Tran-SET

Transportation Consortium of South-Central States

Solving Emerging Transportation Resiliency, Sustainability, and Economic Challenges through the Use of Innovative Materials and Construction Methods: From Research to Implementation

First & Second Cycles Final Report For: Educational and workforce development through creation of programs in transportation to generate future careers for our students in Navajo Nation region

Project No. 17TTNTU01

Lead University: Navajo Technical University

Collaborative Universities:

Final Report

June 2020

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Acknowledgements

Thanks to Project Review Committee Whose Comments Suggestions Helped Improve and Clarify the NTU Project.

TECHNICAL DOCUMENTATION PAGE

1. Project No.	2. Government Accession No.	3. Recipient's Catalog No.
17TTNTU01		

4. Title and Subtitle	5. Report Date
Educational and workforce development through creation of programs in transportation to generate future careers for our students in Navajo Nation region	June 2020
	6. Performing Organization Code
7. Author(s)	**8. Performing Organization Report No.**
Dr. Gholam R. Ehteshami	
9. Performing Organization Name and Address	**10. Work Unit No. (TRAIS)**
Transportation Consortium of South-Central States (Tran-SET) University Transportation Center for Region 6 3319 Patrick F. Taylor Hall, Louisiana State University, Baton Rouge, LA 70803	**11. Contract or Grant No.** 69A3551747106
12. Sponsoring Agency Name and Address	**13. Type of Report and Period Covered**
United States of America Department of Transportation Research and Innovative Technology Administration	Final Research Report Mar. 2018 – June 2020
	14. Sponsoring Agency Code

15. Supplementary Notes

Report uploaded and accessible at Tran-SET's website (http://transet.lsu.edu/).

16. Abstract

Navajo Technical University (NTU) in New Mexico, has made a partnership with the Tran-SET regional center at Louisiana State University, LSU. We have provided learning and training the Native American students in transportation-related Industries to some of STEM students at NTU through these partnerships opportunities. The program was designed and supported by Native American students from high school to STEM undergraduate students. The program was implemented accordingly with four main components: (1). Selected eligible and interested Native American student to paid summer internships to the field and facilities of transportations industries and participate in research summer at LSU. (2). Directed the students to the transportation-related workshops and conducting at research NTU and they provided with and prepared them with the necessary background in transportation fields. (3). Several students were selected to research during the academic semester related to the field particularly, analyzing the causes of workforce shortages in the transportation industry. (4). We are planning to create and offer transportation certificate programs at NTU to train and expose the Native American students in transportation fields in the future if we get additional funding. We also proposed projects and conducted significant outreach activities in some of the local high schools and colleges. If successful we are planning to develop online courses, which would be provided for free to the Native American universities across the nation in order to make this program more sustainable. Also, we are expected and planning to support 15-20 undergraduate and high school students per year through this partnership program. Other activities undertaken by NTU were the collaboration with different research, education, and outreach projects related to transportations undertaken by the NTU faculty partners. Some of the NTU STEM and pre-engineering students participated in the summer research internship programs, educational, laboratory, site visits as well as exposing students to the most technically-advanced Material research laboratories in Region 6 as well as state-of-the-art facilities at LSU. Some NTU students worked with local industries and agencies to enhance workforce development in the region.

17. Key Words	18. Distribution Statement
Educational, Training, workforce, program, transportation, outreach, Navajo Nation	No restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	[Add page length]	

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized.**

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)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		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)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		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

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

NTU	Navajo Technical University
ASCE	Louisiana State University
URM	Under-Represented Minority
Tran-SET	The Transportation Consortium South Central States
STEM	Science, Technology, Engineering, Math
TCU	Tribal College Universities

EXECUTIVE SUMMARY

Navajo Technical University (NTU) in New Mexico has made a partnership with the Tran-SET regional center at Louisiana State University, LSU. We have provided learning and training the Native American students in transportation-related Industries to some of STEM students at NTU through these partnerships opportunities. The program was designed and supported Native American students from high school to STEM undergraduate students. The program was implemented accordingly with four main components: 1). Selected eligible and interested Native American students to paid summer internships to the field and facilities of transportations industries and participate in research summer at LSU. 2). Directed the students to the transportation-related workshops and conducting at research NTU and they provided with and prepared them with the necessary background in transportation fields. 3). Several students were selected to research during the academic semester related to the field particularly, analyzing the causes of workforce shortages in the transportation industry. 4). We are planning to create and offer transportation certificate programs at NTU to train and expose the Native American students in transportation fields in the future if we get additional funding. We also proposed projects and conducted significant outreach activities in some of the local high schools and colleges. If successful we are planning to develop online courses, which would be provided for free to the Native American universities across the nation in order to make this program more sustainable. Also, we are expected and planning to support 15-20 undergraduate and high school students per year through this partnership program. Other activities undertaken by NTU were the collaboration with different research, education and outreach projects related to transportations undertaken by the NTU faculty partners. Some of the NTU STEM and pre-engineering students participated in the summer research internship programs, educational, laboratory, site visits as well as exposing students to the most technically-advanced Material research laboratories in Region 6 as well as state-of-the-art facilities at LSU. Some of the NTU students worked with local industries and agencies to enhance workforce development in the region. The objectives of this project: 1) Research to Analyze the Causes of workforce shortages; create the guidelines for education and workforce development in the transportation industry. 2) Provide Educational workshops, Research, Internships, and workforce development through the creation of programs in transportation to generate future careers. 3) Specific objectives are to recruit, select and introduce STEM students base on the information that we have about those students and their interest and offer them the summer internships and part-time in school stipend, and send them to LSU summer workshops or other centers of consortiums members' institutions for training. We conducted cautious research and analysis which showed that the workforce development for the transportation industry is a critical and challenging issue. It was concluded that the proficiency sets are needed for current transportation industry workers at Navajo nations and that there are many factors effecting, cussing and are related to the workforce shortage in the nation. We found that the community necessity training knowledge, attitudes, and abilities in the transportation areas. We discovered that we demand to deliver the Nations the opportunities for research and teaching in transportation and related guidelines. Therefore we determined that we need to create educational programs in the transportation area at the undergraduate and high school levels, throughout the Navajo Nations. We found that if the above-mentioned strategy is implemented appropriately, it will benefit many of our existing educational programs at Navajo Technical University and it will lead to increase career options for our students and Navajo Nation. This founding and strategy will lead to increase career options for our people and increase business and develop the economic and environmental situations for the nation. After the primary research for

the causes of the shortness of the jobs in transportation industries at the Navajo nation, we conclude that we need to educate community knowledge, outlooks, and abilities in the transportation areas. We need to provide the nation the opportunities for research and teaching in transportation and related disciplines. Therefore we need to create educational programs in the transportation area at undergraduate and high school levels across the Navajo Nations. We need to provide expose experts, teachers, adolescent people, or other members of the community to the transportation, science and technology, in order to improve the implementation, aids, or skills of the members of underrepresented groups in the Nation. This will improve the nation's access and retention in transportation or other related professions. We found also that this project has a significant impact on the society and educational system. If implemented correctly, it will benefit many of our existing educational programs at Navajo Technical University. Furthermore it will lead to increasing the career options for our students and Navajo Nation. Finally, its impact beyond science and technology is that it will increase the career options for our students, further business and economic development and environmental conditions for the nation. Finally it was found that there is a need to expose experts, teachers, young people, and other members of the community to the transportation, science and technology, in order to improve the employment, aids, or skills of the members of understated groups in the Nation.

1. INTRODUCTION

Workforce development for the transportation industry is a critical issue. Research and analysis are needed to understand the causes of the shortage and to determine the skill sets needed for today's transportation industry worker (Meck et al. 2007, Harris 2017).

Possible causes include lack of programs in the field of transportation, increasing the education requirements, and too few educational institutions offering proper degrees. Current newcomers to the transportation construction industry do not have sufficient knowledge or experience when entering the field, while keeping existing workers is often challenging due to the draw of increased salaries and responsibilities offered by private companies (Adcock 2014, Bang and Medin 2010, Kaseko et al. 2014, Nelson-Barber et al. 1995, Wang 2013,).

Rising workforce shortage in the transportation industry is causing serious problems in Navajo Nation, New Mexico, and throughout Region six. Once there is an understanding of the causes, strategies are needed to address them. This project will create a guidance report containing: 1) analysis of the causes of the workforce shortage in the transportation industry, 2) Develop and implement educational workshops through workforce development by creating programs in transportation to generate and support careers in transportation construction (International transportation education and training 1998, U.S. department of transportation, federal highway administration 2012).

Therefore, there is need to investigate as well as implement education and workforce preparedness to better support current and future economic needs as well as improve job opportunities for transportation industry workers. Furthermore, as trends and innovations continue to evolve, workers will require additional education and training to keep pace with economic demands.

Therefore, a proposal related to educational programs in transportation industry, replies to the Tran-SET center call for proposals for American Indian STEM students to engage in transportation fields were applied. This project will direct students and educators towards transportation areas through creation of programs in transportation fields, internship, and workshops using the infrastructure of an existing transportation related program at NTU.

The partnership with the principal institution LSU, as the regional center including other institutions in region 6, will power and reinforce the transportation programs at NTU. Through this partnership, the center will improve the institutional and research competences. With this fund, it is possible to provide undergraduate internships, mentorship and education opportunities for Native-American high school students in STEM fields and encourage them to attend Tribal Colleges and Universities (TCU). The project also provides opportunities for Native-American undergraduate students to transfer to a four-year degree program in a transportation field to train them for a career in interrelated areas.

2. OBJECTIVES

The objectives of this research project include the following:

1) Analyze the Causes of Workforce Shortages, create guidelines for the education and workforce development in transportation industry.

2) Provide Educational workshops, Research, Internships, and workforce development through creation of programs in transportation to generate future careers.

3) Specific objectives are to recruit, select and introduce STEM students based on the information that we have about those students and their interest and offer them the summer internships and part time in school stipend, and send them to LSU summer workshops or other center of consortiums members institutions for training.

3. LITERATURE REVIEW

3.1 Skills needed for workers in the transportation industry

In 2015, the office of career, technical, and adult education (OCTAE) published a report that projected the employment and skills needs for the workers in six sectors of the transportation industry including trucking transportation, transit and ground passenger transportation, air transportation, highway construction and maintenance, rail transportation, and maritime transportation. The industry is mostly in demand of skilled and semi-skilled manpower in the jobs related to operations and maintenance; it is estimated to have two jobs in maintenance ad 21 in operations for every future job openings in the central services or construction in transportation industry. However, there exists a significant skill gap that must be addressed to meet the demand as projected by the preliminary analysis which showed the projected annual job openings to be 68% larger than the number of students who are enrolled in the different sectors of transportation. The report also suggest that a high school diploma with strong proficiency of mathematics and good written and oral English is sufficient for many entry-level positions in transportation. However, the knowledge and skills can be mastered with training through the career and technical educational programs, apprenticeships, and on-the-job learning. Figure 1 presents the wages, education, work, and training requirements for top 20 jobs in transportation industry (United States, Department of Education, Office of Career, Technical, and Adult Education (OCTAE) 2015).

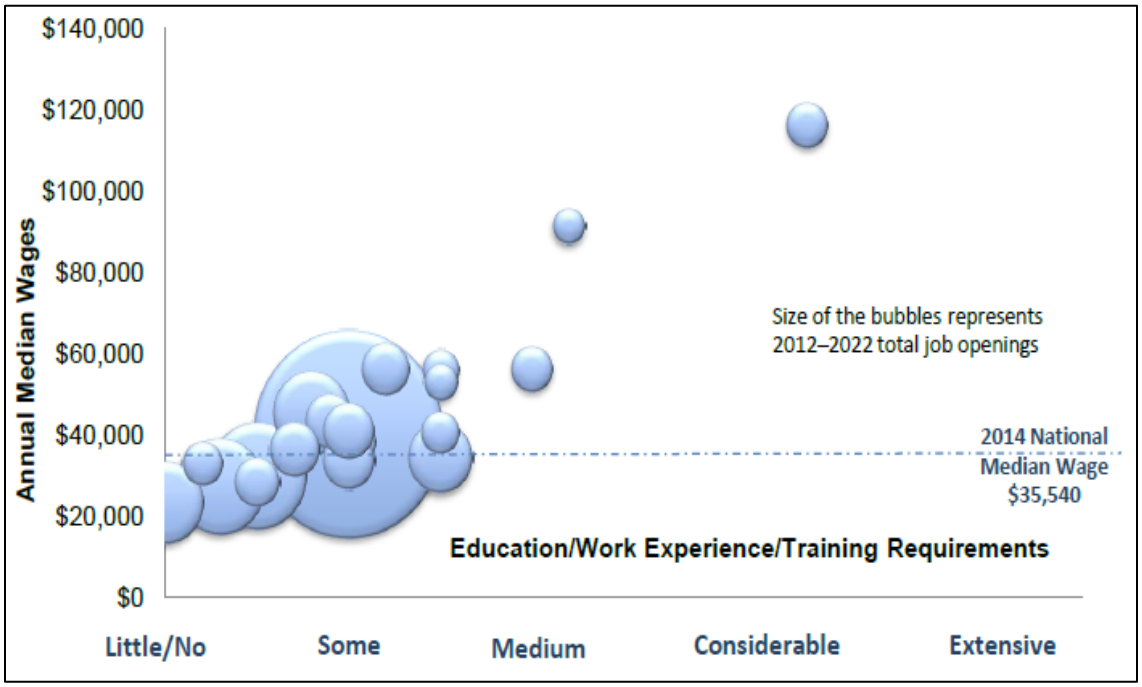


Figure 1. Top 20 Transportation jobs by 2012-2022 projected total job openings: median wages vs education/work experience/training requirements (United States, Department of Education, Office of Career, Technical, and Adult Education (OCTAE) 2015).

Professionalism and work ethic, oral and written communications, teamwork and collaboration, critical thinking and problem solving are general skills that are required for any graduates from high school, two-year colleges or technical schools, and four-year colleges (Casner-Lotto, 2006). However, with the increase in complexity and growing requirements in federal, state, and local levels, the transportation engineers require special skills different than the general engineering skills (Sinha et al. 2002). Pardo da Silva Jr. et al. presented three different alternatives of providing education and developing skills for undergraduate transportation students. The first alternative is through the development of new curriculum that provides degree of transportation engineering which is not a common practice in many countries including US. The second alternative of developing professionals to work is through isolated courses that focus on transportation engineering and the third alternative is through a special studies program (Pardo da Silva Jr. et al., 2015).

The number of women and minorities working in the railroad industry is significantly low (Vieth et al. 2014). The inability of the industry to attract a diverse workforce is partially due to the traditional recruitment process such as 'father and son' and nepotism. The railroad companies have developed programs such as affinity groups to contribute to diverse recruiting, college outreach, and new hire assimilation to recruit diverse and inclusive workforce in the industry. Vieth et al. developed two competency modeling (CM) approaches to present the key knowledge, skill and attributes of the engineers and operations professionals in the rail industry in US. Table 1 presents the general and specific knowledge and skills required for engineers and operations professionals in railroad industry.

Table 1. Competencies required for engineers and operations professionals in railroad industry (Vieth et al. 2014)

Engineers		**Operations Professionals**	
General	Specific	General	Specific
Domain knowledge - Engineering	Track and infrastructure engineering	Domain knowledge – Operations	Communications and signal operations
Commitment to safety	Rolling stock and traction engineering	Commitment to safety	Yard and terminal operations
Project management	Communication and rail signal engineering	Business acumen and customer awareness	Asset management
Personal effectiveness	Engineering of bridges and structures	Project management	Information management
Commitment to standards	Control systems engineering	Personal effectiveness	Traffic and planning logistics
Utilization of engineering tools and support systems			

The transportation industry has been experiencing a major challenge in recruiting skilled workforce within specific work areas due to decreasing number of students entering in the fields of transportation including engineering, construction, and maintenance. In relation to the development of future applicant skills, Cronin (2011) presented the strategies, challenges, and workforce practices. The most common challenges for the agencies include lack of skilled applicants and failure to invest in talent pipeline such as internship programs. The transportation industry should focus on conducting internship programs, partnering with schools for youth development, developing student curriculum and education academics, and adopting scholarship programs to develop the skills of workforce in different fields of transportation. Oregon DOT college internship program (CIP) is one of the noteworthy practices designed to develop future applicants' skills which provides around 70 internship opportunities each summer. In addition to developing skills related to the transportation engineering, the program also focuses in developing skills relating to information system, operation of heavy equipment, and mechanics (Cronin 2011).

In past, transportation industry recruited engineers and technicians with skills and knowledge mainly related to design, construction, materials, structures, hydraulics, transportation engineering, and geotechnical studies. Later, as the industry expanded the transportation workforce were required to have skills related to other factors such as environment, nature, and habitat protection, safety concerns, community impacts including culture and history, metropolitan and regional planning requirements, and changing environmental and community needs. In early 2000s, the transportation agencies began the recruitment of professionals including environmental scientists, economists, statisticians, geologists, architects, lawyers, and acquisition agents. In addition, the emerging technologies such as computing, convergence of communication, sensing, and control technologies have influenced the functions of transportation organizations including planning, design, financial and administrative systems, and program management. Consequently, the industry is constantly in demand of skilled manpower who can understand and operate these new technologies (Committee on Future Surface Transportation Agency Human Resource Needs, Strategies for Recruiting, & Retaining Personnel 2003).

Polzin and Ward reported the major observations that were concluded by a focus group comprising of 12 professionals who were at a level of director in their respective organizations and employed over 4100 employees. The group assessed the needs for an interdisciplinary graduate degree in the transportation industry and produced several observations including the skills and knowledge requirements in the transportation sector. The workforce are required to have understand the political and social environment and have strong communication skills in addition to being independent and technically inept. The focus group concluded that the industry is constantly looking for the employees who can make higher-order contributions, and know how to advance with the application of tools and processes of the profession. The participants from public organizations responded that the people with basic technical and communication skills can meet the needs of the filed while the professionals from private sector believed that the employees should have the knowledge of transportation management with basic understanding of business and entrepreneurial dimensions. There was a general agreement that master's degree is not an optimum level and a student with an undergraduate degree and possessing some work experience can provide the necessary knowledge of the field. One of the participants of the survey stated that his company would look for employee with strong communication and presentation skills, leadership skills, negotiation skills interdisciplinary education, maturity, problem-solving skills and strong work ethics (Polzin and Ward 2002).

Handy et al. compared the knowledge and skills provided by the planning and engineering programs with the knowledge and skills required in the real field applications. The authors concluded that the transportation programs offer potential models of interdisciplinary curricula which however does not have the standard and uniform approach to the transportation planning. Table 2. presents the results of an online survey that was conducted to compare the skills provided by the academic programs with the skills needed in the profession. The skills were rated from 1 to 5, with 1 being 'not important at all' and 5 being 'very important'. The average rating of coverage was rated from 1 to 5 with 1 being 'not enough' and 5 being 'too much'. As shown in the Table, public speaking, data presentation, working with the public, technical writing, and writing for the public were surveyed as the top five skills. Similarly, the respondents rated public involvement, bicycle and pedestrian planning, transit planning, regional transportation planning, and travel demand forecasts as the top priority skills that are not sufficiently covered in the academic programs. The priority score was calculated by multiplying the different of averaging rating of coverage and sufficient score of 3 by the rating of importance. The respondents were also asked to rate the recent applicants on their knowledge and skills and investigate the importance of each skills for the entry-level planners. Technical writing, data presentation, data collection, public speaking, and writing to public were rated as the top five skills in terms of the importance. The authors concluded that a greater deficiency existed in the development of skills than in the coverage of topics as the top priority rating for skills were higher than the top priority scores for the topics. In addition, there appears to be dissatisfaction with the skills of applicants as suggested by the lower average ratings of the abilities of applicants compared to the average ratings of the importance of the abilities for all skills (Handy et al. 2002).

Table 2. Professional needs versus academic courses: skills (Handy et al. 2002)

Skills List	**Average Importance in Job**	**Portion of Course (%)**				**Average Rating of Coverage**	**Priority Score**
		Not Covered	Minor Portion	Major Portion	Full Course		
Public Speaking	4.54	16.8	37.2	27.1	19	2.24	3.45
Data Presentation	4.49	5.8	30.4	47.6	16.2	2.69	1.39
Working with the Public	4.47	29	40.9	22.6	7.5	2.13	3.89
Technical Writing	4.37	14.9	32.3	30.3	22.5	2.5	2.19
Writing for the Public	4.31	32.1	36.6	23.4	7.9	2.23	3.32
Data Collection	4.08	5.6	32.1	47.2	15.1	2.77	0.94
Meeting Facilitation	4.08	46.6	36.6	13.7	3.1	2.06	3.84
Budget Preparation	3.63	45.7	35.7	10.6	8.1	1.9	3.99
Statistical Analysis	3.5	2.8	15.9	29.8	51.5	2.85	0.53

Skills List	Average Importance in Job	Portion of Course (%)				Average Rating of Coverage	Priority Score
		Not Covered	Minor Portion	Major Portion	Full Course		
Geographic Information Systems	3.42	52.4	18.1	10.3	19.2	1.99	3.45
Traffic Impact Analysis	3.35	48	33.7	13.8	4.5	2.1	3.02
Environmental Impact Analysis	3.19	30.7	43.9	16.5	8.9	2.18	2.62
Travel Demand Modeling	3.11	42.1	24.4	19.1	14.3	2.17	2.58
Cost-Benefit Analysis	3.1	12.8	42.2	34.1	10.9	2.34	2.05
System Design	2.98	45.3	33	15.6	9.5	2.26	2.21
Facility Design	2.94	39.5	36.7	12.9	7	2.3	2.06
Survey Administration	2.94	19.6	40.8	30.2	9.2	2.54	1.35
Highway Capacity Software	2.74	64	19	10.1	2	2.09	2.49
Population Forecasting	2.68	27.3	38.4	25.1		2.53	1.26
TransCAD Software	1.97	88.4	7.9	1.7		1.92	2.13

The knowledge, skills, and abilities (KSAs) required for the workforce in the operational sector of the transportation industry are presented in Table 3 (Popkin et al. 2008). The master list of most important KSAs were compiled for 15 jobs across the transportation modes including highway, rail, maritime, and air.

Table 3. Knowledge, skills, and abilities listed in order of importance within the transportation industry (Popkin et al. 2008)

Knowledge	Skills	Abilities
Transportation	Operation and control Speaking Active listening Coordination Operation monitoring Time management Critical thinking Judgement and decision making	Control precision Far vision Oral expression Oral comprehension Near vision Reaction time Selective attention Speech clarity Depth perception

Knowledge	Skills	Abilities
		Problem sensitivity Spatial orientation Time Sharing

3.2 Strategies to address workforce shortage in the transportation industry

According to a report by National Science Foundation (NSF), only 0.6%, 0.4%, and 0.2% represented the number of Native American population pursuing respectively the bachelor's, master's, and doctoral degrees in science and engineering fields (National Science Foundation 2015). The lack of proper exposure and confidence, lack of interest and feeling of belonging are some of the reasons behind low representation of Native Americans in the STEM disciplines. Williams and Shipley conducted a literature review and survey of 96 students from 42 different tribes to investigate the causes of low participation rate of Native Americans in the STEM disciplines. The cultural taboos was deemed as the major factor restricting the Native American students to pursue STEM fields. Therefore, the cultural concerns must be reasonably acknowledged to increase Native Americans in STEM. This will help decrease the poverty rate of the underrepresented population while also increasing the critical thinking and problem solving ability, productivity, and competitiveness with the increasing diversity (Williams and Shipley 2018). The effective collaboration and partnership of the private and philanthropic groups and educational organizations with the state and local government is required to motivate and prepare underrepresented minorities and women for future STEM proficient workforce. In addition, the realization of requirement of significant amount to investment and hard work is essential from students, teachers and educators at all levels (Hossain and Robinson 2012).

Chang analyzed the factors affecting the interest in science, mathematics, and engineering (SME) disciplines and strategies for retaining minorities in SME. The attitudinal factors, lack of interaction, and the strong cultural values of Native Americans, African-Americans, and Latinos are the major reasons for lower participation of minorities in SME. In addition, SME has the lowest retention rate of minority students which is mainly due to the lack of background knowledge and basic math and science literacy. The community colleges play an important role to increase the number of minorities in SME. The National Science Board recommended to restructure the undergraduate curriculum to include laboratory experience and technology and programs that encourage investigative learning and collaborative group works. The proper faculty guidance and mentoring programs that help students to socialize also affect the retention of minority students in SME. Furthermore, the partnerships between two and four year colleges with inclusion of programs such as community college summer research programs aids the transfer the group of students who later pursue the SME studies (Chang 2002).

The Texas State Transportation Innovation (TTI) identified the retirement of the older generation and increasing demand of workforce with advanced technical skills as two major causes for workforce shortage (Gilliland 2001). The recruitment of high quality management personnel is a challenge to many construction firms and even more complicated for state DOTs due to the compensation restrictions (Harper et al. 2018). The dynamic nature of the construction work, the organizational HR philosophy, lower compensation and promotional benefits in public agencies, and changing economy also influence the recruitment and retention of qualified professionals in

the construction industry (Hodges and Crowley 2014). The public transportation agencies comprises of workforce composed of Baby Boomers, Generation Xers, and Millennials and the retirement of baby boomer generation is one of the major causes for workforce shortage in transportation organizations (Committee on Future Surface Transportation Agency Human Resource Needs, Strategies for Recruiting, & Retaining Personnel 2003, Gallagher and Villwock-Witte 2016). Table 4 presents the average retirement age for public agencies across five states in Region 6 which suggest that most old age workers retire around the age of 60 which is younger than workers in other industries (Harper et al. 2018, U.S. office of personnel management 2017). The financial reasons and professional satisfaction however have resulted in the increase in retirement age (as shown in Figure 2) which might be beneficial to retain experienced employees in the agency (Harper et al. 2018, Popkin et al. 2008).

Table 4. The average retirement age for public agency employees by state (U.S. office of personnel management 2017)

State DOT	2014	2015	2016	Increase %
Arkansas	61.4	60.9	60.7	-1.14
Louisiana	60.7	60.3	61.1	0.66
New Mexico	60.9	61.5	62.1	1.97
Oklahoma	60.4	60.5	61.2	1.32
Texas	61	61.2	61.4	0.66

The transportation agencies and state DOTs need to recruit young professionals in various positions as the studies show that more than 50% of public agency workers could retire in next 10 years (Adams et al. 2009). However, with the lower number of students entering in the STEM fields, the transportation agencies face a huge challenge to fill the gaps. The exposure to the transportation engineering before high school with financial aids and scholarships aimed at minorities and women can encourage young people towards the transportation industry and fill the future vacancies (Russel 1991).

Toole and Toole compared the decreasing number of workforce in the transportation industry to an hourglass which represents the connection between various strategies in addition to the flow of actions that start at a very young age. The first strategy of attracting young people to the industry is by increasing the public awareness in a positive manner which can be achieved through changing attitudes within the industry, reaching the media, making transportation fun, and bringing transportation to the schools. The awareness programs especially through the media will improve the public opinion of transportation, increase interest of the youth, and create the basic foundation knowledge of transportation. In the second stage, concentrated recruiting efforts such as career fairs, industry speakers, and site tours should be directed towards the high school juniors as well as juniors and sophomores from the college. In the third stage after the interest is generated into the industry and with strong recruitment efforts, focus should be on the globalization of the transportation market and expansion of the diversity and composition by hiring broader spectrum

of people from different disciplines such as business, social sciences, analytics, and public administration (Toole and Toole 2007).

Nelson and Madsen surveyed the top 100 departments of top 15 science and engineering disciplines to investigate the race/ethnicity including Asian, Black, White, Hispanic, and Native American, rank, and gender of the faculty and students. The Native Americans were observed to have the lowest representation of faculty and students compared to other races despite some increased growth among undergraduate and PhD degree recipients. The authors observed insufficient representation of faculty in most science and engineering disciplines to provide mentoring and stand as a role model to junior faculty and students (Nelson and Madsen 2018).

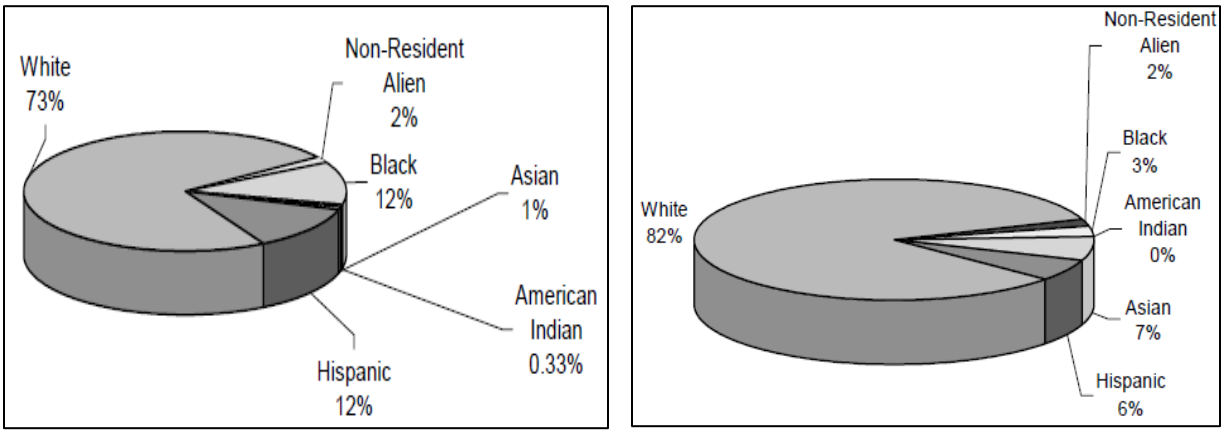
The major reasons for lower participation of racial minorities in engineering filed include, (i) parents inability to effectively support the education beyond high school, (ii) racial bias in standardized testing instruments, (iii) inherent deficiencies in the elementary and secondary education, (iv) lack of support and encouragement and inadequate counseling from academic counselors and advisors, (v) inadequate financial aid to attend higher studies, (vi) insufficient basic engineering knowledge and difficulty of engineering course work, and (vii) lack of interaction with faculty and peers (Waggoner, 1995). The impact of recruiting diverse workforce including women and minorities on the currently employed Iowa Department of Transportation (DOT) employees was also assessed during the study. The DOT employees were observed to be against the agenda of significantly increasing the recruitment of women and minorities over the next decade. Furthermore, the employees agreed on increasing the underrepresented groups in DOT however through the in-state recruitment process. The study suggested that DOT should consider out-of-state hiring by targeting the regions where increased number of women and minorities can be recruited; this would not only broaden the recruiting scope but also will gain an edge in hiring qualified employees without any discrimination between races or gender (Waggoner, 1995).

Waggoner identified (i) sense of community, (ii) student faculty interactions, and (iii) parental support as three major approaches to retain underrepresented groups in the transportation field. The sense of identifying oneself as a member of professional community of present or future workforce will help to alleviate the minority students' feelings of isolation and draw more minority students in the program in the long run. The adequate mentoring and interactions with peers and faculty can significantly increase students' academic performance, develop a positive attitude towards the engineering, develop time management skills, and motivate to work in groups. In addition, students can be retained within the courses by clearing the difficulty of the program during the recruitment or application state and by informing the benefits of the career during the recruitment phase (Waggoner, 1995).

Ayele discussed and summarized the extent of minority representation in professional and managerial positions in the transportation industry (Ayele 1991). The underrepresentation of minorities in the transportation industry has also been recognized by a study by transportation research board (TRB) which has recommended the transportation professionals in universities to encourage further development of programs to attract minorities in the transportation industry. The efforts such as aggressive recruitment, counseling, financial aid, and assistantship programs can significantly attract the minorities in the field of transportation. In summary, following actions were recommended for the transportation community to encourage and increase the involvement of minorities to join the industry (Ayele 1991):

- Development of new programs such as courses and training concentrating in transportation and traffic engineering in historically black colleges and universities (HBCU) in addition to supporting the current programs.
- Conducting extensive recruitment efforts at colleges for minorities with an aim to attract students to different programs including transportation, traffic, planning, and management.
- Providing an attractive financial aids sufficient to pursue the transportation engineering as a career.
- Development of participatory internship and cooperative programs to enrich the work educational experience of the students through hands-on training.

Polzin and Ward investigated the industry demand for employees and the student's interest in transportation as the two key issues that drive the future workforce for the transportation professionals. The authors presented the observations and experiences that were developed while establishing the graduate transportation degree at the University of South Florida (USF). The USF embraced the concept of multidisciplinary transportation in order to attract students from diverse backgrounds to the transportation curriculum and open the discipline to a significantly larger population of minority and female students by offering enhanced opportunity. Figure 2 presents the total undergraduate students at USF in terms of race and ethnicity (Polzin and Ward 2002).



(a) (b)

Figure 2. Distribution of civil engineering undergraduate student population at USF in terms of (a) race, (b) ethnicity (Polzin and Ward 2002)

The major observations that were concluded by a focus group comprising of 12 professionals who were at a level of director in their respective organizations and employed over 4100 employees was also reported. The group assessed the needs for an interdisciplinary graduate degree in the transportation industry and provided a general agreement on the interdisciplinary approach which would satisfy the need for the broader aspects of the transportation. The planners and administrators in the transportation industry are generally the graduates from the disciplines such as planning, geography, economics, and public administration. Therefore, the development of a multidisciplinary curriculum and the programs that establish a competition within the set of transportation knowledge would provide a higher credential value to the transportation degree and ensure the larger participation on the profession. One of the major reasons for a labor shortage in

the industry is the discrepancy between what employers are seeking and what students are motivated to learn. The knowledge dissemination about the various aspects of the career to the DOT program and transportation career would help to attract large number of potential professionals in the industry. However, the authors believe that the glamour and the media attention has not particularly benefited the transportation industry (Polzin and Ward 2002).

Farrell et al. assessed the perception of faculty and students on the inclusivity of the civil engineering curriculum at the civil and environmental engineering (CEE) department at Rowan University and also evaluated the influence of adopting inclusive practices on students' conception of engineering (Farrell et al. 2017). The authors modified the benchmark for cultural change survey tool (Jost 2004) which assessed the inclusiveness of underrepresented groups. The faculty member's readiness of inclusivity at the CEE department at Rowan University is reflected by a welcoming diversity statement at the course syllabus which reads, "I am committed to creating an inclusive environment in which all students are respected and valued. I will not tolerate disrespectful language or behavior on the basis of age, ability, color/ethnicity/race, gender identity/expression, marital/parental status, military/veteran's status, national origin, political affiliation, religious/spiritual beliefs, sex, sexual orientation, socioeconomic status or other visible or non-visible differences." The inclusion of minorities can be increased either through the curriculum design such as content change, non-technical professional skills, and assessment or through the teaching and learning practices such as inclusive teaching methods, laboratories and equipment use, classroom interaction, and language and images. The instructors framed discussions on the social and cultural aspects of engineering and the development of courses such as engineering and social justice, history of technological innovations, engineering ethics, engineering and social justice can positively expand minority students' perception of the profession (Farrell et al. 2017).

The transportation industry is required to focus in attracting and recruiting new talents along with the underrepresented groups of minorities and women as the significant number of workforce is nearing to the retirement age (Ivey et al. 2012). The outreach programs in kindergarten through 12th grade, particularly in the middle school is required to increase the pipeline of transportation professionals which has been the major target of the transportation agencies such as U.S. Department of Transportation and the Institute of Transportation Engineers. The authors presented the findings of a program called as Transportation Engineering Careers (TREC) regarding the students' perception on transportation engineering. The TREC program was designed at the University of Memphis to introduce precollege students to transportation engineering, present the links between math, science, and engineering, develop leadership skills of future professionals, and provide real-life applications of transportation engineering. The pre-survey and post survey results indicated that most of the students were confident on their abilities in math and science. A significant number of students responded the parental influence as the major factor for them joining the TREC program with more than 60% indicating their interest in math, science, and engineering. Similarly, the students were observed to believe transportation engineering would be an exciting career. The program was observed to increase the perception and knowledge of transportation engineering as the students responded with specific responses on a question that asked what transportation engineering do during the post survey. The students were observed to be interested in various fields of transportation engineering including highway design, airport design, bicycle-pedestrian design, and transit system design. The students responded positively on

the impact of TREC program in increasing their abilities in math, science, and engineering and significantly increasing their knowledge about transportation engineering (Ivey et al. 2012).

The University of Missouri-St. Louis and Washington University developed a Joint Undergraduate Program to prepare a diverse workforce including women and minorities in the engineering discipline. The McDonnell Douglas Access to Engineering Program was a natural outreach activity of the joint program which was introduced to recruit and retain talented minorities (especially African-Americans) and women to the field of engineering (Shields et al. 1996). The program established an eight week all day pre-collegiate institute in mathematics and engineering for high school juniors and seniors with backgrounds that were underrepresented in the engineering field. The program addressed the critical need for the improvement of mathematics skills required for a smooth transition for high school to pre-engineering curriculum and provided the participants with the hands-on experience in civil, electrical, and mechanical engineering, and emphasized on the role of mathematics and science in engineering and engineering in society through field trips, engineering laboratories, and lectures by engineers and professionals. The program nominated a total of 194 students with 78% representing the under-represented minorities and women. The participants of the program were provided a stipend of $100 per week as the program require huge time investment and also an offset of the lost income from possible summer employment. The participants who successfully completed the program were also offered a full tuition scholarship for their first year of pre-engineering study at UM-St. Louis. The lecture session covered various topics including mathematics and engineering, science and engineering, introduction to civil engineering, earthquakes, society and technology, automated highway, and transportation overview and the laboratory visits covered various topics including computer aided design (AutoCAD), concrete construction, concrete destruction, environmental engineering, hands on with structures, and introduction to internet. The participants of the program rated laboratory sessions as the most effective activity on every evaluation criteria to enhance their knowledge in math, science, and engineering compared to field trips and presentations. Table 5 presents the participants rating on the type of activity on different evaluation criteria (Shields et al. 1996).

Table 5. Evaluation of types of activities: adjusted least square means (Shields et al. 1996)

Dependent Variable	Type of Activity		
	Lab	Presentation	Field Trip
Challenging*	3.82	2.87	2.37
Understand*	4.16	3.74	3.49
Interesting**	4.22	3.48	3.54
Organized*	4.07	3.75	3.55
Clarity***	3.97	3.82	3.67
Do again**	4.20	3.44	3.46
N	468	361	334

According to Fisher's least-significant-difference test:

* all groups significantly different from one another at .05 level or better
** labs significantly different from field trips and presentations at .05 level or better
*** lab significantly different from field trips at .05 level or better

Among 7,130,000 employers in construction and extraction occupations, 2.6% were women, 6.2% were Black or African American, 1.6% were Asian, and 31% were Hispanic or Latino/Latina (Bureau of Labor 2013). The racial distribution chart of construction workers amongst the New Jersey residents showed that construction workforce was less diverse compared to all industries (see Figure 3).

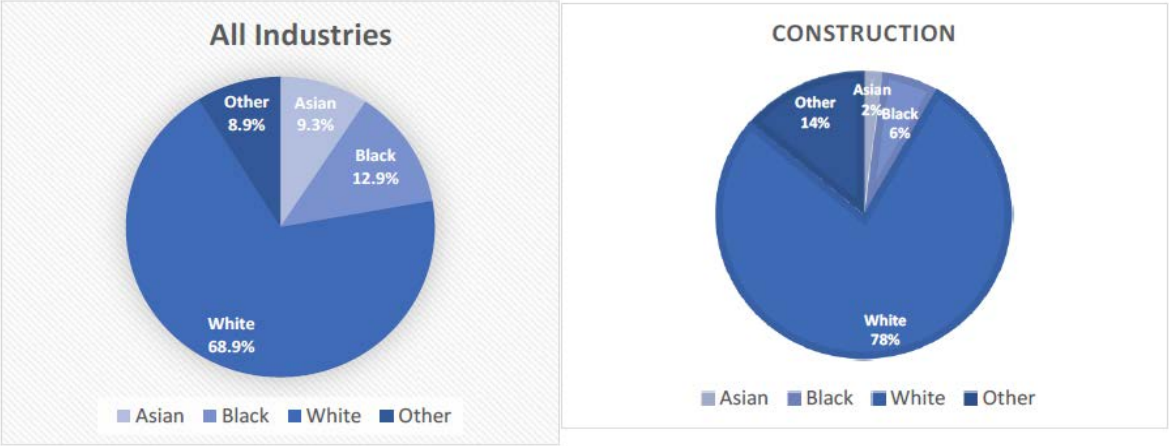


Figure 3. Racial profile of New Jersey residents within construction (Packen, 2105)

New Jersey Department of Transportation (NJDOT) have developed apprenticeship training programs as opportunities for women, minorities and other disadvantaged individuals to achieve related training for careers in highly skilled construction jobs. It has been observed that supportive family with consistent and effective mentorship have encouraged the minorities and women in career path of highway engineering jobs in spite of the obstacles of stereotypes, prejudices, and disadvantages background. Some of the challenges for underrepresented groups to join the apprenticeship programs include, (i) the lack of access to a car and public transportation to complete the application process for the apprenticeship programs, (ii) academic struggle to achieve a high school equivalency for graduation, (iii) limitations of apprenticeship applicants and the frequency of selection, and (iv) the practice of hiring minority and low skilled workers based on placement criteria only. The national survey of On-the-Job Training/Support Services (OJT/SS) programs found some key observations for effective program which include team building and partnership, a well thought-out program with extensive outreach to contractor, good working relationships and industry participation, collaboration between state, local and federal programs with industries and unions, and effective communications with current and prospective trainees, contractors, and state's resident engineers (Daniel et al. 2017).

Daniel et al. developed an On-the-Job Training/Support Services (OJT/SS) pre-apprenticeship Training program framework for NJDOT with an effort to increase participation of underrepresented individuals including women and minorities on journey-level positions of various NJDOT's federally funded highway projects. The NJDOT was provided with five recommendations for the best approach of developing and implementing OJT/SS program for women and minorities which include, (i) understanding the strengths and weaknesses of the department in developing the program, (ii) involving contractors while developing and implementing the program, (iii) establish relationship with unions (such as construction and general laborers union, laborers international union of north America, united brotherhood of

carpenters, international union of operating engineers) by promoting open line communication and seeking to develop direct entry agreements with union and labor organizations, (iv) partnering with government agencies, educational institutions and nonprofit organizations to recruit students, and (v) providing financial aids and academic supports for the participants (Daniel et al . 2017).

The University of South Alabama (USA) developed a summer undergraduate program called as Youth Transportation Institute (YTI) to provide an outreach transportation engineering education for middle and high school students in general with encouraged participation of minority and female students (Islam and Brown 2012). The program consisted of presentations and different activities for middle and high school students. The presentation topics for middle school students included traffic/road signs, overview of transportation design and urban planning, and the presentations for high school students were related to job opportunities within transportation engineering, highway design, bridge design, transportation materials, and crash statistics/driver safety. The program consisted of various interesting activities to attract youths towards transportation engineering which included urban planning exercise using 'SimCity', 'Transportation-OPOLY' game, roadway cross-section lab exercise, simple bridge design using 'west point bridge designer', and concrete cylinder breaking lab (see Figure 4) (Islam and Brown 2012).

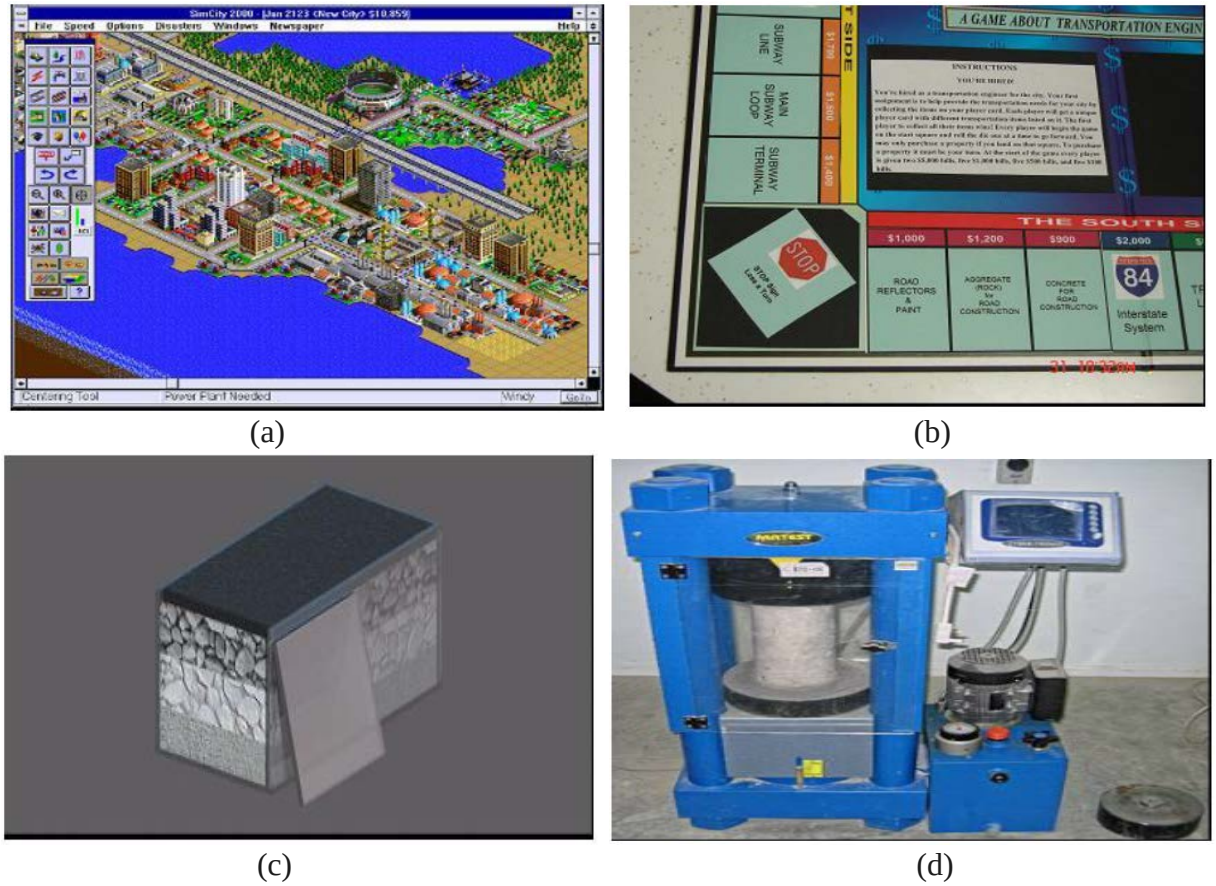
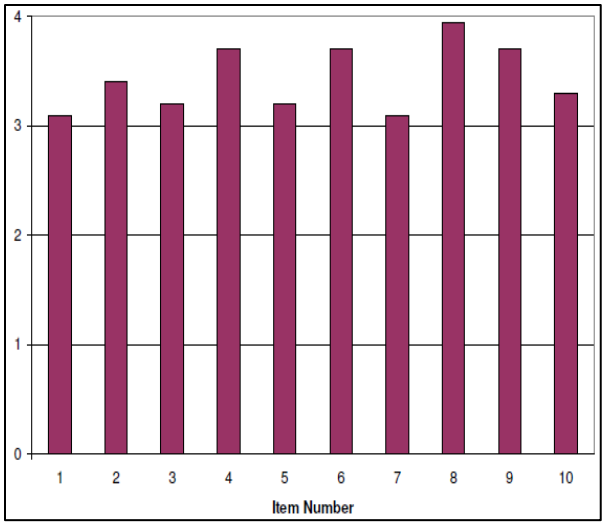


Figure 4. (a) Development of a city using 'SimCity' computer program, (b) the transportation-OPOLY Game, (c) roadway cross-section laboratory activity, (d) compressive strength of Concrete (Islam and Brown 2012)

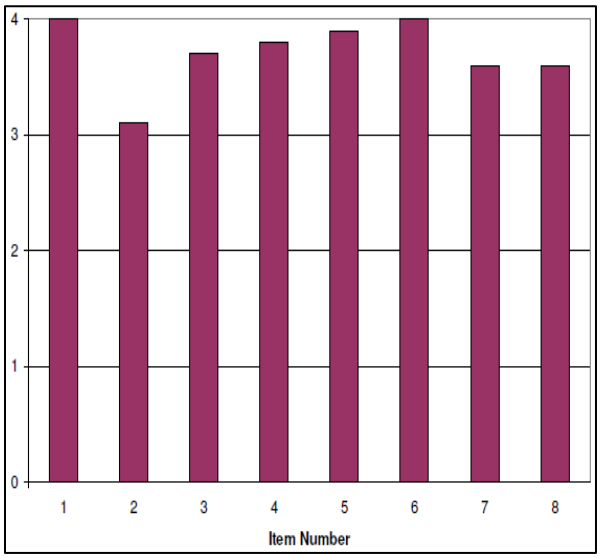
The North Carolina (NC) Center for Minority Engineering Development (CMED) was established with objectives to increase the number of under-represented minority and woman in engineering discipline and provide sufficient mentoring to continuing students. The programs and activities of CMED were intended to have positive impacts of engineering on the minorities and women graduating from NC State University and successful job or graduate school placement opportunities (Mitchell 2000). The major objectives of CMED included, (i) providing financial aids for increasing the number of minorities in undergraduate studies, (ii) significantly expanding mentoring programs to retain diverse population, (iii) providing engineering outreach programs, (iv) supporting faculty for participating in recruitment and undergraduate recruitment, and, (v) expanding research interest amongst undergraduates. The directors of minority engineering, recruiting, and women engineering programs provided effective support and coverage to different constituents including engineering departments, primary and secondary schools, and industries. The major activities of CMED included, (i) student advancement and retention teams (START) which selected mentors from among graduate and upper class undergraduate minority students who act as big brothers or sisters to their mentees, (ii) NC state college of engineering summer transition program (STP) to enhance the academic and social aspects of minority freshmen, (iii) college of engineering professional student development courses which were designed specifically for freshmen minority students, (iv) minority scholarship monitoring to target minority engineering students in providing corporate or private donors scholarship awards, (v) college of engineering writing assistance and tutorial programs to provide assistance in improve writing skills, (vi) engineering outreach teams to provide hands-on experience and teach K-12 students about the engineering, and (vii) undergraduate women in engineering programs which include peer mentoring, email mentoring program and a parents' weekend activities effective for women in engineering (Mitchell 2000).

Chowdhury and Chowdhury investigated the participation and performance of minority women students in civil and mechanical engineering departments at Alabama A&M University. The authors also conducted surveys to evaluate and identify the causes of lower participation and programs to increase the enrollment of minority women in the field of engineering. The female students represented only 20% of the total students in different courses of civil and mechanical engineering. The analysis of the grades for male and female engineering students showed the average grades of female students to be better than that of the male students suggesting that female students are capable of studying engineering. Figure 5 (a) and Figure 5 (b) presents the results of survey regarding the causes of lower participation and solutions to increase enrollment of female minority engineers. The numbers 1, 2, 3, and 4 in the vertical axis represent not agree, somewhat agree, agree, and strongly agree respectively. As shown in Figure 5, survey respondents strongly agreed on the tendency of minority female students to study liberal arts or humanities. The respondents also agreed on lack of proper background in math and subjects, lack of mentoring and support from family, misconception about engineering, economic condition, and ignorance of engineering work as other causes for lower enrollment of female minorities in engineering. The increase in scholarships and summer internship opportunities were strongly agreed as the most effective methods to increase female enrollment in engineering. Similarly, proper education about engineering works and job prospects, encouraging to take math and science classes in high school, and effective communication with parents to encourage their children to study engineering were agreed as other solutions to increase the enrollment (Chowdhury and Chowdhury 2007).



1 = Lack of motivation for challenging position
2 = Lack of proper math and science courses in high school
3 = Ignorance of engineering job prospect
4 = Ignorance of engineering work environment and job pattern (not always field work)
5 = Ignorance of engineering job salary compared to other jobs
6 = Misconception about engineering – 'not suitable for women'
7 = Fear of math
8 = Women have a general tendency to study liberal arts/humanities subjects
9 = Lack of motivation or influence from family to study engineering
10 = Economic condition

(a)



1 = More scholarships for freshmen and sophomore female students
2 = Daycare support for student mothers at affordable costs
3 = Encourage female students at high school to take math and science courses to prepare for engineering
4 = Increase awareness about job prospect and benefit for engineering jobs, among high school students
5 = Give proper idea about engineering work environment and job pattern
6 = More Summer Internship opportunities for women
7 = Communicate with families to encourage female students to study engineering for better prospect
8 = Women have a general tendency to study liberal arts/humanities subjects
9 = "Engineering for all – Male and Female", convey this message to high school and freshmen students

(b)

Figure 5. (a) Possible causes for low enrollment of minority women in engineering, (b) possible ways to increase enrollment of women minority in engineering (Chowdhury and Chowdhury 2007)

The University of Alabama in Huntsville (UAH) developed a summer institute program which invited 20 middle school students to provide knowledge and experience about various topics of transportation engineering (Leonard et al. 2000). The local minority and female engineers served as the mentors for the program that was specially designed to encourage female and minority students to join engineering and introduce them to various transportation related topics. The program activities were based on the template of 'Gearing Up for Transportation Engineering Program' (GUTEP) which was initiated in the year 2000 to provide interactive experiences to

motive interest in transportation engineering. The program recruited 75% female and 55% African American students and provided hands-on experiments in the transportation related topics including bridges, space transportation, construction materials, surveying, alternative energy, transportation safety, soil and geotechnical materials, and future transportation design problems (Leonard et al. 2000).

Harper et al. conducted extensive literature review, interviews, and survey studies to determine the best practices adopted by transportation agencies to recruit and retain qualified and experienced employers, identify the potential causes of limiting the recruitment and retention of the workforce, and develop outreach and educational programs to attract minorities to the transportation industry. The lower salary compensation of state DOTs compared to the private firms specially for the positions of engineers, surveyors and inspectors, equipment operators, and maintenance personnel was found to be one of the major causes for workforce shortage in state DOTs. The health and retirement benefits, and stable employment were major factors to influence the recruitment. The state DOTs in southern U.S. were observed to participate on job fairs at various colleges and universities with a major objective of encouraging underrepresented population towards transportation industry. The study results indicated that more than 50% of the current DOT employees are above the age of 45 affecting different dimensions of HR practices such as recruitment, retention, and employee motivation. The interview results suggested the competitive labor-market conditions as the major contributor for restricting recruitment and retention of employers. The salary compensation and promotion opportunities were found to be major factors to influence the young professionals in joining the transportation industry (Harper et al 2018).

The authors developed seven major recommendations for state DOTs to improve recruiting, retaining, and motivating highly qualified young professionals in the transportation industry which included, *(i)* use of social media and internet sources to advertise and recruit individuals and improve loyalty and retention, *(ii)* quantify benefits and salary to provide a compensation comparable to private firms, *(iii)* offer flexible work schedules to provide a suitable balance between work and life, *(iv)* base promotions and incentives on employee performance, *(v)* improve morale department wide that creates a productive workforce and encourages loyalty, *(vi)* promote the importance of working for a public agency, and *(vii)* require employees that obtain a license to remain with the DOT (Harper et al 2018).

4. METHODOLOGY

The methodology used to collect information and data for this project area included but not limited to the publication research articles, literature reviews, interviews, surveys, observation and outreach activities in the community including both present and historical information about the Navajo Nation community.

5. ANALYSIS AND FINDINGS

After initial research, analysis was conducted to understand the causes of the shortage of the careers in transportation trades at Navajo nation in order to determine the proficiency sets needed for current transportation industry worker at Navajo nation-states. It was found that this project has a significant impact on the society and educational system.

With a careful investigation and exploration we found that the workforce development for the transportation industry is a critical and challenging issue. Our founding shows that many factors are effecting the workforce shortage in the nation. We found that the community requirement instructing awareness, attitudes, and abilities in the transportation areas.

It was exposed that we demand to deliver the Nations the opportunities for research and teaching in transportation and related guidelines. Therefore we determined that we need to create educational programs in the transportation area at undergraduate and high school level, throughout the Navajo Nations.

It remained revealed that if the above-mentioned strategy is implemented appropriately, it will benefit many of our existing educational programs at Navajo Technical University and it will lead to increase in the career options for our students and Navajo Nation. This founding and strategy will increase the career options for our people and will impact further business and economic development and environmental situations for the nation.

The impact beyond science and technology is that it will increase the career options for our students and Navajo Nation. It also, impacts on additional business and economic development for the nation.

Additional actions were performed towards the outreach activities by talking to some of the faculties, high school authorities and teachers for the possible creation of a dual credit courses in transportation industries. This was disclosed that this will increase the educational options and opportunities for high school students, extend course availability, and increase access to college credit-bearing courses. In addition, this will shorten the time it will take them to complete their degree, have the same opportunities as other students in the state, whether you live in an urban or rural region areas.

Tran-SET center provided the summer research internships opportunities for students from Navajo Technical University to get involved with the center's research activities and learn about the career opportunities in transportation. In 2018, the internship took place June 4th – June 29th, 2018 and included two Navajo students: Ms. Christine Whitehorse and Ms. Arlyssia Sells, see Figure 6. The students were exposed to a variety of transportation topics and professions, including a site visit to the FHWA LA Division Office, a site visit to the Capital Region Planning Commission (CRPC), a site visit to the Alliance Safety Council, and two on-site presentations from the Deep South ITE President and Vice President, respectively. It is important to note that these site visits/informal sessions (and the topical presentations) were open to all local students and not just the interns. The events were a great opportunity to learn more about various transportation topics and to meet active professionals in the field. The internship also included hands-on research experience on several Tran-SET-funded projects as a student worker.

Figure 6. NTU Interns at the Alliance Safety Council

Similarly in 2019, Tran-SET hosted Mr. Seth Dennison and Ms. Samantha Francis for the 2019 Internship, see Figure 7. The Internship took place June 3 – 28, 2019 and included (1) hands-on research experience on several Tran-SET funded projects as a student worker (main component), (2) presentation series on diverse, relevant transportation topics, and (3) informal sessions with varied transportation professionals (from industry, practitioner community, and state and federal government). It is worthy to note that the topical presentations and informal sessions were open to all local students (and not just the student Interns). These events are a great opportunity to learn more about various transportation topics and to meet/network with active professionals in the field.

Figure 7. Tran-SET 2019 Summer Internship

Transportation is a key element in a tribe's economic development, well-being, and the overall quality of life of its associates. Transport coordination is an important way for tribal services to work together to make a transport system that is economical and client-efficient. Organization links transportation sources with groups needing transportation to increase people's aptitude to get to health care, jobs and needed services, particularly in isolated areas.

Financial development and transport plays an important role in economic development for American Indians. Indian tribes, whether on or off reservations, are working to produce economic growth to their members. Linking people to their population through employment, health care, social events and shopping is essential to a strong economic upcoming.

It was found also that it is an essential to expose experts, teachers, young people, and other members of the community to the transportation, science and technology, in order to improve the employment, aids, or skills of the members of understated groups in the Nation.

In brief, based on the existing research and evidence, there are some shared subjects, which are suitable to this research review comprising:

1. Subjective needs of tribes and the key impediments to keeping transit services are well acknowledged, but limited information is available on the solutions to meet the needs or overcome these barriers.
2. Effective transit organizations requisite to emphasis on preparation, management with other agencies, making use of current resources, and encouraging public effort correct from the initial planning phases.
3. The body of literature classifies transportation subjects that tribes are challenged with such as geological isolation, low level of education, lower earnings, problems in retrieving funds, confidence issues with non-tribal members, funding and the difficulties of native, state, federal, and tribal governments working in collaboration.
4. Reservations incline to reflect the nation in relations of the size of many mobility-dependent subcategories. However, certain reservations significantly surpass national averages for seniors and low-income residents.
5. Numerous rural Native American counties were amongst the firmest hit by increasing fuel prices since of the travel distances, which are reliable with rural life, and moderately low family income levels. As a result, households spend a high percentage of household income on fuel and there are less transportation choices for rural people who necessity depends on private vehicles.
6. It is significant to collect information on the number and percentage of transportation staff devoted to a transportation system. These replicas can benefit to control suitable governmental structures and staffing supplies for coming services.
7. Particular of the important aspects desired for a cost-effective bus service in low-density areas are active employer input, employ centers that form terminuses, harmonized work shifts, and long-distance commuting.
8. Meanwhile there is unwillingness on the portion of tribal units to work with non-tribal units; there is a need to show welfares to both tribal and non-tribal members of the communal in organizing present transit services.
9. The need for close collaboration and corporations with the indigenous tribes and other administration offices. The research results established this; show that organization and enterprises were answers to effective tribal transit programs.

10. Finding the requests of the tribe remains to be a task, as particular tribes are unwilling to make their needs identified or to share info about their tribes and local circumstances. In the upcoming it may be more problematic for investigators to gain facts from tribes as some tribes are now setting up sovereign research review boards.

6. CONCLUSIONS

After primary research for the causes of the shortness of the jobs in transportation industries at Navajo nation, we conclude that we need educating community knowledge, outlooks, and abilities in the transportation areas. We need to provide the Nations the opportunities for research and teaching in transportation and related disciplines. Therefore, we need to create educational programs in the transportation area at undergraduate and high school level across the Navajo Nations. We need to expose experts, teachers, adolescent people, or other members of the community to the transportation, science and technology, in order to improve the implementation, aids, or skills of the members of underrepresented groups in the Nation. This will improve the Nation access and retention in the transportation or other related professions. We found also that this project has a significant impact on the society and educational system. If implemented correctly, it will benefit many of our existing educational programs at Navajo Technical University. Furthermore it will increase the career options for our students and Navajo Nation. Finally, its impact beyond science and technology is that it will increase the career options for our students, further business and economic development and environmental conditions for the nation.

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