degree program—an online Master's program in construction management. Over the past years, PacTrans has worked closely with

several online educational programs, including an online Master's degree program for sustainable transportation and another one for supply chain transportation and logistics.

The e-learning service that the PacTrans WDI provides is based on Zoom as its online conferencing tool and Canvas as its learning management system (LMS). Our team includes infrastructure developers who were able to develop the LMS with specific learning modules and functions to cater to instructors' requirements. Specifically, the PacTrans WDI provides the following three common e-learning formats:

1. **Asynchronous, group-paced online training:** All lectures are pre-recorded, and the students watch the videos, do the reading, and turn in the assignments by the due date at their own pace every week. Interaction with the instructor and peers occurs through discussion boards and email.
2. **Synchronous, classroom plus online training:** The instructor teaches students in the classroom and online at the same time using Zoom. In this format, Canvas must be well designed, with detailed instructions for accessing Zoom sessions, readings, and assignments to give online students a good experience. However, the lectures are designed by instructors, and questions can be answered in real time.
3. **Real-time online:** In this format, the instructor teaches everyone online in real time via Zoom. In this format, Canvas must be well designed, with detailed instructions for accessing Zoom sessions, readings, and assignments. However, the lectures are designed by instructors, and questions can be answered in real time in Zoom. Instructors can do the lectures from anywhere, and no special equipment is needed.

Below are some examples of e-learning capabilities, including the Canvas welcome page, learning modules, assignments, quizzes, and Zoom, developed for several training courses that

the PacTrans WDI is currently offering. (See figures 4.4 through 4.10.)

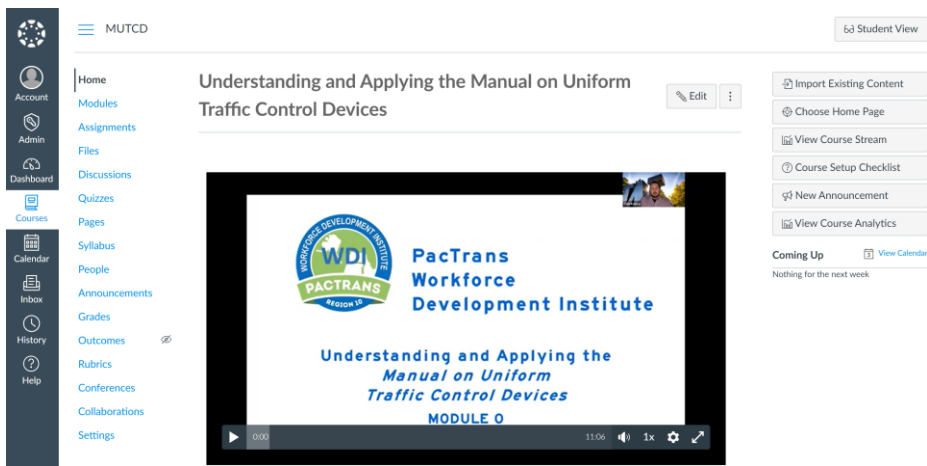


Figure 4.4 Home page for a training course

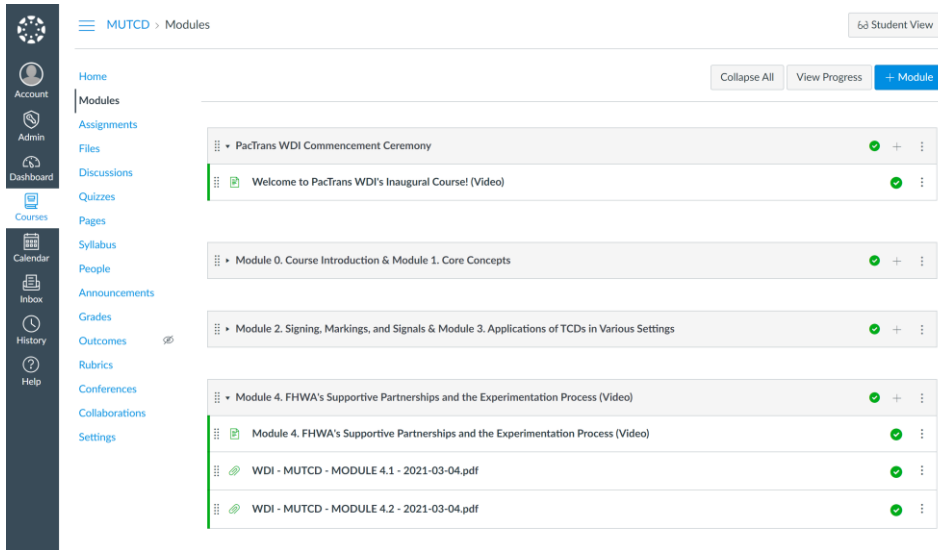


Figure 4.5 Learning modules

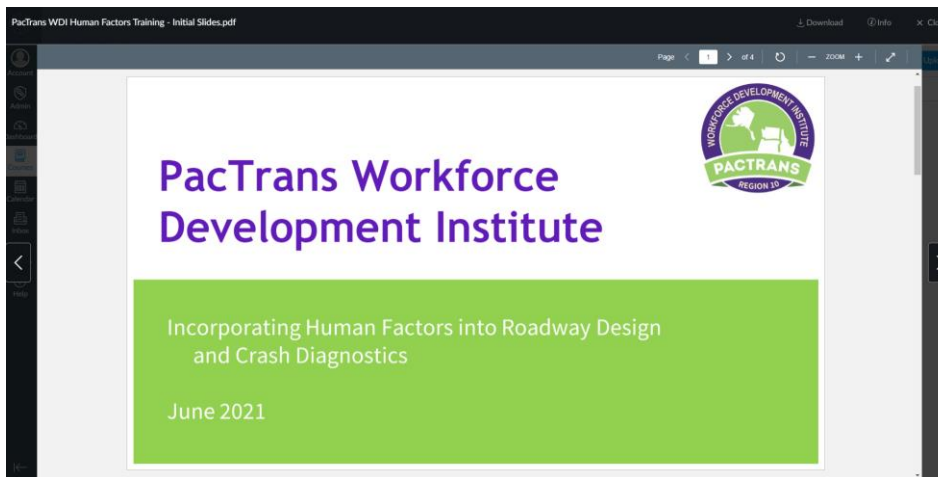


Figure 4.6 Course slide

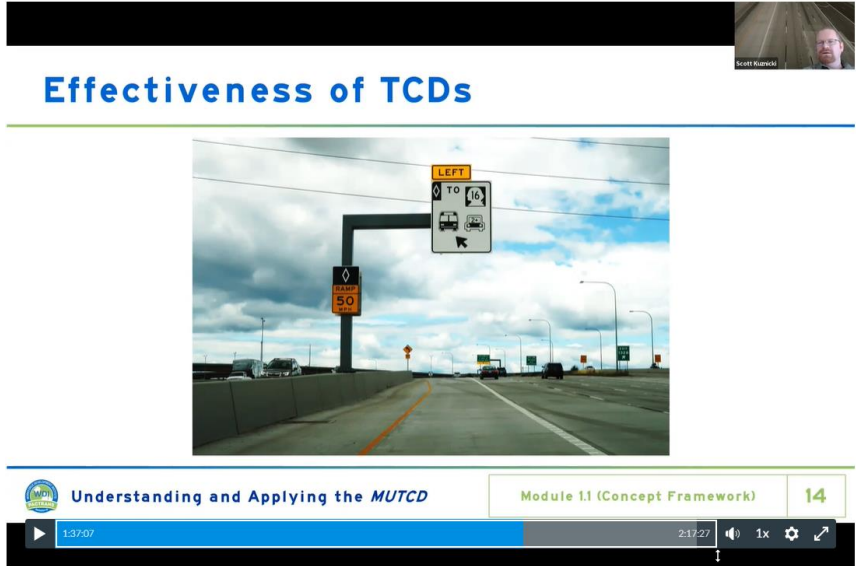


Figure 4.7 Course video

Exponent
Engineering and Scientific Consulting

Perception: Countermeasures for Mitigating Headlamp Glare (21-2)

- **Geometry:** Exposure to oncoming headlamp glare can reduce a drivers ability to see low-contrast hazards

The CIE veiling luminance model below shows that veiling luminance increases as glare angle θ decreases. Wide medians reduce veiling luminance by increasing θ . From (2).

$$\frac{L_{veil}}{L_{source}} = \frac{10}{p^2} + \frac{0.12}{p} \left[1 + \left(\frac{A}{62.5} \right)^{1.4} \right] + 0.0025p$$

where
 L_{source} = luminous intensity of glare source
 θ = glare angle
 p = iris pigmentation factor
 A = driver age

- The Guideline describes how this problem arises and discusses countermeasures for minimizing glare, such as:
 - Wide Medians
 - Independent Alignments
 - Glare Screens, &
 - Fixed Roadway lighting

Figure 4.8 Interface for online training with Zoom

Figure 4.9 Quizzes

Figure 4.10 Survey

CHAPTER 5.DEVELOPMENT AND DELIVERY OF TRAINING COURSES

On the basis of the training needs and demands identified through the previous survey and outreach activities, the research team developed training courses that address the immediate training needs of local transportation agencies and companies. Each university contributes its own strengths in transportation research and education.

5.1. Training Courses

5.1.1. Understanding and Applying the Manual on Uniform Traffic Control Devices (MUTCD)

Today's transportation planning and engineering professionals face the responsibility of managing a wide variety of surface transportation systems that serve the needs of both humans and machine vision systems, that is, road users in various vehicles. The principal resource for designing the information systems of roadway and trail systems in the United States is a regulatory document, the *Manual on Uniform Traffic Control Devices (MUTCD)*. Successful application of the standards, guidance, options, and support in this document requires an understanding of how the MUTCD was developed, the principles that underlie its primary assumptions, the target audience, and a grasp of the emerging technologies that will drive changes to *MUTCD* content and applicability in the future. In this course, participants will gain an understanding of the influence of human factors and contemporary research on the performance of traffic control devices for both human operators and increasingly common machine vision systems that handle portions of the driving task.

5.1.1.1 Learning Objectives

Upon completion of the course, participants will be able to

- Understand of the basics of the MUTCD and its common applications

- Thoroughly understand the practices and applications of the MUTCD in Washington state
- Identify the key characteristics of traffic control devices
- Describe the characteristics of effective traffic signing
- Describe the Washington state MUTCD's considerations for regulatory signing
- Describe the process for designing a guide sign
- Name the four primary patterns for longitudinal pavement markings
- List some common traffic signal design and operational errors
- Describe inconsistencies in pedestrian treatments
- List Washington's MUTCD Supplement for School Signing
- Contrast bicycle wayfinding and motorway signing concepts
- Discuss the major design elements for Work Zone Typical Applications
- Describe the process for requesting permission to experiment
- Discuss the applicability of a current Interim Approval
- Identify the key components of a successful experiment.

5.1.1.2 Content Outline

Module 0 Course Introduction

- Course Launch
- Introductions
- Background Information

Module 1 Core Concepts

- Conceptual Framework Introduction
- Introduction to Human Factors

- Machine Vision Primer
- Designing for People and Logic

Module 2 Signing, Markings, and Signals

- MUTCD Resources
- Traffic Signing Fundamentals
- Regulatory Signs
- Warning Signs
- Guide and Motorist Information Signing
- Pavement Markings and Delineation
- Traffic Signals
- Changeable Message Signs

Module 3 Applications of Traffic Control Devices in Various Settings

- Safety and Operations for All Users in Complex Environments
- Low-Volume Roads and Local Streets
- Rail-Grade Crossings
- School Zones
- Bicycles and Micromobility
- Work Zones

Module 4 FHWA's Supportive Partnerships and the Experimentation Process

- MUTCD Databases and Evolution
- Successful Requests for Experimentation

5.1.1.3 Length

20 hours

5.1.2. Incorporating Human Factors into Roadway Design and Crash Diagnostics

In this course, participants will gain an understanding of the impacts of human factors in transportation systems and will learn how to incorporate human factors into roadway design and operations.

5.1.2.1 Learning Objectives

By the end of this training, the students will be able to

- Understand the overall concept of human factors and the impacts of human factors on traffic system design and operations from both driver and pedestrian perspectives
- Describe the principles and practices guiding roadway design, given the influence of human factors
- Thoroughly understand human factors characteristics and how they are involved in traffic safety analysis (e.g., gap acceptance)
- Obtain hands-on experience in analyzing human factors through case studies of safety and the design impacts of traffic safety.

5.1.2.2 Content Outline

Module 1. Introduction to Human Factors Training

Module 2: Human Factors Fundamentals within the Roadway Environment

Module 3: Human Factors vs. Human Behavior

Module 4: Tool: Use of the Human Factors Interaction Matrix (HFIM)

Module 5: Workshop Exercise: Human Factors Aspects of a Typical Driving Scenario

Module 6: Tool: Introduction to the Human Factors Guidelines for Road Systems (HFG).

Module 7: Evaluating, Analyzing, and Diagnosing the Factors that Contribute to Crashes

Module 8: Tool: Overview of the HSM/HFG Primer

Module 9: Method: Incorporating Task & Workload Analyses into Diagnostic
Assessment

Module 10: Method: Incorporating Human Factors into the Road Safety Audit (RSA)
Process

Module 11: Automated Vehicles: Key Human Factors Topics

Module 12: Wrap Up

5.1.2.3 Length

20 hours

5.1.3. Project Management and Key Skill Capability Building

High turnover in project management staff due to retirements and employees seeking new opportunities has resulted in a shortage of experienced project managers. The old paradigm of employees working their way up to a project or program manager level does not apply to the current work environment. Employees find themselves being promoted into project management roles at a younger age, with little training and little or no mentorship. Mistakes in the project management environment are often costly, with the potential to delay project completion.

This course provides leadership development and project management training course modules needed for new and existing DOT project managers to build and refresh necessary competencies in the dynamic DOT environment throughout their career journey. It also demonstrates investment in career development for personnel, aiding in the accelerated contribution of project managers new to a DOT, and the retention and career growth of existing project managers.

The multiple course modules are designed to address capability building for DOT project managers throughout their career journey. New and experienced project managers will benefit

from a “scaffolded” approach to learning and hands-on engagement and practice with peers. Modules include the fundamentals of project management; project management tailored to the DOT project delivery environment, including hands-on application; and a portfolio of focused, stand-alone skill building courses, some developed uniquely for DOTs, others leveraged from PACTRANS and NHI training modules.

The course modules fall into three major categories:

1. Fundamentals of Project Management:
2. Project management and delivery tailored to and integrated with the DOT environment and processes
 - a. Preconstruction
 - b. Construction
3. A portfolio of stand-alone skill building modules.

Learning to be a good project manager requires a combination of experience and education. Project management styles are a function of individual personalities, circumstances, and corporate policies and procedures. Consequently, this course relies on integration of reading, lectures, case studies, role playing, and sharing of personal experiences. Students are encouraged to interact fully with instructors and class members to stimulate the sharing of ideas and experiences.

5.1.4. Transportation Data Analysis and Tools

In this course, participants gain an understanding of transportation data analytics and learn how to use tools to develop data-driven solutions.

5.1.4.1 Learning Objectives

By the end of this training, the students will be able to

- Understand the basic concepts and typical applications of data collection, management, and analysis in transportation industry
- Implement the fundamental methods, techniques, and tools for data analysis and visualization
- Claim experience with data management and analysis through hand-on exercises
- Claim familiarity with big data and its applications in ITS.

5.1.4.2 Content Outline

Module 1. Overview

- Concept and applications of data analysis in transportation engineering
- Challenges and opportunities of big data

Module 2: Transportation data

- Types of data
- Traditional and emerging data sources
- Data collection and quality control

Module 3: Data storage and management

- Database management systems
 - Relational database structure and design
 - Structured Query Language (SQL)
- How databases are used for advanced transportation applications
 - Introduction of data warehousing
 - Introduction of geographic information systems (GIS)

Module 4: Data analysis techniques and applications

- Analytical approaches: regression analysis, AI/ML algorithms

- Data science programming languages: Python, R, SQL, etc.
- Transportation applications: Highway Performance Monitoring System (HPMS), freight and goods, safety analysis, travel time prediction, traffic status analysis and traffic performance evaluation, asset management

Module 5: Data visualization techniques and tools to support decision making

- Excel, Tableau, Python (Jupyter Notebook)

Module 6: Hands-on experience with data analysis and supporting tools with example applications

5.1.4.3 Length

20 hours

5.1.5. An Introduction to School Zone Safety

This PacTrans WDI training opportunity introduces students to all aspects of safety in school zones. The content will benefit professionals who manage, provide consulting for, or are considering a school zone safety program in their community.

The training begins with an overview of school zone safety. This discussion is followed by an explanation of the current guidelines in the MUTCD to help identify whether current practices in the relevant city, town, or jurisdiction are in compliance. Case studies and specific examples are provided to help in understanding why different treatments apply to different conditions. The training concludes with a discussion on the Safe Routes to School Program and the important guidance that professional can provide to their community to foster an environment that promotes safety for both the motoring and non-motoring public near neighborhood schools.

5.1.5.1 Learning Objectives

Participants will learn about

- Existing MUTCD guidelines
- Different school zone speed assembly options and the pros and cons of each
- Specific solutions or treatments to improve school zone safety in local communities
- School zone safety and the correlation between travel behavior and student health.

5.1.5.2 Content Outline

- Introduction
- The Importance of School Zone Safety
- School Safety in the MUTCD
- Signage Enhancements
- Safe Routes to School Programs
- Conclusions / Training Takeaways

5.1.5.3 Length

3 hours, presented as two 90-minute modules

5.1.6. Geospatial Analysis for Transportation Planners and Practitioners

Transforming data and information into actionable knowledge and understanding is increasingly needed for transportation planners, practitioners and stakeholders involved in maintaining and planning for the public/private transportation system. As data become more available and our transportation system more complex, transportation professionals must possess a variety of data management and analytical skills, including those with spatial and geographic properties. This course is designed for professionals with a variety of skill sets and experiences in working with spatial data, but whose jobs involve aspects of managing transportation assets or

performance of transportation systems and for professionals interested in improving their spatial and geographic analysis capabilities. The course utilizes the ArcGIS software.

5.1.6.1 Learning Objectives

Upon completion of the course, participants will be able to

- Understand the broader strengths and capabilities of geospatial analysis, as it relates to transportation
- Manage data (import/export) within ArcGIS from various formats
- Geocode data using address and lat/long properties
- Conduct various buffer and service area analyses
- Create maps with appropriate symbology for polygon, line, and point attributes
- Create interpolated images
- Conduct common network analyses, including
 - Optimal routing
 - O-D cost matrices
 - Resiliency planning (route impediments)

5.1.6.2 Content Outline

Module 1: Course Introduction

- Introduction to Spatial Analysis
- Learning ArcGIS Software Basics
- Understanding Different Data Types (vector vs raster) and Coordinate Systems

Module 2: Map Creation and Analytical Concepts

- Symbology
- Feature and Attribute Selections

- Conducting Queries
- Data Exports (shapefiles, geodatabases, feature classes)

Module 3: Geocoding and Proximity Analysis

- Geocoding Data
- Conducting Data Joins
- Buffer Analysis and Service Areas
- Editing/Clipping Features

Module 4: Basic Network Analysis

- Creating Optimal Routes
- Creating Transportation Cost Contours (O-D Cost Matrices)
- Interpolating Images

Module 5: Advance Network Analysis

- Site Selection for New Facilities
- Resiliency Planning for Transportation Impediments (closures)

5.1.6.3 Software Requirement

ArcGIS 10.5 or newer

5.1.6.4 Length

20 hours

5.2. Course Delivery

With the launch of the PacTrans WDI on Feb. 22, 2021, the PacTrans WDI has delivered the following two training courses:

- Understanding and Applying the *Manual on Uniform Traffic Control Devices (MUTCD)* (as shown in figure 5.1)

- Incorporating Human Factors into Roadway Design and Crash Diagnostics (as shown in figure 5.2)

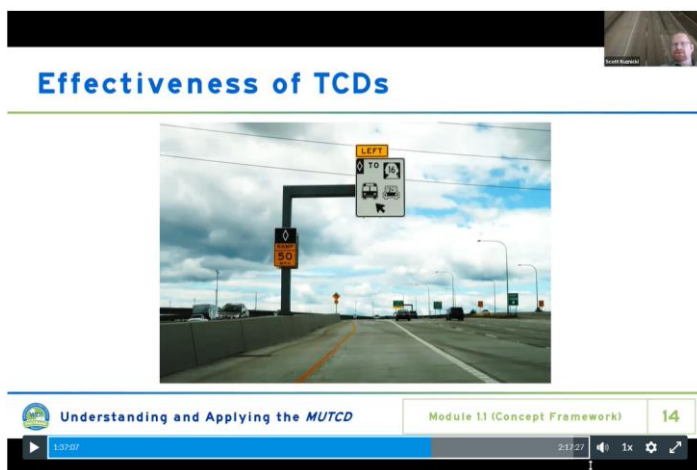


Figure 5.1 Training delivery: Understanding and Applying the *Manual on Uniform Traffic Control Devices* (MUTCD)

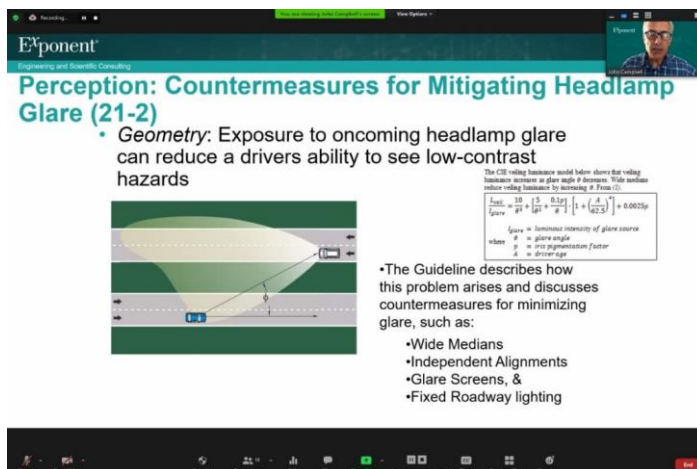


Figure 5.2 Training delivery: Incorporating Human Factors into Roadway Design and Crash Diagnostics

Because of Covid-19 restrictions, both courses are delivered through an online training workshop via Zoom with the support of the Canvas LMS. For transportation professionals who successfully completes the training, the PacTrans WDI sends them a Certificate of Completion (as shown in figure 5.3).



Figure 5.3 Certificate of completion

Upcoming course deliveries include, but are not limited to, Transportation Data Analysis and Tools, Project Management and Key Skill Capability Building, An Introduction to School Zone Safety, and Geospatial Analysis for Transportation Planners and Practitioners.

CHAPTER 6. GUIDEBOOK FOR CURRICULUM DEVELOPMENT, IMPLEMENTATION, AND EVALUATION

In order for the PacTrans WDI to develop and deliver high quality training services to working professionals, it was critical that a guidebook be developed on how to implement best practices in the design, implementation, and evaluation of training courses. The research team developed and updated this guidebook iteratively during the project's training course development.

The purpose of this guidebook is to provide guidance on the development, implementation, and evaluation of WDI courses. Course development is ubiquitous to colleges and universities and professional development efforts. A wealth of research and evidence supports a wide range of practices that can be implemented. There is also an abundance of experience and intuition from expert teachers that leads to positive and impactful course experiences. This guidebook incorporates research on effective educational practices with experience from teaching. Educational best practices include course development processes with carefully designed learning outcomes and associated learning activities (J. Biggs, 1996; Wang, et al., 2013), active learning strategies (Chi and Wylie, 2014; Prince and M.J., 2004; Smith, et al., 2005), reliable assessment of and evaluation processes for learning (Reddy and Andrade, 2010; Wollenschläger, et al., 2016), and overall program and course evaluation (Project Star, 2006).

6.1. Adult Learning

Adult learning theory provides a useful lens through which to view professional development efforts because it provides theory and context for the particular needs of adults as they engage in learning experiences. Adults are considered in this context to be individuals who engage in a learning experience of their own choice and who do so in relation to professional development needs related to their job and/or profession. Adults, therefore, normally enter into

these learning experiences assuming that they will gain specific value in relation to their goals for the experience. Adult learning, and more specifically, andragogy, holistically describes aspects of the learner that are important to consider in this context.

There are five unique attributes of adult learners (Knowles et al., 2015, pg. 5). As noted, five principles are core to andragogy. The first principle is about adult learner's need to know. Adult learners will probe "... into the benefits they will gain from learning it and the negative consequences of not learning it." (Knowles et al., 2015, pg. 43) They will contemplate the benefits of the content to their jobs and lives and do this throughout the learning process. Therefore, the course designer needs to incorporate this by including content about why the content is important to the course participants and elicit this information from participants.

Adult learners generally have a self-concept of being responsible for their learning and need to be recognized as such in the learning environment. As stated by Lindeman in Knowles, "Adults have a deep need to be self-directing; therefore, the role of the teacher is to engage in a process of mutual inquiry with them rather than to transmit his or her knowledge to them and then evaluate their conformity to it." Their self-direction should be recognized and incorporated into the course design. For example, the course designer should assume that learners will have goals they bring to the environment and interest in engaging with the material in autonomous and self-directed ways. If the content is relevant to the participants, they will engage under their own volition.

Adult learners come to the learning environment with a wealth of personal experience and life experiences. From Lindeman in Knowles, "Experience is the richest resource for adults' learning; therefore, the core methodology of adult education is the analysis of experience." From these experiences they have developed mental models, or internal relations, of how things work

in a particular domain. As a result, they bring tremendous value to the learning environment because they know something about the content of the course. What they know may not always be correct but should be considered in the course design, as it is an important part of how they will incorporate course material into what they already know. In other words, “It assures that in any group of adults there will be a wider range of individual differences than is the case with a group of youths.” And that “Even more potent tools for raising the level of awareness of the need to know are real or simulated experiences in which the learners discover for themselves the gaps between where they are now and where they want to be.” The course designer should understand, to the degree possible, what participants know about the content and what they aspire to know by the end of the experience.

Adult learners’ orientation to learning is around problems or experiences, not around concepts or abstractions. “Adults are motivated to learn to the extent that they perceive that learning will help them perform tasks or deal with problems they confront in their life situations. Furthermore, they learn new knowledge, understandings, skills, values, and attitudes most effectively when they are presented in the context of application to real-life situations;” and “Adults’ orientation to learning is life-centered; therefore, the appropriate units for organizing adult learning are life situations, not subjects.” Course content should be embedded in experiences that are common to the participants’ workplace. Participants will want to take what they learn and be able to apply it to their jobs when they return to work, and they will expect to leave the training with a sense of how they will do this. Course instructors should help participants envision this explicitly through course design, and participants should share their plans with how they will use their newly developed knowledge in their jobs, with the added

benefit of other participants envisioning value of the content they had not recognized before hearing from others.

Finally, adult learners are intrinsically motivated and expect a payoff from the course content. The content needs to be relevant and useful to course participants. As stated by Lindeman in Knowles, “Adults are motivated to learn as they experience needs and interests that learning will satisfy; therefore, these are the appropriate starting points for organizing adult learning activities.” The course instructors should embed practices that facilitate participants taking ownership of their learning. For example, participants could describe how they will use course content in their workplace and how they will continue to learn about the content from the course

“Even dyed-in-the-wool pedagogical instructors have reported that their teaching became more effective when they adapted some of the andragogical concepts to the pedagogical model. Some ways they do this are by providing a climate in which the learners feel more respected, trusted, unthreatened, and cared about; by exposing them to the need to know before instructing them; by giving them some responsibility in choosing methods and resources; and by involving them in sharing responsibility for evaluating their learning.”

Table 6-1 summarizes the key elements and example actions that can be taken by curriculum designers. As summarized by Knowles, “The andragogical instructor (teacher, facilitator, consultant, change agent) prepares in advance a set of procedures for involving the learners and other relevant parties in a process involving these elements: (1) preparing the learner; (2) establishing a climate conducive to learning; (3) creating a mechanism for mutual planning; (4) diagnosing the needs for learning; (5) formulating program objectives (which is content) that will satisfy these needs; (6) designing a pattern of learning experiences; (7)

conducting these learning experiences with suitable techniques and materials; and (8) evaluating the learning outcomes and re-diagnosing learning needs.”

Table 6-1 Summary of andragogy design elements and how to address them

Adults are motivated to learn and expect a payoff	The content and focus of the course should align with the needs of the students. The instructor should understand these needs to the greatest extent possible before designing and implementing instruction.
Adults’ orientation to learning is life centered, not centered on concepts or abstractions	Instruction should incorporate cases, examples from the field, cases provided by participants
Adult learners come with a wealth of experience	Instructors should elicit this experience from participants both before and during the course offering.
Adults need to be self-directing	Course participants should be active in the course and have a say in how the course goes so it meets their needs and takes advantage of their self-directing orientation. Mechanisms for mutual planning should be put in place.

It may be useful to align suggested activities in relation to stages of course implementation, as shown in the list below. These suggestions are also aligned with Adult Learning Theory. For example, all pre-course activities are aligned with understanding participant backgrounds and expectations, and using case examples during the course will resonate with adult knowledge based on experiences.

- Before the course
 - Understand the learning expectations/desires
 - Understand participants’ backgrounds, as related to the course content
 - Solicit ideas for course planning
- During the course
 - Use case examples that highlight main ideas
 - Engage participants with you, and with each other

- Rely on participants knowledge and backgrounds
- After the course
 - Did they fill their learning needs?
 - Do they use the content in their work?

Another perspective to consider when designing learning experiences for adults is how a pedagogical approach, commonly used in higher education, compares to an andragogical approach. Table 6-2 copied from Knowles, highlights the differences. The key element in this comparison is that the adult learner must be considered and included holistically in the course design and evaluation. They have specific needs they are desiring to fill, and they want and need to be actively considered in the design and implementation of the course, as noted in the quote below.

One aspect of educational practice that most sharply differentiates the pedagogical from the andragogical, the mechanistic from the organismic view, and moving from the teaching to the facilitating of learning perspective includes the role of the learner in planning. Responsibility for planning traditionally has been assigned almost exclusively to an authority figure (teacher, programmer, trainer). But this practice is so glaringly in conflict with the adult's need to be self-directing that it is a cardinal principle of andragogy (and, in fact, all humanistic and adult education theory). A mechanism should be provided for involving all the parties concerned in the educational enterprise in its planning. One of the basic findings of applied behavioral science research is that people tend to feel committed to a decision or activity in direct proportion to their participation in or influence on its planning and decision making.

This section provides information on Adult Learning Theory from multiple perspectives, ranging from table 6-2 to the five tenants presented above. The purpose of doing so is to recognize that different instructors will understand and incorporate these ideas in different ways, and these examples provide different access points for doing so.

Table 6-2 Comparison of pedagogical and andragogical approaches to course design and implementation

<i>Process elements</i>		
<i>Element</i>	<i>Pedagogical approach</i>	<i>Andragogical approach</i>
1. Preparing learners	Minimal	Provide information Prepare for participation Help develop realistic expectations Begin thinking about content
2. Climate	Authority-oriented Formal Competitive	Relaxed, trusting Mutually respectful Informal, warm Collaborative, supportive Openness and authenticity Humanness
3. Planning	By instructor	Mechanism for mutual planning by learners and facilitator
4. Diagnosis of needs	By instructor	By mutual assessment
5. Setting of objectives	By instructor	By mutual negotiation
6. Designing learning plans	Logic of subject matter Content units	Sequenced by readiness Problem units
7. Learning activities	Transmittal techniques	Experiential techniques (inquiry)
8. Evaluation	By instructor	Mutual re-diagnosis of needs Mutual measurement of program

6.2. Participant Backgrounds and Expectations

As noted from Adult Learning Theory, professional development courses are unique from most college courses because students present a variety of backgrounds to and have a variety of needs from the course. For example, a university statistics course has a relatively homogenous student population and the content of statistics is relatively *static*! College courses are normally part of a larger structured curriculum in which students progress from one course to the next. Professional development courses, even if part of a sequence, rarely see the same group of

students progress through the sequence. Because of this, it is very important for instructors to understand the backgrounds of their audience and their hopes and expectations for in the course.

This can be done by collecting data from the students in the class or from students who could take the class at some time. It is more effective to gather this information from students who take the course, because all participants have unique needs, and current adult students will be different from the general population. The suggested ideas and questions are shown in table 6-3. The most efficient way to gather this information is by using an online survey tool, such as Qualtrics or Survey Monkey. These questions will affect how structured the curriculum is and how interactive activities are designed. For example, if everyone has a relatively common and limited knowledge base, then active learning pairings can be random, but if there is a wide variety, then pairings should be strategically based on previous knowledge.

Table 6-3 Example questions on course participants’ backgrounds and learning goals

Scope	Questions
Background	Who do you work for? What types of projects do you work on? How long have you been in your current job? In the profession?
Learning Goals and Relevant Knowledge	What do you expect to learn in this course? What experience do you have related to the content of this course? How do you expect to use what you learn in your work?

6.3. Establishing Course Goals, Outcomes, and Evaluation Measures

Armed with an understanding of the participants’ backgrounds and needs, the first step in the design of any educational activity is to establish the goals and outcomes of the course and activities. These goals can come in a variety of forms and serve many constituents. For example, a new course on transportation safety offered to transportation professionals may have the goals

of attracting participants, developing expertise, serving as the basis for future courses in related topics, being profitable, developing contacts among participants, etc. The developer should first articulate these goals and related outcomes as clearly as possible, so they can be explicitly considered in the course development process. This will allow the owner and the developer to understand the degree to which they were successful and to improve future course offerings.

The goals and outcomes can be considered in three categories; the course goals, participant learning goals, and the teacher implementation goals for the course, as noted in table 6-4 below.

Table 6-4 Course goals with example outcomes and measures

Goal Category	Example	Outcome	Measure
Course goals	Attract participants from regional DOT offices	DOT employees participate	Number of participants
Participant learning goals	Students will learn about the Highway Capacity Manual	Student will be able to determine roadway capacities	Formative assessment during course where participants are asked to do this
Teacher implementation goals	Create an active learning environment	Students will engage with each other about course content	During course and/or End of course survey
	Incorporate participants' experiences	Students will share their relevant experiences with other students	

Participant learning goals should consider multiple levels of learning and comprehension, as well as Bloom's Taxonomy. Learning outcomes are specific measurable statements about what participants should be able to do after completing the course. Learning outcomes should use verbs from Bloom's Taxonomy (<https://tips.uark.edu/blooms-taxonomy-verb-chart/>) across the spectrum of cognitive difficulty. Specifically, Bloom's Taxonomy is a set of verbs assigned

to categories, which range from cognitively simple (remember) to challenging (evaluate or create). Example outcomes are: The student will be able to:

- Recall the sight distance equation
- Evaluate criteria used to determine sight distance.

A very rough approximation of the number of outcomes needed is one to four per hour of class time. Learning outcomes should be present in course documents, with the goal of maintaining focus and transparency with students about the intention of assessments and learning activities. For adult learning, they must also carefully consider and include the context of learning, with a focus on cases and stories. Specifically, “A statement of objectives should describe both the kind of behavior expected and the content or the context to which that behavior applies.” As an example, a DOT engineer from Washington should learn about geometric design within the context of regional and statewide regulations through case examples from the appropriate regional area.

Teacher implementation goals should incorporate an evaluation of if and how the needs of the learners are being addressed in the course. A core principle of adult learning is that the enrollees will have specific needs that they want filled, and desire for the knowledge gained to be worthwhile for their day-to-day work. “Here is the addition of a fifth dimension—one that springs directly from the fundamental conception of adult education as continuing education: re-diagnosis of learning needs. If every learning experience is to lead to further learning, as continuing education implies, then every evaluation process should include some provision for helping the learners re-examine their models.” Teachers can do so through formal and informal means throughout the course. For example, the teacher could ask the students if they are learning

things that will be useful, and if not, how the focus could be modified. This should also be included in an end of course survey.

6.4. Alignment of Learning Outcomes, Assessments, and Activities to Achieve Overall Course

Goals

The learning outcomes are the core resource in curriculum design, particularly for adult education in which participants have particular expectations of content. A focus on learning outcomes also requires the instructor to stay committed to what is considered important.

There are two well-developed and widely used approaches to curriculum development that begin with learning outcomes and that share a common approach. One is Constructive Alignment (Biggs, 1996) and the other is Backwards Design (McTighe & Wiggins, 2013). Both focus on the alignment between goals and outcomes, assessment, and learning activities, and course development should occur in this order. This focus has many positive attributes, including having evidence of the degree to which goals and outcomes are met, forcing curriculum to support goals and outcomes, and developing clear measures of success.

The next step in the development process is developing assessments that represent evidence that students are able to do the things described in the learning outcomes. In a college course, these include quiz and exam questions. However, these types of assessments are rare in professional development courses. Instead, the focus is on developing formative assessments, or questions that can be used during the course to check in with students about their understandings. These formative assessments may include multiple choice, short answer, and open-ended questions. Course designers should develop two to five questions per learning outcome. These questions may not all be implemented, depending on the layout of the course. However, many should be implemented as formative assessments during the course. Formative assessments are

those that are intended to gather feedback about what students know and used to make decisions about how and when to move to subsequent subjects.

The final step is to develop learning activities intended to facilitate student understanding of the developed learning outcomes. This consists of direct instruction using PowerPoint, notes, and other means. Information on developing these materials is not included in this document because most teachers have substantial experience in this area.

Instructors should develop active learning activities that are used throughout the course. Active learning is when students are engaged alone or in groups on course content because of specific instructions provided by the instructor. Michelene Chi developed the ICAP theory, which suggests that Interactive, Constructive, Active, and Passive learning environments are decreasingly effective on student learning (Chi and Wylie, 2014). Interactive engagement is when students work in groups on a problem that would be challenging for any of them to solve on their own. In Adult Learning this may be particularly appropriate because it will result in information sharing among participants about valuable and relevant experiences with others. Active learning and interactive engagement can take many forms, and many resources have been developed to guide instructors in the implementation. Examples are provided in Appendix 1. Examples do not distinguish between active learning and interactive engagement. The instructor will need to use judgment to determine which category the activity falls into.

6.5. Conclusion

The goal of this guidebook is to provide a summary of Adult Learning Theory and how it can and should inform the design, implementation, and evaluation of professional development courses. Appendix C provides example active learning exercises and how to implement these in in-person and online learning environments. Appendix D provides guidance on implementing

active learning exercises and gathering student responses. Appendix E provides information on tools that can be used to engage students in online learning experiences. Appendix F provides a list of resources and descriptions of these resources that may be useful in course design, implementation, and evaluation. Appendix G provides some tips on engaging students in asynchronous learning environments.

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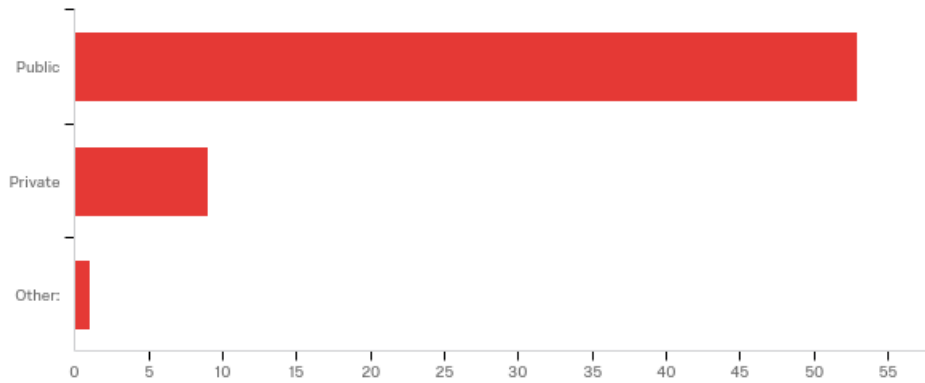
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APPENDIX A

Manager Survey Summary Report

Q4 - In which sector of transportation engineering do you work?



#	Answer	%	Count
1	Public	84.13%	53
2	Private	14.29%	9
3	Other:	1.59%	1
	Total	100%	63

Other:

Other: - Text

State Government

Q7 - What is the region in which your work applies (e.g., zip code, town, municipality)

What is the region in which your work applies (e.g., zip code, town, municipality)

Based in Juneau Alaska; responsible for Southcoast Region (SE AK, Aleutians, Kodiak, Lake and Peninsula Borough)

Southcoast Region

Alaska

Northwest 979229

99901

Alaska

Southeast Alaska

99507

State of alaska

Southeast Alaska

99502

99502

Anchorage, Alaska 99501

99811

Municipality of Anchorage, Anchorage, Alaska

99701

Municipality of Anchorage

99801

99507, Anchorage, AK

Alaska DOT Northern region ~ 65% of the state

99507

Municipality of Anchorage, Alaska

Fairbanks, Western, and Northern Alaska

99801

Alaska

All Alaska
Southcoast (zip code 99801)
Anchorage Alaska
Alaska
99708
99503
ODOT Region 1
97266
Salem Oregon
98109
Oregon
Sacramento, CA 95814
Seattle, WA
Sacramento CA
King County, WA
Portland
Seattle
98040
97301
Pullman, Washington
98004
98004
98004
98006
Washington State
99709
99709
State of Alaska

Fairbanks, AK 99709

99709

99701

Northern Region og Alaska

99709

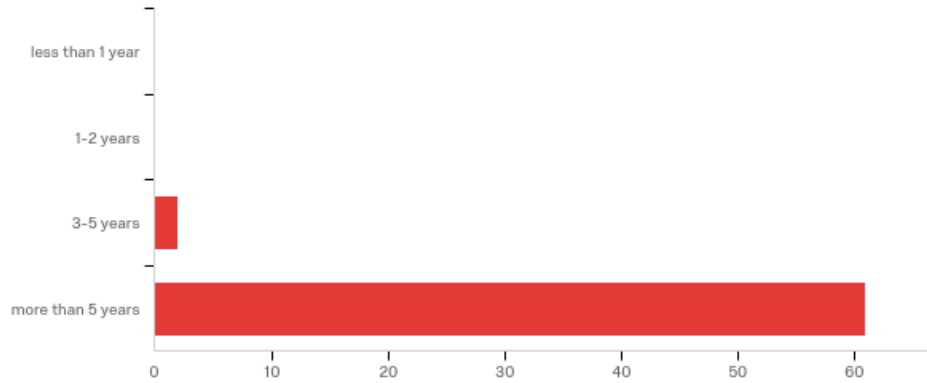
State of Alaska, Northern region

Fairbanks, AK 99709

99709

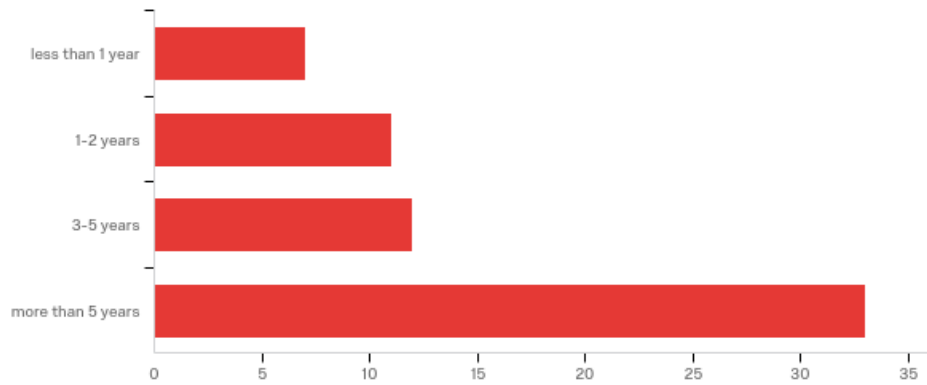
99709

Q5 - How long have you been working in the field of transportation engineering?



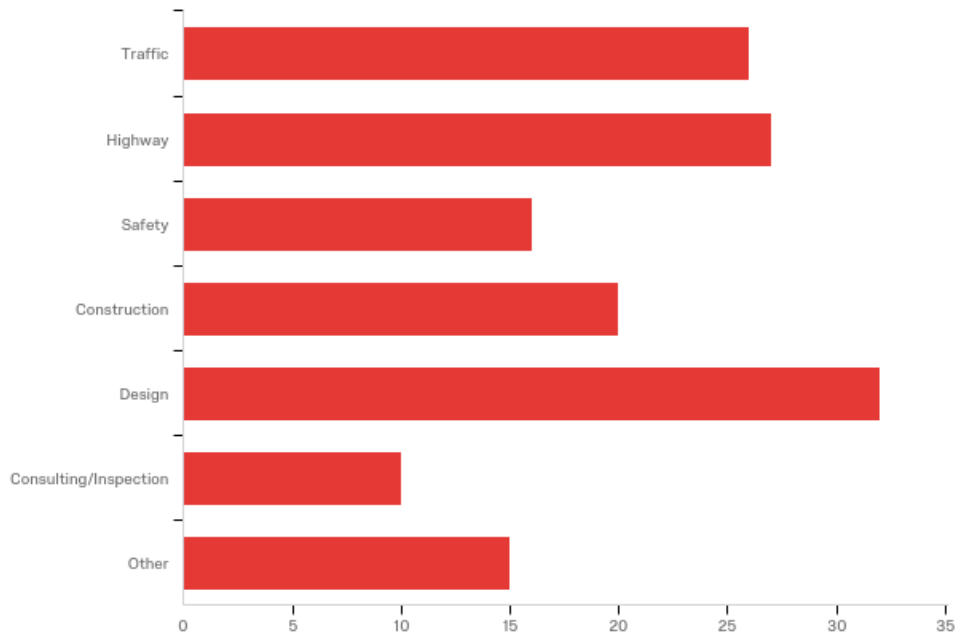
#	Answer	%	Count
1	less than 1 year	0.00%	0
2	1-2 years	0.00%	0
3	3-5 years	3.17%	2
4	more than 5 years	96.83%	61
	Total	100%	63

Q6 - How long have you been working in your current position?



#	Answer	%	Count
1	less than 1 year	11.11%	7
2	1-2 years	17.46%	11
3	3-5 years	19.05%	12
4	more than 5 years	52.38%	33
	Total	100%	63

Q8 - Which area or discipline best describes your work (check all that apply)?



#	Answer	%	Count
1	Traffic	17.81%	26
2	Highway	18.49%	27
3	Safety	10.96%	16
4	Construction	13.70%	20
5	Design	21.92%	32
6	Consulting/Inspection	6.85%	10
7	Other	10.27%	15
	Total	100%	146

Other

Other - Text

Marine Engineering & Project Management

Bridge

Heavy civil construction contract administration

ROW

Bridges and structures

utilities

Travel Modeling

Project Management

Planning

Operations

Research

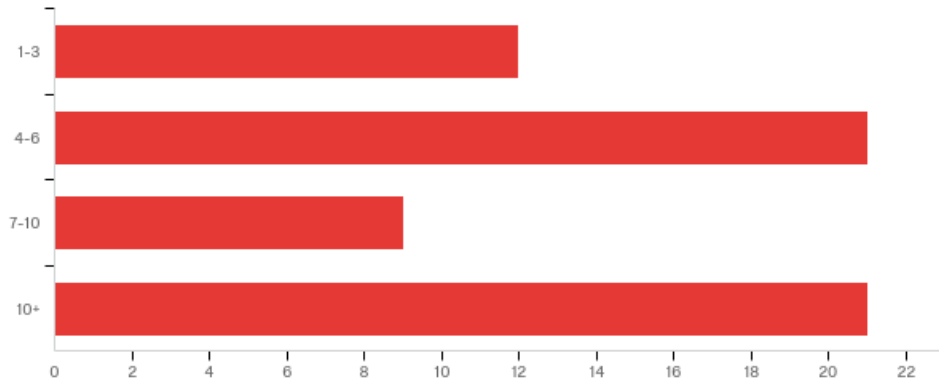
Aviation / FAA

Hydraulics

Utilities/ROW

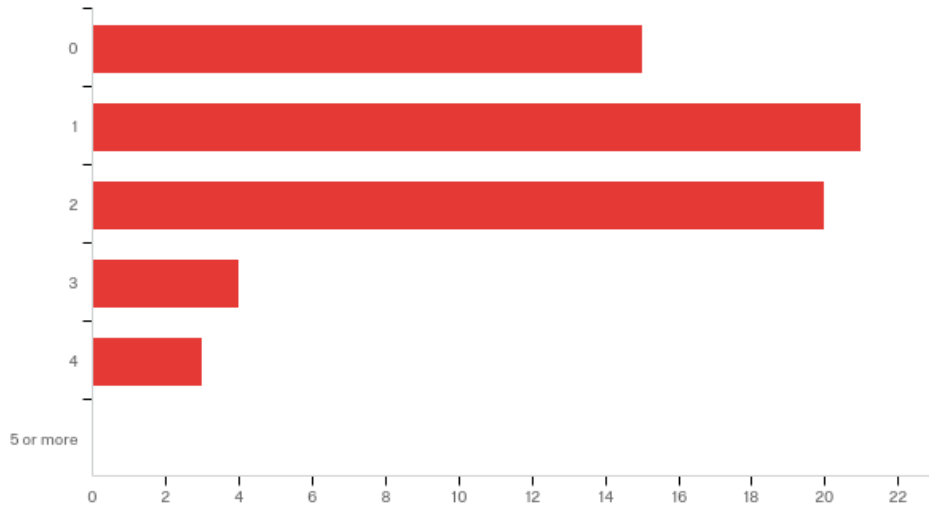
geotechnical

Q9 - How many employees do you supervise?



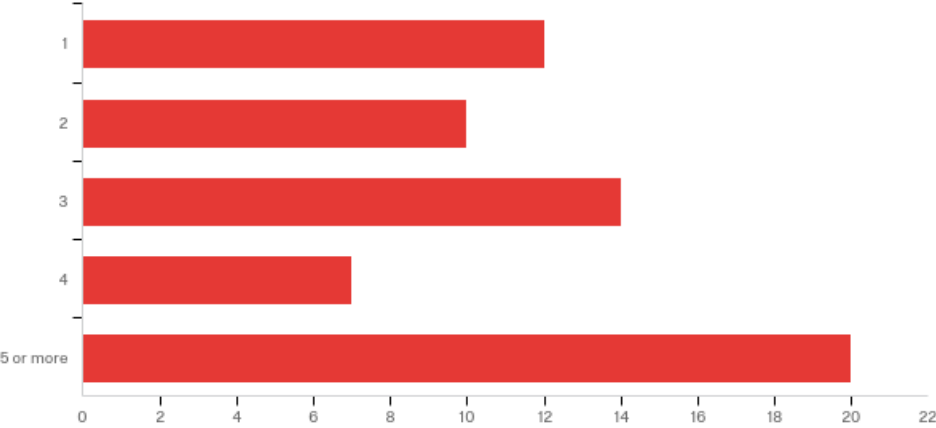
#	Answer	%	Count
1	1-3	19.05%	12
2	4-6	33.33%	21
3	7-10	14.29%	9
4	10+	33.33%	21
	Total	100%	63

Q10 - On average, how many times does a typical employee attend external training within a year?



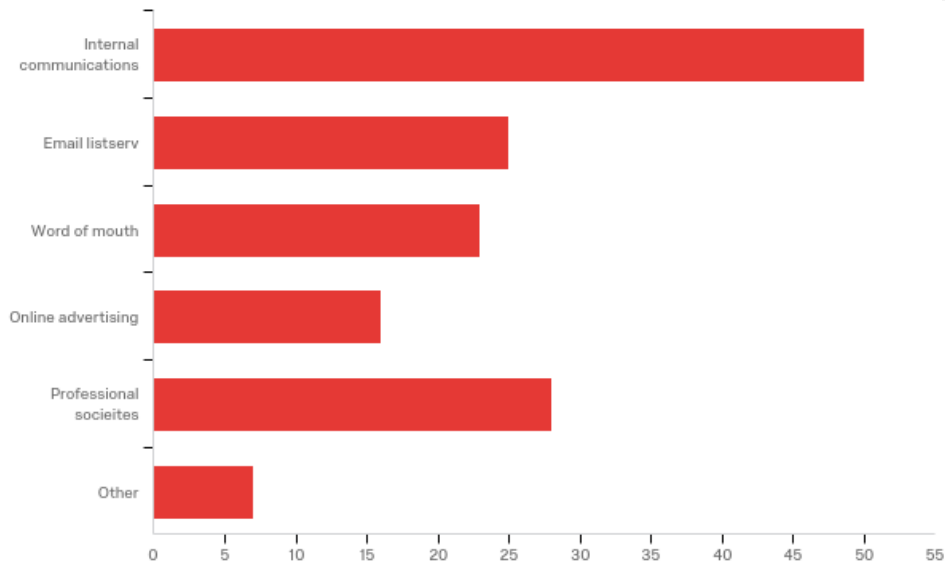
#	Answer	%	Count
6	0	23.81%	15
1	1	33.33%	21
2	2	31.75%	20
3	3	6.35%	4
4	4	4.76%	3
5	5 or more	0.00%	0
	Total	100%	63

Q11 - On average, how many times does a typical employee attend internal training within a year?



#	Answer	%	Count
1	1	19.05%	12
2	2	15.87%	10
3	3	22.22%	14
4	4	11.11%	7
5	5 or more	31.75%	20
	Total	100%	63

Q12 - How do you typically find out about training opportunities?



#	Answer	%	Count
1	Internal communications	33.56%	50
2	Email listserv	16.78%	25
3	Word of mouth	15.44%	23
4	Online advertising	10.74%	16
5	Professional societies	18.79%	28
6	Other	4.70%	7
	Total	100%	149

Other

Other - Text

Web

All the above

Local consultant engineers

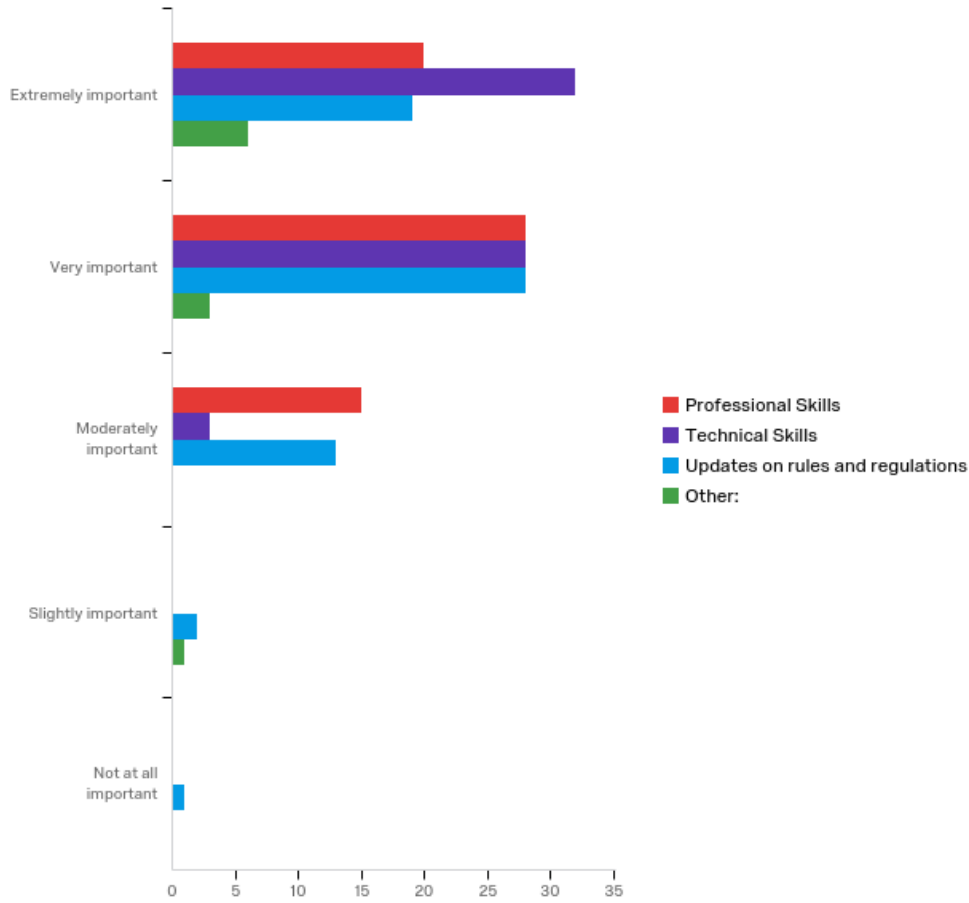
old fashion us mail

email and DOT website

NHI website

mailed flyers

Q13 - How important are the following kinds of training for employees in your workplace?



#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Professional Skills	31.75%	20	44.44%	28	23.81%	15	0.00%	0	0.00%	0	63
2	Technical Skills	50.79%	32	44.44%	28	4.76%	3	0.00%	0	0.00%	0	63
3	Updates on rules and regulations	30.16%	19	44.44%	28	20.63%	13	3.17%	2	1.59%	1	63
4	Other:	60.00%	6	30.00%	3	0.00%	0	10.00%	1	0.00%	0	10

Other:

Other: - Text

Communication skills

Safety

New Technologies

Internal cross-training

people skills

Fed-Aid program requirements

Planning

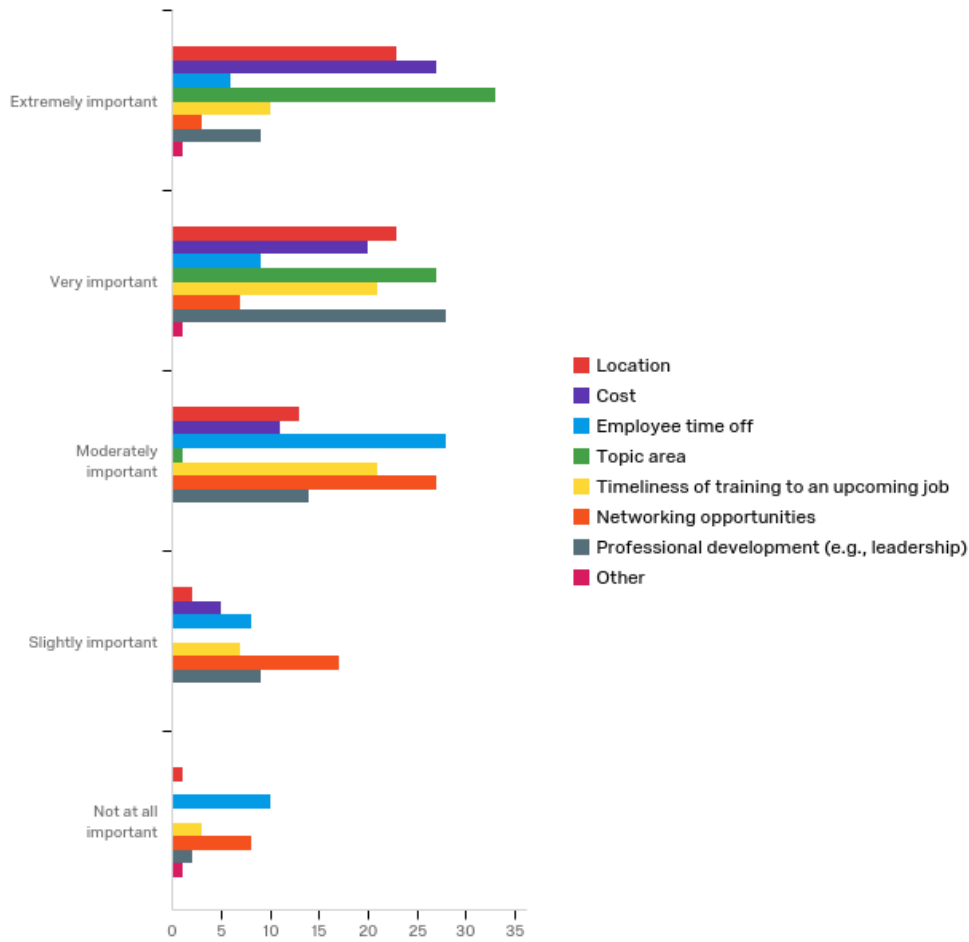
Computer Modeling

Emerging topics

People/Communication skills

Soft Skills (Communication, Leadership, etc.)

Q15 - How important are the following factors when deciding to send an employee to a particular training?



#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Location	37.10%	23	37.10%	23	20.97%	13	3.23%	2	1.61%	1	62
2	Cost	42.86%	27	31.75%	20	17.46%	11	7.94%	5	0.00%	0	63
3	Employee time off	9.84%	6	14.75%	9	45.90%	28	13.11%	8	16.39%	10	61
4	Topic area	54.10%	33	44.26%	27	1.64%	1	0.00%	0	0.00%	0	61
5	Timeliness of training to an upcoming job	16.13%	10	33.87%	21	33.87%	21	11.29%	7	4.84%	3	62
6	Networking opportunities	4.84%	3	11.29%	7	43.55%	27	27.42%	17	12.90%	8	62
7	Professional development (e.g., leadership)	14.52%	9	45.16%	28	22.58%	14	14.52%	9	3.23%	2	62
8	Other	33.33%	1	33.33%	1	0.00%	0	0.00%	0	33.33%	1	3

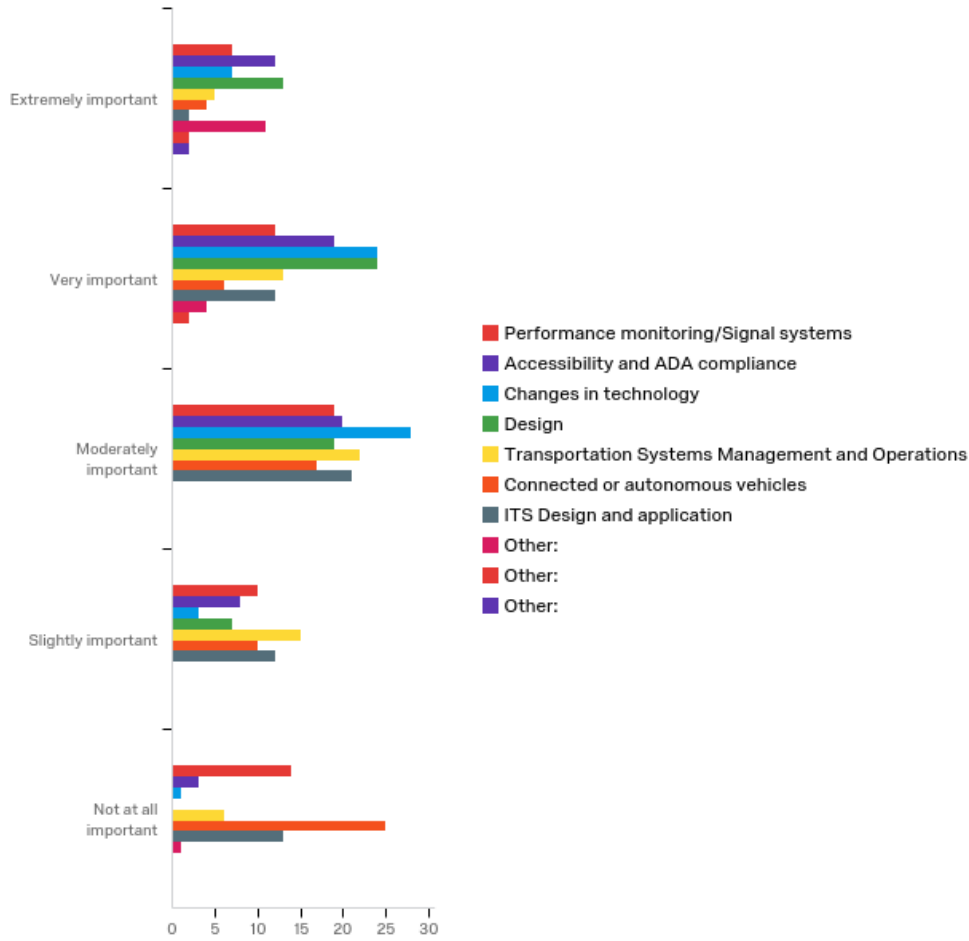
Other

Other - Text

Safety

Wide technical skills

Q16 - How important are the following topics in terms of timeliness of training needs?



#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Performance monitoring/Signal systems	11.29%	7	19.35%	12	30.65%	19	16.13%	10	22.58%	14	62
2	Accessibility and ADA compliance	19.35%	12	30.65%	19	32.26%	20	12.90%	8	4.84%	3	62
3	Changes in technology	11.11%	7	38.10%	24	44.44%	28	4.76%	3	1.59%	1	63
4	Design	20.63%	13	38.10%	24	30.16%	19	11.11%	7	0.00%	0	63
5	Transportation Systems Management and Operations	8.20%	5	21.31%	13	36.07%	22	24.59%	15	9.84%	6	61
6	Connected or autonomous vehicles	6.45%	4	9.68%	6	27.42%	17	16.13%	10	40.32%	25	62
7	ITS Design and application	3.33%	2	20.00%	12	35.00%	21	20.00%	12	21.67%	13	60
8	Other:	68.75%	11	25.00%	4	0.00%	0	0.00%	0	6.25%	1	16
9	Other:	50.00%	2	50.00%	2	0.00%	0	0.00%	0	0.00%	0	4
10	Other:	100.00%	2	0.00%	0	0.00%	0	0.00%	0	0.00%	0	2

Other:

Other: - Text

Communication with non-professionals

ROW Acquisition

AASHTOWare

structures

Public Involvement /Speaking

Active Transportation

Construction administration

Federally mandated Bridge Inspection

Construction related

Planning

Pavements

Non motorized design

Professional development for new/prospective managers

Claims and Negotiations

Utility relocations/permits

geotechnical

Other:

Other: - Text

NEPA

Writing Skills

Bridges

Construction Administration

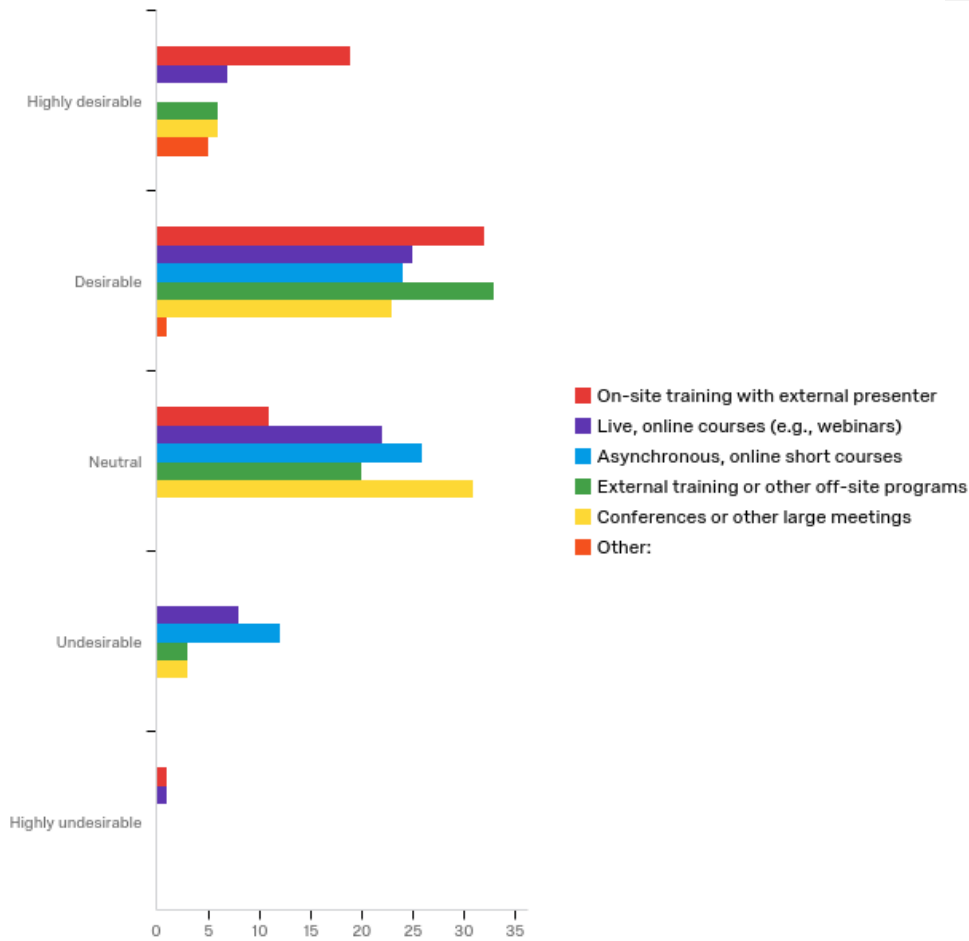
Other:

Other: - Text

Contract Admin

Soft Skills / Communication, etc.

Q18 - Please rate your preference for the following training formats.



#	Question	Highly desirable		Desirable		Neutral		Undesirable		Highly undesirable		Total
1	On-site training with external presenter	30.16%	19	50.79%	32	17.46%	11	0.00%	0	1.59%	1	63
2	Live, online courses (e.g., webinars)	11.11%	7	39.68%	25	34.92%	22	12.70%	8	1.59%	1	63
3	Asynchronous, online short courses	0.00%	0	38.71%	24	41.94%	26	19.35%	12	0.00%	0	62
4	External training or other off-site programs	9.68%	6	53.23%	33	32.26%	20	4.84%	3	0.00%	0	62
5	Conferences or other large meetings	9.52%	6	36.51%	23	49.21%	31	4.76%	3	0.00%	0	63
6	Other:	83.33%	5	16.67%	1	0.00%	0	0.00%	0	0.00%	0	6

Other:

Other: - Text

college classroom style

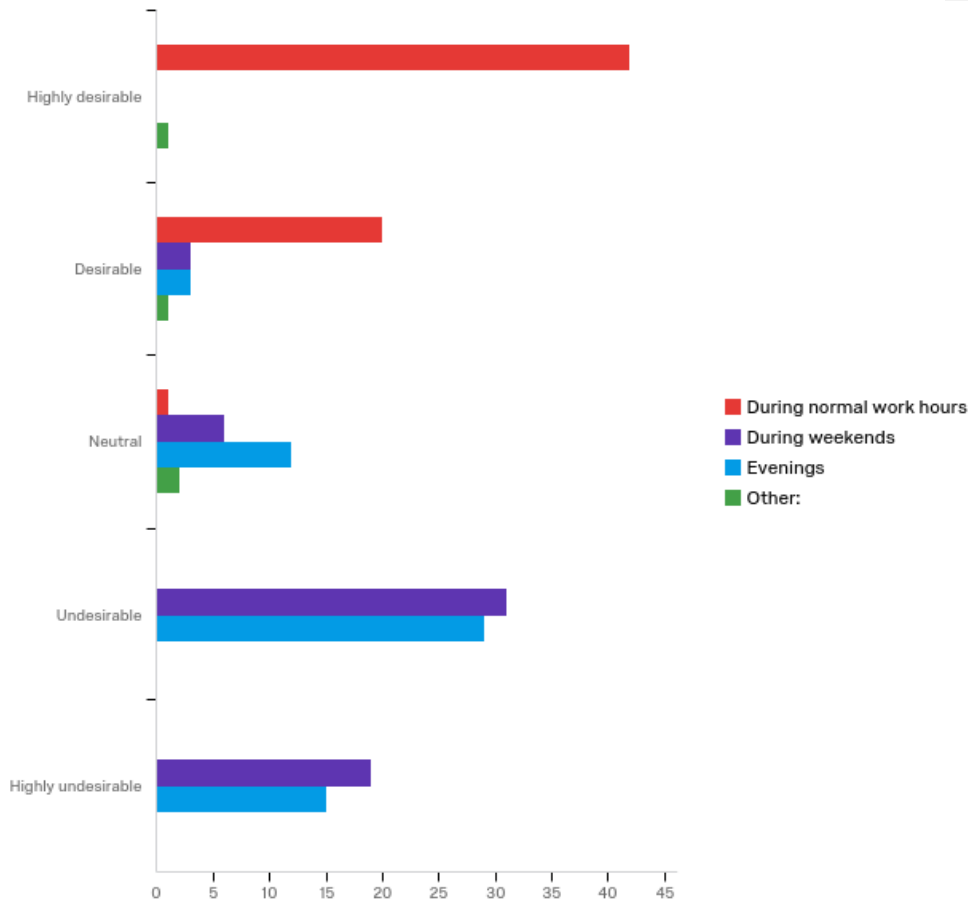
University-based short courses with homework

On site, live training

On-site training with internal presenter

On-site training with INTERNAL presenter (i.e. Peer Sharing)

Q19 - Please rate your preference regarding the timing of training opportunities.



#	Question	Highly desirable	Desirable	Neutral	Undesirable	Highly undesirable	Total
1	During normal work hours	66.67%	31.75%	1.59%	0.00%	0.00%	63
2	During weekends	0.00%	5.08%	10.17%	52.54%	32.20%	59
3	Evenings	0.00%	5.08%	20.34%	49.15%	25.42%	59
4	Other:	25.00%	25.00%	50.00%	0.00%	0.00%	4

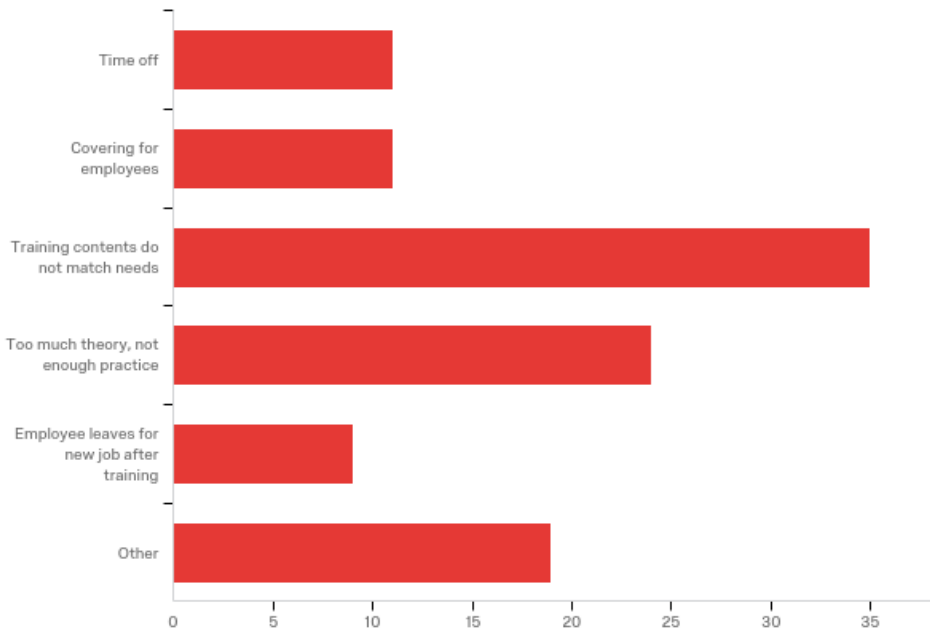
Other:

Other: - Text

Small group: peers/multidiscipline

Between the months of October - April

Q14 - Which factors are the biggest limitations or drawbacks to training programs?



#	Answer	%	Count
1	Time off	10.09%	11
2	Covering for employees	10.09%	11
3	Training contents do not match needs	32.11%	35
4	Too much theory, not enough practice	22.02%	24
5	Employee leaves for new job after training	8.26%	9
6	Other	17.43%	19
	Total	100%	109

Other

Other - Text

COST

Travel & Perdiem Cost

Long weeks. Usually done while keeping up with work.

Not new information

cost

Lack of funds.

Cost

no training money

Gauging how effective the training will be ahead of time

Not enough homework which is really needed to acquire / learn new material

travel cost

cost

Cost

cost

Availability when needed (just in time training)

Cost

Available funds

Lack of funding, remote location makes travel expensive and hard to get classes brought here.

no funding available for training

Q17 - Are there any topics for which you would like training but that are not currently available or personally accessible?

Are there any topics for which you would like training but that are not currently available or personally accessible?

We have the ability to request specific training as needed - so no.

Office Engineering practices

Innumerable

Highway Construction Specification development

Communication skills with non-professionals (average citizens/laypersons). Management of small teams

No

no

No.

Construction Administration Software in general

No

Federal, State, and Local Funding 101 for Projects (Design thru Construction)

unknown

Utility training, railroads, fiber optic

No

An periodical overview of 'what's new' would be very helpful.

Hydraulic Engineering Topics

Autonomous Vehicle Implications

Asphalt paving, bridge, retaining wall (construction or contract admin based)

No

data storytelling

Nope

Systems Operations Documents for Adaptive Signal Networks

no

Multimodal transportation

no

why is there a silly war on cars and a hatred of freeways?

Technician training -- most training focuses on engineering employees

Connected Vehicles

NACTO and Vision Zero

Construction's input on lesson's learned - big picture - what to look for when designing or reviewing projects?

no

Leadership, managing resources

skip tracing & archive research

No

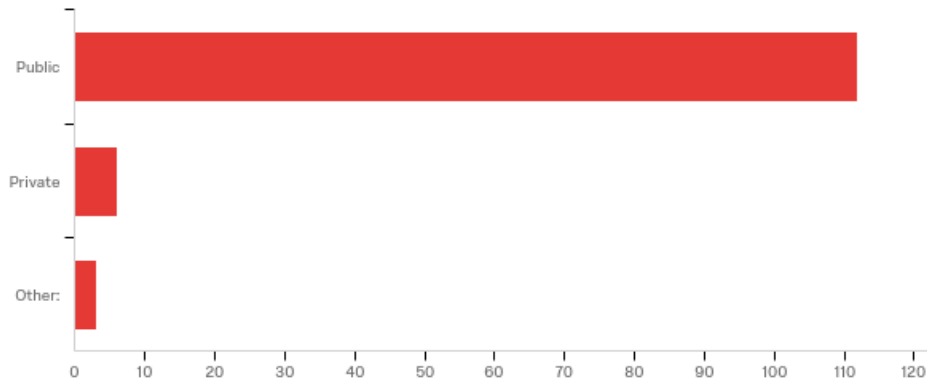
Needs to be more training for utility coordination and relocation. More training on the applicable state laws and how they interact with FHWA/FAA regulations.

aviation base training - covering AC's

APPENDIX B

Engineering Practitioner Survey Report

Q20 - In which sector of transportation engineering do you work?



#	Answer	%	Count
1	Public	92.56%	112
2	Private	4.96%	6
3	Other:	2.48%	3
	Total	100%	121

Other:

Other: - Text

N/A

academia

Q21 - In which zip code do you conduct most of your work?

In which zip code do you conduct most of your work?

99500

T2M1M3

98005

99801

99709

98009

99508

99519

97301

99518

99503

99501

99701

99709

99780

99508

99503

99801

99925

99833

99508

99519

99503

97210

Statwide

Various, by county would be Lincoln, Benton, Lane, Polk, Yamhill, and Marion

97470

97302

972xx

83709

97302

98516

98004

97850

97209

97301

97301

97301

98057

97209

97302

97471

97301

97301

97301

98004

97333

Jackson, Josephine, Coos Curry & Douglas Counties Equally

97527

97301

97302

98004

97209

97302

97850

97302

97301

92501

98004

Norway

98155

97330

83703

83844

97205

98004

98004

98004

98004

98004

98004

98004

98005

98008

98004

98004

98009

98004

98009

99762

99709

97302

97701

97301

97306

99701

99709

97302

99701

97301

99709

97301

97302

99707

99712

99709

97302

97703

97703

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99712

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99701

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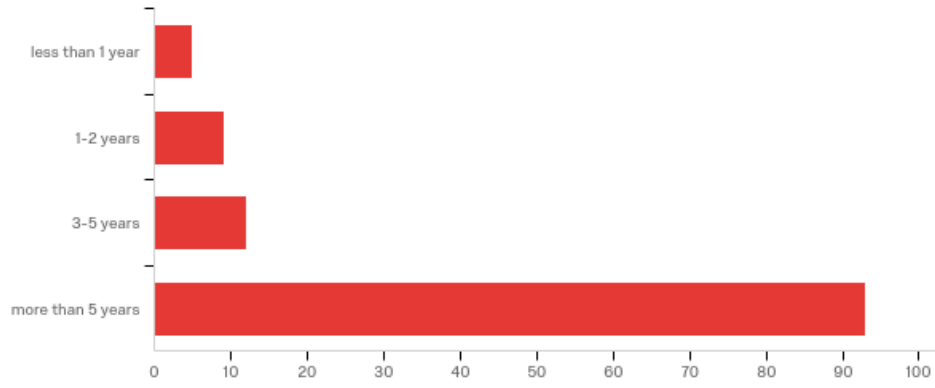
99709

99709

99701

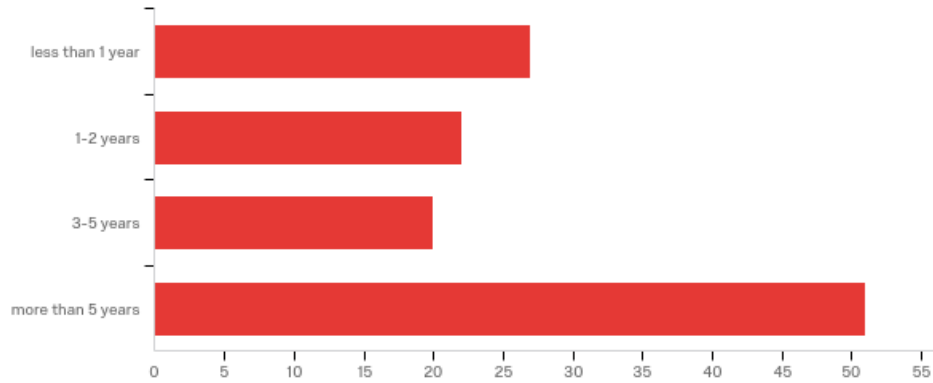
99708

Q22 - How long have you been working in the field of transportation engineering?



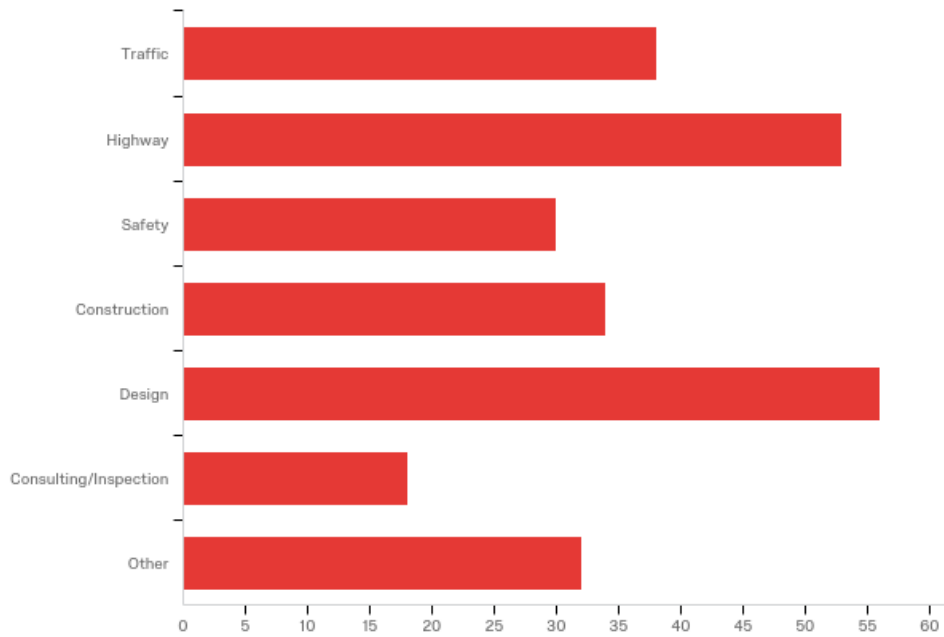
#	Answer	%	Count
1	less than 1 year	4.20%	5
2	1-2 years	7.56%	9
3	3-5 years	10.08%	12
4	more than 5 years	78.15%	93
	Total	100%	119

Q23 - How long have you been working in your current position?



#	Answer	%	Count
1	less than 1 year	22.50%	27
2	1-2 years	18.33%	22
3	3-5 years	16.67%	20
4	more than 5 years	42.50%	51
	Total	100%	120

Q24 - Which area or discipline best describes your work (check all that apply)?



#	Answer	%	Count
1	Traffic	14.56%	38
2	Highway	20.31%	53
3	Safety	11.49%	30
4	Construction	13.03%	34
5	Design	21.46%	56
6	Consulting/Inspection	6.90%	18
7	Other	12.26%	32
	Total	100%	261

Other

Other - Text

Planning

Planning

Planning

Policy

Maintenance and Operations

Maintenance and Operations

Active Transportation

Civil Rights and Realty

Audit

Survey

Survey

bridge

Human Resources

Roadway

Technology Development

Right of Way

Environmental permitting

Data Management

Hydraulics

Permitting

Asset Management

Load rating

Communications

Research

Research

Planning

fuels and materials

Locations Surveyor

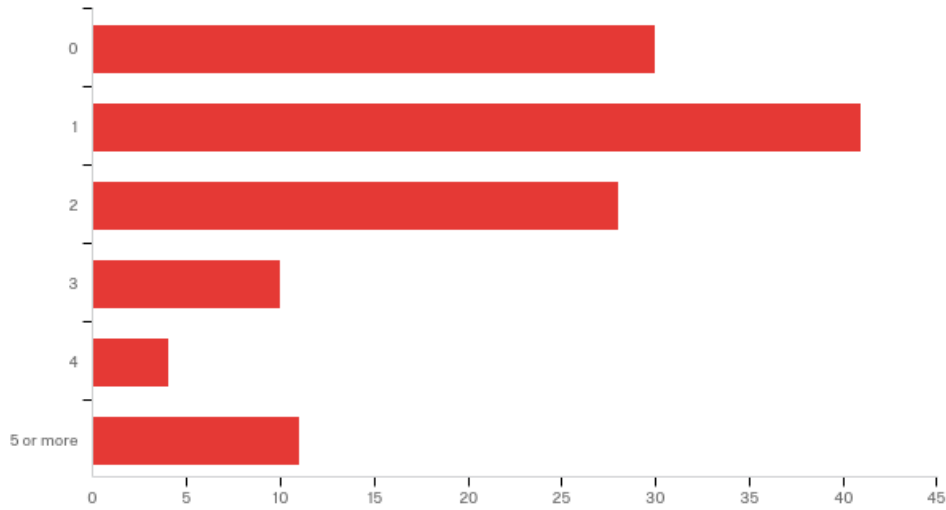
Admin

Utilities (Highways)

ROW

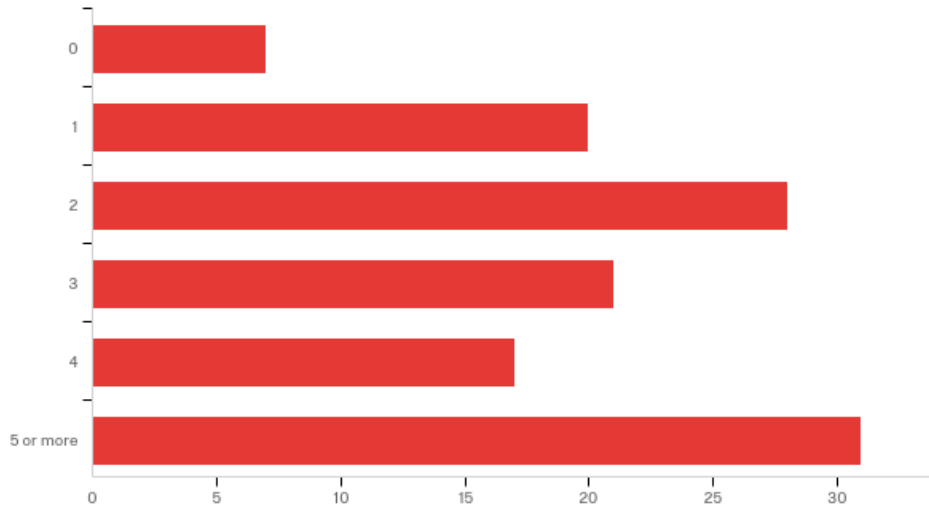
Utilities

Q26 - On average, how many times do you attend external training within a year?



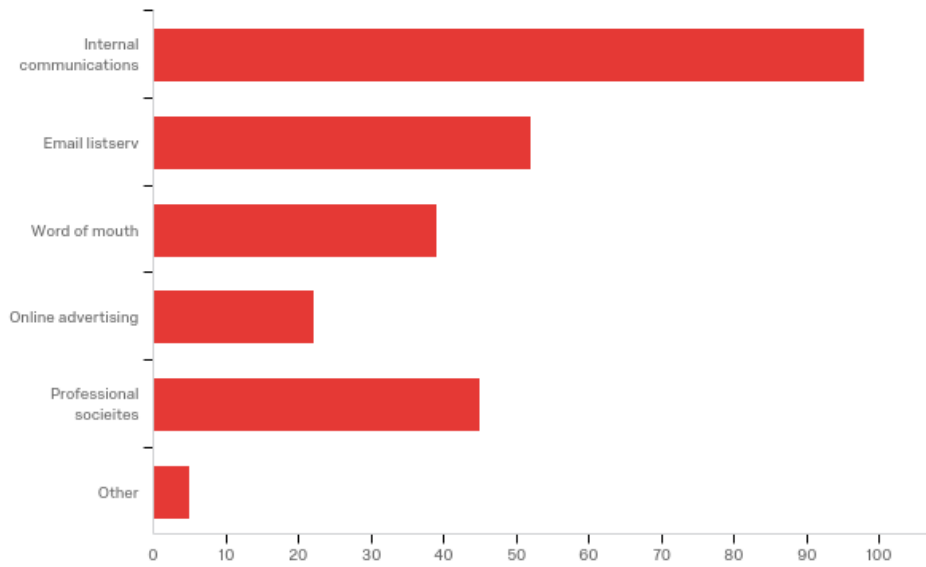
#	Answer	%	Count
6	0	24.19%	30
1	1	33.06%	41
2	2	22.58%	28
3	3	8.06%	10
4	4	3.23%	4
5	5 or more	8.87%	11
	Total	100%	124

Q27 - On average, how many times do you attend internal training within a year?



#	Answer	%	Count
6	0	5.65%	7
1	1	16.13%	20
2	2	22.58%	28
3	3	16.94%	21
4	4	13.71%	17
5	5 or more	25.00%	31
	Total	100%	124

Q28 - How do you typically find out about training opportunities?



#	Answer	%	Count
1	Internal communications	37.55%	98
2	Email listserv	19.92%	52
3	Word of mouth	14.94%	39
4	Online advertising	8.43%	22
5	Professional societies	17.24%	45
6	Other	1.92%	5
	Total	100%	261

Other

Other - Text

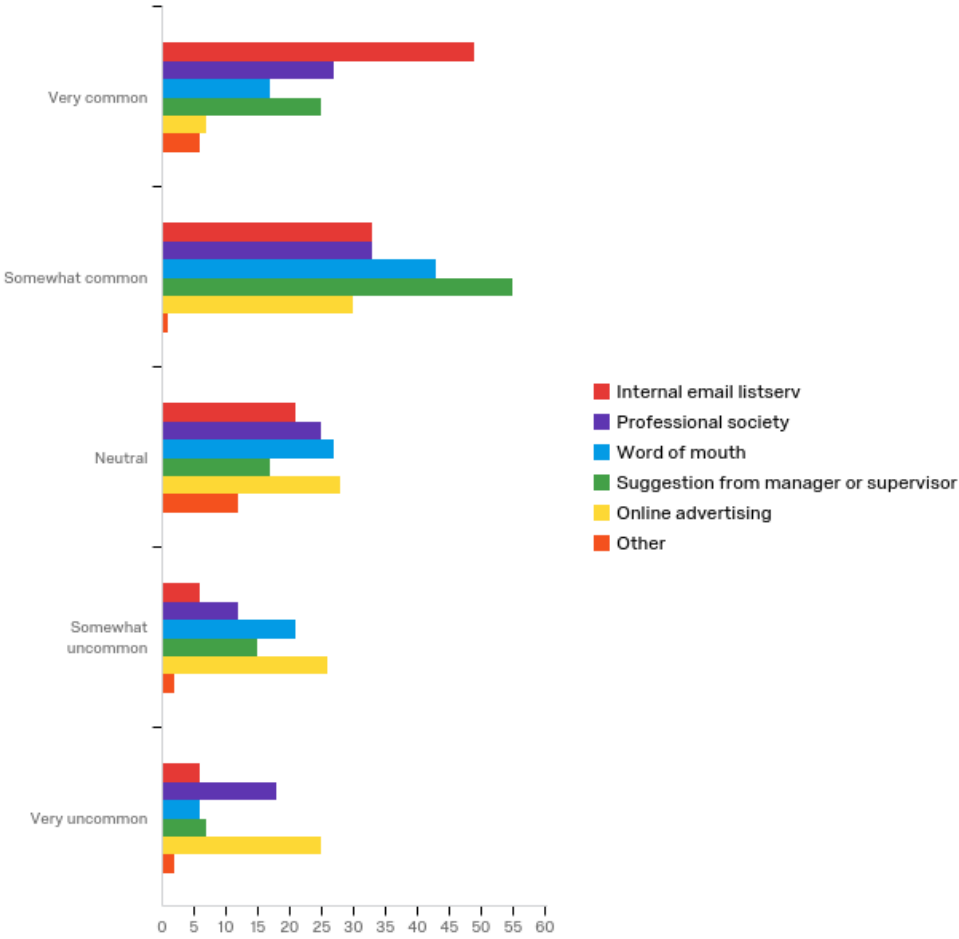
Internal website

Searching

Dept. Training website

Ilearn

Q36 - How common are the following methods in discovering training opportunities?



#	Question	Very common		Somewhat common		Neutral		Somewhat uncommon		Very uncommon		Total
1	Internal email listserv	42.61%	49	28.70%	33	18.26%	21	5.22%	6	5.22%	6	115
2	Professional society	23.48%	27	28.70%	33	21.74%	25	10.43%	12	15.65%	18	115
3	Word of mouth	14.91%	17	37.72%	43	23.68%	27	18.42%	21	5.26%	6	114
4	Suggestion from manager or supervisor	21.01%	25	46.22%	55	14.29%	17	12.61%	15	5.88%	7	119
5	Online advertising	6.03%	7	25.86%	30	24.14%	28	22.41%	26	21.55%	25	116
6	Other	26.09%	6	4.35%	1	52.17%	12	8.70%	2	8.70%	2	23

Other

Other - Text

Twitter, LinkedIn, Facebook

Internal website

Searching

ept Training website

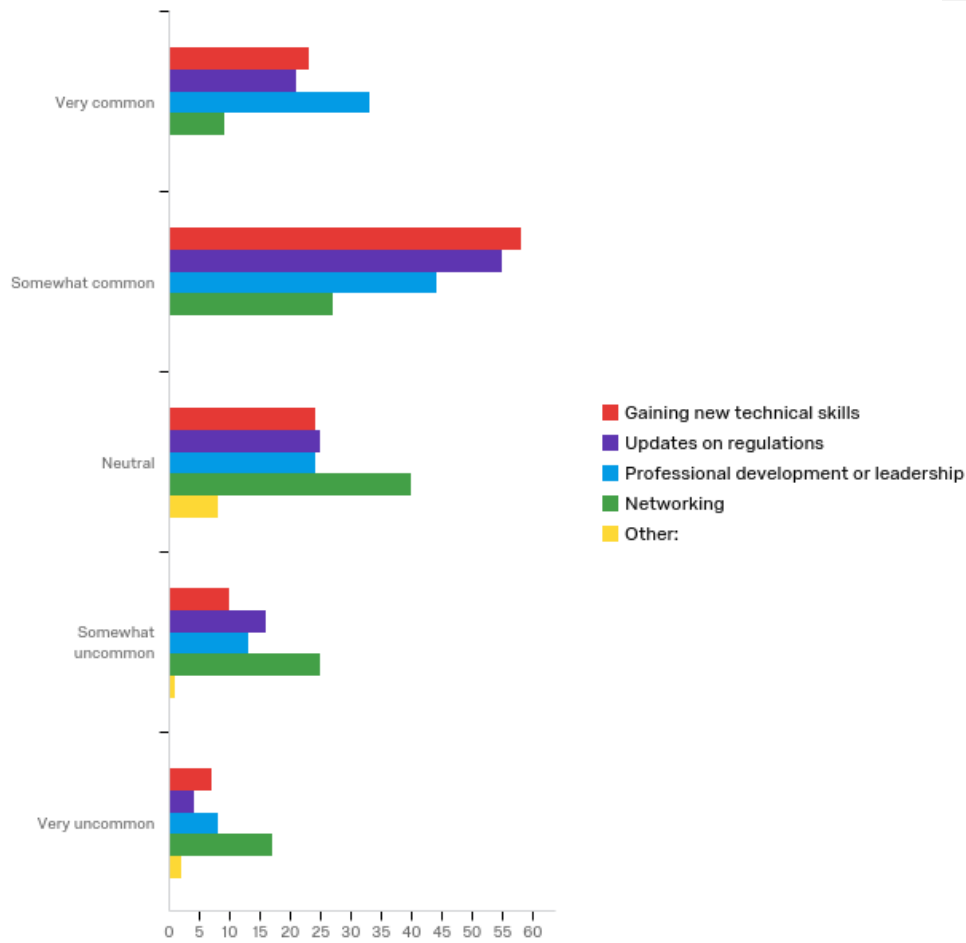
Search the internet

Twitter/Advocacy

internal publications

School announcements

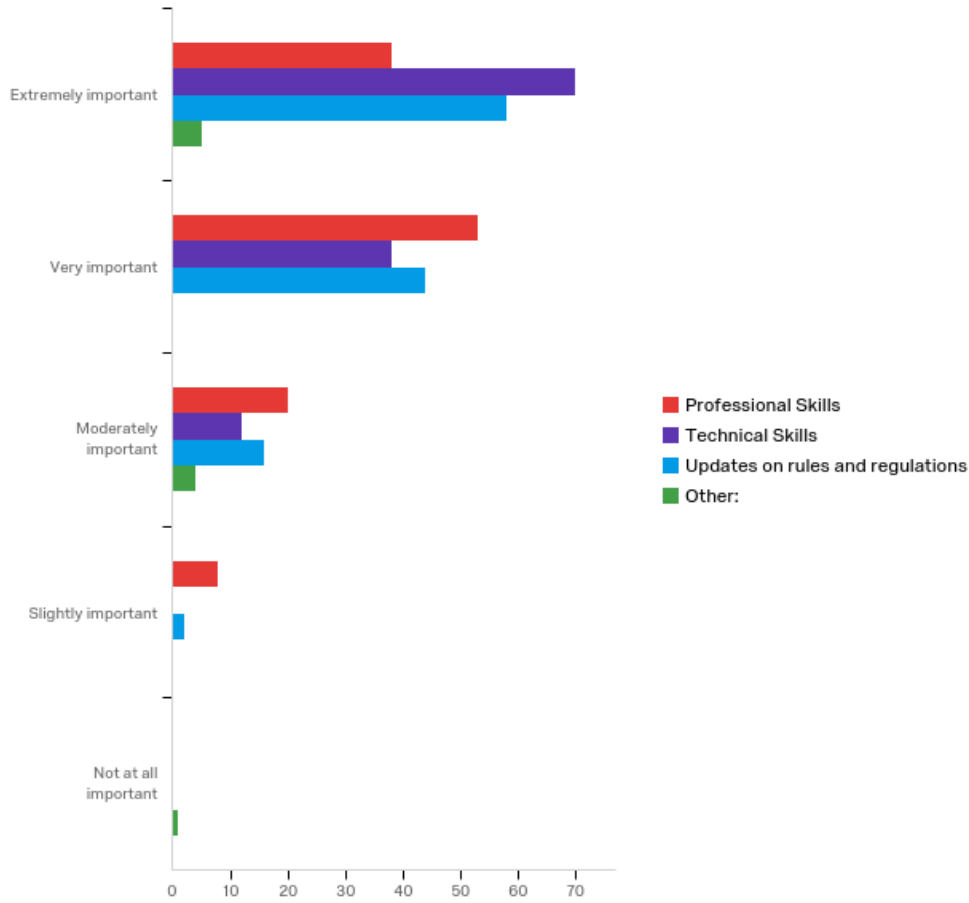
Q37 - How common are training opportunities related to the following topics or content areas?



#	Question	Very common		Somewhat common		Neutral		Somewhat uncommon		Very uncommon		Total
1	Gaining new technical skills	18.85%	23	47.54%	58	19.67%	24	8.20%	10	5.74%	7	122
2	Updates on regulations	17.36%	21	45.45%	55	20.66%	25	13.22%	16	3.31%	4	121
3	Professional development or leadership	27.05%	33	36.07%	44	19.67%	24	10.66%	13	6.56%	8	122
4	Networking	7.63%	9	22.88%	27	33.90%	40	21.19%	25	14.41%	17	118
5	Other:	0.00%	0	0.00%	0	72.73%	8	9.09%	1	18.18%	2	11

Other:
Other: - Text

Q29 - How important are the following kinds of training for employees in your workplace?



#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Professional Skills	31.93%	38	44.54%	53	16.81%	20	6.72%	8	0.00%	0	119
2	Technical Skills	58.33%	70	31.67%	38	10.00%	12	0.00%	0	0.00%	0	120
3	Updates on rules and regulations	48.33%	58	36.67%	44	13.33%	16	1.67%	2	0.00%	0	120
4	Other:	50.00%	5	0.00%	0	40.00%	4	0.00%	0	10.00%	1	10

Other:

Other: - Text

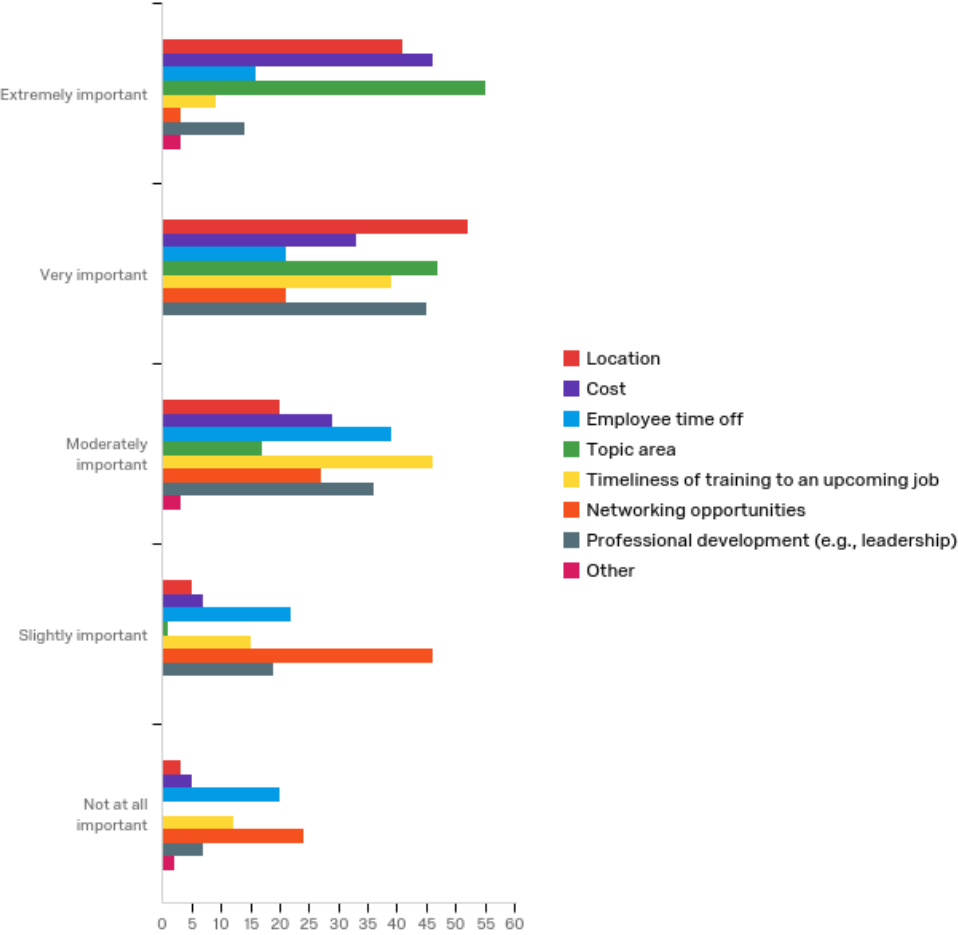
Certification Training

networking

Advancement Skills

PDH's/CEUs

Q30 - How important are the following factors when deciding to attend a particular training?



#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Location	33.88%	41	42.98%	52	16.53%	20	4.13%	5	2.48%	3	121
2	Cost	38.33%	46	27.50%	33	24.17%	29	5.83%	7	4.17%	5	120
3	Employee time off	13.56%	16	17.80%	21	33.05%	39	18.64%	22	16.95%	20	118
4	Topic area	45.83%	55	39.17%	47	14.17%	17	0.83%	1	0.00%	0	120
5	Timeliness of training to an upcoming job	7.44%	9	32.23%	39	38.02%	46	12.40%	15	9.92%	12	121
6	Networking opportunities	2.48%	3	17.36%	21	22.31%	27	38.02%	46	19.83%	24	121
7	Professional development (e.g., leadership)	11.57%	14	37.19%	45	29.75%	36	15.70%	19	5.79%	7	121
8	Other	37.50%	3	0.00%	0	37.50%	3	0.00%	0	25.00%	2	8

Other

Other - Text

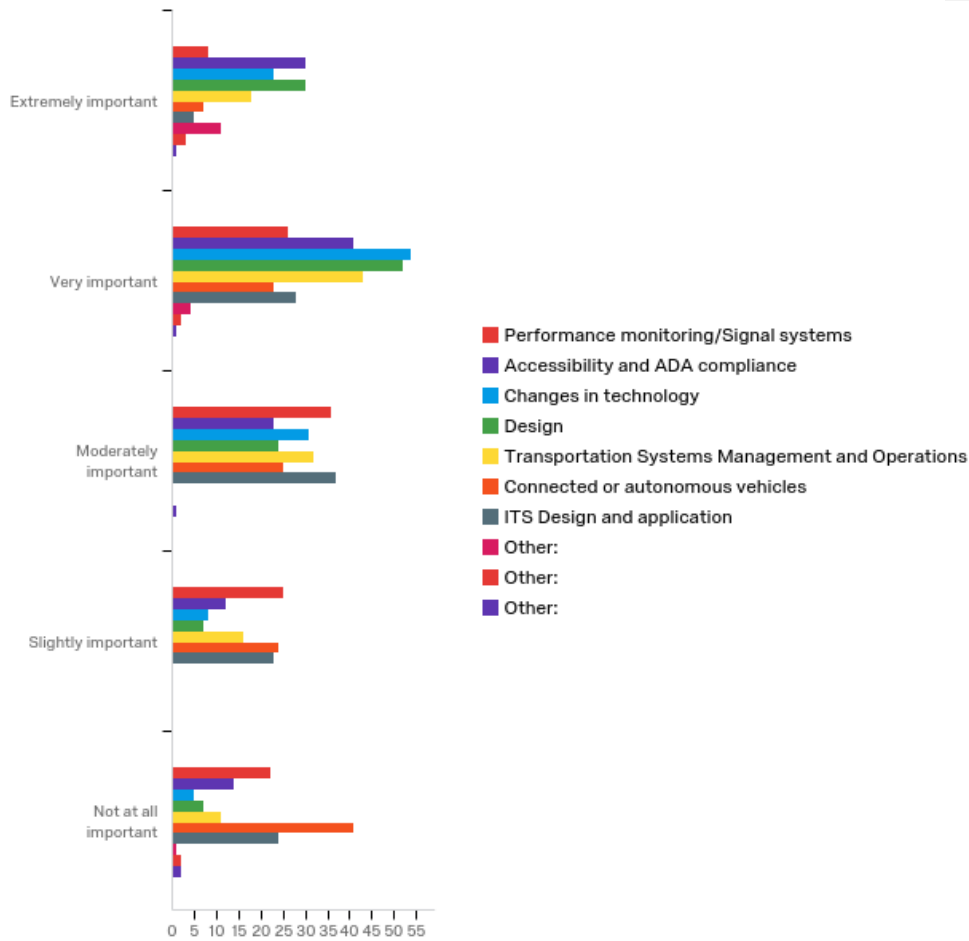
PDH

Training budget available

Relevance

Nepotism / Favoritism

Q31 - How important are the following topics in terms of timeliness of training needs?



#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Performance monitoring/Signal systems	6.84%	8	22.22%	26	30.77%	36	21.37%	25	18.80%	22	117
2	Accessibility and ADA compliance	25.00%	30	34.17%	41	19.17%	23	10.00%	12	11.67%	14	120
3	Changes in technology	19.01%	23	44.63%	54	25.62%	31	6.61%	8	4.13%	5	121
4	Design	25.00%	30	43.33%	52	20.00%	24	5.83%	7	5.83%	7	120
5	Transportation Systems Management and Operations	15.00%	18	35.83%	43	26.67%	32	13.33%	16	9.17%	11	120
6	Connected or autonomous vehicles	5.83%	7	19.17%	23	20.83%	25	20.00%	24	34.17%	41	120
7	ITS Design and application	4.27%	5	23.93%	28	31.62%	37	19.66%	23	20.51%	24	117
8	Other:	68.75%	11	25.00%	4	0.00%	0	0.00%	0	6.25%	1	16
9	Other:	42.86%	3	28.57%	2	0.00%	0	0.00%	0	28.57%	2	7
10	Other:	20.00%	1	20.00%	1	20.00%	1	0.00%	0	40.00%	2	5

Other:

Other: - Text

Safety, walking, cycling

Regulation updates

Sustainable Products

Environmental implications

Auditing AASHTO

Survey/LiDar

Engineering Geology

Don't Know

Funding Regulation and Compliance

Work zones

Highway Safety and applications to those identified above

Arctic Design

Uniform Act

Accountability

Other:

Other: - Text

Active Transportation

Regulatory oversight

Geotechnical Engineering

Project Management

Ethics

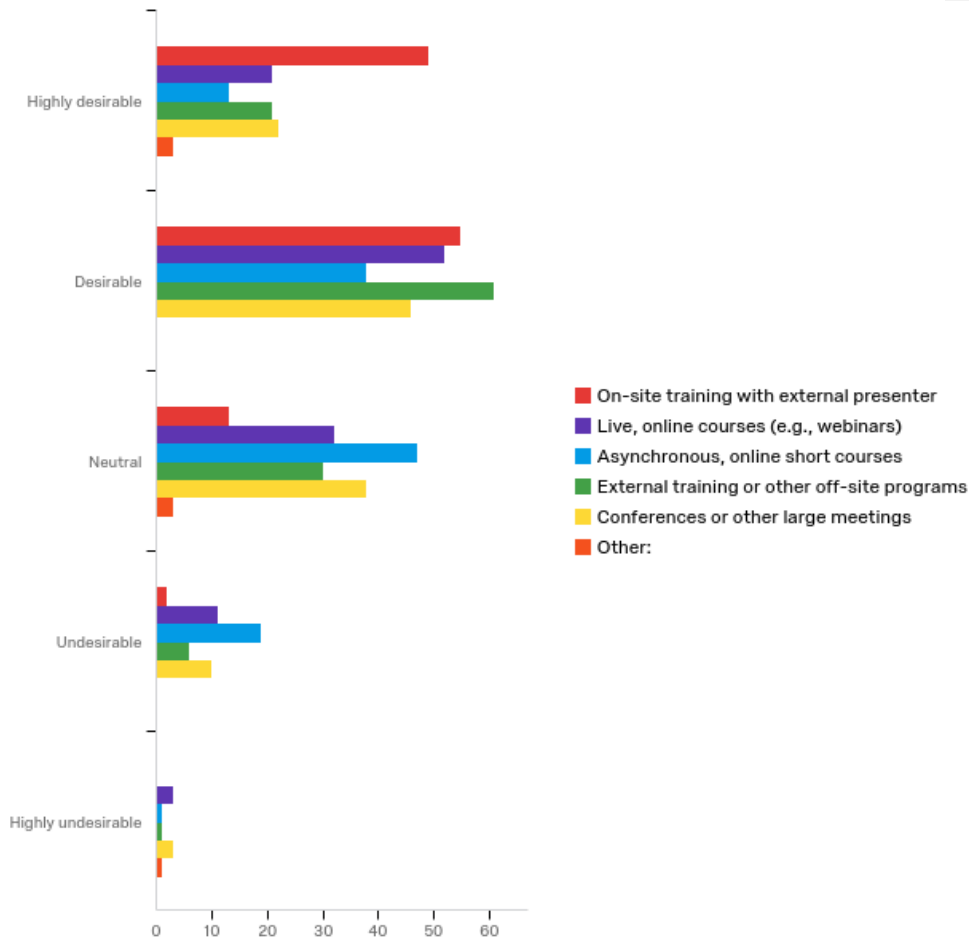
Other:

Other: - Text

Public Involvement

Contract Administration

Q32 - Please rate your preference for the following training formats.



#	Question	Highly desirable		Desirable		Neutral		Undesirable		Highly undesirable		Total
1	On-site training with external presenter	41.18%	49	46.22%	55	10.92%	13	1.68%	2	0.00%	0	119
2	Live, online courses (e.g., webinars)	17.65%	21	43.70%	52	26.89%	32	9.24%	11	2.52%	3	119
3	Asynchronous, online short courses	11.02%	13	32.20%	38	39.83%	47	16.10%	19	0.85%	1	118
4	External training or other off-site programs	17.65%	21	51.26%	61	25.21%	30	5.04%	6	0.84%	1	119
5	Conferences or other large meetings	18.49%	22	38.66%	46	31.93%	38	8.40%	10	2.52%	3	119
6	Other:	42.86%	3	0.00%	0	42.86%	3	0.00%	0	14.29%	1	7

Other:

Other: - Text

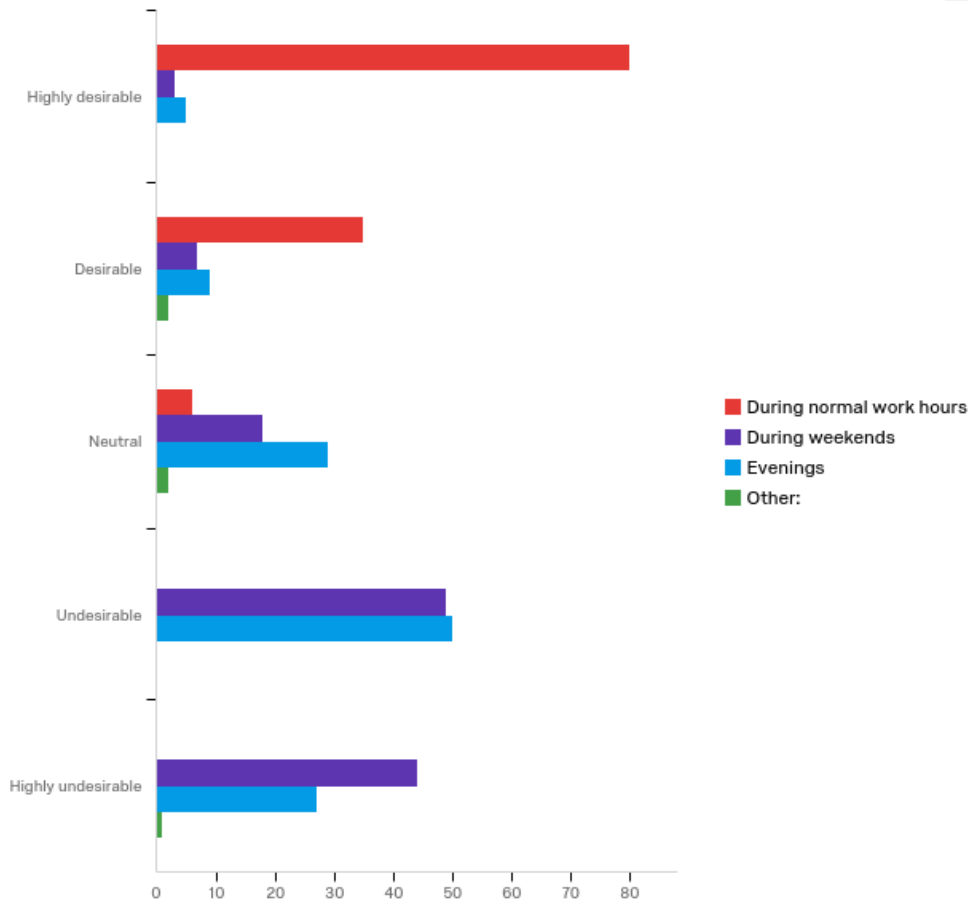
internal training with internal staff

WTH is Asynchronous?

Self Study

Classroom training through university

Q33 - Please rate your preference regarding the timing of training opportunities.



#	Question	Highly desirable	Desirable	Neutral	Undesirable	Highly undesirable	Total
1	During normal work hours	66.12%	28.93%	4.96%	0.00%	0.00%	121
2	During weekends	2.48%	5.79%	14.88%	40.50%	36.36%	121
3	Evenings	4.17%	7.50%	24.17%	41.67%	22.50%	120
4	Other:	0.00%	40.00%	40.00%	0.00%	20.00%	5

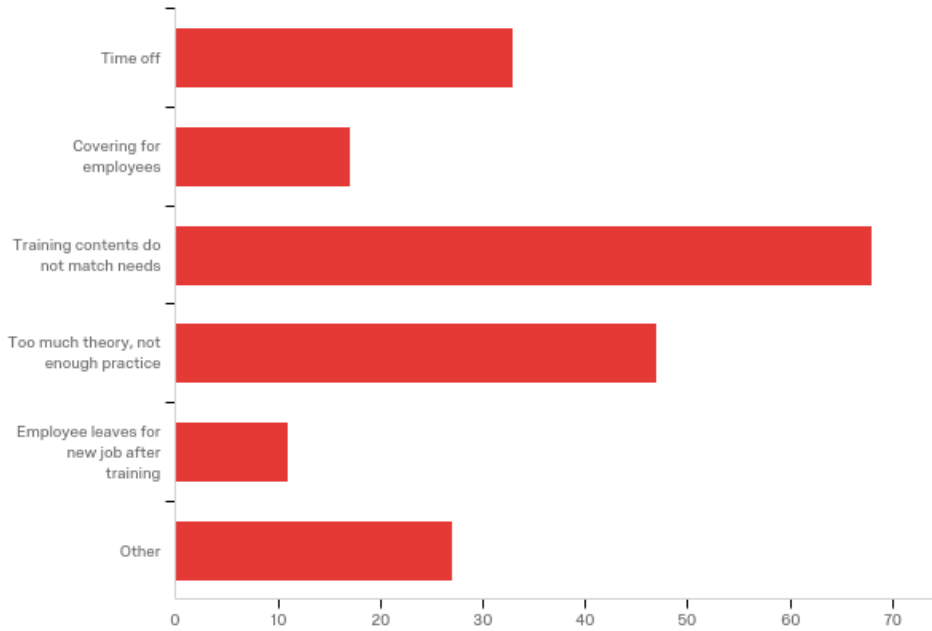
Other:

Other: - Text

on the web to gain knowledge like a tedX talk

Vacations

Q34 - Which factors are the biggest limitations or drawbacks to training programs?



#	Answer	%	Count
1	Time off	16.26%	33
2	Covering for employees	8.37%	17
3	Training contents do not match needs	33.50%	68
4	Too much theory, not enough practice	23.15%	47
5	Employee leaves for new job after training	5.42%	11
6	Other	13.30%	27
	Total	100%	203

Other

Other - Text

Not enough ongoing training in a laid-out format

Training budget

Employer denies opportunity

Cost of travel to attend and lack of, or prerequisites for online courses

budget restraints

Cost

Scarcity

Work diversity makes training often silly... I use little of my degree let alone a short professional course

No \$\$ set aside for training.

knowledge of whats available

Certification training preferred over formal education

training efficiency, workload, convenience

Cost

Limited location, inability to travel out of state to attend

Current workload

Not very many opportunities offered and those that are offered are repetative.

Too much paper work to apply to attend training outside and inside the State. Please symplify the process!

at 60 years less training

Conflicts with deadlines or other applicable trainings

Lack of employer support for external or out-of-town/State training opportunities that require ANY travel.

associated cost of training

Location

Cost

funding

Immediate Application (knowledge loss after training)

agency funding

Cost

Q35 - Are there any topics for which you would like training but that are not currently available or personally accessible?

Are there any topics for which you would like training but that are not currently available or personally accessible?

Complete streets, equity, walking and cycling

not at the momeent

Linkage between Planning, Programming and Project Development

AASHTO Geometric Design

Aviation

Regulatory environmental compliance all topics

Drainage design, hydraulic modelling, fish passage culvert design.

No

N/A

no

thanks

No

AASHTO 48 CFR 31.2

general web based training like TedX talks.

N/A

leadership skills, PEOPLE management skills

Training on our guidance docuemens, manuals and applicable laws, such as the Oregon Highway design manual, bike bill, the Oregon Bike and Pedestrain Plan. Actual human scale design training for roadway designers. Land use concepts for roadway designers. Multimodal transportation creative design courses.

Northwest Geotechnical Workshop, Highway Geology Symposium

How to make your boss care about his/her employees? Should we develop EIT or continue to burn them out and make them cynical mutes.

3D CAD and/or structural (bridge) BIM

unknown

No.

Advanced ArcGIS, Python, Visual Basic

Yes. External training is not normally allowed because of 1) no funding for training, 2) statewide travel bans for State employees that are not in upper management, 3) Agency concern regarding "public perceptions"

no

Roundabouts and Urban Ped and Bike design

No

ArcGIS Online

Hydraulics

computer programs related to my position

PE Exam Review

no

no

no

PowerPoint skills

No

no

None

NA

n/a

Efficient Communication, dealing to high-maintenance team members

Federal administration of contracts, including requirements for specifications.

fiber networking basics

field applications

structural pole information, base design, signal design

electric vehicles as it relates to infrastructure planning, urban design as it relates to engineering design and project performance, franchise utility infrastructure planning, property acquisition processes and federal guidelines, impacts of autonomous vehicles and 5G technologies integrated into public infrastructure

no

N/A

NO

Advanced training classes for ArcGIS, C3D. Classes for career advancement such as PE/FE Exam study workshops.

no

How to incorporate safety culture in Oregon.

Corsim, QuickZone

Hands on sUAV training and CIVIL3D course

no

no

Practical ADA course (with standard applications and lots of exceptions to standard situations)

Not that I can think of

Infraworks

ADA Design for Temporary Traffic Control

Team Building, Change Management

Trainings related to hydraulics.

3D, 4D and 5D Construction Visualizations and Time vs. Cost Constructability Models

Additional transportation safety training, statistical training and applications to safety,

ArcGIS or similar, Adobe forms or similar form building software,

n/a

none

No

n/a

Right of Way

No

Hydrology, hydraulics, climate impact resiliency

Design considerations for low volume, permafrost/discontinuous permafrost/warm permafrost, or other non-standard conditions

Utility Design for state agencies dealing with Utility relocates by others.

GIS training

no

No

No

APPENDIX C

Interactive Learning Examples

1. Minute Paper

Brief Description

The Minute Paper is a classroom assessment technique that is used by instructors to gain feedback from students on their understanding of course material. The assessment tool can be beneficial for instructors because students are asked to provide feedback by self-reflecting on their learning as opposed to simply recalling facts that were learned in lecture. This added dimension can provide valuable feedback while only using minimal class time.

To administer the Minute Paper technique, the instructor asks the class to write down their responses to two main questions after a lecture or section of material has been covered: (1) what was the most important thing(s) you learned during this lesson? (2) what important question(s) remains unanswered? The instructor then collects the written responses from the students and uses them to evaluate the students understanding of main topics and discover the parts of the lesson where they struggled. This provides the instructor with feedback that can help improve the course material and inform them on topics that could use more lecture time. An important benefit for students is this assessment gives them an opportunity to bring up questions that they might not have asked otherwise, and hopefully get those questions answered by the instructor in the beginning of the next lecture. This timely feedback helps students follow the future lecture material more clearly since they are given the chance to clarify important concepts before moving on to new lecture material.

Resources list

- Textbook - Classroom Assessment Techniques: A Handbook for College Teachers 2nd edition by Thomas A. Angelo and K. Patricia Cross. Pg 148-153

How to Implement in Person and in Zoom

Refer to the section on “Administering Teaching Techniques and Collecting Responses” for some general guidelines on written response questions. Located below are some helpful tip specific to this classroom assessment technique:

- Administer the Minute Paper written response questions after a section where students learn a significant amount of new information. This is typically after an information dense lecture or series of lectures, but can also include assigned reading, educational video, etc.
- The two main questions presented in the brief description above can be personalized to better align with the instructors needs.
- Provide feedback on the student responses during the start of next lecture or as quickly as possible. The feedback should include answering some of the most common student questions and helping students distinguish between main points and minor details.

2. Muddiest Point

Brief Description

The Muddiest Point is a classroom assessment technique that instructors can use to evaluate student learning from a lecture, reading assignment, discussion, or any other learning opportunity. Students are asked to reflect on their learning and give written input on the information they struggle to understand. With this immediate feedback, the instructor can make informed decision on how to improve their future lectures and assignments.

To implement the technique, the instructor asks the class to write down their “muddiest” point from the information they just learned. In other words, what did the student find unclear, confusing, or difficult to understand from the information presented in the lesson. The instructor uses this student feedback as an opportunity to improve their future lesson plans as well as provide clarity to the students on the confusing aspects of the lesson. The students benefit from the instructor feedback on common issues that the instructor chooses to address.

Resources list

- Textbook - Classroom Assessment Techniques: A Handbook for College Teachers 2nd edition by Thomas A. Angelo and K. Patricia Cross. Pg 154-158

How to Implement in Person and in Zoom

Refer to the section on “Administering Teaching Techniques and Collecting Responses” for some general guidelines on written response questions. Located below are some helpful tip specific to this classroom assessment technique:

- It is best to ask about the “muddiest” point at the end of a lesson or activity where students learn a significant amount of new information.
- Once you collect all the responses, read through them, and look for common issues that students are reporting from the information they learned.
- Use the feedback from students to put together some clarifying comments for the beginning of the next lesson or provide some other response to address the students’ confusion (send out an email with clarifying comments and additional learning resources, make a quick Khan Academy style video, etc.). Also use this feedback to improve your lesson plan for future courses.

3. Update Your Classmate

Brief Description

Update Your Classmate is an active learning technique to help students recall information from previous lessons and anticipate how that learned knowledge will connect to the upcoming lesson. The process of recalling the most important topics and predicting how they will connect with new information can be an effective way of engaging a student at the start of a lecture.

To begin implementing the technique, at the beginning of a new lesson each student is asked to write out a summary of the main points from the previous lesson to a fictional student who missed class. Then each student is asked to explain how the information that the absent student missed in the previous lesson will be connected to the upcoming lesson. The two written responses are collected and can be quickly graded. Instructors should look for basic recollection of main lecture points and logical predictions for how the learned information connects to new information. The intended benefit for students participating in this writing exercise is to help them recall information from previous lessons and prime their brain to make connections with new lecture material. They also get practice using their prediction skills by creating a hypothesis for how the material in each lesson will connect to each other and actively refining their predictions as new material is presented.

Resources list

- Textbook – Interactive Lecturing: A Handbook for College Faculty by Elizabeth F. Barkley and Claire Howell Major. Pg 217-220
- <https://kpcrossacademy.org/techniques/update-your-classmate/>

How to Implement in Person and in Zoom

Refer to the section on “Administering Teaching Techniques and Collecting Responses” for some general guidelines on written response questions. Located below are some helpful tip specific to this active learning technique:

- Typical format for the two question in the memo to the absent student: (1) Write a short summary of the 2-4 main points from the previous lesson? (2) How will the information learned in the previous lesson be connected/useful to the upcoming lesson?
- If you would prefer to not use classroom time, try send an email with the Google Form link out to all the students during the morning of the day of the lecture and tell students to write responses to the two question in the Google Form before class starts. Then begin class going over some of the successful student responses.
- This technique can be presented as an ongoing journal activity instead of a single memo written to a fictional student who missed class. This gives the student an ongoing cycle of recalling old information and prediction connections to new information that could be beneficial for learning.
- Instructors can review the written responses after the lecture to get a sense of the student understanding of the class material.

4. Background Knowledge Probe

Description

The Background Knowledge Probe is a classroom assessment technique that instructors can use to gain insight into students’ knowledge before classroom instruction begins. The feedback gained from this assessment can provide the instructor with information that can lead to adjustments to their course content and future lesson plans.

This assessment technique is implemented at the beginning of a course or section of course content. The instructor puts together a quiz based on a mixture of material that the students are expected to learn in the course and some information they might already know. The questions are generally multiple choice, fill in the blank, and short answer, but the style of questions can be adjusted any way the instructor believes will reveal the depth of each student's knowledge. Once the quiz is put together by the instructor, it is administered to the students and collected for evaluation. Results from the quiz can be used by the instructor to make decision on adding or reducing instructional time given to specific subjects or adding assignments that allow students to increase their knowledge base. Presenting the results to the class and going over common misconceptions exposed by the quiz can help students know where the class knowledge stands and where they fit in relative to their peers. The students can increase their preparation for the course in accordance with how they performed.

Resources list

- Textbook - Classroom Assessment Techniques: A Handbook for College Teachers 2nd edition by Thomas A. Angelo and K. Patricia Cross. Pg 121-125

How to Implement in Person and in Zoom

Refer to the section on “Administering Teaching Techniques and Collecting Responses” for some general guidelines on multiple-choice/survey questions. Located below are some helpful tip specific to this classroom assessment technique:

- A helpful tip for instructors writing questions is to have at least one question easy enough for everyone to answer and one difficult enough that no one can answer. The goal is to get each student on the scale and have no one tipping over either side. Some concepts should be review and some should be new.

- An important part of analyzing quiz results is to present the results to the class as soon as possible. The instructor should give the group a sense of where the average class knowledge is currently at (what concepts could most students answer), correct any commonly held misconceptions on questions, and give students a sense of where their knowledge base resides relative to their classmates.
- For students who performed poorly on the knowledge probe, encourage them to allocate more of their time to studying this course because this material will be comparatively new. For the students who performed above average, encourage them to help other students with understanding concepts.
- Style of questions for the knowledge probe: multiple-choice and fill-in-the-blank questions to gauge basic understanding of content, Short-answer and open-ended questions to gauge deep understanding of content.

5. Think-Pair-Share

Description

Think-Pair-Share is an active learning technique used to get students actively engaged and participating in class discussions and problem-solving exercises. This technique gives students an opportunity to measure their understanding and ideas with their peers.

To implement this technique during a lesson, the instructor asks a question or presents a problem for the students to think about, pairs the students up, and tells them to share their response to the question with an assigned partner. Then the instructor brings the whole class back together and asks for a few students to share their rehearsed responses to facilitate a class discussion. Using this technique encourages students to think critically about the topics and problems discussed in class and gives them an opportunity to formulate their opinion. During

the pairing part of the activity, students are given a low risk environment to practice communicating their ideas and listening to other thoughts generated by their partner. This can be greatly beneficial for students that do not feel comfortable sharing their opinions in front of the whole class.

Resources list

- Textbook - Interactive Lecturing: A Handbook for College Faculty by Elizabeth F. Barkley and Claire Howell Major. Pg 293-296
- <https://kpcrossacademy.org/techniques/think-pair-share/>

How to Implement in Person and in Zoom

Refer to the section on “Administering Teaching Techniques and Collecting Responses” for some general guidelines on group interactions. Located below are some helpful tip specific to this active learning technique:

- The key to generating quality group discussion is to create a question that has many different viewpoints or solutions. For ideas on how to formulate questions, go to the K. Patricia Cross Academy and download their material on Think-Pair-Share (<https://kpcrossacademy.org/techniques/think-pair-share/>). below the video is a box that says, “download materials.” There is a section in the materials that will provide ideas for creating compelling questions.
- If students that are paired up disagree, then it can be beneficial for each student to clarify their opinions so they can articulate why they disagree.

APPENDIX D

Administering Teaching Techniques and Collecting Responses

Many active learning techniques and classroom assessment techniques produce some form of student feedback and present the instructor with an opportunity to examine the learning that takes place in the classroom. This section is meant to give a general overview of things to consider when instructors get set to administer teaching techniques for three common formats: multiple-choice/surveys, written response questions, and group interactions. Within this overview are a few suggestions on how to implement techniques in Zoom vs in person, and some tips on how to collect real-time feedback vs archived feedback.

Multiple-Choice Survey Questions

- Decide on the specific content you want to generate feedback from. This can be a lesson, series of lectures, a discussion, etc.
- focus on the intent of the feedback and what you plan to do with the student responses after they are collected (will the students be graded? Are you trying to spark students recall of information? Are you trying to find common misunderstanding among the class?)
- Plan the time out of lecture to gather responses, and plan for time to address student responses in the next lesson if you plan on providing feedback to students.
 - If you don't want to use class time to administer a quiz/survey, you might consider creating the quiz/survey in a Google Form and emailing the link with instructions to students so they can complete the quiz/survey before or after the scheduled lecture time. You can consider it an assignment. Instructional time can often be too valuable to take give up.

- Give students expectations on what their responses should look like, how much time they should take to respond, and what you will do with the information that the students provide from the survey or quiz.
- Direct students to either include their name or keep them anonymous, depending on how you will use the information.
 - If you are collecting survey information through Google Forms, go into the settings > general and select/deselect “collect email addresses” depending on if you want the questions graded or anonymous.
- Administer quiz or survey.
 - Zoom
 - Real-time data – Create a quiz/survey using one of the interactive survey programs listed in the “resources for online teaching” section of this document. These programs include Poll Everywhere, Mentimeter, Kahoot, etc. Integrate these real-time surveys into a Zoom lecturing by sharing your screen with the class and giving them the website address and code for them to join the survey. The students will need to toggle between the Zoom window and their survey window to participate in the interactive survey.
 - Archive data – Create a quiz/survey using Google Forms and share the link with students in the Zoom Chat window. This will create an organized collection of responses that can be accessed at any time to be graded or evaluated by the instructor.
 - In Person

- Real-time data – Use a quiz/survey program listed in the “resources for online teaching” section of this document. I suggest trying Mentimeter since students will be able to respond to survey questions in real-time on their smartphones in class. This will provide the instructor with a real-time compilation of answers from the students.
- Archive data – If students have access to their smartphones or computers, I suggest creating a quiz/survey in Google Forms and emailing the link to the students. The student responses will be available for the instructor to analyze later.
- Analyze the answers to the quiz or survey and provide feedback to the students if necessary.

Written response questions

- Write/tell the students about upcoming open-ended response question so they can keep them in mind during the lecture.
- Provide clear instructions on how students should construct their written responses. Should they write in complete sentences? How long should their responses be?
- Give students expectations on what you will do with the written responses that the students provide.
- During the student response time, make the open-ended questions clear and accessible to the students.
 - Zoom – Create a Google Form with all the open-ended questions listed. At the appropriate time, provide students with a link to the Google Form in the Zoom Chat box.

- In Person – write questions on the whiteboard or have the questions written on a presentation slide that you can leave up during response time.
- Collect results for analysis
 - Zoom – Tell the students to submit their written answers into the Google Form so instructors can view their submission in the “responses” tab of the Google Form.
 - In person – pass out notecards or sheets of paper for students to respond to the open-ended questions. Collect the paper at the end of class.

Group interactions

- Pose group discussion questions during the lecture to the entire class and give students enough time to think about the question and formulate a well thought out opinion or answer. It is helpful to write the question on the board so the students can refer to the question.
 - Zoom – instructors can create a Google Document with all the group discussion questions that will be asked during the lecture. Then share a link to the document in Zoom Chat so students can download it and refer to the questions as they are coming up with their responses.
- Before pairing student up into groups, set a time limit for their discussion. Students should be given enough time to share and articulate their thought with each other.
- Collect any group responses for analysis or grading.
 - In person – break people into groups and assign each group a number and a designated notetaker. The designate notetaker is responsible for documenting the group responses and submitting them to the instructor for analysis.

- Zoom - send students into Breakout Rooms in groups and assign them a group number and group notetaker. Create a Google Document and provide the link in Zoom Chat for the groups to submit their response along with their identifying group number.
- Bring the whole class back together and ask for groups to submit their responses. Then ask for volunteers or select groups to share their best response to the question.
- Zoom - Use the “broadcast message to all” feature to send out a friendly reminder to wrap up their comments because the Breakout Room session is about to end. End the Breakout Rooms session and check the Google Document to see if all the groups have submitted a response. Then see if any students would like to volunteer to share their opinion with the whole group.

APPENDIX E

Resources for Online Teaching

- Poll Everywhere - <https://www.polleverywhere.com/>
 - Use: collect real-time responses to multiple-choice questions and classroom surveys.
 - General info: Instructors can set up polls or multiple-choice questions from the Poll Everywhere website. For each poll there is a designated URL that students can access to provide their real-time response from their phone, tablet, or laptop. In addition to the unique URL, they provide a texting option to submit responses if the students have phones without internet access. Instructors must activate poll for students to be able to respond.
 - Tips: Can be used in conjunction with Google Slides and Microsoft PowerPoint. You will need to select Poll Everywhere as an Add-on to be able to use the feature.
- Mentimeter - <https://www.mentimeter.com/>
 - Use: Collect real-time responses to multiple-choice, short answer questions.
 - General info: Instructors can create a quiz with multiple-choice, as well as open ended questions. Most instructors create their questions and administer their question slides all from the Mentimeter website. Students can interact with the quiz straight from a web browser on their smartphone. Students visit the URL <https://www.menti.com/> and enter the code associated with the instructor's quiz. For an interactive presentation, the instructor can scroll through each of their question slides and students can submit their response for each question as they come up.

- Tips: Mentimeter can be integrated with PowerPoint, but only with a paid plan. It would be easy to use the free version and administer the quiz from the Mentimeter website and toggle back and forth from your presentation slides.
- Kahoot - <https://kahoot.com/>
 - Use: collect real-time responses to multiple-choice questions and classroom surveys.
 - General info: Instructors can create a multiple-choice quiz that can be administered to students in real-time. The students can use a smartphone, tablet, or laptop to participate. The instructor starts the quiz on their computer and the students will get an access pin to join the quiz. The students visit the website <https://kahoot.it/> and enter the game pin number to start participating. Students do not need to create an account to participate.
 - Tips: Instructors can set a time limit for each question. Students get points for answering the questions quicker. This program presents more as a game than a formal survey.
- Pear Deck - <https://www.peardeck.com/>
 - Use: collect real-time responses to multiple-choice, true or false, short answer, and a couple more styles of questions.
 - General info: Instructors can use Pear Deck as an Add-on in Google Slides (<https://www.peardeck.com/googleslides>). This allows instructors to create interactive slides within a Google Slides presentation. For the students to submit their interactive answers, they go to [joinpd.com](https://www.joinpd.com) and type in the instructors presentation code to join the instructors Pear Deck.

- Tips: For lectures, use the instructor-paced activity so you can click through the slides at your pace and students can interact once they come to a slide with an interactive poll or activity. I think students might have to add the Pear Deck Add-on in Google Slides to be able to participate.
- Scrumblr - <http://scrumblr.ca/>
 - Use: collect student questions, comments, or ideas onto a shared virtual whiteboard. It can also be used as a brainstorming or planning activity.
 - General info: This website provides a virtual whiteboard where users can write out ideas or questions onto a notecard and pin them to the whiteboard. This simple format allows for a collaborative space where students can share written responses. To start collaborating, instructors can go to the website, create a new board, and share the link with students.
 - Tips: The plus/minus sign on the far-right side of the whiteboard adds/subtracts new columns, and the plus sign on the bottom-left side of the whiteboard adds new notecards.
- A few links for more “clicker” response software.
 - <https://tophat.com/blog/classroom-clickers/>
 - <https://qwizdom.com/education>

APPENDIX F

Resources for Teaching Techniques

Books

- Angelo, T. A., & Cross, K. P. (1993). *Classroom Assessment Techniques: A Handbook for College Teachers* (2nd ed.). Jossey-Bass.
 - This book provides detailed explanations for 50 classroom assessment techniques. These assessment techniques range from assessing skills in: problem solving, analysis and critical thinking, course-related learning and study skills, students' self-awareness as learners, and many more. These assessment techniques are a tool for instructors to help understand how their students are learning in their classroom and how effective their teaching practices are at delivering intended learning outcomes.
- Barkley, E. F., & Major, C. H. (2018). *Interactive Lecturing: A Handbook for College Faculty*. Jossey-Bass.
 - This book provides instructors with presentation tips to help produce an engaging lecture and active learning techniques that help support student learning during lectures. There are 53 engaging presentation tips that all follow the format of: explanation of the presentation tip, a short example, and a list of additional resources. Additionally, there are 32 active learning techniques that provide: a description of the technique, tips for preparing to use the technique, procedures for implementing the technique, a variety of examples for different classroom settings, variations and advice that instructors can use with the technique, and sources for more information.

Websites

- <https://kpcrossacademy.org/>
 - The K. Patricia Cross Academy provides instructional videos and downloadable supplemental material for 47 teaching techniques. The videos for each teaching technique provide a short summary and the downloadable materials provide a detailed guide for instructors to implement the technique, along with additional reading suggestions to learn more about the technique. The primary source material for these videos and documents are textbooks written by Elizabeth F. Barkley and Claire H. Major. Since there is currently a need in today's world for implementing teaching techniques for online learning, they are currently developing guidelines for online adaptation. As of this writing they have 14 online adaptation videos completed. They are working to produce more instructional material in the future.

APPENDIX G

Tips to engage students in asynchronous environments

- Break lectures up into a few videos of manageable lengths (5-10 minutes) instead of recording an entire one-hour lecture video. Videos under 10 minutes will hold the attention of students better. Students will have an easier time finding and reviewing specific material from shorter videos. Shorter videos also allow for more engaging activities to take place before or after the short lecture videos. These activities might engage the student in learning the material presented in the short lecture videos.
 - Find additional information on lecture videos from Resource 2 and 3 listed below.
- Build an effective discussion forum and create other paths of communication where students can interact with their instructor, as well as their peers. It is important for students in online courses to be able to get their questions answered in a timely manner in order to progress through the lectures and coursework. Instructors should provide some combination of discussion forums, scheduled virtual office hours, and sign-ups for additional help. Setting up a structured time for instructors to provide feedback on forums and hold office hours will help students plan their study time better. Some learning management systems, such as Canvas, have features for discussion forums. Consider creating a dedicated message board sections where students and instructors can post questions and answers
 - Find additional information on discussion forums from Resource 1 listed below.
- Incorporate engaging learning activities that are structured around lectures that will help create deep learning opportunities for students. Student engagement activities can take place before, during, or after online lecture material.
 - Examples of student engagement activities

- Before lecture - “Anticipation Guide”
 - During lecture - “Guided Notes”
 - After lecture - “Muddiest Point”
- Find additional information from Resource 1 and 4 listed below. Resource 1 provides strategies to deepen student learning. Resource 4 provides tips on student engagement activities in an online environment (including asynchronous learning)
- Provide students with targeted feedback on their assignments and coursework. Instructor’s time is usually limited in online courses, so it is important to use the finite time to pick opportunities for providing specific feedback. The feedback might be limited to a certain aspect of an assignment due to the instructor’s time constraints, so inform the students that feedback is specifically for a certain aspect of an assignment or project. Then the student will know how to use the feedback to improve their learning and know it doesn’t apply to their whole assignment.
 - Find additional information on instructor feedback from Resource 1 listed below.
- Communicate the expectations for the online course to the students. These expectations can include the amount of time students should expect to spend on coursework, the availability for help from instructors each week, and the additional resources that students can turn to when they have questions. Some instructors might propose a pace for learning each module/section of the course if the entire course has a specific deadline. This information can help the students keep their learning structured.
 - Find additional information on course expectations from Resource 3 listed below.
- In addition to original lecture material, consider providing students with links to supplemental material. Using already available internet resources, including documents and

videos, can provide additional learning material for students to reinforce their understanding of topics. It also can save time in developing videos yourself.

- Popular educational websites: YouTube, Khan Academy, Coursera

Asynchronous Learning Resources

Resource #1

“Asynchronous Strategies for Inclusive Teaching” from the Sheridan Center for Teaching and Learning at Brown University.

Link: <https://www.brown.edu/sheridan/asynchronous-strategies-inclusive-teaching>

- Description of Resource:
 - This resource provides strategies and activities for instructors to consider while creating an asynchronous course.
 - Tips on keeping students engaged with asynchronous course material by showing the students the connection between expected learning outcomes and the online course assignments.
 - Tips on focusing student attention and creating deeper learning while implementing an asynchronous course.
 - Tips on how to provide structured discussion forums for students to deepen their understanding through dialog with their peers and instructors.

Resource #2

“Creating Engaging Asynchronous Lectures with Your Phone or Laptop” from the K. Patricia Cross Academy.

<https://kpcrossacademy.org/creating-engaging-asynchronous-lectures/>

- Description of Resource:

- This resource provides a few quick tips on how instructors can create videos for their asynchronous courses.
- In addition to the article above, the K. Patricia Cross Academy provides many instructional videos for implementing teaching techniques in classrooms (<https://kpcrossacademy.org/videos/>). For many of the videos, there is a section for adapting the technique for online use. These videos might be useful to reference while creating content for asynchronous courses.
 - Example: the teaching technique in the link below has two videos. The second video, called “Adapting Guided Notes for Online Teaching” describes the Guided Notes teaching technique adapted to online teaching - <https://kpcrossacademy.org/techniques/guided-notes/>.

Resource #3

“Asynchronous Teaching Tips” from University of Louisiana at Lafayette.

<https://distancelearning.louisiana.edu/teach-remotely/asynchronous-teaching-tips>

- Description of Resource:
 - This resource provides seven tips for teaching asynchronous courses: (1) Break up long lectures, (2) Encourage student interaction, (3) Encourage active learning, (4) Communicate expectations, (5) Provide effective feedback, (6) Add instructor presence, and (7) Monitor student activity.

Resource #4

Center for Excellence in Teaching and Learning at Virginia Tech.

Link: <https://teaching.vt.edu/>

- Description of Resource:

- This resource from Virginia Tech provides some resources and tips for teaching online courses and asynchronous courses. This webpage seems to be intended to support Virginia Tech faculty in the transition to online teaching. There are a couple helpful resources that can help provide guidance for asynchronous teaching. One helpful link, located below the “Faculty Tips: building community and engaging students in online courses” section, provides some tips for adapting student engagement activities to asynchronous online courses - https://teaching.vt.edu/content/dam/teaching_vt_edu/Converting%20F2F%20activities%20to%20online_edited.pdf

