

CIAMTIS

U.S. DOT Region 3 University Transportation Center

Railroad Engineering Education & Outreach

September 28, 2020

Prepared by:

B. Schlake, S. Shen, H. Huang, and S. Dillen, Penn State Altoona

r3utc.psu.edu



**LARSON
TRANSPORTATION
INSTITUTE**

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated in the interest of information exchange. The report is funded, partially or entirely, by a grant from the U.S. Department of Transportation's University Transportation Centers Program. However, the U.S. Government assumes no liability for the contents or use thereof.

Technical Report Documentation Page

1. Report No. CIAM-COR-R19		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Railroad Engineering Education & Outreach				5. Report Date September 28, 2020	
				6. Performing Organization Code	
7. Author(s) Bryan W. Schlake Shihui Shen https://orcid.org/0000-0002-5718-722X Hai Huang https://orcid.org/0000-0002-0023-2915 Stephen L. Dillen				8. Performing Organization Report No. LTI 2021-02	
9. Performing Organization Name and Address Penn State Altoona 3000 Ivyside Park Altoona, PA 16601				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. 69A3551847103	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Research and Innovative Technology Administration 3rd Fl, East Bldg E33-461 1200 New Jersey Ave, SE Washington, DC 20590				13. Type of Report and Period Covered Final Report 03/01/2019 – 08/01/2020	
				14. Sponsoring Agency Code	
15. Supplementary Notes Work funded through The Pennsylvania State University via the University Transportation Center Grant Agreement, Grant No. 69A3551847103.					
16. Abstract Due to high levels of attrition, the railroad industry is in need of trained engineering students who are qualified to fill professional and management roles for railroad, consulting, and supply companies. Penn State Altoona offers the nation's only four-year Bachelor of Science degree in Rail Transportation Engineering. While this program is growing and is attracting students from across the United States and from other countries, enrollments are still low. Other universities offer railroad engineering education in the form of minor offerings, graduate programs, rail transportation coursework, and railroad engineering student clubs. Penn State is working with these universities to promote both regional and national K-12 outreach activities.					
17. Key Words Railroad engineering, education, K-12, STEM, outreach				18. Distribution Statement No restrictions. This document is available from the National Technical Information Service, Springfield, VA 22161	
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 20	22. Price

TABLE OF CONTENTS

1. Introduction.....	1
Background.....	1
2. Methodology/Scope.....	6
Introduction.....	6
Objectives.....	6
Methodology.....	6
3. Results.....	8
Introduction.....	8
Activities.....	8
4. Conclusion.....	15
References.....	16

LIST OF FIGURES

Figure 1. Project Objectives and Target Demographics Mapped to Educational Outreach Activities	7
Figure 2. Railroad Engineering Kids College Camp for students aged 11-14 at Penn State Altoona	8
Figure 3. Penn State Altoona Faculty visited Transit Tech High School to discuss the City-to-the-State Program	9
Figure 4. Penn State Altoona Faculty hosted Transit Tech High School students in April 2019 (a and b) and again in November 2019 (c).....	9
Figure 5. Final Presentations for EDSN 100 class with representatives from Norfolk Southern Railroad	10
Figure 6. Students Participating in Round 3 of the 2019 WE-Design Competition in Altoona, PA	11
Figure 7. WE-Design students, mentors, and judges; and the winners of the 2019 competition.....	12
Figure 8. Students presenting 360-degree VR video research at the Altoona Expo in October 2019 and Penn State RTE field research for Senior Capstone project in March 2020	12
Figure 9. Technical presentation by Amtrak Track Engineers on Railroad Track Maintenance Practices and Short Line Railroad Overview Presentation by Carl Belke of WNPR	13
Figure 10. Flyer used to advertise the Engineering Mini-Sumposium (left) and Presentation on Positive Train Control by Dr. Edwin Kraft (right).....	14

LIST OF TABLES

Table 1. US-Engineering Schools – Study Sample for Railway Education Report completed for APTA ..	2
Table 2. US Railway Education (source TRB – NCRRP).....	3
Table 3. Civil and/or Rail Transportation Engineering Degrees Awarded by Country	4

CHAPTER 1

Introduction

BACKGROUND

The railroad industry has shown strong and steady growth over the last several decades, and due to a large percentage of railroad employees nearing retirement age, there is an increased demand for experienced and educated railroad engineering professionals. Despite this demand, the railroad industry has limited options when seeking to hire railroad engineering professionals and managers. One option is to hire experienced managers and professionals from other industries and train them in railway operations. Railroads have a strong record of hiring veterans to fill these types of positions. The other approach is to recruit from colleges and universities.

Due to the scarcity of rail-related educational programs, railroads have relied heavily on recruiting from traditional engineering disciplines. The downside of this approach has been high attrition rates in the first five years of employment, as new hires to the railroad are often unprepared or underprepared for the demands of the job [1]. For this reason, railroads and transit agencies have approached the academic community to develop rail-related engineering programs such as the Rail Transportation Engineering (RTE) program at Penn State Altoona. At least two major studies have been conducted to assess railway education in the United States. In 2011, Sunderland and Hughes prepared a report for APTA entitled, “Transit and Rail Educational Programs in the United States and Abroad” [2]. Another report, entitled, “A Guide to Building and Retaining Workforce Capacity for the Railroad Industry” was published by the Transportation Research Board in 2015 as part of the National Cooperative Rail Research Program (NCRRP) [3]. The RTE program at Penn State Altoona was identified in both studies as the only undergraduate degree in Rail Transportation Engineering in the nation. Additionally, the only other countries identified in the reports that offer the equivalent of a Bachelor’s Degree in Rail Transportation Engineering were China, Taiwan, and Germany. Thus, the Penn State RTE program is unique both nationally and internationally. While considerable demand exists for college graduates with railroad engineering expertise, universities have been slow to adopt rail-focused educational programs. The RTE program at Penn State Altoona is seeking to meet the educational need within the industry by providing both undergraduate education and professional training opportunities.

Current College and University Programs

Other universities identified by the NCRRP with a defined focus on railroad engineering education included the RailTEC program at the University of Illinois at Urbana-Champaign and the Michigan Tech Transportation Institute (MTTI) housed at the Michigan Technological University. Additional colleges and universities were identified that offer specialized training or continuing education: University of Wisconsin at Madison, the University of Tennessee, and the University of Nevada, Las Vegas. Finally, the National Academy of Rail Sciences (a partnership between BNSF railway and Johnson County Community College in Overland Park, KS) was identified as a source of rail industry technical training. As of 2019 there were

at least 34 university-level railroad engineering courses being offered at universities across the United States [4].

Since rail-focused university programs are relatively scarce, other universities have been identified as potential recruiting pools for the railroad industry. The selected schools have strong civil and/or transportation engineering programs. Results from the two recent railway education studies [2,3] are provided in Tables 1 through 3.

Table 1. U.S. engineering schools – study sample for railway education report completed for APTA [2].

School	Bachelor's in Civil Eng	Bachelor's in Rail Transportation Engineering	Master's in Civil Engineering	Master's in Civil Engineering with a Concentration in Transportation	Notes
University of California, Berkeley	x		x	x	
University of California, Davis	x		x	x	
California State Poly U	x		x	x	
Clemson University	x		x		
Cornell University	x		x		
University of Florida	x		x	x	urban planning
Georgia Institute of Technology	x		x	x	
University of Illinois at Urbana-Champaign	x		x	x	RR engineering courses, high speed rail course
Massachusetts Institute of Technology	x		x	x	
Michigan Technological University	x		x	x	rail transportation program, urban rail transit course
University of Michigan–Ann Arbor	x		x		
North Carolina State University	x		x	x	
Penn State University Park	x		x		
Penn State Altoona	x	x			first class will graduate in 2015
Purdue University–West Lafayette	x		x	x	
Stanford University	x		x		
Texas A&M–College Station	x		x	x	
University of Texas at Austin	x		x		
Virginia Tech	x		x	x	rail and public transit courses
Washington State	x		x		

NOTE: Schools listed here (except those in boldface) are based on inclusion in list of top-10 undergraduate schools for civil engineering, as reported in *US News College Compass* (colleges.usnews.rankingsandreviews.com/best-colleges/rankings/engineering-doctorate-civil; accessed Nov. 1, 2011) and list of schools awarding largest number of undergraduate civil engineering degrees, as reported in *Engineering by the Numbers*, by Michael T. Gibbons (www.asee.org/papers-and-publications/publications/college-profiles/2009-profile-engineering-statistics.pdf; accessed Nov. 1, 2011). Schools shown in bold were added in recognition of their strong rail engineering programs.

Table 2. U.S. railway education (source TRB – NCRRP) [3].

Institution	Operations Manager	Systems Engineer	Conductor/Brakeman	Locomotive Engineer	Railroad Dispatcher	Electrician & Communications Maintainer	Signalman & Lineman	Mechanical Personnel	Maintenance-of-Way	Limitations & Challenges
ARC-Tech.net	△	△	△	△	△	△	△	△	△	Limited curricula.
Johnson County Community College			⬢			⬢	⬢		⬢	
Dakota County Technical College			⬢							
Keeping Track Railroad Consulting & Training										No publicly available curricula.
Michigan State University										General rail certificate available.
University of Tennessee, Knoxville							⬢			General transportation certificate available.
Mineta Transportation Institute										High-speed rail certificate available.
Modoc Railroad Academy			⬢	⬢	⬢					
Northwest Railroad Institute	⬢		⬢	⬢	⬢			⬢	⬢	General rail certificate available.
Okefenokee Technical College						⬢				
Transportation Certification Services										Can administrate certification training by contract with carriers.
Tarrant County College					⬢	⬢				
Virginia Polytechnic Institute and State University	⬢	⬢					⬢			General transportation graduate degrees and certificate available.
University of Maryland, College Park	⬢	⬢					⬢			
University of Illinois at Urbana-Champaign	⬢	⬢					⬢			
Michigan Technological University	⬢	⬢					⬢			
Penn State Altoona	+	+				+	+	+		
University of California, Berkeley	⬢	⬢								
University of California, Davis	⬢	⬢								
California State Polytechnic University										Offers M.S. in transportation planning.
Massachusetts Institute of Technology										Graduate degrees in transportation.
North Carolina State University										Offers M.S. in civil engineering with specialization in transport systems and materials.
Purdue University										Offers M.S. in civil engineering with specialization in transportation engineering.
Texas A&M University										Offers graduate and undergraduate degrees in transportation engineering.
Colorado State University, Pueblo						⬢				
Gateway Community College						⬢	⬢	⬢		
Sacramento City College	+	⬢								



Table 3. Civil and/or rail transportation engineering degrees awarded by country [2].

Country	Bachelor's in Civil Engineering	Bachelor's in Rail or Transportation Engineering	Master's in Rail or Transportation Engineering
US	X	*	
Brazil	X		X
China and Taiwan	X	X	X
France	X		X
Germany	X	X	X
India	X		X
Japan	X		X
Spain	X		X
UK	X		X

* Penn State Altoona introduced a bachelor's degree program in rail transportation engineering in 2011.

As stated previously, both reports identified Penn State Altoona as the only bachelor's degree offered in Rail Transportation Engineering in the United States. Additionally, the only other countries that offer the equivalent of a Bachelor's Degree in Rail Transportation Engineering are China, Taiwan, and Germany. Thus, the Penn State RTE program is unique both nationally and internationally.

The railway education studies did not quantify the number of students graduating from the programs listed in Tables 1 and 2, so an attempt is made here to estimate the current supply of "rail-qualified" students in the United States from colleges and universities. Railroads have reported high attrition rates during the first 5 years of employment among new hires from traditional engineering programs who had little or no prior background in railroad engineering. For our purposes, "rail-qualified" will refer to a student who has sufficient railroad engineering knowledge and/or training upon graduation to be hired by a railroad company and pursue a successful career in the railroad industry. One means of quantifying the number of "rail-qualified" students in the United States is to consider data from the American Railway Engineering and Maintenance-of-Way Association (AREMA) [5]. The existence of an AREMA student chapter may be a good proxy to determine whether railroad-oriented students are graduating from a specific university. The following 23 U.S. schools currently have AREMA student chapters:

- Brigham Young University - www.byu.edu
- California State University - Fresno - <http://fresnostate.edu/engineering/institutes/fsti/index.html>
- Illinois Institute of Technology - <https://www.facebook.com/IITrailroad/>
- Kansas State University - <https://www.ce.ksu.edu/>
- Michigan Tech University - reac-students.blogspot.com - www.rail.mtu.edu
- North Carolina State University - www.facebook.com/groups/117509478329251
- North Dakota State University - <https://www.ndsu.edu/>
- Oregon State University - engr.oregonstate.edu
- Pennsylvania State University - www.altoona.psu.edu/rte/
- Rutgers University - www.rutgers.edu
- University of Tennessee – Knoxville - <https://tickle.utk.edu/>
- University of Akron - <http://www.uakron.edu/>
- University of Delaware - <https://www.udel.edu/>
- University of Illinois at Urbana-Champaign - sites.google.com/site/aremauiuc/home

- University of Kentucky - www.railcats.engineering.uky.edu
- University of Massachusetts, Lowell - <https://umasslowellclubs.campuslabs.com/engage/organization/arema>
- University of Minnesota, Twin Cities - <https://twin-cities.umn.edu/>
- University of Nevada, Las Vegas - www.unlv.edu
- University of New Mexico - <https://www.unm.edu/>
- University of South Carolina - www.sc.edu
- University of Toledo - sites.google.com/site/utaremaswebpage/
- University of Wisconsin-Madison - win.wisc.edu/organization/badger_rr_engineers/
- Virginia Polytechnic Institute and State University - www.vt.edu

AREMA requires a minimum of 5 student members to establish a student chapter. Assuming an average of 12 students per chapter and that all students in each AREMA chapter enter the railway industry, this will result in only 66 railroad-oriented graduates each year from schools other than Penn State (assuming 25% of all AREMA students are graduating seniors).

Of the schools listed in Tables 1 and 2 that do not currently have AREMA student chapters, at least 4 of them conduct graduate level research in transportation engineering that may include rail-related research: Purdue University, Texas A&M University, Massachusetts Institute of Technology, and California State Polytechnic University. Additionally, there are 10 other universities listed with strong civil engineering programs that may produce rail-qualified students who have gained rail-related experience through a summer internship or other avenue. Assuming that all four of the schools that are conducting transportation engineering research each produce at least 2 rail-qualified graduates per year and the other 10 universities each produce at least 2 rail-qualified graduates, this results in 28 additional candidates per year. Based on these estimates, there would be approximately 94 railroad-oriented students entering the job market from U.S. colleges and universities each year. On average, Penn State Altoona has graduated 6 students per year for the last 6 years from the RTE program, bringing the estimated number of “rail-qualified” U.S. graduates to approximately 100. Thus, Penn State represents about 6% of the national supply of rail-qualified students entering the job market. With increased K-12 outreach and college-level education and recruiting efforts, it is believed that Penn State can successfully recruit a greater number of students into the RTE program (or other universities with railroad education/research options) and inspire them to pursue careers in the railroad industry.

CHAPTER 2

Methodology / Scope

INTRODUCTION

In order to best steward our resources, the RTE faculty identified seven strategic demographic areas of focus for the educational outreach activities. As events and activities were planned throughout the year, each activity was mapped with a specific target demographic and aligned with the overall objectives of the program.

OBJECTIVES

The objectives of this project are to (1) advance undergraduate education in the field of rail transportation engineering, (2) expose K-12 students to the STEM-related aspects of the railroad industry in order to inspire a new generation of railroad engineering professionals, and (3) promote professional education and training for current railroad industry professionals.

METHODOLOGY

After consultation with the RTE Industry Advisory Board, five distinct target demographics were identified for the educational outreach efforts. These target demographics included the following:

- A. K-12 students
- B. Students from minority communities
- C. Women engineering students
- D. Engineering students not yet familiar with railroad transportation engineering
- E. Industry professionals

These target demographics were chosen for a variety of reasons. First, K-12 students were identified as a key target demographic. Recent railway engineering education studies have indicated that early exposure to railway engineering topics had a positive impact on student choice of major and career path [5]. Additional target demographics included women and minorities, as railroads, consulting companies, and suppliers have also indicated a desire to specifically recruit from those underserved populations. Another key demographic is undecided engineering majors. Students majoring in engineering at Penn State enter the University as “general engineering” students. Typically in their 4th semester students declare their major and enter their specific engineering major of choice after they have completed the necessary entrance-to-major requirements. As a result, some students do not make a final decision on their major until their 3rd or 4th semester at Penn State. Therefore, it is important to expose all 1st and 2nd year engineering students

to rail transportation engineering so that those interested in this field can select the RTE major before their 4th semester. Finally, industry professionals were identified as a target demographic in order to disseminate Penn State research knowledge to the broader railroad industry and identify partners for student recruitment and support.

Once the three primary objectives and five target demographics were identified, the RTE faculty began planning outreach activities that would meet the objectives and reach the strategic demographics. These activities are mapped to the objectives and target demographics in Figure 1.

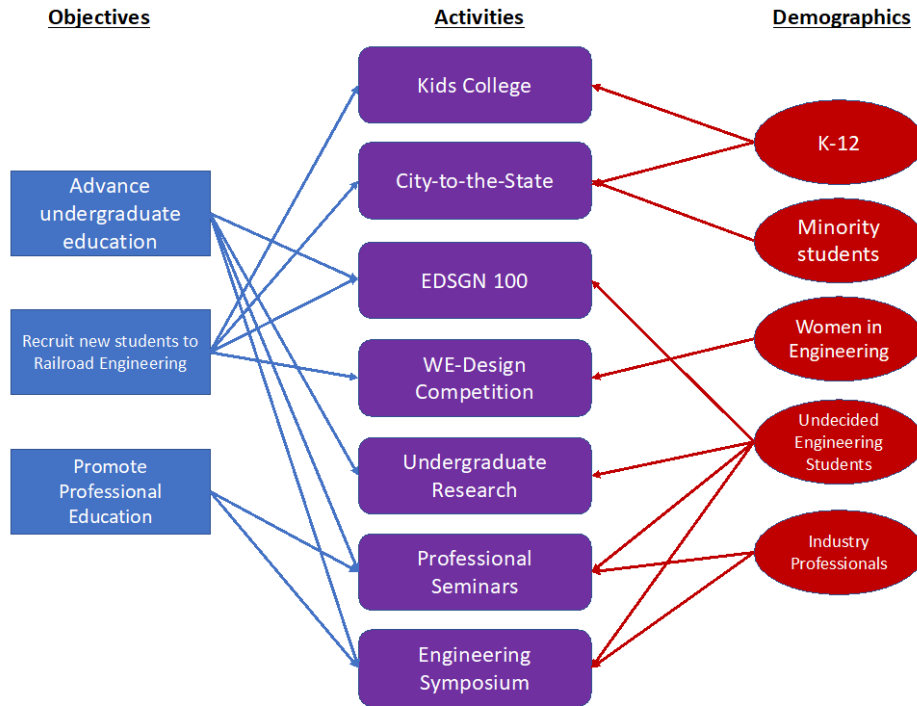


Figure 1. Project objectives and target demographics mapped to educational outreach activities.

As

shown in Figure 1, each of the project objectives and demographics were mapped to the education and outreach activities. Each objective had at least two activities designed to meet the objective, and the first two objectives had four activities mapped to each. Additionally, all demographics were targeted with multiple activities aimed at reaching K-12 students and undecided engineering students. The descriptions and results of these activities are provided in Chapter 3.

CHAPTER 3

Results

INTRODUCTION

This chapter describes the activities hosted and/or conducted by the Penn State RTE program in support of the academic outreach and education goals for each of the target demographics. The activities are listed in order of age/experience of the participants.

ACTIVITIES

1. Kids College

(Target Demographic: 6th–8th grade students)

Altoona Summer Kids College introduces K-8 students to various aspects of rail transportation engineering through a one-week summer program in Altoona, PA. Faculty and volunteers offer hands-on education in the areas of railroad civil infrastructure, signaling, mechanical engineering, and train transportation. The primary goal is to introduce young STEM-minded students to the fascinating aspects of both engineering and transportation. In the summer of 2019, there were 11 students, ages 11-14 who attended our Railroad Engineering Kids College (Figure 2). Students participated in hands-on activities related to railroad operations. Due to the Covid-19 outbreak Altoona did not host a Railroad Engineering Kids College Camp in 2020. However, Penn State Altoona does plan to host a Railroad Engineering Kids College Camp for 11-14 year old students again in 2021.



Figure 2. Railroad Engineering Kids College Camp for students aged 11-14 at Penn State Altoona during the summer of 2019.

2. City-to-the-State

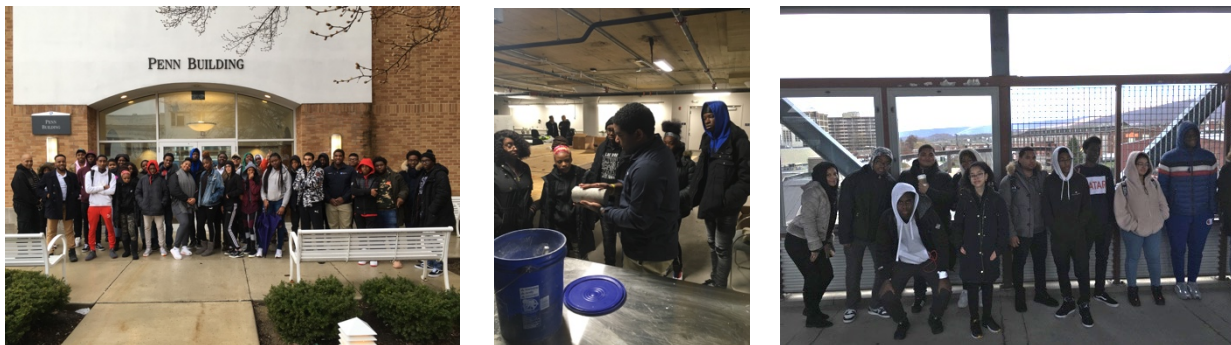
(Target Demographic: 9th–12th grade minority students)

This is a two-phase program aimed at recruiting minority and inner-city high school students to explore railroad engineering as a college major and future career field. In Phase I, RTE faculty from Penn State Altoona worked directly with high schools and transit agencies / commuter railroads in both Chicago, IL and New York, NY in order to foster new relationships with Penn State. Two partner high schools were identified to participate in the program. Transit Tech CTE in Brooklyn, NY provides rail transit technical training for its students (see Figure 3) and has shown considerable interest in the RTE program, and one of its graduates is currently pursuing an RTE degree in Altoona. In April of 2019, Transit Tech High School sent a group of about 40 students and staff to Altoona, PA to visit campus and learn about the RTE program

and tour our labs (Figure 4a and 4b). During November of 2019 another group of 20-30 Transit Tech students and staff visited the Altoona Campus (Figure 4b). During the Spring of 2020 Transit Tech students were not able to visit Altoona due to the Covid-19 pandemic. However, RTE faculty have been invited to present to the Transit Tech students during the Fall 2020 semester as part of their virtual college orientation program. Unfortunately, the high school that was identified in Chicago has been overwhelmed by the Covid-19 pandemic and as a result the program in Chicago has been delayed until further notice.



Figure 3. Penn State Altoona faculty visited Transit Tech High School to discuss the City-to-the-State Program.



(a)

(b)

(c)

Figure 4. Penn State Altoona faculty hosted Transit Tech High School students in April 2019 (a and b) and again in November 2019 (c).

During Phase II of the City-to-the-State program, Penn State Altoona plans to host a 2-3 day overnight engineering summer camp in Altoona, PA for select high school students from the major urban areas including Chicago and New York City. Students from several high schools will be selected to receive scholarships and travel stipends to attend the engineering summer camp. This camp will cover various engineering disciplines found in the railroad industry including mechanical, electrical, and civil engineering, and cyber security. The camp is currently planned for the summer of 2021.

3. First Year Engineering Design Courses (Target Demographic: 1st year engineering students)

Sections of EDSGN 100 (first year engineering course) at Penn State Altoona are now featuring a team-based rail transportation engineering project involving the design and prototyping of a functional railroad system (track, vehicles, propulsion, etc.). Prototypes are designed using SolidWorks® software and are produced using 3D printers in the Center for Additive Manufacturing and Printing (CAMP) at Penn State Altoona. Each team designs a different component of the railroad system and at the end of the semester they come together to give a final project presentation that combines all of the system components (Figure 5). This course project provides early development for students already interested in the RTE major and also helps to inspire students from other engineering majors to consider rail transportation as a potential major. In past classes, representatives from Norfolk Southern Railroad have served on the panel of judges for the final presentations.

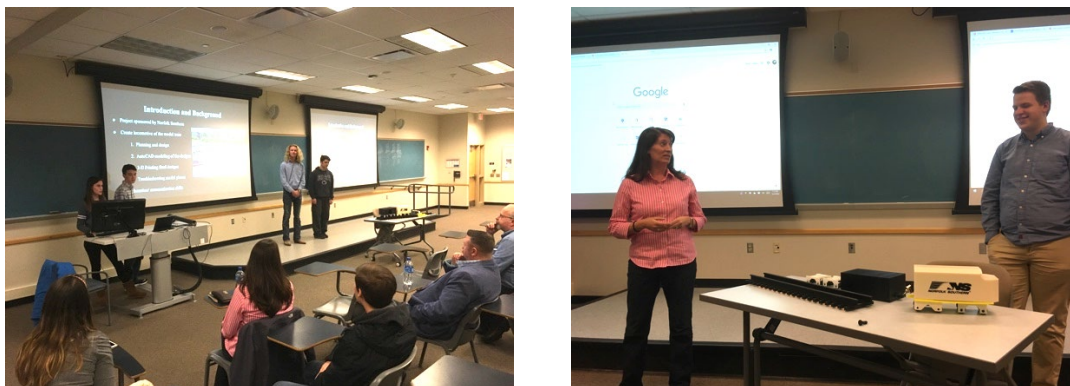


Figure 5. Final presentations for the EDSGN 100 class with representatives from Norfolk Southern Railroad.

4. Women in Engineering Design (WE-Design) Competition (Target Demographic: 1st and 2nd year women engineering students)

The goal of the WE-Design competition is to inspire 1st and 2nd year women engineering students from across Penn State to consider railway engineering as a major or future career path. The first WE-Design competition, jointly funded by Norfolk Southern and CIAMTIS, occurred in the Spring of 2019. A webpage was designed.

The first round included an online quiz bowl for women engineering students and was open to all Penn State campuses. These students completed an online assessment in which they answered a variety of transportation-related engineering questions. The top scoring students were then invited to participate in Round 2. In the second round, students formed teams and worked with a faculty and/or industry advisor (mentors) to develop an engineering solution aimed at improving safety/efficiency in the railroad industry.

These designs were then judged by Penn State faculty and industry volunteers on various criteria. Of the 11 teams that participated in Round 2, 8 teams were moved on to the final round. For the third and final round, students traveled to Altoona in April 2019 to participate in a hands-on design competition where they had to select a specific railroad alignment for a scale model and then design and build the necessary bridge, track, and tunnel infrastructure based on a 4E criteria: efficient, economical, engineering soundness, and environmental friendliness. The projects were then judged by a panel consisting of RTE faculty, RTE students, and industry volunteers. The winning team received \$4,000 in scholarship money (\$2,000 per student) and the second place team received \$2,000 in scholarship money. This program is sponsored in part by Norfolk Southern Railroad. Figure 6 shows students working on hands-on models. Figure 7 shows Round 3 participants, mentors, and judging panel, as well as the winning team.

For the 2020 competition, the WE-Design competition used a “highway-railway” grade crossing problem as the theme area, with the purpose of improving safety at the grade crossing while maintaining or improving its efficiency. Rounds 1 and 2 were completed in the Spring of 2020 and were similar in format to the 2019 competition. Due to the Covid-19 pandemic, Round 3 was postponed until the Fall of 2020. For Round 3 student teams received packages by mail that included project materials and a \$50 gift card to purchase additional supplies for the hands-on project. Students who received these materials in September of 2020 were to design and build a solution to a real-life railroad crossing problem. They then presented their results virtually on Saturday, October 31, 2020 in front of a panel of judges.



Figure 6. Students participating in Round 3 of the 2019 WE-Design Competition in Altoona, PA.



Figure 7. WE-Design students, mentors, and judges (left); and the winners of the 2019 competition (right).

5. Undergraduate Research & Travel
(Target Demographic: 3rd and 4th year RTE students)

Various undergraduate students majoring in Rail Transportation Engineering are currently involved in rail-related research. In 2019, students received research funding for a virtual reality (VR) education project where they processed 360-degree VR videos from various railroad locations. These videos were then published on the Penn State RTE YouTube channel and are available to the public. Students presented this research at the Penn State Altoona Research Expo in October of 2019 (Figure 8). In 2020, conferences were postponed due to the Covid-19 pandemic; however, RTE students did receive travel funding in early March 2020 for a field visit to Alabama for their senior capstone project (Figure 8).

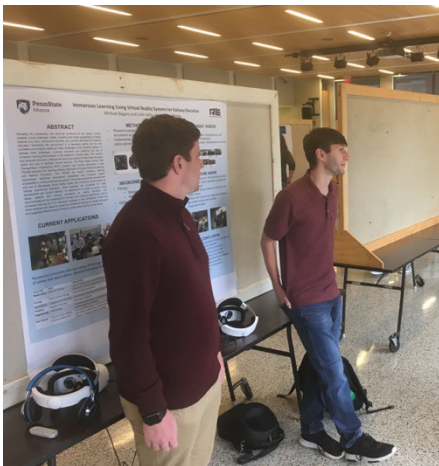


Figure 8. Students presenting 360-degree VR video research at the Altoona Expo in October 2019 (left) and Penn State RTE field research for Senior Capstone project in March 2020 (right).

6. Professional Seminars

(Target Demographic: Undergraduate engineering students and graduate students)

Railroad Engineering Professional Seminars were held during the Fall of 2019 in Altoona, PA. These seminars were made available to the Penn State campus community and were co-hosted by the Penn State Altoona AREMA student chapter. RTE students, engineering students at Altoona, and graduate students participating in rail-related research were encouraged to attend. Two of the seminars given in the Fall of 2019 are shown in Figure 9. Due to the Covid-19 pandemic, seminars scheduled for the Spring 2020 semester were postponed.



Figure 9. Technical presentation by Amtrak track engineers on railroad track maintenance practices (left) and short line railroad overview presentation by Carl Belke of WNPR (right).

7. RTE Engineering Mini-Symposium

(Target Demographic: Undergraduate engineering students, graduate students, faculty and industry professionals)

In November of 2019, the RTE program held its first ever Engineering Mini-Symposium. This event featured technical presentations from three notable experts from the railroad industry, including Dr. Edwin Kraft from TEMS, Dr. Peter Swan from Penn State Harrisburg, and author Walter Simpson. This was a half-day symposium that included lunch for all participants. Over 25 students, faculty, and industry professionals participated in the event. Figure 10 shows the advertising flyer for the symposium and a photo of one of the speakers.

**Penn State Altoona RTE program presents
Engineering Mini-Symposium in 321 Penn Building
Friday, November 15, 2019 | Presentations: 9:00 a.m. – noon
Lunch served at noon (must RSVP)**

**Dr. Edwin “Chip” Kraft
9:00 a.m. Positive Train Control**

Dr. Edwin “Chip” Kraft, director of operations, has over 25 years of experience in the railroad industry. Chip has worked on both freight and passenger planning projects in prior positions at Conrail, CSX, Union Pacific, and Amtrak. He is a recognized expert in passenger and freight rail operations, simulation, and project evaluation.

**Dr. Peter Swan
10:00 a.m. Precision Scheduled Railroading**

Peter Swan, from Penn State Harrisburg, comes from the School College of Business at University Park. Peter earned his Ph.D. in business administration at the University of Michigan Business School. He holds an MBA from the University of Tennessee and a bachelor's degree from the University of Michigan. He has published in such journals as *Journal of Business Logistics*, *Transportation Journal*, *Public Works Management & Policy*, *International Journal of Physical Distribution and Logistics Management*, and *Academy of Management Journal*. Prior to joining academia, he spent a decade working in the railroad industry.

**Walker Simpson, Author
11:00 a.m. Energy & Trains**

Walker Simpson is author of *Diesel Electric Locomotives: How They Work, Use Energy, and Can Become More Efficient and Environmentally Sustainable*. He is also author of *Good Campus A How-to Guide for College and University Climate Action Planning*, and editor and co-author of *The Green Campus: Meeting the Challenge of Environmental Sustainability*. Walker's latest work is a book on turbine power locomotives which should be published in early 2020.

For lunch, please RSVP to Bryan Schiller at bschill@psu.edu by November 13.



Figure 10. Flyer used to advertise the Engineering Mini-Symposium (left) and presentation on positive train control by Dr. Edwin Kraft (right).

CHAPTER 4

Conclusion

This report presented the motivation for railroad engineering outreach, the process of identifying educational outreach activities, and the current progress toward the education and outreach goals at Penn State Altoona.

References

- [1] US Department of Transportation, Federal Railroad Administration, Office of Research Development, and Technology (2016). *Railroad Industry Modal Profile: An Outline of the Railroad Industry Workforce Trends, Challenges, and Opportunities – Update*. Final Report DOT/FRA/ORD-16/09. Washington, DC.
- [2] Sunderland, V., and K. Harrington-Hughes (2011). Transit and Rail Educational Programs in the United States and Abroad. Prepared for the American Public Transportation Association (APTA), November 16, 2011. Easton, MD.
- [3] Qinetiq North America. (2015). *A Guide to Building and Retaining Workforce Capacity for the Railroad Industry*. NCRRP Report 2, Transportation Research Board of the National Academies, Washington, D.C.
- [4] Dick, C.T., P. Lautala, and B.W. Schlake (2019). STEM K-12 outreach as the root of transportation education: Experiences from the railway engineering field. *Transportation Research Record: Journal of the Transportation Research Board*, 2673(12): 558–569. doi:10.1177/0361198119841564.
- [5] American Railway Engineering and Maintenance-of-Way Association (AREMA) (2020). Student Chapters. https://www.arena.org/AREMA_MBRR/Students/Student_Chapters_List.aspx. Accessed on September 28, 2020.