GEORGIA DOT RESEARCH PROJECT 14-08
FINAL REPORT

STEM AND OUR FUTURE TRANSPORTATION LEADERS

OFFICE OF RESEARCH
15 KENNEDY DRIVE
FOREST PARK, GA 30297-2534

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GDOT Research Project No. RP 14 08

Final Report

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By
Adjo Amekudzi Kennedy, Ph.D., Margaret Avis Akofio Sowah, Ph.D., Stefanie Brodie, Ph.D.,
Yanzhi (Ann) Xu, Ph.D., Audrey Leous, Valerie Curtis

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16. Abstract:
Between 2012 to 2022, 40 to 50 percent of the transportation workforce is expected to retire taking valuable knowledge with them. State Departments of Transportation (DOT) are expected to play a significant role in replenishing the workforce pipeline by raising awareness about transportation careers, providing internship and apprenticeship opportunities, supporting workforce development programs and research, implementing mentoring programs for new workers and emerging leaders, and supporting partnerships with education and workforce organizations. STEM development is considered a critical priority in the state of Georgia and the nation at large to preserve science and technology efficacy and promote economic competitiveness. This report reviews state DOT

involvement in transportation related science, technology, engineering and mathematics (STEM) outreach programs and identifies opportunities to engage kindergarten through high school (K 12) students in STEM programs to enhance their interest in the transportation field. Both theory and empirical evidence show that STEM has academic and behavioral benefits, and that students exposed to STEM are more likely to choose a career in STEM. Information on DOT involvement in STEM programs was gathered from the literature, DOT and other websites; a targeted online survey administered to DOTs and University Transportation Centers that have hosted STEM outreach programs; and semi structured phone interviews conducted with selected survey respondents to gather additional information on their programs. Results show that over 40% of state DOTs are involved in K 12 STEM outreach programs: most commonly residential or non residential summer programs, teacher training and curriculum development programs, internship and shadow opportunities, one day STEM awareness events, and periodic employee visits to schools to present on transportation STEM. A business case analysis conducted shows that agencies will benefit from including both longer term and shorter term alternatives in their STEM programming to cultivate STEM efficacy and build long term relationships with a smaller percentage of students while increasing STEM awareness broadly among K 12 students. Such strategic programming will contribute to developing a pool of students for future recruitment to replenish the transportation workforce, while enhancing STEM culture within the agency.

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Table of Contents

List of Tables

List of Figures

Executive Summary

In the decade from 2012 to 2022, 40 to 50 percent of the transportation workforce is expected to retire taking valuable knowledge with them. State Departments of Transportation (DOT) are expected to play a significant role in efforts to replenish the workforce pipeline by raising awareness about transportation careers, providing internship and apprenticeship opportunities, supporting workforce development programs and research, implementing mentoring programs for new workers and emerging leaders, and supporting partnerships with education and workforce organizations. This report reviews state DOT involvement in transportation-related science, technology, engineering and mathematics (STEM) outreach programs and identifies opportunities to engage kindergarten through high school (K-12) students in STEM programs to enhance their interest in the transportation field.

Information on DOT involvement in STEM programs was gathered from the literature, DOT and other websites; a targeted online survey administered to DOTs and University Transportation Centers that have hosted STEM outreach programs; and semi-structured phone interviews conducted with selected survey respondents to gather additional information on their programs. Results show that over 40% of state DOTs are involved in K-12 STEM outreach programs: most commonly residential or non-residential summer programs, teacher training and curriculum development programs, internship and shadow opportunities, one-day awareness events, and periodic employee visits to schools to present on transportation STEM.

A business case analysis, together with STEM theory and existing empirical evidence, shows that agencies will benefit from both longer-term and shorter-term alternatives in their STEM programming to cultivate STEM efficacy and build long-term relationships with a smaller percentage of students while increasing STEM awareness broadly among K-12 students. Such strategic programming will contribute developing a pool of students for future recruitment to replenish the transportation workforce while cultivating STEM culture within the agency.

The National Academy of Sciences views STEM education and development as essential to preserve the nation's science and technology leadership, and a strategic and economic security initiative to optimize the nation's knowledge-based resources by sustaining the most fertile environment for new and revitalized industries and their associated well-paying jobs. The Georgia Department of Education (GDOT) considers STEM education an economic imperative and workforce development issue for Georgia and America. Based on these national and statewide strategic priorities, GDOT must view STEM investments as aligning not only with agency strategic objectives for workforce development and replenishment, but also as a means to advance Georgia's science and technology efficacy and economic development.

Acknowledgements

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1 Introduction, Objectives and Report Organization

With the movement of the "Baby Boomer" generation into retirement, an estimated 40 to 50 percent of the transportation workforce is expected to retire by 2022, taking with them valuable specialized knowledge and historical perspectives (CUTC, 2012; Ivey et al., 2014). At a National Transportation Workforce Summit in 2012, the Council of University Transportation Centers (CUTC) determined that State Departments of Transportation (DOTs) have a significant role to play in feeding the workforce pipeline by raising awareness about transportation careers, providing internship and apprenticeship opportunities, supporting workforce development programs and research, implementing mentoring programs for new workers and emerging leaders, and supporting partnerships with education and workforce organizations (CUTC, 2012).

This research was sponsored by the Georgia Department of Transportation (GDOT) to identify opportunities to engage K-12 students in STEM (Science, Technology, Engineering and Mathematics) programs and enhance their interest in careers in transportation. STEM education, in Georgia, is defined as "an integrated curriculum (as opposed to science, technology, engineering, and mathematics taught in isolation) that is driven by problem solving, discovery, exploratory project/problem-based learning, and student-centered development of ideas and solutions" ("STEM Georgia", n.d.).

STEM education has received increasing attention over the past decade and remains a national priority in the U.S. (National Academies, 2014). In response to a request from the nation's Congress in the mid-2000s, the National Academies identified actions that federal policy-makers could take to enhance the U.S. science and technology enterprise to enable the nation to successfully compete, prosper and be secure in the global community of the 21st Century. In the report: Rising Above the Gathering Storm, STEM education was not only viewed with urgency as essential to preserve the nation's science and technology leadership, but also as a strategic and economic security initiative to optimize the nation's knowledge-based resources by sustaining the most fertile environment for new and revitalized industries and their associated well-paying jobs (National Academies, 2007).

Many arguments have been advanced for exposing children to fields like transportation that are in the STEM pathway at younger ages (Swift & Watkins, 2004; Russell et al., 2007; DeJarnette, 2012). Researchers have shown that during the early years, there is a higher potential to build a child's confidence and self-efficacy relative to their ability to succeed in STEM fields, and that an early interest in pursuing science and engineering is a better indicator of whether a student will pursue a career in these fields than a student's grade in school ("Afterschool", 2011).

Furthermore, there is evidence that STEM out-of-school time (OST) programs that engage students for longer periods of time (e.g., summer programs) hold greater potential for affecting intermediate and long-term outcomes than do short-duration programs. STEM OST programs are designed to supplement school work, ignite student interest, and extend STEM learning. Program outcomes include STEM awareness and interest, positive attitudes toward STEM fields and careers, program-specific knowledge and skills, continued participation in STEM programs, STEM self-efficacy, STEM course taking, STEM degree pursuit and STEM learning and achievement (Dorsen at al., 2006; Wilkerson & Haden, 2014).

Evaluation of STEM programs in the afterschool (i.e., before school, after school and summer learning opportunities) show that participants are more likely to pursue higher education and study STEM fields. For example, 69% of students reported an increased interest in STEM careers as a result of their participation in FIRST (For Inspiration and Recognition of Science and Technology), a STEM OST that provides several leagues in which K-12 student teams compete in robotics. Moreover, 89% reported an increased interest in science and technology generally, 89% reported increased self-confidence, and 70% reported an increased motivation to do well in school as a result of their participation in FIRST. The benefits of afterschool programs are generally well documented, showing positive impacts on both academic and behavioral development ("Afterschool", 2011)

Beyond empirical evidence, the literature shows there is a theoretical basis for investing in STEM enrichment experiences. Funded by the National Science Foundation, the ITEST Learning Resource Center at the Education Development Center in Waltham, MA, commissioned a literature review in order to better understand the pathway for students from early exposure to STEM experiences to pursuing a STEM career. The study focused on OST activities in informal environments. The study reiterates that young people cannot choose a specific STEM career or field of study if they do not know of its existence: lack of knowledge of STEM careers may be one reason why students choose non-STEM careers (Dorsen et al., 2006).

Furthermore, the ITEST study references Super's Career Development Theory (1957) that divides career development into stages roughly corresponding to age: young people pass from the growth state to the exploratory state during their teenage years, and eventually into the establishment stage. As young people begin to make choices about their futures, one way to make sense of their decisions is using the Possible Selves Theory. "Possible Selves" are positive or negative visions of what one might become and people tend to make decisions in order to work toward what they would like to be, and avoid what they fear. Thus, if girls and boys cannot envision themselves as scientists or engineers, they will not make the choices necessary to pursue STEM fields, such as enrolling in advanced mathematics, for example. The study also

references Social Cognitive Career Theory (SCCT). SCCT suggests that three personal factors -- self-efficacy, outcome expectations, and interests -- operate together and interact with external barriers and supports to inform a person's career goals and actions (Dorsen et al., 2006).

Thus, a lack of knowledge of STEM fields and STEM role models, and a lack of STEM self-efficacy are key factors preventing students from pursuing STEM fields and choosing STEM careers. State DOTs can therefore contribute to the development of the transportation workforce pipeline by participating in and supporting kindergarten through high school (K-12) STEM outreach programs and infusing transportation applications into activities, partnering with education and workforce development organizations that run these kinds of programs, or even providing internship and apprenticeship opportunities where possible.

This report presents the findings of a study to identify STEM outreach opportunities with state DOT involvement and conduct a business case analysis on practical program alternatives to introduce and interest K-12 students in the field of transportation. A literature review, including a review of websites, was conducted to characterize DOTs' participation in STEM outreach programs nationwide. The findings were used to develop a survey that was distributed to selected DOTs to gather additional information on their STEM outreach programs. Case studies were then developed to characterize the range of STEM outreach programs found in the state DOTs. Five main program categories were identified as follows: (1) residential or non-residential summer programs, e.g., the National Summer Transportation Institute; (2) Teacher-training and curriculum development programs, e.g., AASHTO's TRAC and RIDES program; (3) Internships and shadow programs (4) One-day high publicity STEM awareness workshops; and (5) Speaker's Bureau involving DOT employee visits to schools.

Simultaneously, a review of STEM activity and programming in Georgia was conducted through data gathering from websites and the 2014 first annual STEM Conference in Georgia. Subsequently, a panel meeting was organized with GDOT officials to characterize the nature and scope of STEM activity within the agency, followed by a survey of GDOT employees to assess their interests in participating in a range of STEM programs. The results of these activities were used in conducting a business case analysis of the five STEM program alternatives identified and developing recommendations to guide STEM programming, and cultivate a culture of STEM engagement at GDOT.

Following this introduction, Chapter 2 presents a synthesis of the literature review and survey findings on STEM programming activity at state DOTs. Chapter 3 reviews STEM initiatives in Georgia and Chapter 4 reviews STEM initiatives at the Georgia Department of Transportation. Chapter 5 presents the results of a business case

analysis for the five STEM program alternatives identified, and Chapter 6 concludes with recommendations and guidance for implementing a STEM program at GDOT to replenish the pipeline of retiring professionals while promoting a culture of STEM engagement within the agency.

2 Overview of State DOT Involvement in STEM Programs

This chapter presents an overview of state DOT involvement in STEM outreach programming, highlighting a selection of programs from various agencies, and the value of increased investment in STEM programs. A preliminary search was conducted for information on state DOT participation in STEM outreach programs in literature and from DOT websites. In the second phase of the study, an online survey (Appendix A) was distributed to DOTs with present or past STEM programs identified through the preliminary search. Based on a finding that most DOTs partner with universities, colleges and University Transportation Centers (UTCs) to conduct STEM programs, a second online survey (Appendix B) was distributed to UTCs to gather more information on these outreach programs. For a number of programs considered potentially good case studies, additional information was gathered through phone interviews. The programs identified were limited to those officially affiliated with the state DOT. Isolated events such as employee participation in career fairs were excluded unless the agency played a significant role in planning the event.

2.1 Results from the Literature & Website Reviews

A total of 57 programs were identified from 26 DOTs, with Illinois, Texas, Idaho, and Arizona DOTs having the most number of programs, as shown in Figure 1.

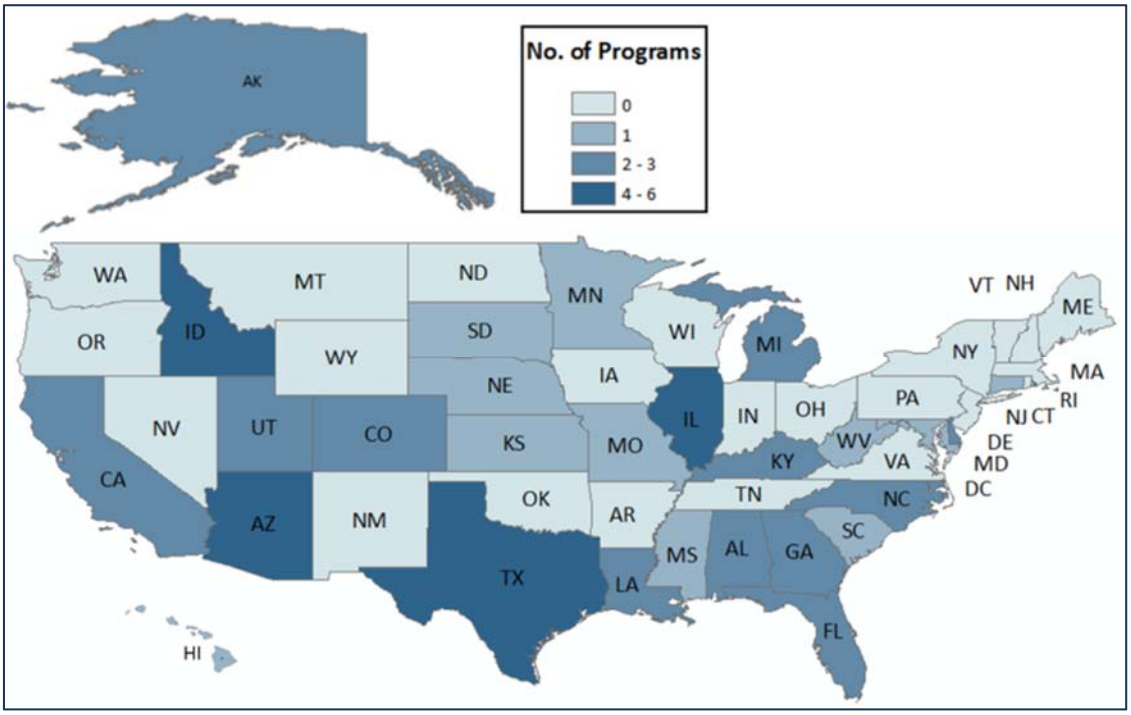

Figure 1 Number of Programs with DOT Involvement from Preliminary Search

Almost half (47%) of the programs identified target high school students, compared to 38% targeting middle school students and 15% targeting elementary school students, as shown in Figure 2.

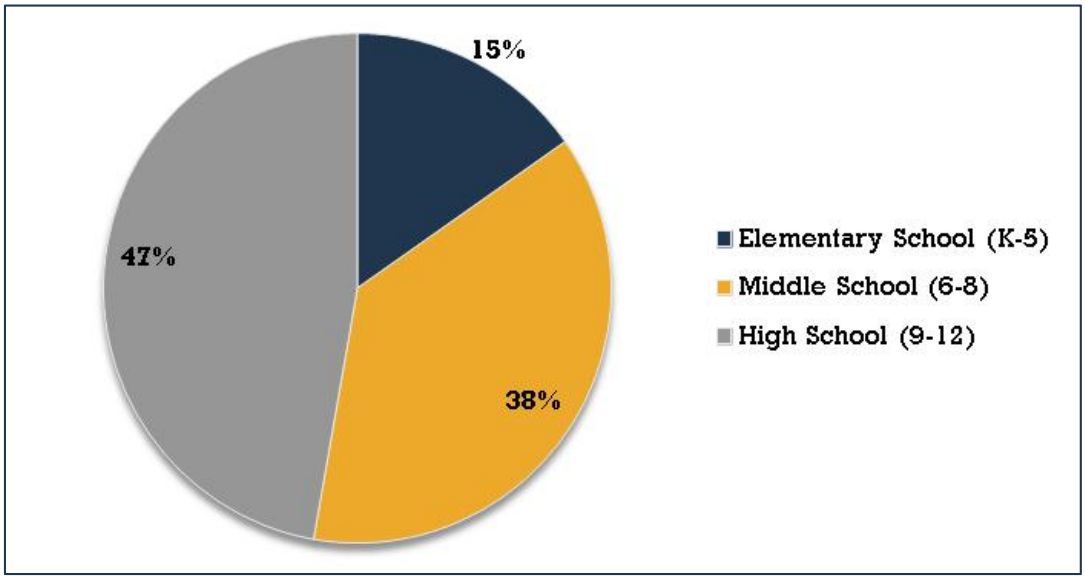

Figure 2 Target Audiences of 47 STEM Programs from Preliminary Search

Figure 3 shows the duration of 33 of the programs identified, varying from a few hours to more than six months. Almost half (43%) of the programs are two to four week programs usually occurring over the summer months.

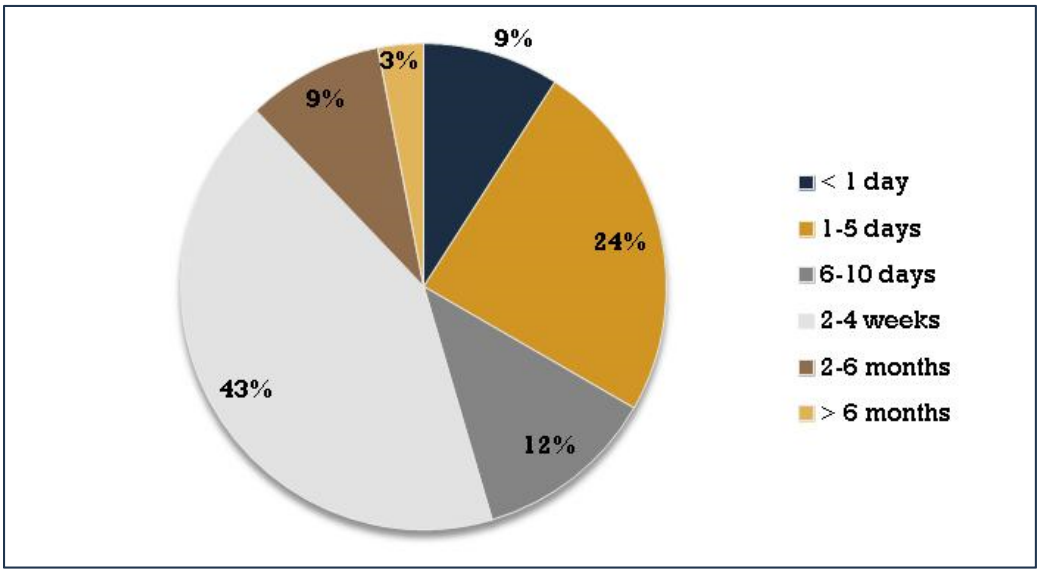

Figure 3 Program Duration of 33 STEM Programs from Preliminary Search

Programs lasting up to one day include workshops such as Utah DOT's Girls in Transportation Workshop, while programs that have an estimated duration of 6 months are mostly competitions such as West Virginia DOT's West Point Bridge Design Competition that engage student teams throughout most of the school year. Most of the programs identified involved more than one partner organization with the highest representation from research institutions (UTCs) and universities and colleges, as shown in Figure 4.

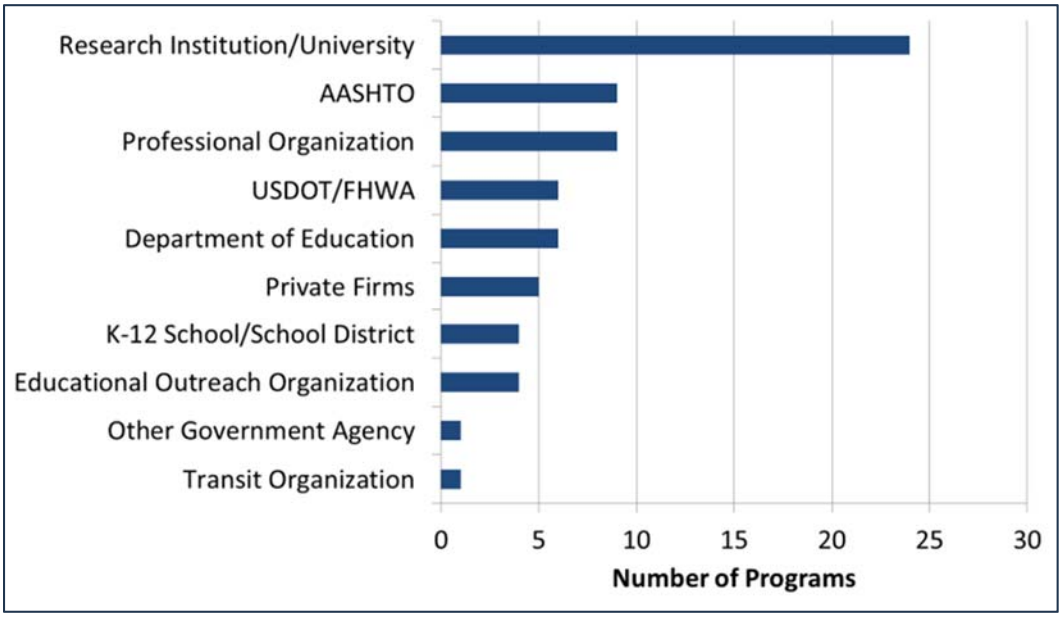

Figure 4 Partner Organizations for 69 Programs from Preliminary Search

These results from the preliminary literature and website reviews indicate that DOTs around the country are involved in quite a number of STEM outreach programs, although comprehensive information on the programs is not very readily available.

2.2 Results of Survey of STEM Outreach Programming with DOT Involvement

Similarly, online surveys, distributed to the 26 DOTs identified in the preliminary searches as well as contacts from all UTCs in the country, identified a total of 43 programs from 22 DOTs as shown in Figure 5. Unlike the preliminary search, less than 50% of all State DOTs are represented in this dataset and the states with the most number of programs are Nevada and New Hampshire. In a similar trend to the results from the preliminary searches, most of the programs reported target high school students, with smaller percentages targeting middle and elementary school students

(Figure 6). All the same, these results show a greater percentage of programs (67%) targeting high school students, compared to 47% from the initial search (see Figure 2).

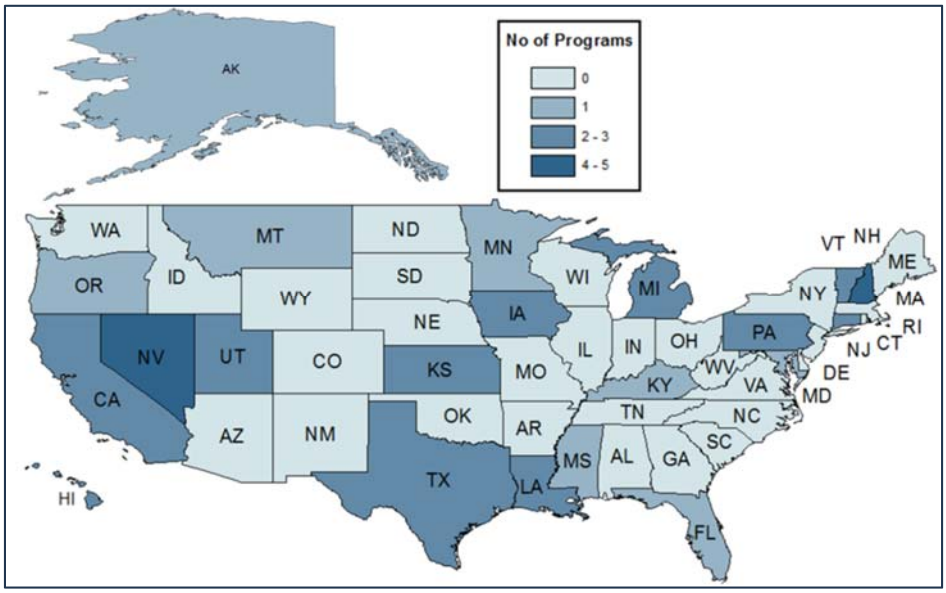

Figure 5 Number of programs with DOT involvement from Online Survey

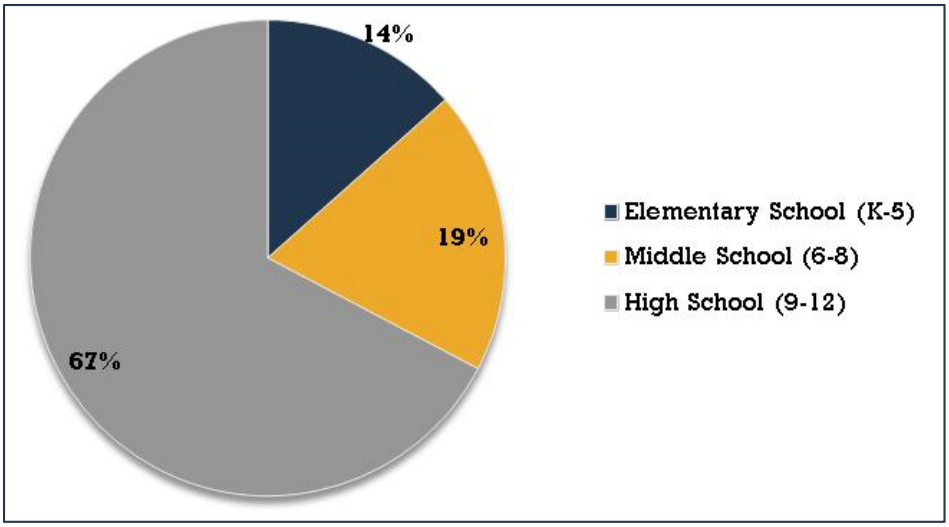

Figure 6 Target Audiences of 43 STEM Programs from Survey

Figure 7 shows the duration of the 43 programs identified from the survey. Again, similar to the preliminary search results, program duration varies from a few hours to

more than six months, with a significant proportion (39%) running from two to four weeks usually occurring during the summer. From the survey, there was a higher proportion (27%) of programs reported to last more than six months. Most of these programs involve transportation-related modules that are incorporated into the school curriculum, such as the AASHTO TRAC & RIDES program.

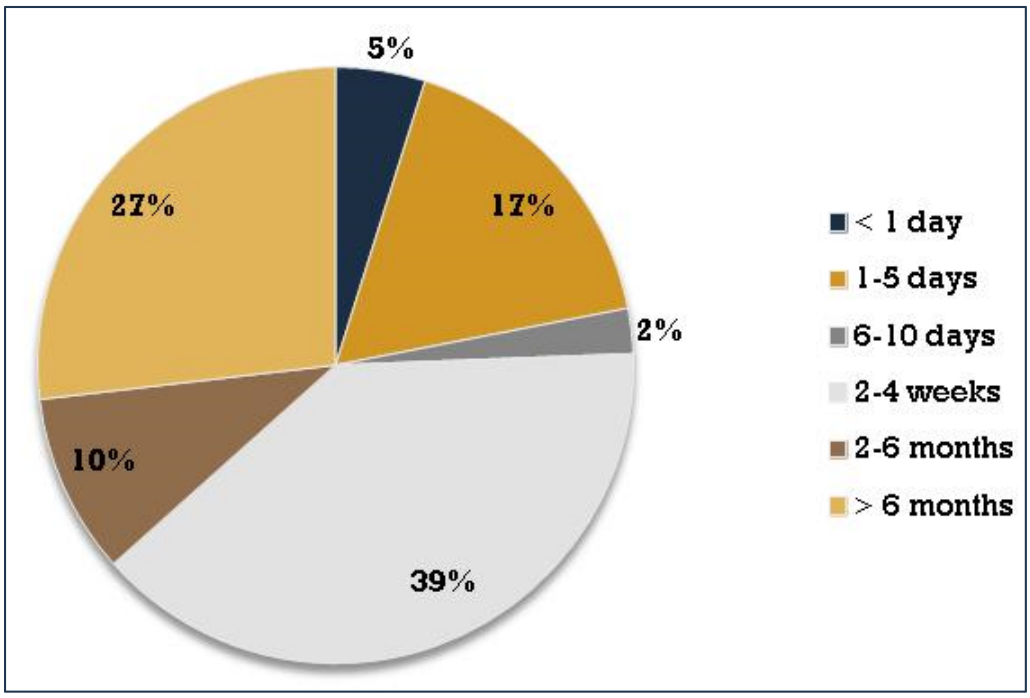

Figure 7 Program Duration of 43 STEM Programs from Survey

While the surveys did not collect information on partner organizations for these programs, information was gathered on financial support (Figure 8**Error! Reference source not found.**), revealing that over 50% (23) of the programs receive some financial support from the DOT involved, with 9% (4) receiving in kind support. Furthermore, 9% (4) of the programs also receive financial support directly from the Federal government through the U.S. Department of Transportation (USDOT).

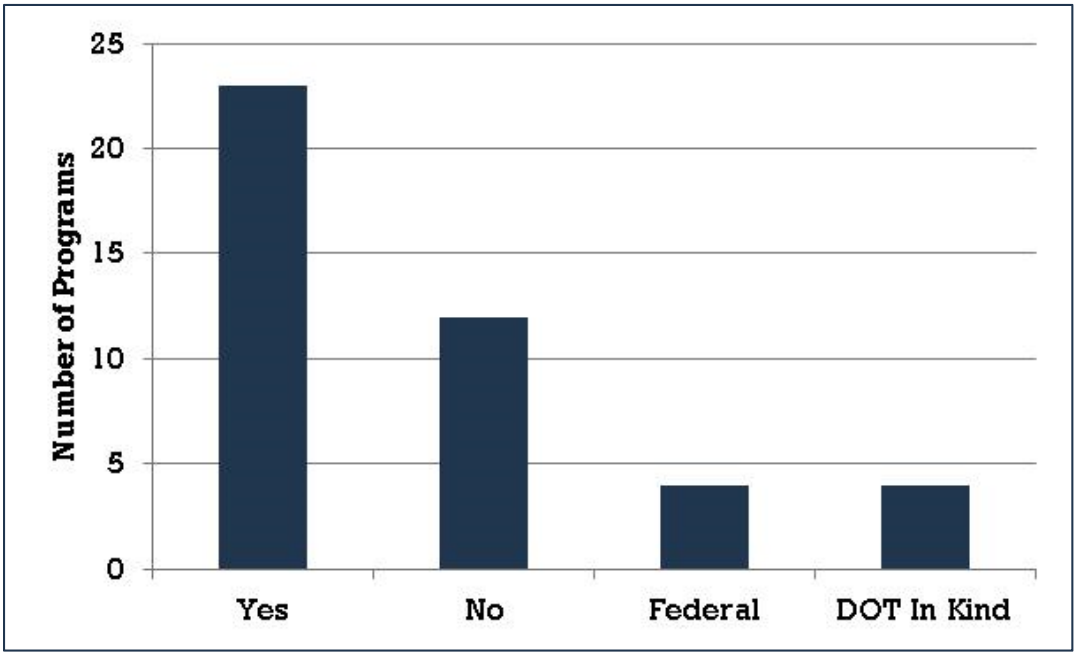

Figure 8 Financial Support of 43 STEM Programs from State DOTs

The results from the preliminary searches and the survey provide a broad view of DOT involvement in K-12 STEM outreach programs; however, they are not necessarily comprehensive -- they are simply an indication of the agencies that are responsive and willing to share information about their programming. Nonetheless, these findings show that many state DOTs are involved in STEM outreach programming on some level. Appendix C provides a catalogue of STEM programs at State DOTs.

2.3 Highlighted Programs

Five main types of STEM outreach programs were identified from the literature and website review, the online surveys, and follow-up conversations with DOT representatives: the Summer Transportation Institute (STI), the AASHTO TRAC & RIDES Program; Internships and Shadow Programs; One-Day STEM Awareness workshops, and the Speakers' Bureau outreach programs. These programs are described below with examples.

2.3.1 STI/California DOT (Caltrans) Summer Transportation Institute

STI programs are funded by the Federal Highway Administration (FHWA) as part of the National Summer Transportation Institute (NSTI) program. The NSTI is an educational initiative of the USDOT and the FHWA, championed by the FHWA Office of Civil Rights through its Division Offices. A number of DOTs are involved in STI programs held at universities and colleges around the country. The program was formally established in 1998, and is the first of its kind to be authorized by the nation's

Congress under Section 1208 of the Transportation Equity Act for the 21st Century (TEA-21). The purpose of the NSTI is to promote awareness of STEM educational and career opportunities among disadvantaged and at-risk middle and high school students. FHWA Division offices oversee the program which is provided at no cost to students with a typical duration of two to four weeks. In addition to the grants from the FHWA, NSTI programs can be supported by local sponsors. In 2013, 68 grants were awarded for NSTI programs adding up to $2,773,897 in 42 states, Puerto Rico, and American Samoa. While most states had only one program, 11 had two host sites, five had three host sites, and the state of New York had four host sites. Two STIs were hosted in the state of Georgia at Albany State University and Clark Atlanta University. Grants provided by the FHWA to individual host sites ranged from $12,200 (American Samoa Department of Public Works) to $63,689 (Idaho State University).

Caltrans was involved in two Summer Transportation Institutes (STIs) in 2014. The STI at San Jose State University was organized by the Mineta Transportation Institute (MTI) as a free, four-week, non-residential program to introduce high school students (Grades 9 to 12) to transportation systems development, construction management, technology, inter-modalism, and environmental impacts. This program has been running for about twelve years with funding from Caltrans which is reimbursed by the FHWA. A Caltrans employee serves as the program contract manager and visits the campus a few times during the program. The program hosted a total of 26 high school students structured in the style and format of a pre-college internship, incorporating a college-level, three-unit, environmental education course with an emphasis on science; the equivalent of one week of aviation-oriented learning and related activities, field trips (30% of the curriculum), short talks by experts, and a job skills component.

In 2014, a second STI was held at California State University, Los Angeles. The STI at San Jose State University is structured in the style and format of a pre-college internship with an emphasis on civic leadership and public policy, which are anchoring principles of MTI. The program seeks to offer a balance between academic and field activities designed to motivate participants to expand their horizons into the field of transportation and be connected to the University in a meaningful way. It is designed to be both academically challenging and fun for participants. The 2014 program incorporated a college-level, three-unit, environmental education course with an emphasis on science, the equivalent of one week of aviation-oriented learning and related activities, field trips (30% of the curriculum), short talks by experts, and a job skills component. Overall, the program's curriculum exposes students to key components of scientific inquiry, new frontiers in some of the major transportation-related topics of the day, and gives them the opportunity to see "behind the scenes" operations of major Bay Area transportation sites and agencies such as the San Francisco-Oakland Bay Bridge, BART, SamTrans (the San Mateo transit agency), the San Jose traffic control center and the Port of Oakland. The 2015 SJSU/MTI STI is again

planning to offer students three college credits, the resources of a specialized teacher, and a comprehensive number of field trips.

For each program, host sites present reports to the DOT at the end of the program which include information on the program impact.

2.3.2 AASHTO TRAC & RIDES PROGRAM/LADOTD TRAC & RIDES

The AASHTO TRAC and RIDES program is AASHTO's education outreach initiative which provides hands-on activities to introduce K-12 students to transportation and civil engineering. Through this program, curricula activities that are aligned with Core Curriculum Standards of Learning are provided to schools to be incorporated into their lessons. These programs are provided at no cost to schools in the state. According to the program website, 24 states participate in the program. Georgia is not a listed participant. To participate in the program, state DOTs pay an annual membership fee of $7000 to purchase the TRAC PACs and form partnerships with schools to implement the program. Volunteer transportation professionals and engineers work with teachers and students to support the lessons and can provide mentoring to the students.

TRAC stands for Transportation and Civil Engineering. The TRAC program targets middle and high school students, providing a Transportation Research Activities Center (TRAC PAC) to teachers. The most recent TRAC PAC includes eight self-contained education modules made up of a teacher reference guide, a volunteer guidebook, a movie showing how each activity works, and supplies to perform up to 75 activities. The topics included are bridge design, highway safety, city planning, magnetic levitation, motion, environmental engineering, traffic technology, and design and construction.

RIDES stands for Roadways in Developing Elementary Students and targets K-8 students. With this program, teachers attend a two-day training session and receive a curriculum aligned with National Math and Science Standards as well as the Core Curriculum Standards. This resource also includes a trunk of materials to complete hands-on activities in the following four units: Transportation and Energy, Roadway Geometry, Humans and Nature, and Designing Ways.

As part of the TRAC & RIDES program, a National Bridge and Structure Competition is held annually for students from participating states at the AASHTO Spring Meeting in May. The competition is held in three categories by grade (7th and 8th, 9th and 10th, 11th and 12th). AASHTO offers an Adopt-A-State program for $5000, where companies can support their state's TRAC and RIDES activities.

For about three years, LADOTD has participated in AASHTO's TRAC & RIDES program by conducting two-day training workshops for upper middle and high school teachers, and elementary and lower middle school teachers, respectively. The FHWA provides

funding to LADOTD (in addition to the agency's own funds) to sponsor the program. These funds go towards purchasing packets and supplies for schools, to be implemented in and used throughout the school-year curriculum. The modules emphasize hands-on activities to introduce students to careers associated with transportation specifically, and civil engineering, more broadly. Schools are invited to participate at no cost through a general solicitation process and many teachers attend the training after finding out by word of mouth.

Schools in Louisiana participate in the program at no cost. The TRAC packet, known as the TRAC PAC, is made up of eight self-contained modules that include a teacher reference guide, a volunteer guidebook, a movie showing how each activity works, and the supplies to perform about 75 hands-on activities. Through the activities, students design bridges, build magnetic-levitation trains, plan cities and learn about traffic technology and environmental issues that impact transportation.

Similarly, the RIDES program is provided at no cost to schools. The curriculum is aligned with the National Standards for Math and Science and 21st Century Skills and Core Curriculum Standards. The RIDES packet includes a teacher reference guide designed to encourage critical thinking and improve problem solving skills while teaching students about careers in the transportation industry.

2.3.3 Internship & Shadow Programs/MnDOT Phoenix Internship Program

Several transportation agencies provide internships to students, giving them exposure to transportation careers, as well as basic job training during working hours. Internships may be paid or unpaid, part-time or full time, and may run only during the summer months or throughout the whole year. An alternative to a full-fledged internship program is a shadow program. These programs pair students with DOT staff for one week, during which the student follows individual employees throughout their workday exploring the DOT's work and the employee's role in the organization. Shadow students may be assigned to a particular division or a particular district to spend a week rotating through various functions. It is the responsibility of each division or district to expose the students to the agency and the transportation industry.

In either of these programs, each student will have a mentor who will serve as the primary point of contact. Throughout the week, however, the student will spend time with various other employees in the division. Activities during the internship or shadow program may include small-scale research projects, informational interviews with employees, assisting employees with work, and preparation for various meetings. Either model could be scaled up to increase the number of students or increase the program duration. Students who have taken basic or advanced STEM courses may be recruited from STEM schools.

For nine years, the Minnesota DOT (MnDOT) has provided year-long, paid internships for high school juniors and seniors (11th and 12th graders) enrolled in pre-engineering

or STEM courses. This program, the Phoenix Internship Program, is a partnership with Project Lead The Way (PLTW) high schools in Minnesota which places students in various MnDOT offices and districts throughout the state working in areas like highway design, traffic surveys, materials, and data analysis. PLTW is a nonprofit organization that provides STEM curricula and teacher training to more than 6,500 elementary, middle, and high schools in all 50 states in the nation and the District of Columbia (PLTW, 2014).

In the Phoenix program, students work full time during the summer and part-time during their senior year at a rate of about $11 per hour. Eligible applicants must have a minimum grade point average (GPA) of 3.0. On average, five to twelve students are employed in this program per year; this number is based on the needs of MnDOT district offices. While in the program, students can gain credits towards their high school graduation, if approved by the school district. Phoenix interns who choose to pursue an engineering major in colleges and universities in Minnesota may be eligible to transfer to MnDOT's student worker/internship program for college students (for up to four years), sustaining the established relationship with the department. Since the conception of this program, 21 students have transitioned into the student worker program. Eight of MnDOT's current employees are products of the Phoenix Internship Program and others currently work for private and other transportation firms like 3M.

The Phoenix Internship Program is run out of MnDOT's Office of Human Resources and recruiting staff members participate on advisory boards with PLTW and school districts. Phoenix interns also participate in additional activities such as tours, seminars, and career fairs.

2.3.4 One-Day STEM Awareness Workshops/Various Examples

Many transportation agencies around the country also participate in outreach programs that are up to one full day, exposing students to transportation careers through guest speakers, hands-on activities and one-on-one interactions. Examples include Introduce a Girl to Engineering Day or DOT Career Day. Introduce a Girl to Engineering Day is an event held all around the country by different engineering-related organizations including the Society of Women Engineers (SWE). This program is also included as part of the National Society of Professional Engineers' (NSPE) annual Engineers Week which occurs in February. In the past, GDOT has been involved in this event hosted at the Georgia Institute of Technology. A number of DOTs also participate in Construction Career Days, as part of a national initiative developed by the FHWA. This program was born out of the need for more skilled highway construction workers. The inaugural program was held in Texas in 1999. The National Construction Career Days Center is located at the University of Rhode Island Transportation Center.

KDOT's Aviation Division hosted a one-day career exploration workshop for high school students (11th and 12th graders) in collaboration with the Kansas Commission on Aerospace Education, the Wichita Area Technical College, and National Geographic's Emerging Explorer Barrington Irving. The program included Barrington Irving's The Flying Classroom activities, a career exploration fair with 35 aviation and STEM companies, and motivational speeches from high-profile guests such as Congressman Mike Pompeo, aviator Amelia Rose Earhart, KDOT Secretary Mike King, and KDOT Director of Aviation Jesse Romo. The program hosted over 300 students, teaching them about the options aviation has to offer and creating connections with STEM. KDOT's support of this event was primarily in-kind through time and resources. The workshop was the highlight event of a "Fly Kansas Air Tour" program in which pilots flew around the state with stops in designated towns and cities hosting smaller-scale but similar workshops on STEM careers in aviation.

2.3.5 Speakers' Bureau/Kentucky Engineering Exposure Network (KEEN)

A number of DOTs support speakers' bureaus that involve sending DOT employees out to schools within their localities to give presentations on their jobs, particularly on STEM applications in their jobs, and possibly to engage students in transportation-related demonstrations and/or hands-on activities.

The Kentucky Engineering Exposure Network (KEEN) is a program conducted as a partnership between the Kentucky Transportation Cabinet (KTC) and the Commonwealth of Kentucky's school system. It has been in place since 1991. Through the program, KTC engineers visit K-12 schools throughout the state, discussing applications of math and science in their jobs and increasing awareness of the opportunities and challenges available to students interested in STEM fields. Presentations are adapted to suit the audiences which range from elementary school through college. Through the program, engineers interact with students in their own communities at no cost to the schools. Schools can schedule presentations by contacting KEEN Coordinators located in each of the twelve district offices of the KTC. This program is reported to have reached over 70,000 students throughout the state since its implementation.

2.4 Assessing the Impact of STEM Outreach Programs

In general, some of these STEM programs have reported significant efforts to measure the impact on the students that have participated, primarily through qualitative data collection. Methods include student daily journals (free-form or with prompts), academic quizzes, weekly evaluation surveys, and pre- and post- evaluation surveys. Other less common data collection methods are focus groups and longitudinal tracking after a period of time. These methods measure program effectiveness, exposure to and understanding of STEM, transportation careers and real-world applications, and educational enrichment.

For example, all participants (100%) of a Montana DOT STI at Montana State University agreed that they learned more about transportation careers in the end-of-program survey, while 94% reported increased understanding of the importance of various transportation modes and increased confidence in making college and career choices; and 88% agreed that the STI helped improve their problem-solving skills and helped them prepare for college (Gallagher, 2013). STI Scholars from a Texas DOT STI at Prairie View A&M University were tracked after the program, revealing that 100% of students responding to the survey were pursuing higher education, with more than 70% in STEM-related fields of study (Kommalapati et al., 2012). Similarly, the University of Memphis Transportation Engineering Careers (TREC) program tracked 44 participants after the program, finding that of the 21 students enrolled in college at the time of the survey, 90% were enrolled in a STEM major.

Appendix D provides more extensive descriptions of the assessment approaches of selected state DOT STI programs. Program effectiveness is generally measured based on program objectives, which can vary from program to program. This results in a range of subjective measures rather than objective and standardized measures for various programs around the country. While these assessment methods can depict the positive impacts of specific STEM programs, they may not be as useful for comparing the impacts of different programs with each other.

2.5 Summary

The results of the literature review and surveys indicate that a substantial number (i.e., over 40%) of state DOTs are involved in STEM programming through the National Summer Transportation Institute, AASHTO's TRAC and RIDES Program, Internship and Shadow programs, one-day STEM awareness workshops, and Speakers' Bureau programs. The literature shows evidence of multiple benefits of STEM out-of-school-time (OST) programs including STEM efficacy, increased confidence in students and increased chances of selecting a STEM career. STEM education and development has been identified both as a national priority to increase science and technology leadership and economic competitiveness. Thus, by investing in STEM, GDOT achieves multiple benefits. Investing in STEM is one means of achieving the agency's strategic priorities on workforce development and pipeline replenishment. Furthermore, it is a means to advance Georgia's science and technology effectiveness and economic competitiveness. The next chapter describes STEM in the state of Georgia.

3 Review of STEM in Georgia

The Georgia Department of Education (GA DOE) is committed to preparing students for 21st Century workplace careers by providing high-quality educational opportunities in science, technology, engineering, and mathematics (STEM) fields, together with several business, industry and education partners. In Georgia, STEM education is defined as an integrated curriculum (as opposed to science, technology, engineering and mathematics taught in isolation) that is driven by problem solving, discovery, exploratory project/problem-based learning, and student-centered development of ideas and solutions (stemgeorgia.org). The GA DOE views STEM education as an economic imperative and workforce development issue for Georgia and America. At the 2014 GA STEM Forum, GA DOE STEM Coordinator Gilda Lyon noted that the demand for workers in STEM occupations is increasing at every education level, and highlighted that America will be short of 400,000 engineers, 200,000 doctors and one million nurses by 2018 (Lyon, 2014).

The President's Council of Advisors on Science and Technology (PCAST) found that economic forecasts point to a need for producing approximately 1 million more college graduates in STEM fields than expected under current assumptions, over the next decade (PCAST, 2012). This, coupled with the ongoing retirement of the Baby Boomer generation leads many to view STEM as imperative for both workforce and economic development.

In Georgia, STEM is a wide-ranging curriculum reform initiative promoted by the GA DOE. PCAST found that economic forecasts point to a need for producing approximately 1 million more college graduates in STEM fields than expected under current assumptions, over the next decade (PCAST, 2012). This, coupled with the ongoing retirement of the Baby Boomer generation leads many to view STEM as imperative for both workforce and economic development.

3.1 STEM Goals in Georgia

In Georgia, the goals for STEM are to ("STEM Georgia," n.d.):

(1) Empower students to become innovators and technologically proficient problem solvers;
(2) Ensure that all students have access to the appropriate technology conducive to enhancing their learning experiences both in and outside the traditional classroom;
(3) Increase student 21st century skills and technological literacy by providing students with opportunities to use the technical tools of the STEM industry;
(4) Guide community understanding of the importance of STEM education to build capacity to sustain a viable STEM educational program and prepare students for work and life in the 21st century;

(5) Increase Georgia's capacity to provide high quality K-12 STEM professional learning opportunities;
(6) Nurture partnerships that allow schools and the business sector to join efforts to improve students' STEM-career opportunities, and
(7) Increase the number of students pursuing careers in STEM-related fields and/or post-secondary STEM-related education/training.

3.2 STEM Certification in Georgia

The GA DOE is working with K-12 schools to develop STEM certification for entire schools (typically at the elementary level) or programs (middle and high school levels), as well as teachers. STEM schools and programs may be exclusive, inclusive or career academies. The GA DOE conducts performance assessments to determine the extent to which schools and programs are meeting pre-defined STEM objectives.

At the 2014 GA STEM Forum held in Athens in October (first of its kind), Lyon reported that 46% (i.e., 90 out of 195) of Georgia's school districts have at least one school working on STEM certification. At the same event, Lyon and Aguilar also reported that over 400 schools are working toward STEM certification in the state of Georgia. The GA Department of Education's goal is for 100% of STEM teachers to be certified in their subject area(s), with ongoing professional learning in their content areas.

3.3 Integrated STEM Curriculum in Georgia

The National Academy of Engineering has reported that there is considerable concern among policymakers, educators, employers, and others about improving K–12 STEM education in the United States and in raising the number and quality of students who are both interested in and prepared to enter STEM and related professions. Historically, most efforts to improve STEM education at the pre-college level have focused on the individual subjects - particularly science and mathematics - rather than on how or whether they can or should be connected in ways that might improve student thinking, learning, engagement, motivation, or persistence. Advocates of more integrated approaches to K–12 STEM education argue that teaching STEM in a more connected manner, especially in the context of real-world issues, can make the STEM subjects more relevant to students and teachers. This in turn can enhance motivation for learning and improve student interest, achievement, and persistence. And these outcomes, advocates assert, will help address calls for greater workplace and college readiness as well as increase the number of students who consider a career in a STEM-related field (NAE, 2014).

The GA DOE has adopted an integrated approach to pre-college STEM education, and is working with K-12 schools to develop STEM certification for entire schools (typically at the elementary level) or programs (middle and high school levels), as well as teachers. STEM schools and programs may be exclusive, inclusive or career

academies. Exclusive STEM schools focus on STEM subjects exclusively while inclusive schools have a broader curriculum that includes STEM. Career academies are schools for special instruction or training on a particular subject or particular subjects, e.g., the Rockdale Academy of Science and Technology; the Gwinnett School of Mathematics, Science and Technology, and the Academy of Mathematics, Science and Technology at Kennesaw Mountain High School. The students in STEM programs must be designated as the STEM population, and must complete a STEM pathway. They are required to take advanced math and science courses in high school and math and science courses in middle and elementary schools. Beyond information and knowledge acquisition, the students are expected to apply acquired knowledge in solving problems and designing solutions, including applications to new and unpredictable situations. Progressively, students are expected to extend and refine their acquired knowledge and be able to use that knowledge to automatically and routinely analyze and solve problems and create solutions. At the highest level, students are expected to develop the competence to think in complex ways and apply their knowledge and skills to create solutions in new situations while extending this knowledge. The instructional programs are expected to involve business, community and post-secondary partners. The GA DOE conducts performance assessments to determine the extent to which schools and programs are meeting pre-defined STEM objectives.

Below are student learning objectives in STEM as described by Lyon and Aguilar at the STEM Forum (2014). A STEM student must be able to:

(1) Ask questions (for Science) and define problems (for Engineering)
(2) Develop and use models
(3) Plan and carry out (their own) investigations
(4) Analyze and interpret data
(5) Use Mathematics and Computational thinking
(6) Construct explanations (for Science) and design solutions (for Engineering)
(7) Engage in argument based on evidence
(8) Obtain, evaluate and communicate information

Recently, both the Common Core State Standards for Mathematics (CCSSM) and the Next Generation Science Standards (NGSS) have called for more and deeper connections among the STEM subjects. The NGSS explicitly includes practices and core disciplinary ideas from engineering alongside those for science, raising the expectation that science teachers will be expected to teach science and engineering in an integrated fashion (NAE, 2014). The Georgia STEM integration model integrates the science process and the engineering design process. Over time, students should be able to engage in an integrated science-engineering design process. Curricular should be integrated in the sense that there should be connections among all the courses, and students must engage in scientific research.

Exercises that simply engage in building artifacts without any clear ties to some science or math concepts are not considered good examples of STEM. At some point during a unit of study, students should be engaged in all the science and engineering practices; however one does not have to do everything all the time or at the same time. Failure should be an option in STEM curricular. Students should be given the time to fail, go back and redesign until they get it right.

3.4 STEM Education Awareness Events

Beyond the integrated approach to pre-college STEM education in Georgia, there are several STEM education and awareness events including Georgia STEM Day, instituted in 2013 and held annually in May to raise STEM awareness. STEM festivals, STEM Without Borders, Girls Adventures in STEM, STEM Georgia Teachers' Academy, STEM Guest Teacher Laureates and the Georgia STEM Forum are all examples of STEM education and awareness events in Georgia.

The first ever of its kind in the history of Georgia, the Georgia STEM Forum was held on October 20-21, 2014 in the City of Athens to advance STEM implementation in the state of Georgia. Attended by over 900 K-12 and post-secondary educators from Georgia and other parts of the world, the STEM forum focused on clarifying the model for STEM education in Georgia, showcasing implementation best practices and lessons learned, and exhibiting a range of STEM and STEAM (i.e., Science, Technology, Engineering, Art and Mathematics) instructional materials, programs and other resources available. Evident in the 2-day program was a strong commitment to STEM implementation in the state of Georgia; a reiteration of the strong expectation for integration (of science, technology, engineering and mathematics) in the context of real-world experiences (using project or problem-based approaches) expected in STEM programs in Georgia; a recognition that different school and programs were at different levels of maturity in program implementation and would continue to work through the process of implementation and refinement; and an acknowledgement that a high quality STEM education in Georgia will result in better and higher-paying jobs and economic advancement.

Today, there are several STEM education and awareness events in Georgia including Georgia STEM Day instituted in 2013 and held annually in May (a day for schools, students, teachers and companies to raise awareness, celebrate and engage in activities involving science, technology, engineering and math); STEM festivals with over 3,000 participants, the Georgia STEM Institute (supporting teacher development); STEM Without Borders (hosted by Georgia Tech Research Institute bringing subject matter experts to work with students on research project ideas), Girls Adventures in STEM, STEM Georgia Teachers' Academy (designed to support JK-12 efforts to include STEM education in the school curriculum), and STEM Georgia Teacher Laureates (offering teachers the opportunity to earn digital badges to become the Georgia Power Teacher Laureate).

3.5 Resources to Support STEM Development

The US Department of Education's Race to the Top Fund provides competitive grants to encourage and reward states that are creating the conditions for education innovation and reform. STEM education and awareness development in Georgia is part of an ongoing and broader education reform agenda in the state. Georgia's education reform agenda is supported by a $400 million *Race to the Top* grant that focuses on K-12 education. The Race to the Top Innovation Fund is a $19.4 million fund created under Georgia's RT3 plan, a competitive grant program that encourages new and innovative partnerships among K-12 schools, colleges and universities, nonprofit organizations, and businesses on projects to improve student educational achievement. The initiatives range from the creation of STEM schools and programs, formal instructor training, and student education, and offer several possibilities with respect to leveraging already existing initiatives to promote transportation-STEM (Table 1).

Table 1 Examples of STEM initiatives in Georgia (Race to the Top Innovation Fund)

Round 1 Winners 1. *The Regional Charter STEM Academy*: A partnership between White, Hall and Lumpkin county school systems and North Georgia College & State University to create a tri-county STEM charter school 2. *The KIPP Teacher Fellows Program*: A teacher induction program that will train Georgia State University and Mercer University College of Education graduates and deploy them to metro Atlanta Schools where they are most needed. 3. *21st Century STEM Collaborations*: Applications of the Direct to Discovery Model – A collaboration between Barrow County Schools and the Georgia Institute of Technology to integrate the Direct to Discovery method into the requirements of Georgia Performance Standards. 4. *Teach for Georgia*: A teacher pipeline program modeled after Teach for America that will recruit Georgia Institute for Technology STEM majors to each in rural areas of Georgia. 5. *Drew Charter School Partners of Innovation*: A partnership between Georgia State University and Georgia Institute of Technology and Drew Charter School to create one of the state's first STEAM (Science, Technology, Engineering, Arts and Mathematics) schools.
Round 2 Winners 6. *Murray County STEM Academy*: Murray County Schools, in partnership with Georgia Northwestern Technical College, the Chatsworth-Murray County Chamber of Commerce and others will open program focused on remediating 8th grade students and developing their interest in STEM careers.

7. *The New Teacher Residency Project*: A partnership between Atlanta Neighborhood Charter School and Georgia State University College of Education to address fundamental flaws in the transitional new teacher induction model.

8. *Smyrna Academy of Excellence*: The Smyrna Educational Alliance, in partnership with Georgia State University, Georgia Institute of Technology, Lockheed Martin Corp., and others, seeks to open a STEM charter school serving students in south Cobb County.

9. *STEM for Life Program*: A partnership between Carroll County Schools and Southwire to expand and replicate the existing 12 for Life Program, which supplements classroom learning with real-world experience in advanced manufacturing.

10. *The STEM Targeted Education Program (STEP) Academy*: An accelerated coursework, mentoring and Biotechnology Research and Development career pathway program serving at-risk overage 8th grade students in Gwinnett County Public Schools through a partnership with Gwinnett Technical College and the Gwinnett Chamber of Commerce.

11. *Student Applied Learning, New Teacher Induction and Staff Leadership Program*: Morehouse College, in partnership with Clayton County Schools, will provide an interwoven approach to applied learning and teacher professional development through the implementation of a summer student research and teacher development program.

12. *Teach to Learn*: A teacher induction program that builds a comprehensive support bridge between teacher preparation at the University of Georgia and teacher induction in Clarke County Schools while building school leadership capacity.

13. *Tift County Mechatronics Partnership*: Tift County Schools, in partnership with Moultrie Technical College, ConAgra Foods, Heatcraft Manufacturing and others, will develop a career pathway focused on Mechatronics, an interdisciplinary field of study involving control systems, electronic systems, computers and mechanical systems that will equip students to work in a variety of industrial, manufacturing and health sciences settings.

14. *UGA/GAEL Early Career Principal Residency Program*: The University of Georgia and the Georgia Association of Educational Leaders will implement a 2-year induction program for early career principals in the state's lowest achieving schools.

Round 3 Winners

15. *Building the Pipeline of Highly Effective Charter Teachers and Leaders*: The Georgia Charter Schools Association and Lake Oconee Academy will develop and expand three recruitment, training and alternate certification programs to attract, support and retain highly effective teachers and leaders in the charter school sector.

16. *Community Partnership for a Quality Pipeline of Effective High School Leaders*: The Georgia Leadership Institute for School Improvement will support Paulding County School System to build district capacity and create a pipeline of effective high school teachers.

17. *Computational Thinking: 21st Century STEM Problem-Solving Skills for Georgia Students*: The Georgia Institute of Technology will work with B. E. Mays High School and Tapjoy, Inc. to incorporate computational thinking into high school STEM curricula, teaching students to construct models to simulate, visualize and solve real-world problems.

18. *Charter System Leadership Development and Governance Certification Program*: As a newly approved charter system, Fulton County Schools and its partners will launch the Leadership and Innovation Academy, a program to equip principals and School Governance Councils with the skills they need to successfully operate and govern a charter school.

19. *Drew Charter School Partnership for Expansion*: Drew Charter School, the Georgia Tech Center for Education Integrating Science, Mathematics and Computing (GT CEISMC), the Georgia State University School of Music and others will expand Drew's highly successful pre K – 8 STEAM curriculum to grades 9-12, creating a true cradle-to-college pipeline serving inner city students.

20. *Greene County STEAM TLA Collaborative*: Greene County Schools, the Georgia Institute of Technology, University of Georgia faculty and Ed Innovation Partners seek to open a charter school in Greene County with the mission of increasing the number of students who choose STEM fields as a career.

21. *Museum in a Box*: The Museum School of Avondale Estates will work with Zoo Atlanta, the Georgia Aquarium, Fernbank Museum of Natural History, the Atlanta History Center and others to expand the school's highly successful museum-based learning strategy to metro-area schools.

22. *Real STEM*: A partnership between Georgia Southern University, seven area research institutes and six school districts to develop hands-on STEM learning modules related to the environmental concerns of Georgia's coastal region.

23. *Rockdale 21st Century Academy of Environmental Studies*: Rockdale County Schools, in partnership with GT CEISMC and Advancement Via Individual Determination (AVID), will create a STEM-focused middle grades school that provides students with portfolio and project-based learning modules.

3.6 STEM Initiatives at Universities and Professional Organizations

3.6.1 STEM Initiatives at CEISMC

Under the Race to the Top plan, the state has also partnered with the Center for Education Integrating Science, Mathematics and Computing (CEISMC) at the Georgia Institute of Technology to enhance teacher development and student learning opportunities in STEM areas. GA DOE has partnered with CEISMC to provide professional development for teachers in grades 3-12 in STEM content and content delivery skills. The Georgia Institute of Technology is also involved in several K-12 outreach initiatives in the Metro Atlanta area through activities in the University Transportation Center. These programs and initiatives are especially important for

providing support and contact with members of underrepresented groups in transportation engineering such as women and minorities, and target elementary, middle and high school students.

GA DOE has partnered with CEISMC to provide professional development for teachers in grades 3-12 in STEM content and content delivery skills. The state has six CEISMC STEM projects that do the following:

(1) Provide online professional development to STEM teachers in STEM best practices;
(2) Develop instructional toolkits for administrators and teachers to support the effective use of technology in a standards-based classroom;
(3) Expand the Georgia Intern-Fellowships for Teachers (GIFT) program;
(4) Provide a new operations research-based mathematics course as a Math 4 option;
(5) Use robotics/engineering design to create an integrated STEM course, and
(6) Offer advanced courses in college-level calculus II and III through video conferencing.

During the 2011-2012 academic year, CEISMC formed content teams to develop the self-paced online course content for advanced courses for students. CEISMC had developed, piloted and offered the first prototype STEM online course for teachers by April 2012. CEISMC also worked with the Georgia Department of Education and the Georgia Virtual School to design and test the first module of the Instructional Technology Toolkit. In summer 2012, 102 teachers participated in the GIFT program in which they produced lesson plans for classroom implementation that were shared with the Department for placement on the Department's website. CEISMC also developed an 8th grade 9-week robotics and engineering course.

3.6.2 STEM at Universities and Colleges in Georgia

The Georgia Institute of Technology is involved in several K-12 outreach initiatives in the Metro Atlanta area through University Transportation Center (UTC) activities. Transportation researchers and students at Georgia Tech strongly believe it is important to be involved in the larger community and attract young talent and ideas to the dynamic and challenging world of transportation engineering. These programs and initiatives are especially important for providing support and contact with members of underrepresented groups in transportation engineering such as women and minorities. Three types of activities are on-going, covering a wide range of grades and topics.

- Elementary and middle school outreach at Centennial Place Academy
  Under the auspices of the Southeastern Transportation Research, Innovation, Development and Education Center (STRIDE), researchers from Georgia Tech have been working with 5th and 6th grade students at Centennial Place

Academy to introduce elements of Engineering such as measurements, data collection, data analysis, presentation, and group work focusing on examples from topics in Transportation Engineering. Activities include introductory presentations that provide an overview of the transportation discipline, as well as two-day hands-on research sessions during which students participate in the entire research planning, data collection, analysis, and presentation process. The initiative has encouraged the diverse student body found at Centennial Place (student body: 49.8% Female, 86% African American, 5% Caucasian, 2% Asian, 3% Hispanic, 4% Multi Racial, 71% Free and Reduced Lunch) to consider Engineering (and particularly Transportation Engineering) as a fun and accessible field of study that applies to everyday life.

- Middle school summer camps and curricula development
  For two years, the National Center for Transportation System Productivity and Management (NCTSPM) has partnered with Chamblee Middle School, Forest Park High School, and CEISMC to host Summer STEM programs focused on developing innovative transportation related curricula for use in middle and high school classrooms. Teachers from Atlanta area schools were selected through the Georgia Intern Fellowships for Teachers (GIFT) program to develop transportation curricula. The Chamblee Middle School principal implemented a STEM program focused on transportation after 2013 Summer Camp.

- Research projects incorporating high school student participation
  Georgia Tech researchers have embraced high school student participation in research projects. Students gain first-hand experience taking part in cutting-edge transportation research.
  - Decatur High School
    In the Automated Sidewalk Quality and Safety Assessment System project sponsored by STRIDE, Georgia Tech researchers reached out to Decatur High School. High school students learned about the sidewalk quality assessment system. Using the automated system, the students planned and implemented sidewalk data collection.
  - Kennesaw Mountain High School
    The Safety and Operations Lab at Georgia Tech is hosting a Kennesaw Mountain High School Magnet student as a high school intern. The student is studying the driver performance of high school students in complex driving environments, and will design and run a research experiment at her high school. This initiative supports the efforts of area Magnet high schools in providing science, math, and technology education to deserving students.

Several other universities and colleges are involved in STEM programming including the University of Georgia, Georgia Perimeter College, Georgia College, Georgia State University, University of West Georgia, Albany State University, Clark Atlanta University, Southern Polytechnic University. Table 2 provides information on selected colleges and universities.

Table 2 STEM programs in universities and colleges in Georgia

College/ Univ.	Dept.	STEM Contact	Email	Phone	Website
Georgia College		Dr. Rosalie Richards	rosalie.richards@gcsu.edu		http://www.gcsu.edu/stem/usg.htm
			stem@gcsu.edu		http://www.gcsu.edu/evaluation/stemprojects.htm
University of Georgia	Office of STEM Education	Dr. Charles Kutal	ckutal@uga.edu		http://ose.uga.edu/
		Melissa Kinney	mkinney@uga.edu	(706) 542-4514	
	College of Letters and Science			(706) 568-2056	
Georgia Perimeter College	Office of STEM Initiatives	Dr. Cynthia Lester	gpc.stem@gpc.edu	(678) 891-2895	http://depts.gpc.edu/~gpcstem/
Georgia State University	Georgia State University Center for STEM Education	Dabne Dixon	stemoffice@gsu.edu		http://cas.gsu.edu/stem/stem-projects/
University of West Georgia	College of Science and Mathematics	Dr. S. Swanny Mruthini	smruthin@westga.edu		http://www.westga.edu/uwise/index_310.php
		Amanda Wright	awright@westga.edu	(678) 839-5190	
Albany State University	STI	Charles Ochie, Sr.	charles.ochie@asurams.edu	(229) 430-4864	
Clark Atlanta University	STI	Carlos Graza	cgarza@cau.edu	(404) 880-6903	

College/ Univ.	Dept.	STEM Contact	Email	Phone	Website
Southern Polythenic University	CE Summer Camp	Dr. Wasim Barham	wbarham@spsu.edu	(678) 915-3946	http://www.spsu.edu/camps/

3.6.3 STEM Initiatives with the Involvement of Professional Organizations

Multiple professional organizations active in the transportation field including ASCE (American Society of Civil Engineers), ITE (Institute of Transportation Engineers) and WTS (Women's Transportation Seminar) have on-going programs that support K-12 STEM education. Table 3 summarizes major activities undertaken by the ASCE, WTS and the Institute of Transportation Engineers (ITE). Since a lot of engineers are already part of these organizations, there is a considerable amount of synergy in promoting STEM education and development through professional organizations.

Table 3 STEM initiatives of major professional organizations

Org.	Program	Description	GA Activities	Audience	Duration	Contact
ASCE	Future City Competition	Students plan cities using the SimCity software and write research essays on civil engineering challenges and solutions.	Southern Polytechnic State University hosts the Georgia region Future City competition.	Grades 6-8	September to February, annually	Tony Rizzuto, Ph.D. Future City Georgia Region Coordinator Assoc. Professor School of Arch. & Constr. Mgmt. SPSU, Email:tony7957@bellsouth.net
WTS	Transportation YOU	Transportation YOU is a mentoring program that pairs young girls ages 13-18 with mentors, who are WTS members. The goal is to encourage young girls to take courses in STEM fields and eventually pursue a career in the transportation industry.	The WTS Atlanta chapter coordinates ongoing mentor-protégé activities, currently mainly at Grady High School.	Girls ages 13-18	Monthly meetings, on-going	Angela Snyder President, WTS Atlanta Chapter Email: angela.snyeder@wolverton-assoc.com
ITE	Exploring Engineering Academy	The Exploring Engineering Academy brings talented students to engineering laboratories on the Georgia Institute of Technology campus. The goal is to attract the students to science and engineering degrees, and, eventually,	GA specific	High school boys and girls, grades 10-12	One week, yearly	Tony Belcher Georgia Department of Transportation tbelcher@dot.ga.gov

		engineering careers. Students also tour engineering facilities of major corporations around metro Atlanta.				

3.7 Implications for Effective STEM Programming at GDOT

In 2012, the Council of University Transportation Centers estimated that 40 to 50 percent of the transportation workforce is expected to retire in the next 10 years, with the influx of the "Baby Boomers" generation to the retirement pool (CUTC, 2012). State Departments of Transportation (DOTs) have therefore recognized the need to invest in K-12 programs to increase students' interest in the field of Transportation and increase the pool of employees for DOTs, as well as private sector firms and academic institutions that support state DOT functions and the transportation industry in various ways. There is also evidence that students are more likely to choose transportation as a specialization if they are informed about the profession (Agrawal and Dill, 2009). Furthermore, there is evidence that a high quality early STEM education has the highest rate of return for public dollars (ROR of $7 – 13 for every dollar spent or 13-18% annual ROR) (Strobel, 2014). These facts and the developing STEM climate in the state of Georgia offer several opportunities for GDOT to invest in transportation STEM activities to promote workforce development within the state. The following observations should influence the types of programs that are considered and developed to achieve this goal.

(1) There are several STEM schools in Georgia where students are already obtaining STEM education. Targeting students from such schools would likely increase the rate of return for GDOT by building on an already established STEM foundation to develop Transportation-STEM awareness and efficacy.

(2) While there is evidence that early STEM education results in a higher rate of return on investment for public dollars, a major objective of GDOT's STEM initiative is to create awareness of Transportation Engineering and related fields in the minds of students, and in competition with other STEM fields. Thus, from an agency perspective and in the shorter term, there may be more value to be derived from prioritizing high school STEM awareness initiatives targeting students who have already been exposed to STEM, and only considering additional early STEM education initiatives as there are sufficient resources to do so.

(3) In light of the workforce development goals of GDOT, it will make sense to consider carefully the relative value of recurrent STEM events (e.g., STI) versus of ongoing STEM education processes to be found in STEM school programs. While recurrent STEM events could be designed to be exclusively

about Transportation, embedding material within school curricular will place this material in the context of several different STEM fields within pre-existing curricula. Extended one-time events, such as Summer Transportation Institute extending over two or more weeks, allow the students to gain more extended and in-depth knowledge about Transportation in ways that are more likely to have an indelible mark on them and influence their career choices.

(4) In light of GDOT's desire to develop the workforce pipeline, a clear distinction must also be drawn between one-day events that simply raise awareness of transportation careers and programs that extend over multiple weeks allowing for more in-depth and broader knowledge about Transportation. As the intent is to have an indelible mark on the students and interest them in the field of Transportation, extended transportation-related STEM programs are likely to be the more effective alternative than shorter one-day STEM awareness programs.

(5) Several established resources should be considered in developing a STEM program at GDOT including various funding opportunities to support STEM development (e.g., Race to the Top Funds, the National Summer Transportation Institute), various universities and colleges in Georgia, STEM education organizations like CEISMC at Georgia Institute of Technology, various professional organizations interested in STEM engagement (e.g., ITE, WTS, ASCE), various K-12 schools and programs already involved in integrated STEM education, private transportation consultants, the GA DOE, and other parties interested in supporting and promoting STEM programming and activities throughout the state of Georgia.

(6) Focusing on partnerships with some of the state's local education authorities (LEAs) or charter schools will lead to potential access to some of Georgia's most talented students and economically disadvantaged students. The participating LEAs in Georgia's Race to the Top (RT3) plan enrolled 40 percent of Georgia's K-12 students and 44 percent of the state's K-12 students who lived in poverty as of 2011.

(7) It would also be expedient to consider partnerships between GDOT and professional organizations in Transportation (e.g., ITE, ITS, WTS, COMTO, etc.), some that already have recurrent STEM events, as well as other transportation agencies in Georgia (i.e., ARC and other MPOs, GRTA, SRTA, MARTA, GA FHWA Resource Center, etc.), and private consultants, as well as leverage resources as it makes sense from University Transportation Centers (UTC) with STEM experience.

(8) Finally, in light of the growing STEM programming in K-12 schools and the competition from other fields, it will be important to develop transportation-STEM programs that students will consider exciting, engaging and fun to promote the field of transportation as one that can compete effectively with other exciting choices in other disciplines that have been successful at engaging elementary, middle and high school students. Field trips that expose students to various kinds of careers in Transportation; exciting designs linked with Scientific principles; practical applications and simulations that teach these principles in a real world context, explications of how transportation impacts our daily lives and our nation's economy – these and other examples of practices that are likely to capture the students' imagination will be strong candidates for consideration in the development of an effective Transportation-STEM program.

4 Review of STEM in Georgia Department of Transportation

This chapter details existing capabilities and interest within GDOT to support STEM outreach programming to K-12 students. It outlines past and current programming, identifies various ways in which GDOT employees are interested in supporting STEM activities, and opportunities for cultivating STEM outreach as part of GDOT culture.

Current STEM programs and past efforts were initially identified through conversations with GDOT staff. A panel of GDOT employees was also convened to identify any additional programs at the Department and to develop potential future programs and activities based on transportation-related STEM programs across the country. One result of the panel meeting was the development of GDOT employee survey designed to assess the interest of the employees in STEM outreach programming. This chapter reports on ongoing STEM activities at GDOT and details the results of that survey.

4.1 Panel Meeting Outcomes

A panel of GDOT employees was also convened on November 21, 2014 to identify programs at the Department and to develop potential future programs and activities based on other transportation-related STEM programs across the country. The Panel consisted of four GDOT employees with an interest in STEM and a recent retiree who had championed GDOT STEM initiatives in the past. The discussion was guided by the research group and supported by a PowerPoint presentation (Appendix E).

4.1.1 GDOT Involvement in STEM Outreach Programs

Past STEM involvement includes informal employee participation in Introduce a Girl to Engineering Day and Future City Competition, tours of facilities such as the Transportation Management Center, the Materials Lab and the Office of Bridge Design, and provision of speakers for Career Days through a Speakers' Bureau.

The Future City Competition is a national program where teams of middle-school students research, design, plan and build a city over the course of four months. Each team is guided by a mentor who assists them in dealing with the complex issues related to cities. The state of Georgia is represented at the national competition by the team that wins the regional competition. GDOT employees have served as judges at the regional competition. In fact, the Commissioner served as head judge in the past and has agreed to do so again this year (2015). GDOT also provides a monetary award for the top transportation system for the region; this award is supported by internal donations.

Introduce a Girl to Engineering is a national initiative with events typically held during or around National Engineers Week (E-Week). Activities generally consist of half-day programs that involve hands-on activities, motivational speakers, and

informational forums that are geared towards middle-school girls and their parents. In the Atlanta metropolitan region, there were often two sessions, one in which GDOT participated. This session was previously held at Georgia Tech and hosted by Women In Engineering and the College of Engineering. Past GDOT employees have played a role in organizing the event or have participated in the informational forum by manning booths on different civil engineering disciplines, including transportation.

A third program was identified through conversations with Human Resources. This is not a formal program supported by the Department: the Office of Bridge Design hosts a small group of elementary school students once a year. For approximately an hour, engineers present and explain bridge design to students.

4.1.2 Panel Discussion of STEM Alternatives

The panel discussed initial findings of the research relative to identifying the most beneficial program alternatives, as well as the resources and capabilities that GDOT possesses to implement a continued STEM outreach program. Discussion on the five program alternatives provided the following feedback:

1. The National Summer Transportation Institute (NSTI) was identified as the most attractive program alternative. NSTIs have previously been held at Albany State University and Clark Atlanta University.
2. AASHTO TRAC & RIDES workshops and training are an option for teacher training and curriculum development programs. Past employees at GDOT suggested this program but it has not yet been implemented. This alternative was not highly preferred, but it was recommended for further consideration in a phased approach to enhancing STEM programming at GDOT.
3. A high school internship program was suggested as an ideal alternative for relationship-building between students and GDOT officials. There is currently a collegiate level internship program and GDOT has hired high school level interns in the past as a part of the Governor's summer workers program. There were approximately ten interns who primarily performed clerical tasks. It is important that such a program be mutually beneficial. Therefore, it was suggested that the various divisions of the Department be surveyed to identify the types of work these units could provide high-school level interns. A less involving, "shadow" program was proposed as an alternative.
4. Ideas for one-day STEM awareness events were brainstormed and included tours of labs, the sign shop, the Transportation Management Center (TMC), the Materials Lab, the Office of Bridge Design, and Highway Emergency Response Operators (HERO) units. The Construction Expo Foundation of Georgia and Construction Career Days were identified as other potential opportunities. Introduce a Girl to Engineering, which has had GDOT involvement in the past, was recommended as a model for a one-day event.

5. The suggested alternative for employee school visits pulls from and builds on the former GDOT Speakers' Bureau that was replaced by the Communications Office around 2006. The panel noted that supporting resources such as public speaking training (available through GDOT), presentation content and templates, and advice/training on how to teach middle school students were necessary to support the implementation of such a program. Career days and career fairs were also identified as potential alternatives for school visits.

The following recommendations were offered to frame the development of future STEM programming strategies:

1. Think in terms of long-term extended STEM programs versus short-term STEM awareness events
2. Target STEM certified schools
3. Design initiatives with exclusive/in-depth focus on transportation
4. Design long-term extended initiatives focused on high schools
5. Focus awareness programs on elementary and middle schools
6. Leverage existing resources and build partnership with transportation-related STEM stakeholders.

4.2 GDOT Employee Survey and Results

As a follow-up to the panel meeting discussion, GDOT employees were surveyed to determine their interest in STEM programming with the agency.

The survey requested information on employee participation in STEM outreach activities, including how often and in what capacity they participate. It also asked if the employees had been involved in GDOT STEM outreach, why or why not, and in what types of activities they had been involved in. It then gauged their interest in future participation in STEM outreach, also asking what activities would be of interest. The survey instrument is included in Appendix F.

The 13-question survey was sent to the approximately 4,000 employees of GDOT on January 21, 2015. Over two weeks, 339 responses were collected, a response rate of about 8 percent. The sections below detail the results of the survey.

The survey asked about employee participation in STEM programming previously sponsored by GDOT. The vast majority of respondents (97 percent) had not participated in any GDOT STEM outreach. The reason most cited for not participating was lack of awareness or knowledge of opportunities to participate in. Of the respondents that commented on why they did not participate (256 respondents), 92 percent were unaware of opportunities. Of the remaining responses, being a new employee and time constraints were most often mentioned (8 percent of 256 respondents). There were 12 respondents that had participated in GDOT STEM activities. Over half of these respondents had participated in school presentations

and/or Construction Career Days. These and the other activities with their respective participation levels are shown in Figure 9.

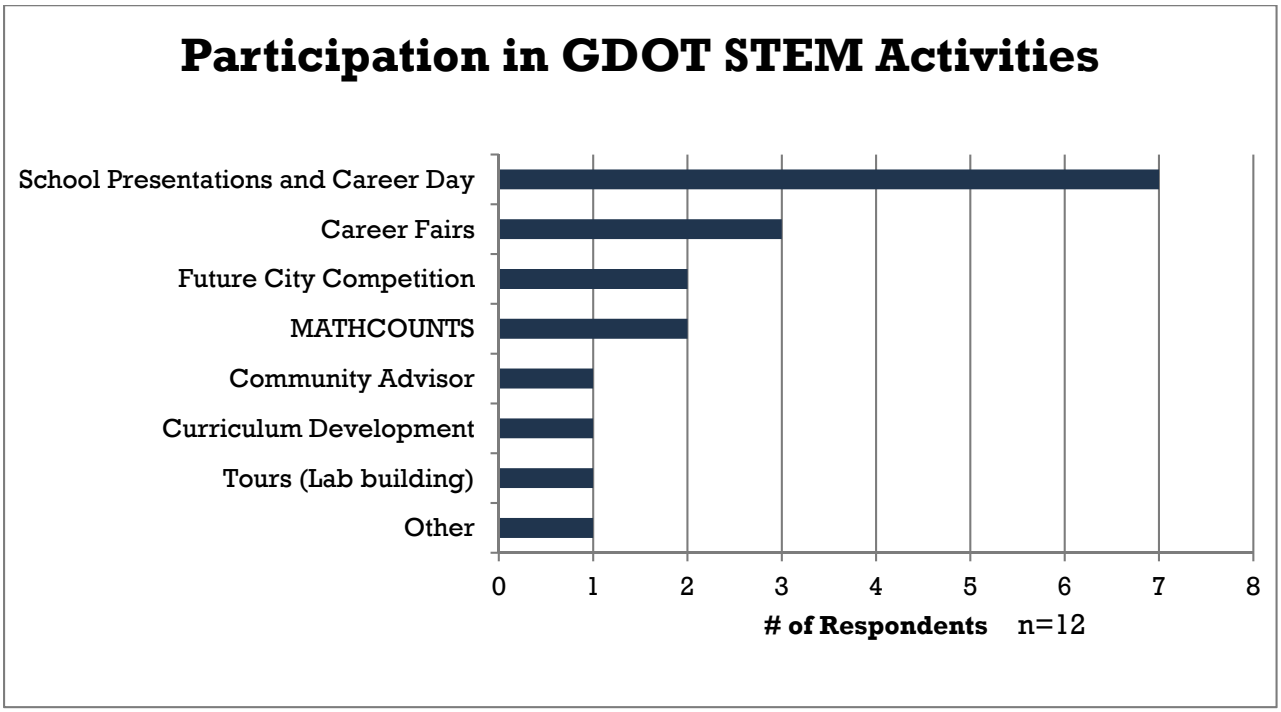

Figure 9 STEM activities in which employees have participated through GDOT

Employees were also asked about their interest in participating in GDOT STEM activities. The majority of respondents (72 percent) were very or somewhat interested in participating in STEM activities through GDOT (Figure 10). When given a list of potential activities, nearly half of the respondents were interested in serving as a judge for a competition or speaking at a school. Participating in a 2-6 hour event or helping to plan such an event also garnered a good deal of interest (Figure 11). There is some overlap in participating in a 2-6 hour event, judging a competition and participating in a 4-6 week summer program. It is likely that in a summer program, there will be competitions and smaller events that employees can volunteer to assist with.

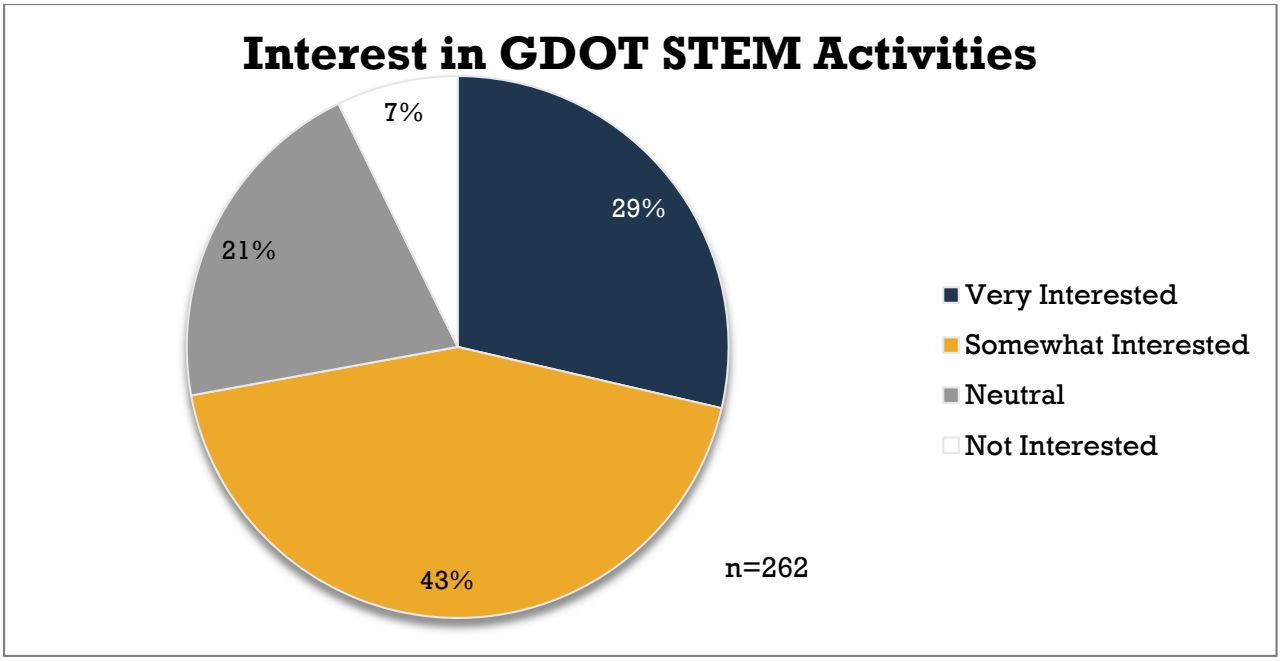

Figure 10 Interest in participating in STEM outreach programs through GDOT

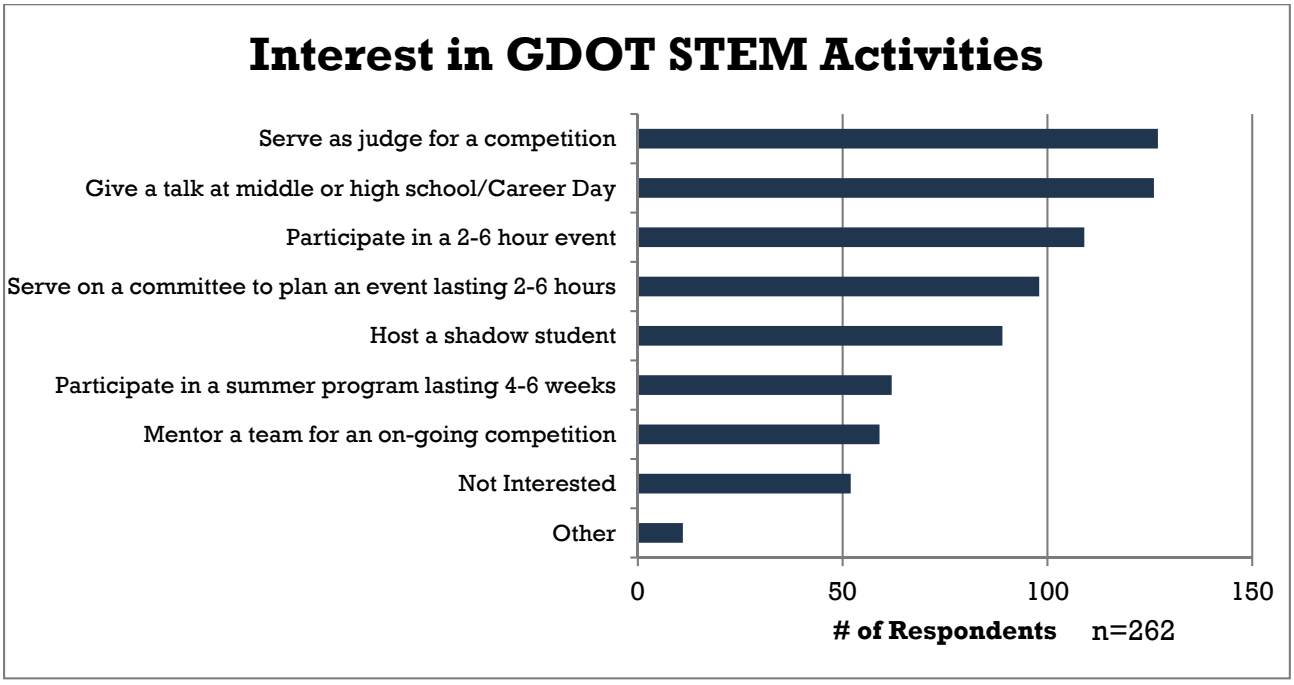

Figure 11 Interest in potential GDOT STEM outreach activities

The ranking for employee preference of activities was similar across all categories of interest (very, somewhat, and neutral interest in GDOT STEM activities) and mirrored

the activity ranking of all respondents (Figure 11). For employees with neutral interest, however, mentoring a team outranked hosting a shadow student or participating in a summer program.

More information was gathered about STEM activities by asking if employees were involved in efforts outside of GDOT. Only about 9 percent (20 respondents) of the 214 respondents to this question were involved in STEM-related activities outside of GDOT. GDOT employees were also asked about outreach activities (STEM or otherwise) in which they participate. These are shown in Figure 12. Of the employees that had participated in previous GDOT STEM outreach, half (6 of 12) were also active outside of GDOT. Of the respondents that were not involved in GDOT STEM activities (202 respondents), 7 percent (14) reported participation in STEM outreach outside of the organization. Of all the respondents who participate in STEM outreach activities outside GDOT (20), all but two respondents (who expressed neutral interest) also expressed interest in becoming involved in GDOT STEM activities; most were "very interested."

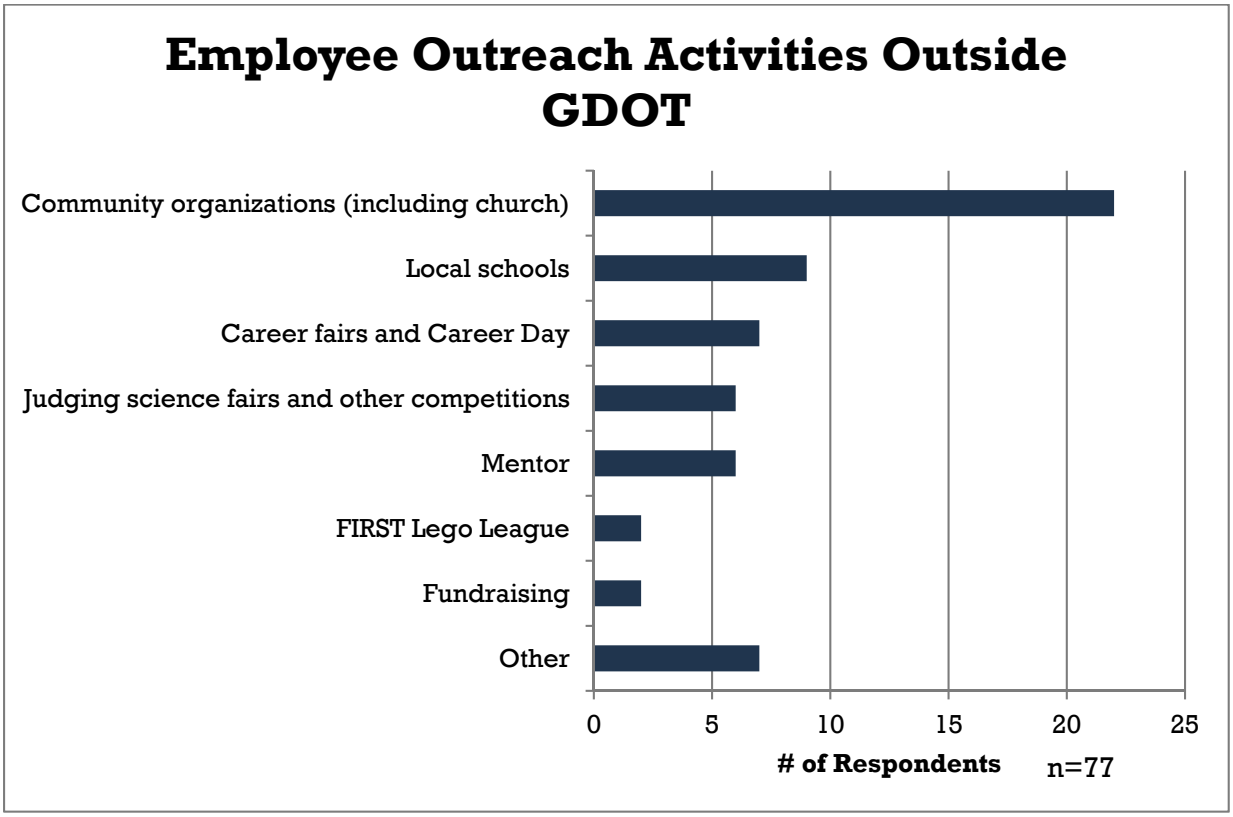

Figure 12 Types of outreach activities that GDOT employees participate in

The frequency of outreach activities is shown in Figure 13. It is important to note that respondents represented in Figure 12 and those in Figure 13 are not necessarily the same pool, although there is some overlap. Overwhelmingly, GDOT employees that

participated in some outreach activities did so through a community organization, including churches, or local school.

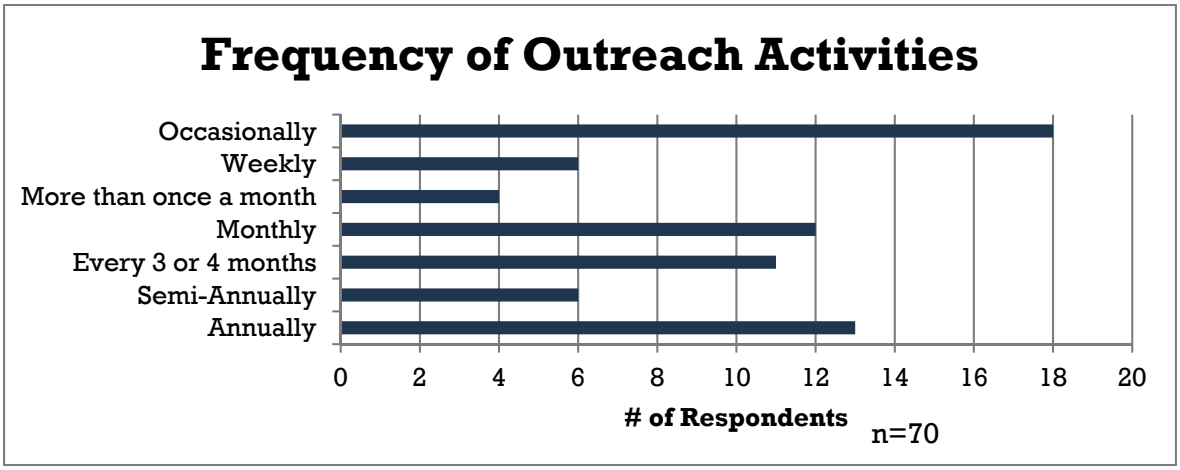

Figure 13 Frequency of participation in outreach activities

The depth of interest in STEM outreach was also gauged by asking how likely employees were to join an advisory or planning board for STEM programming at GDOT. Just over half of the respondents were either very or somewhat likely to consider serving on such a board. These results are shown in Figure 14.

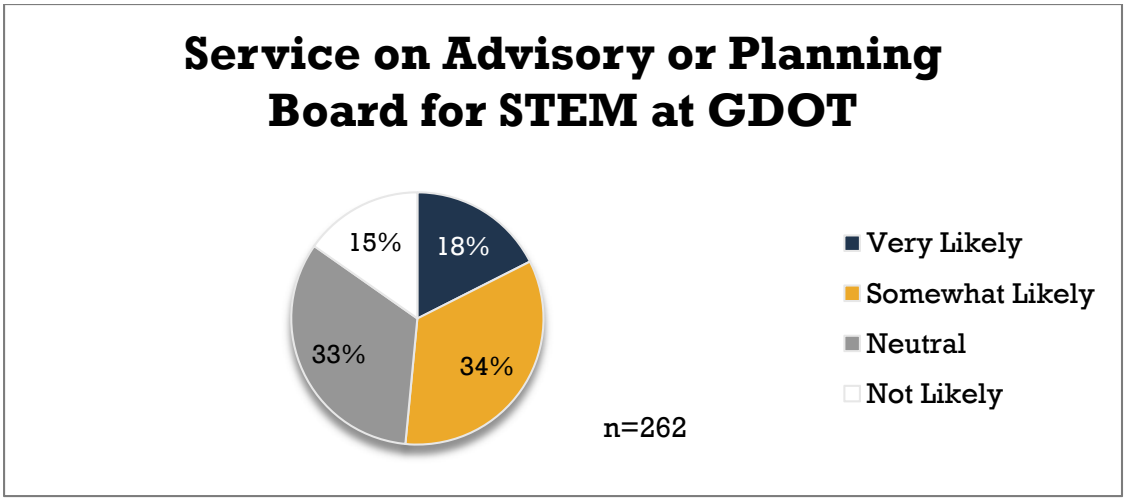

Figure 14 Interest in serving on an advisory or planning board for GDOT STEM programming

4.3 District-Level STEM Activities

Much emphasis was placed on initiatives coming from the Department headquarters; however, it was also discovered that there are programs run out of district offices as well. Each of the seven district offices were contacted about their STEM outreach efforts. Programs and activities are generally run through or by the Communications

Officer for each district. In speaking with the Communications Officers for the districts, several activities were identified.

District 4 was invited to Tift County High School's Career Fair in the spring of 2014. This was the first such event in recent years as the Communications Officer position had been vacant a year prior. The school contacted GDOT, and a recent graduate and new hire attended the fair with the Communications Officer.

District 5 has an established program with elementary schools. Over the past three years, employees have visited six schools to present on road design and construction topics. The Communications Officer and the Design Engineer created an interactive presentation geared towards 5th graders using PowerPoint, video of machinery, asphalt samples, and other visuals. The goal was to touch on all aspects of STEM in the 30-45 minute presentation. This program was initiated by an invitation from a local school and grew to other schools in the Savannah and Hinesville areas as the word spread.

4.4 Opportunities for STEM in GDOT

A concluding, yet very important, part of the panel meeting centered on the role of the panel in leveraging GDOT resources to cultivate a culture of STEM within the agency and continue to enhance the existing program; as well as the long term benefits of the program for pipeline development.

An integral component in instilling STEM outreach into the culture of GDOT is establishing ownership of the program. The panel meeting established a foundation for developing a partnership to support future efforts. This led to a discussion on the future role of the panel. The development of a STEM steering committee was suggested. This committee would involve external partners and stakeholders that may include (but are not limited to) STEM schools, universities (including Georgia Tech), UTCs, CEISMC, professional organizations, FHWA, firms in private industry, and the GA DOE.

The need for a champion and succession plan was discussed and it was suggested that a STEM Liaison be appointed for a 2-year term. This liaison would work with the GDOT panel to advance STEM programming in the agency. Longer-term STEM programming would involve Human Resources, the Communications Office and executive leadership.

Finally, opportunities to cultivate STEM outreach within the culture of GDOT were discussed. Program highlights in the Milepost and other agency communications, visibility in "Our GDOT" (i.e., human resources tool used internally for the organization with resources for employees including information on volunteer opportunities), human resources materials, publicity around E-Week and STEM Day, and coordination with GDOT Communications all support promoting STEM efforts

throughout the organization. The survey of employees provided additional insight suggesting that email would be the best way to inform employees of STEM outreach opportunities (Figure 15).

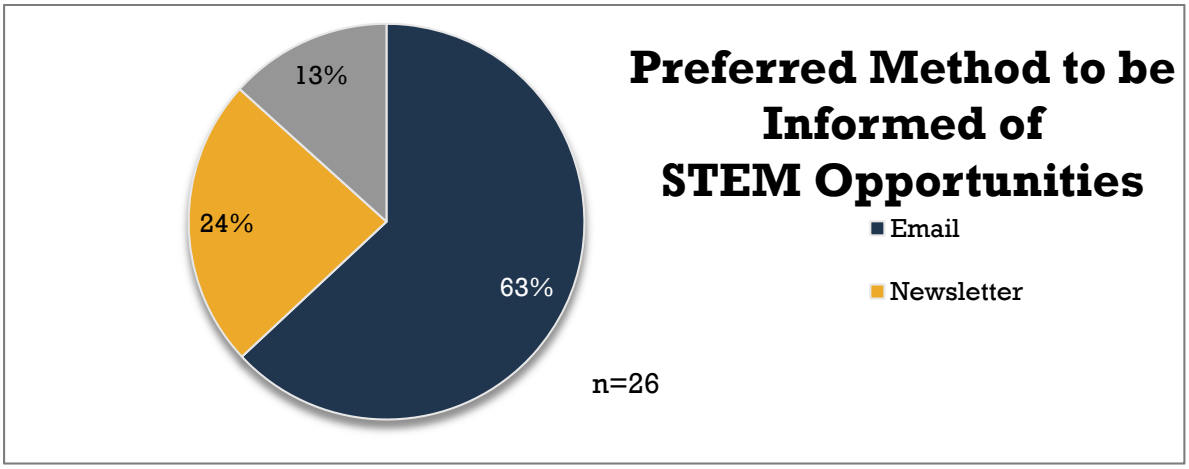

Figure 15 Methods for informing GDOT employees of STEM outreach opportunities

Financial resources are crucial to the development of a STEM outreach program. Funds could be leveraged from external sources, such as GA DOE, FHWA, etc., to support such a program. Additionally, it would be very important to develop a business case for the recommended programs to support requests for funding from within the Department.

4.5 Summary

By meeting with GDOT representatives, conducting an employee survey, and interviewing district offices and human resources staff, a picture of programmatic STEM outreach at GDOT has begun to emerge. GDOT is currently involved informally in two STEM outreach programs: Future City Competition and Introduce a Girl to Engineering. In addition, several units are involved in student tours including the Traffic Management Center and Office of Bridge Design. Outside of these activities, district offices also have initiatives that they participate in periodically. Additionally, individual employees participate in STEM outreach, sometimes outside of GDOT.

Employee feedback on STEM outreach at GDOT presented useful insights on the types of activities the employees are involved in and would be interested in participating in. First and foremost, employees that responded to the survey indicated strong interest in and supported establishing a formal STEM outreach program at GDOT. School presentations, Construction Career Days, and career fairs were the most common STEM outreach activities and judging competitions, giving

school talks and participating in a half day event were the activities that garnered the most interest.

Key steps in creating a formal STEM outreach program have been identified through research and discussions with GDOT staff. These include identifying owners of the program, establishing strategic partners, identifying a champion and establishing a steering committee that includes executive leadership. Opportunities that currently exist within GDOT were also identified such as publicity through the Communications Office and "Our GDOT". Finally, any program will need financial support and it will be necessary to make a business case to support requests for funding from within the agency as well as leverage external resources at the state and Federal levels. The next chapter conducts a business case analysis for the five STEM outreach alternatives identified in this study.

5 STEM Program Alternatives: Business Case Analysis

5.1 Introduction

This chapter presents a business case analysis on select STEM outreach activities for GDOT's consideration. The activities were designed based on an inventory of STEM initiatives and activities nationwide and within the state of Georgia; and the resources available within GDOT to support STEM activities. The research team has proposed five alternatives for GDOT to enhance transportation-STEM initiatives in Georgia, namely: a Summer Transportation Institute, AASHTO TRAC & RIDES, an Internship/Shadow Program, One-day STEM Awareness Events, and a Speaker's Bureau for School Visits. For each alternative, the report provides a program description, evaluates the resources required and available to execute the program, and identifies the potential benefits to the agency –- both to replenish the pipeline as GDOT personnel retire, and to enhance the culture of STEM within the agency. A summary of benefits and costs is developed for all five alternatives. The cost-effectiveness analysis offers a bird's-eye view of the proposed alternatives, what it would take to implement them and their resulting benefits. The cost-effectiveness analysis is not meant to rate one alternative against another; rather, it is to highlight the purposes and merits of the alternatives as standalone programs or in conjunction with some or all of the other alternatives. The combination of these alternatives provides a menu of options as the agency develops and implements a STEM program. Below, the alternatives are described in detail and then evaluated.

5.2 Georgia Tech Summer Transportation Institute (GTSTI)

The NSTI program is the first transportation career education program for secondary school youth to be authorized by the United States Congress. It was authorized under Section 1208 of the 1998 Transportation Equity Act for the 21st Century (TEA-21). With oversight from the U.S. Department of Transportation (USDOT), the Federal Highway Administration (FHWA) through its Division Offices implements the program by approving proposals and funding requests from accredited colleges and universities working with state DOTs. The objectives of the program are to increase student understanding of transportation engineering, promote awareness of transportation-related STEM careers, and improve students' STEM capabilities.

A Summer Transportation Institute (STI) is proposed as a free, two-week, non-residential program for high school students to be held at Georgia Institute of Technology. A partnership between the National Center for Transportation Systems Productivity and Management (NCTSPM), CEISMC, and Spelman College, this program aims to expose students to the field of Transportation through hands-on introductions to three important areas of Transportation Engineering: bridge design, traffic simulation, and transportation/city planning. The NCTSPM is a USDOT/RITA

grant funded Tier 1 University Transportation Center (UTC) that conducts transportation-related research in the areas of safety, state-of-good-repair, and economic competitiveness. CEISMC's goal is to ensure that K-12 students in Georgia receive the best possible preparation in STEM as they seek their place in the modern world. CEISMC has an excellent track record of effective STEM programming in the state of Georgia. This program will be the first NSTI held at Georgia Tech.

5.2.1 Program Description

During the GTSTI, students will be engaged in activities centered on three main challenges that will culminate in oral presentations where students will be evaluated against each other competitively, in teams and individually. Activity-based, in-class lessons organized into four modules will be coupled with field trips to locations that are relevant for the topics presented. These will be complemented with seminar sessions with high-profile guest speakers, and enhancement activities for career and college readiness and development. Students will also be taught professional oral and visual technical communication skills to help with their project challenge presentations. Table 4 provides an overview of the proposed activity schedule.

The introductory module will cover topics including transportation history, modes of transportation, pedestrian accessibility, and the engineering design process. There will be a featured guest speaker to help kick off the program, and a field trip to either the Atlanta Beltline or the newly inaugurated Atlanta Streetcar. The second module will be built around the Bridge Designer Software (formerly West Point Bridge Design). It will begin with an overview of bridges and bridge design and culminate in a bridge building challenge. Student teams will design a bridge using the software and translate their design into a physical prototype. In the third module, students will be introduced to intersection traffic control and traffic simulation models in a challenge to design the best signal timing plan for a selected intersection using the PTV VISSIM simulation software application. This will be coupled with a field trip to the GDOT Traffic Management Center. The final module will be centered on the SimCity video game, where students will build a city focusing primarily on transportation features (roads, mass transit, and planes). Module lessons will be interspersed with enhancement activities such as college admissions sessions by the Georgia Tech and Spelman College Offices of Admissions, discussions with current undergraduate and graduate students in transportation-related fields that include non-Civil Engineering disciplines (e.g., Electrical Engineering, Computer Science, etc.), and a career "speed dating" event with professionals in transportation-related fields. A baseline program schedule is provided in Table 4.

Table 4 GT STI - Example program schedule

Week 1	Monday	Tuesday	Wednesday	Thursday	Friday
9:00AM-11:30AM	Program Overview & Pre-Assessment Transportation 101 The Transportation Process	The Engineering Design Process College Student Panel	Pedestrian Accessibility Wheelchair Rides	Designing Your Bridge Challenge Work Time Building Your Prototype	Testing Your Prototype Challenge Work Time Presentation Preparations
11:30AM - 12:30PM	LUNCH				
12:30PM – 3:00PM	Guest Speaker Modes of Transportation	Streetcar/Beltline Tour with Scavenger Hunt	Introduction to Bridges & the Challenge The Bridge WebQuest Bridge Design Software Introduction	Challenge Work Time Technical Presentations 1.0	Bridge Design Presentations Week 1 Evaluations

Week 2	Monday	Tuesday	Wednesday	Thursday	Friday
9:00AM-11:30AM	Intersection Mumble Jumble Intersection Control Traffic Simulation & the Challenge	Building Your Simulation Model Challenge Work Time Testing Your Model	Presentation Preparations Traffic Simulation Presentations	Building Your City Challenge Work Time	Presentation Preparations SimCity Presentations
11:30AM - 12:30PM	LUNCH				
12:30PM – 3:00PM	TMC Field Trip	Technical Presentations 2.0 Challenge Work Time Office of Admissions	Career Speed Dating Transportation & City Planning Introduction to SimCity & the Challenge	Measuring the Performance of Your City Challenge Work Time Technical Presentations 3.0	Post-Program Assessment Closing Ceremony with Guest Speaker

5.2.2 Program Administration

Students will be recruited from public schools either in close proximity to the Georgia Tech campus or with which Georgia Tech has an existing relationship (through participation in other summer programs). Marketing materials will be sent to guidance counselors and STEM program/subject coordinators, applications will be submitted online, and selections will be made by a committee of CEISMC staff, faculty and graduate students from the School of Civil and Environmental Engineering at Georgia Tech, faculty from Spelman College, and members of an advisory committee that will include GDOT staff. Students will be accepted based on the following criteria:

- Completion of algebra, or qualification for enrollment in algebra for the coming school term
- Minimum cumulative GPA of 2.0/4.0
- Interest in STEM or transportation education and/or career
- Two recommendation letters from a teacher or guidance counselor
- Written statement of interest

The program will primarily be staffed by Georgia Tech students and faculty, and CEISMC staff. CEISMC staff will lead pre- and post- program evaluations, as well as weekly student evaluations.

5.2.3 Resources Required

GDOT employee participation will be on a volunteer basis primarily within an advisory committee (two to three GDOT employees), challenge facilitation (up to 2 hours each challenge day), competition judging, hosting the TMC field trip, and as panelists for the Career Speed Dating session.

The total program cost is estimated to be $40,000. An application developed to host the program in June 2015 requested $25,000 from the FHWA with $5,000 in sponsorship received from the NCTSPM, and additional in-kind donations expected from partner organizations and private companies.

5.2.4 Resources Available

Georgia Tech hosts several different programs throughout the summer, and in the past, this has included transportation-related programs. As such, the institute is already prepared to host programs like the STI, with available funding.

5.2.5 Benefits to Agency

This research project found evidence that participation in NSTIs across the country improved students' understanding of transportation, familiarity with transportation and other STEM fields, and general feelings of preparedness for college. In the same way, the GTSTI seeks to make significant impacts on students and to provide a platform for the development of transportation-STEM efficacy and the formation and development of relationships between student participants, program staff and GDOT personnel involved. Although the main benefit

to the agency is student exposure to and awareness of transportation that can fuel the workforce pipeline in the long run, additional benefits can be found in publicity opportunities for GDOT and increased employee satisfaction for those employees who value opportunities to give back. With this program, GDOT can actively address the strategic goal theme: "making GDOT a better place to work will make GDOT a place that works better."

5.3 AASHTO TRAC & RIDES

5.3.1 Program Description

The American Association of State Highway and Transportation Officials (AASHTO) has two educational programs: TRAC™ (Transportation and Civil Engineering) and RIDES (Roadways Into Developing Elementary Students). One or both may be implemented as a program alternative for a STEM outreach program at GDOT. TRAC and RIDES are hands-on education programs developed by AASHTO for use in classrooms. The goal is not only to encourage critical thinking and develop problem-solving skills, but also to introduce students to the fields of transportation and civil engineering and related careers.

AASHTO provides TRAC and RIDES toolkits for purchase. The costs for modules are listed in Table 5. The toolkits include curricula and materials for hands-on activities. RIDES is targeted at K-8 grade students and there is one RIDES module available for purchase. TRAC is for middle and high school students, and the following TRAC modules are available for purchase:

- Bridge Builder Module
- Bridge Builder Upgrade
- Construction Module
- Environmental Module
- Maglev Module
- Motion Module
- Motion Module Upgrades
- Safety Module
- SIMCITY Module
- SIMCITY Upgrade
- Technology Module

Table 5 Cost of TRAC and RIDES modules (2015)

Module	Unit Price
Bridge Builder Module	$ 569.00
Bridge Builder Upgrade	$ 350.00
Construction Module	$ 575.00
Environmental Module	$ 650.00
Maglev Module	$ 678.00
Motion Module	$ 917.00
Motion Module +TI-84 Calculator	$ 1,000.00
Motion Module +8' Maglev Track	$ 1,159.00
Motion Module +TI-84 Calculator & 8' Maglev Track	$ 1,259.00
Safety Module	$ 1,495.00
SIMCITY Module (5 licenses)	$ 299.00
SIMCITY Module (20 site licenses)	$ 899.00
Technology Module	$ 897.00
RIDES	$ 1,500.00

Typically, state DOTs purchase TRAC and RIDES materials from AASHTO and then partner with teachers who implement the programs in their classrooms. Schools participate free of charge. The state DOT purchases the kit(s) and AASHTO trains the teachers on how to implement the toolkits in the classroom. The teachers then lead classroom activities in which DOT employees can participate on a volunteer basis.

5.3.2 Resources Required

Generally, state DOTs purchase the toolkits from AASHTO. DOTs can either join as a member state or purchase modules a la carte. To become a member state, the membership fee is $7,000. This covers the entire state as well as training for all the modules. It includes training for teachers by AASHTO, as well as participation of students in the National Bridge Competition for students in grades 7-12. AASHTO has established an Adopt-A-State program, in which private companies provide sponsorship to a state DOT to join as a member. If a state purchases a module without joining as a member, free teacher training will not be provided. Most states use On-The-Job-Training (OJT) funds from FHWA to purchase individual modules.

In addition to the cost of purchasing the modules, GDOT will also need to appoint an individual to oversee implementation. It is estimated that this would require an employee to spend approximately 8 hours per week for 4-8 weeks (0.2 FTEs). This person would coordinate with AASHTO to purchase the toolkits and arrange the teacher training; work with the schools to identify teachers, provide teacher training, and coordinate any GDOT volunteer activities; and communicate volunteer opportunities to GDOT employees. Additionally, this person could seek a corporate sponsor to underwrite the cost of TRAC and RIDES materials.

5.3.3 Resources Available

Financial resources are available through OJT funds from FHWA, which are commonly used to purchase the modules. Additionally, AASHTO has established an Adopt-A-State program, in which private companies provide sponsorship to a state DOT to join as a member, defraying the cost to the state DOT.

Georgia Tech has developed relationships with a number of public schools in the Atlanta region and these relationships can be leveraged to identify schools and teachers who might be interested in partnering to implement these programs. Additionally, the survey conducted by the research team revealed a number of existing relationships between GDOT employees and area schools. A number of employees have represented GDOT at career days or school presentations, as well as conducted non-GDOT-related outreach. These individuals have relationships that can be leveraged to coordinate TRAC and RIDES activities. Moreover, some survey respondents mentioned instances of schools reaching out to district offices and some provided contacts of educators that would be interested in outreach efforts.

5.3.4 Benefits to Agency

The main benefit of a TRAC and RIDES program to GDOT is pipeline development. By implementing transportation-related activities in schools, GDOT would expose students to the field of Transportation as well as give them an opportunity to develop skills that would be useful in a transportation career. Moreover, this type of activity allows for deeper engagement than a career fair or a one-time visit to a school. In addition to training the current students who participate in the activities, this kind of program also trains teachers who have influence over future students. The TRAC and RIDES program alternative offers a more indirect approach to GDOT for pipeline development, but offers a prospect with ongoing benefit.

5.4 Internship/Shadow Program

5.4.1 Program Description

Internships provide students with exposure to transportation careers, as well as basic job training. Several state DOTs are able to sustain high-school level internship programs, namely Minnesota, Michigan and New York. GDOT only offers internship opportunities to collegiate level students (at least 18 years of age) to limit liability.

An alternative to a full-fledged internship program is to establish a shadow program. This program pairs a student with GDOT staff for one week. During the week, the student follows individual employees throughout their work day, in order to explore GDOT's work, and the employee's role in the organization, and to get a feel for the work of a transportation professional.

There are several ways in which a shadow program may be implemented. This report offers two models: assigning shadow students to a particular division (Option 1), and assigning students to a particular district (Option 2). In Option 1, each division hosts one shadow student. The shadow students then spend a week at the central office in Atlanta and rotate

through various divisions. It will be the responsibility of each division to expose the students to GDOT and the transportation industry. Each student will have a mentor who will serve as the primary point of contact. Throughout the week, however, the shadow student will also spend time with other employees in the division.

In Option 2, each field district hosts a local student from within that district. As with the first option, a student will be assigned a primary mentor and each district will provide information, experience, and stimulating activities for the students during the week. Activities may include small scale research projects, interviewing employees and assisting employees with work such as plan reviews, simulations and preparation for meetings.

Either model could be scaled to increase the number of students or increase the program duration. The program could initially start with one week and one student per division/district. The program could then be extended to four weeks, hosting a new set of students each week for one full month during the summer. If the program gains high levels of interest, the number of students may be expanded as well. It is possible for each division and/or district to host more than one shadow students per week, or for both divisions and districts to host students. The particular arrangement will depend on the number of employees interested in/available to host students, the number of students that can be attracted to the program and other related factors.

The program could be strengthened by adding a few events for the students. For example, the students could be treated to a lunch with the commissioner and a limited number of presentations from the Department's divisions. The presentations will be the primary way that other shadow students will learn about divisions other than their own. This would help the students fit the work they see in the divisions/districts into the bigger picture. Each division can briefly present on their role and responsibilities, identifying particular positions and the impacts of division roles on the Department. Students can also share feedback on their experience and what they have learned. There is an opportunity for the shadow students who work with a division to help develop the division presentations based on their experiences over the course of the week.

The lunch would be held at the central office in Atlanta and give the students an opportunity to hear from the commissioner about how the agency and transportation in Georgia are managed. The lunch can be held at the beginning of the week as a welcome, but the scheduling will ultimately have to accommodate the commissioner's schedule. The division presentations could also be held at the central office. This event can be held at the conclusion of the week.

Logistics for these supplementary events are minimal for Option 1: the shadow program organized by divisions. For Option 2, the district-based shadow program, the supplementary events could be combined and held at the conclusion of the program to

minimize travel to the central office. While at the central office, a tour can also be provided for shadow students working at district offices.

STEM schools, and schools that GDOT has previously partnered with, will be informed of the shadow program through their guidance departments. Additional recruitment may happen at career fairs and career days. Students will apply to the program by responding to several short answer questions that pique their interest in transportation such as: "How does transportation impact society?" "How do you deal with traffic in Atlanta?" or "How does a bridge carry heavy trucks without collapsing?" The application selection process can be handled by a representative from each division/district. This person may or may not serve as the mentor for the chosen student. Alternatively, the divisions/districts may convene an ad hoc committee to review applications. The selected students will be notified by Human Resources.

Another option for a relationship-building program is to phase an internship program into existence. Students can be selected based on their involvement in previous GDOT outreach efforts such as STI, TRAC or the Shadow Program. The internship would only be open to high school seniors. Limiting the number of students and the duration of the program may also reduce liability. GDOT would only host a small cohort of students (5-10) a year. Similar to the structure of shadow program, each district or division would support an intern. The internship would last for two summer months (June and July). The internship program could also be strengthened with supporting events, such as those mentioned for the shadow program, to provide additional information and opportunities for the students to develop strong relationships as a cohort.

5.4.2 Resources Required

The most critical resource for the internship/shadow program is GDOT staff to act as mentors.

The shadow program requires one FTE per division or district for each week of the program. The student will be assigned to one staff member; however, during the week, the student may shadow other employees for a short time. Additional GDOT staff is needed to coordinate the student application and selection process and staff recruitment efforts. Also, staff will be required to create and deliver the division presentations. Organizing the supporting events will require additional resources, such as employee time to reserve space for the lunch with the commissioner and the division presentations; and to order catering the lunch for 7-10 students and their supervising employees. The estimated cost is $300 to $400 (at $20 per person).

An internship program does not require one FTE per student for the duration of the program. Employees mentoring the intern will devote some time to teaching and training the students; however, the students will also contribute to ongoing work within the divisions. As such, one resource specific to the internship program and not the shadow program, is

intern salary. Other states with high school internship programs pay students $10-$14 per hour. For a month of full-time work, total salary accrues to $3,200 to $4480 per intern.

5.4.3 Resources Available

Manpower is critical to a shadow program. Of the 262 employees surveyed, 89 (34%) expressed interest in hosting a shadow student, reflecting enthusiasm among the employees. This suggests that GDOT has the capacity necessary to recruit staff for the program. Space for lunch and presentations is available at the central office. Financial resources for catering and intern salary would have to be secured.

5.4.4 Benefits to Agency

One of the returns to the program is the individual relationships established between GDOT employees and the students. This would occur while the students are also offered first-hand transportation experience. The program may also produce students who continue into the collegiate internship program and, eventually, into full-time employment after graduation. This continuing relationship has the potential to produce prospective employees already familiar with the Department at entry level. Additionally, for the internship program in particular, the divisions or districts would provide tasks that offer students opportunities to contribute to the work of the Department, creating a mutually beneficial relationship.

5.5 One-Day STEM Awareness Events

5.5.1 Program Description

A one-day event will focus on increasing awareness of STEM and transportation for middle school students. Three alternative structures for such an event are a STEM Day Fair, Introduce a Child to Transportation, and Transportation Day.

The STEM Day Fair event will reach the largest audience, between 150 and 200 students. The event would be held on Georgia STEM Day and provide an opportunity for schools to participate in festivities held across the state that day. GDOT would partner with one or more middle schools and invite them to the event. The fair would consist of approximately 25 exhibits from GDOT, transportation firms, and professional organizations from metro Atlanta and across the state. Each exhibitor would be asked to create a display, preferably interactive, that explains their role in the organization, what they do, and how it impacts transportation in the state of Georgia. To encourage exhibitors to be creative, a "people's choice" award will be presented to one exhibitor based on the students' votes. Students would also be encouraged to learn from as many exhibits as possible with an activity that incentivizes them to visit and speak with exhibitors (e.g., BINGO, trivia, and passport). These activities are described in Table 6. Small prizes such as GDOT paraphernalia will be presented to students who complete the activity by the end of the event.

Table 6 Student incentivizing activities for STEM Day Fair

Activity	Description
BINGO	Exhibits are organized randomly in a 5X5 grid. Each exhibitor has a stamp or stickers and confirms that students have visited his/her booth by notarizing the box corresponding to his/her exhibit. Students must complete a row of five (or other combination).
Trivia	Each exhibitor is asked to provide a trivia question (in advance) that will be answered when students visit their booth. Students will receive a sheet/card with a random set of 10 of these questions. Throughout the day, they will work to answer a minimum number of these questions.
Passport	Students will receive a card that has a blank 5X5 grid. Each exhibitor will have a unique stamp or stickers and as the students visit the exhibits, they will receive confirmation on their card. Students will collect at least 12 unique stamps/stickers.

The STEM Day Fair requires a large space. It could be held at GDOT in an atrium or hall/ballroom space that can accommodate 150-200 students and staffers for 25 exhibits. Tables and possibly easels would be provided; all other supplies would be furnished by the exhibitors. The fair could be scaled up to host additional schools and include more exhibits as it grows.

Each one-day event will need a coordinator. For the STEM Day Fair, the coordinator would be responsible for recruiting and communicating with external exhibitors. The individual would also work with internal GDOT exhibitors. The coordinator will communicate with the schools and oversee logistics, including space reservation. This individual will also be responsible for the activity and prizes and awards. He or she will manage these responsibilities but should be assisted by a committee of employees to provide the necessary support for a successful event.

The second alternative, Introduce a Child to Transportation, is modeled after the national program, Introduce a Girl to Engineering. The event will serve 75 to 100 middle-school students. The program is designed to be held on a weekend, preferably during Engineers' Week, but can also be held on STEM Day. Introduce a Child to Transportation is a structured program that will run from 9:00 am until 2:30 pm. The proposed schedule is shown in Table 7. A light continental breakfast will be provided during sign-in and the program will open with a welcome and keynote speaker. This will be followed by a fair of exhibits from GDOT's divisions. Each division will present on their role at GDOT and how it impacts transportation in general. Similar to the incentives for the STEM Day Fair, students can have a passport or trivia sheet to incentivize them to visit all the exhibits.

Table 7 Schedule for Introduce a Child to Transportation

Time	Activities
09:00AM - 09:15AM	Sign-in and Breakfast
09:15AM - 10:15AM	Welcome and Keynote
10:15AM - 11:15AM	Division Fair
11:15AM - 11:30AM	Break
11:30AM - 12:30PM	Group Activity
13:00PM - 14:30PM	Lunch Panel & Closing

After a short break, there will be a group activity. Students will be separated into small groups to complete an activity that relates transportation more directly to STEM. Examples of suitable activities are given below. TEACHENGINEERING.org is a useful resource for such activities.

- *Bridge Types – Tensile and Compressive Forces*: Students explore how tension and compression forces act on three different bridge types. Using sponges, cardboard and string, they create models of suspension bridges and apply forces to understand how they disperse or transfer these loads.
- *Carve that Mountain – Topography and Infrastructure*: Students investigate major landforms such as mountains, rivers, plains, hills, oceans and plateaus. They build a three-dimensional model of a landscape depicting several of these landforms. Once they have built their model, they act as civil and transportation engineers to build a road through the landscape they have created.
- *Silver Streak – Future Transportation Modes*: Students design a futuristic transportation device that will hold the most people (pennies) as possible and move across the room as fast as possible.
- *Beams - Building Begins with a Beam*: Students build a simple-span beam (vertically supported at both ends) out of foam insulation material to support a test load at mid-span without significant deflection under the load. The "cost" of construction materials of the beam should be as small as possible while meeting the performance criteria related to the load capacity and permissible deflection.

The program will end with a box lunch and panel discussion on transportation careers during the lunch.

It is possible to scale up this event to reach more students. This would necessitate a larger space, additional volunteers, and multiple activities.

The coordinator for this event will be responsible for recruiting students to participate. The individual will reserve a hall/ballroom space for the event and oversee logistics, including catering. They will confirm a keynote speaker and panelists from GDOT and/or the broader transportation industry as well as coordinate with GDOT divisions for the fair. The coordinator will also prepare the activities, including securing supplies, and recruit GDOT employees to

volunteer for the event. It is recommended that the coordinator has a committee to assist to ensure successful implementation of this program.

The third and final alternative, Transportation Day, will cater for about 45 middle-school students. The program is designed to be held on a weekend during Engineers' Week, and can also be held on STEM Day. The program runs throughout the morning, from 8:30 am until 12:30 pm. The proposed schedule is shown in Table 8. Transportation Day primarily consists of a series of three activities. After sign-in, the program opens with a welcome and panel on transportation careers. Following the panel, the activities will begin. Students will be separated into three groups of 15 students and will rotate between three activities. Examples of suitable activities are given above (e.g., Bridge Types, Carve the Mountain, Sliver Streak and Beams. Whatever activities are chosen should relate transportation directly to STEM). After the first activity (i.e., Rotation 1), there will be a short break that may include a snack. The second and third rotations will ensure that all students will be able to participate in each activity. The program will be concluded with a short discussion that allows the students to take stock of what they have learned and debrief on how transportation is related to STEM.

Table 8 Schedule for Transportation Day

Time	Activities
08:00AM - 08:15AM	Sign-in
08:30AM - 09:30AM	Welcome and Panel
09:30AM - 10:15AM	Rotation 1
10:15AM - 10:30AM	Break
10:30AM - 11:15AM	Rotation 2
11:15AM - 12 noon	Rotation 3
12 noon - 12:30PM	Closing

The coordinator for Transportation Day will be responsible for recruiting students and GDOT volunteers to participate in the program. This will include confirming panelists. The individual will secure a presentation hall/classroom space for the welcome and closing, and three breakout rooms for the activities. The coordinator will also organize and prepare the activities for the event, including securing supplies. The coordinator may find it useful to enlist a committee to assist in planning and implementing this event.

5.5.2 Resources Required

There will be different resource requirements for the different alternatives. One critical resource for these events is labor. A dedicated coordinator is needed for all of the alternatives to recruit volunteers, publicize the event, and handle logistics. Between 6 and 20 volunteers will be needed depending on the alternative. The STEM Day Fair will need at least 10 volunteers to assist with logistics. Introduce a Child to Transportation will need between 15-20 volunteers and Transportation Day will need at least 6-10 volunteers to lead

and supervise activities and serve as panelists. Volunteers will also be needed to create presentations and speak at fair booths. Finall, the STEM Fair requires volunteer participation from external partners as well. Space is another necessary resource for all the alternatives. Both Introduce a Child to Transportation and Transportation Day require supplies for activities, which are estimated at approximately $50 per activity. Introduce a Child to Transportation requires catering for 100-125 people for two meals. This may range from $2,000 to $2,500 (at an estimated $20 per person). Also, prizes and awards are desirable for all the event alternatives (at least $300 for new GDOT paraphernalia and approximately $20 for the exhibitor prize).

5.5.3 Resources Available

Based on the employee survey, participation in a one-day event is a favored option for outreach. Of the 262 respondents, 109 (42%) showed interest in participating in such an event and 98 (37%) were interested in helping to plan it. This is encouraging for recruiting volunteers from the staff. The GDOT building provides space but funds would have to be identified to support these events.

5.5.4 Benefits to Agency

The one-day event has the potential to be a highly publicized event that provides positive visibility for the Department while increasing awareness of transportation-related careers for middle school students. These single events will give interested employees an opportunity to engage in K-12 outreach; an outreach option that elicited interest from several employees.

5.6 Speaker's Bureau/School Visits

The suggested alternative for employee school visits pulls from and builds on the former GDOT Speakers' Bureau that was replaced by the Communications Office in or around 2006.

5.6.1 Program Description

The GDOT Speakers' Bureau for School Visits, referred to as Speakers' Bureau for brevity, will offer STEM-related talks to middle and high school students within each of the seven transportation districts in Georgia. Members of the GDOT Speakers' Bureau will have the opportunity to visit schools and facilitate presentations covering STEM subject matter. The talks, given by GDOT employees, will provide interactive, hands-on, problem-based learning activities to engage the students and generate excitement about and interest in careers within the transportation industry. Students will have the chance to learn first-hand about the opportunities and challenges faced by industry professionals within the various GDOT divisions.

The GDOT Speakers' Bureau will be made up of a headquarters (HQ) program coordinator, district coordinators, and GDOT employees that will serve as speakers (**Error! Reference source not found.**). During the first year, the HQ program coordinator will seek out target schools in each district to schedule speakers. In subsequent years, an online request form,

which will be managed by the HQ coordinator, will be created for schools/organizations to contact GDOT to schedule speakers. Speaker training will take place at least once a year to provide an overview of speaker resources and expected content. During this training, each speaker will be provided with a manual explaining responsibilities, program guidelines, and a database of approved topics and interactive activities. A sample program layout for a school visit is shown in Table 9.

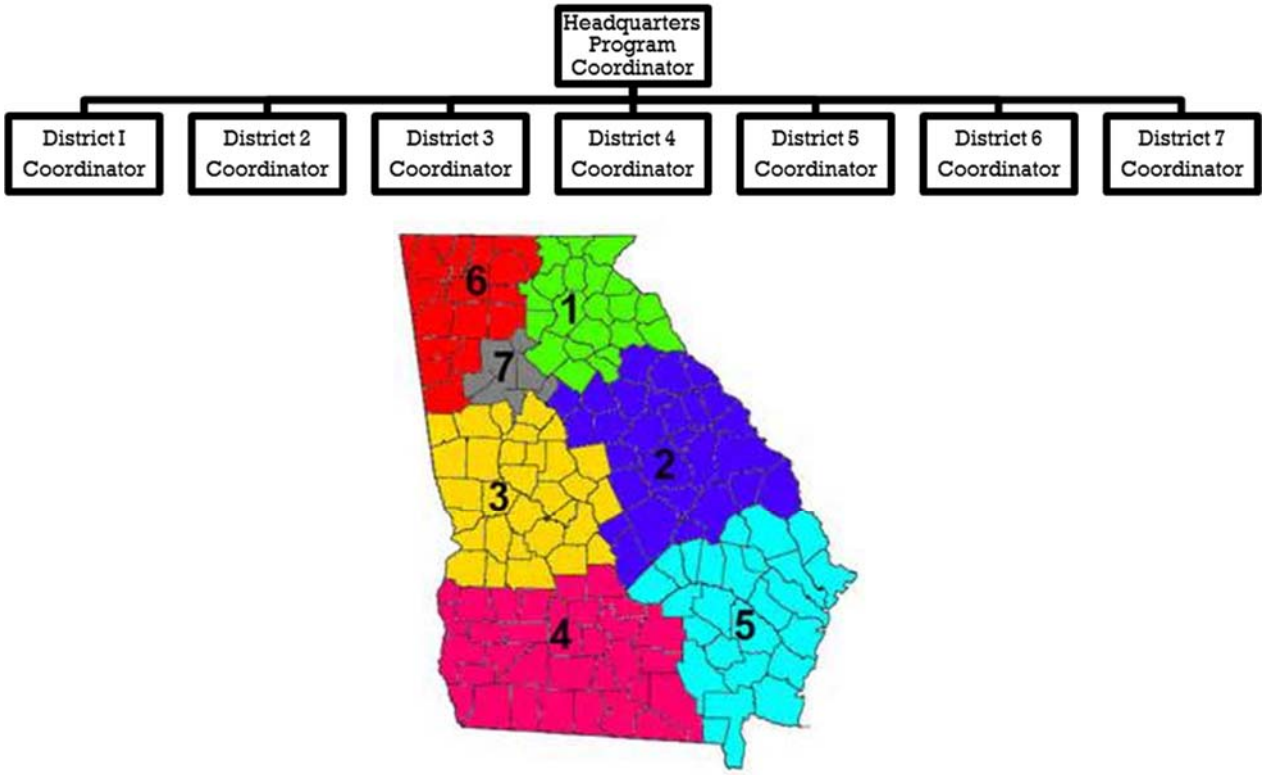

Figure 16 Proposed program structure

Table 9 Sample program layout

• Introduction
  • Introduction of speaker(s) and role at GDOT
  • Introduction of transportation industry and careers

• Presentation topic related to transportation
• Interactive/hands-on activity (See examples in One-Day Stem Awareness Section)
• Question & Answer session
• Presentations will be adapted to different age groups and topics

5.6.2 Resources Required

The GDOT STEM panel noted that supporting resources such as public speaking training (available through GDOT), presentation content and templates, and advice/training on how to teach middle school students would be necessary to support the implementation of a new Speakers' Bureau for School Visits.

GDOT will need a program coordinator at headquarters to manage the efforts of the Speakers' Bureau. The coordinator will be responsible for partnering with at least one school within each of the established transportation districts to connect transportation professionals to classrooms in order to educate students about STEM-related topics and transportation careers. The HQ coordinator will also be responsible for distributing requests to the district offices to fill district coordinator positions and speaker requests.

District coordinators will be appointed by District engineers. District coordinators are needed to facilitate requests within each of the districts and will be responsible for fielding speaker requests and recruiting volunteers to join the Speakers' Bureau on a continuing basis.

GDOT employee volunteers will be needed to facilitate this initiative. Volunteers will visit schools and deliver or facilitate talks on their areas of expertise. Nearly half of the respondents of the GDOT Survey expressed an interest in speaking to middle- and high-school students about STEM-related topics and careers in the transportation industry. Clearly, GDOT is equipped with personnel resources readily available to implement a program of this nature.

GDOT will need to partner with at least one school within each of the seven districts. Target schools should include those with STEM initiatives, charter schools, or college and career academies. Each of the partner schools will be visited by a member of the Speakers' Bureau at least twice within each school year to establish a presence.

5.6.3 Benefits to Agency

Based upon similar programs conducted by other transportation departments, offering a program of this type increases a student's awareness and understanding of existing and potential opportunities in the field of Transportation engineering. This increased awareness and understanding could in turn result in increased interest, which could eventually lead to recruiting of GDOT employees from the targeted students.

5.7 Benefits and Costs of Programs

Table 10 below details benefits and costs for the program alternatives described in this report. This information will support the development of agency STEM programming. It can be used in comparing and contrasting the different program alternatives as well as in developing an overarching program consisting of a menu of alternatives.

Table 10 Benefits and costs of STEM program alternatives

Performance Measures	GTSTI Program	TRAC & RIDES	Internship & Shadow Program		One-Day Event			Speaker's Bureau
			Internship	Shadow	Fair	Intro a Child	Transpo Day	
Reach per Year (Students)	20 25	70 140	7 10	7 10	150 200	75 100	45	140 350
Cost per Student ($)	1,600	107 690	3,200 4,500	20	3	35	15	Varies, Low
Cost to GDOT ($)	10,000	2,700 11,000	32,000 – 45,000 for 2 months' full time salary at $10/hr. $14/hr. for 10 students	400	350	2,500 3,000	500 650	Cost to provide training manuals
Employee Commitment	First year: 50 employee hours over 1 month, minimum of 2 employees required Subsequent years: 20 employee hours over 3 weeks,	First year: 40 employee hours over 8 weeks, minimum 1 employee required Subsequent years: 10 employee hours over 4 weeks, minimum 1	560 employee hours over 2 months; minimum of 7 employees plus 10 hours for planning	280 employee hours over 2 months; minimum of 7 employees plus 10 hours of planning	45 employee hours over one day; min of 15 employees plus 12 hrs. for planning	150 employee hrs. over one day; min of 25 employees plus 24 hrs. for planning	32 employee hrs. over one day; min of 6 employees plus 12 hrs. for planning	Approximately 13 hours/year • 2 hours (1 hour preparation x 2 times/year) • 3 hours (1.5 hour presentation x 2 times/year)

Performance Measures	GTSTI Program	TRAC & RIDES	Internship & Shadow Program		One-Day Event			Speaker's Bureau
			Internship	Shadow	Fair	Intro a Child	Transpo Day	
	minimum of 2 employees required	employee required						• 8 hours (Training)
Program Duration	Long term	Short term Programs offered in conjunction with other non Transportation programs	Long term	Long term	Short term	Short term	Short term	Short term
Relationship Building	High potential for agency personnel to build long term relationships with students.	Low potential for agency personnel to build long term relationships with students High potential for agency personnel to build long term	High potential for agency personnel to build individual long term relationships with students	High potential for agency personnel to build long term relationships with students	Mid range High potential for agency personnel to build long term relationships with school officials and teachers			Low Mid range potential for agency personnel to build long term relationships with students Mid range – High potential for agency to build long term

Performance Measures	GTSTI Program	TRAC & RIDES	Internship & Shadow Program		One-Day Event			Speaker's Bureau
			Internship	Shadow	Fair	Intro a Child	Transpo Day	
		relationships with teachers.						relationships with school officials and teachers.
Awareness of Transportation Engineering discipline and career	High	Medium (Transportation presented with other disciplinary material in class)	High	High	Low			Medium (Periodic visits to schools can help cultivate student interest especially if same students are engaged multiple times)

6 Conclusions, Recommendations & Implementation Guidance

6.1 Conclusions and Recommendations

Transportation workforce development has been recognized as a national priority. State Departments of Transportation have a significant role to play in feeding the workforce pipeline by raising awareness about transportation careers, as a large percentage of the baby-boomer generation retires from the workforce. In the state of Georgia, STEM education is defined as an integrated curriculum (as opposed to science, technology, engineering and mathematics taught in isolation) that is driven by problem solving, discovery, exploratory project/problem-based learning, and student-centered development of ideas and solutions. The Georgia Department of Education (GA DOE) views STEM education as an economic imperative and workforce development issue for the state and the nation. Together with several business, industry and education partners, GA DOE is committed to preparing students for 21st Century workplace careers by providing high-quality educational opportunities in STEM fields.

This study results show that over 40% of state DOTs are involved STEM programming outreach to K-12 schools, several in partnership with university transportation centers and other STEM stakeholders such as professional organizations (e.g., ITE, WTS, ITS and ASCE); private consultants, and the Federal Highway Administration (FHWA). The majority of state DOT STEM programs target high school students and have a duration of two to four weeks. A majority of the programs have some financial support from state DOTs; a number have financial support from the FHWA and in-kind support from state DOTs. The STEM programs identified can be classified into five categories: (1) Residential or non-residential summer programs (e.g., summer transportation institute); (2) Teacher training and curriculum development programs (e.g., AASHTO's TRAC and RIDES programs); (3) Internship and Shadow Programs; (4) One-Day STEM awareness events (e.g., Introduce a Child to Transportation Day); and (5) Speakers' Bureaus (involving periodic employee visits to schools to present on transportation STEM applications). The level of activity indicates there is perceived value in developing and sustaining STEM programs in state DOTs. Empirical evidence and theory highlight the multiple benefits of STEM in academic and behavioral development, and an increased likelihood for students to select careers in STEM.

The business case analysis shows that STEM program alternatives that develop strong long-term relationships with middle and high school students have a higher potential for payoff in terms of recruiting employees for GDOT from the student pool. To this end, the Summer Transportation Institute and Internship/Shadow Programs are recommended as strong STEM-efficacy building, relationship building and career awareness programs to cultivate a

pool of students from which GDOT employees can be recruited. On the other hand, one-day STEM awareness and speaker's bureau programs are good programs for cultivating STEM culture within the agency while developing transportation career awareness broadly, rather than in-depth, among a larger number of students. Teacher and curriculum training programs such as AASHTO's TRAC and RIDES programs are more useful for the agency to develop relationships with teachers rather than directly with students of local elementary, middle and high schools. Such programs will lead in the long run to instruction in transportation-STEM and increased transportation-STEM awareness and efficacy; however this will likely happen in the context of other STEM disciplines and priorities.

The business case analysis also shows that programs with strong relationship-building elements (e.g., summer transportation institute, internship and shadow programs) tend to require a higher level of investment of agency resources (employee time, funds, etc.) but also have higher potential to replenish the transportation pipeline in the long term. On the other hand, one-day STEM awareness programs (e.g., Introduce a Child to Transportation Day) tend to require less investment but also have lower potential for building strong relationships between GDOT employees and students. At the same time, such programs create STEM awareness in a larger number of students, and support enhancement of STEM culture in the agency as employees find opportunities to give back. The programs that can help build stronger relationships between employees and students in the long term have a higher potential to offer a recruitment pool in the future.

GDOT is currently involved informally in two STEM outreach programs at an organization level: Future City Competition and Introduce a Girl to Engineering. GDOT employee feedback on STEM outreach in the agency indicates there is strong interest in and support for establishing a STEM outreach program at GDOT. School presentations, career days, and career fairs were the most common STEM outreach activities that employees were engaged in, and judging competitions, giving school talks and participating in a half day event were the activities that garnered the most interest. All of these are examples of one-day STEM awareness events. Outside of these activities, some district offices also have initiatives that they participate in periodically. Additionally, individual employees participate in STEM outreach, sometimes outside of GDOT.

A survey of GDOT employees indicates that there is broad interest among employees in volunteering for STEM outreach to local schools. Out of over 300 employees that responded to the survey, the majority (i.e., 72%) indicated that they would be interested in participating in STEM activities through GDOT. Several employees indicated that they had not participated in GDOT STEM programming in the past because they were not aware of the existence of such programs. Several indicated that they would be interested in participating in such programs if they were informed via email.

In addition, the study revealed several critical elements in establishing an effective STEM outreach program at GDOT: (1) establishing ownership of the program; (2) establishing strategic partners; (3) identifying a champion and (4) establishing a steering committee that includes executive leadership. Supporting resources that currently exist within GDOT were also identified including publicity through the Communications Office and "Our GDOT".

Thus the main recommendation from this study is that GDOT should therefore move forward with the development of a formal STEM outreach program that combines one or more long-duration program alternatives with a strong relationship-building component (e.g., the summer transportation institute or internship/shadow programs for middle or high school students) with one or more shorter-duration program alternatives (e.g., STEM awareness or speaker's bureau programs for middle and elementary school students). Longer duration programs such as the summer transportation institute will allow GDOT to develop stronger and long-term relationships with pool of high and middle school students from which the agency can recruit future GDOT employees. GDOT can work with a university or university transportation center to develop such a program. One-day programs reach a larger number of students to create STEM awareness while offering several GDOT employees the opportunity to volunteer. Such programs help to cultivate STEM culture within the agency; however they do not offer opportunities for developing strong and long-term relationships. Therefore, this combination will allow the agency to develop a strong pool of students from which to recruit future employees while continuing to enhance STEM culture within the agency and increase transportation-STEM awareness more broadly. Both of these outcomes contribute directly to GDOT's strategic goal theme: "Making GDOT a better place to work will make GDOT a place that works better." Strategic development of a STEM outreach program would allow the GDOT STEM champion to identify and leverage external funding sources to support and sustain the STEM outreach program through other STEM stakeholders such as universities and university transportation centers, the Georgia Department of Education, professional organizations and private consultants.

The Georgia Department of Education considers STEM education an economic imperative and workforce development issue for Georgia and America. The National Academy of Sciences views STEM education and development as essential to preserve the nation's science and technology leadership, but also as a strategic and economic security initiative to optimize the nation's knowledge-based resources by sustaining the most fertile environment for new and revitalized industries and their associated well-paying jobs. Based on these statewide and national strategic priorities, GDOT must view investments in STEM as aligning not only with agency strategic objectives for workforce development and replenishment, but also as a means to advance the state of Georgia and the nation's science and technology efficacy and economic development.

6.2 Implementation Guidance

To this end, GDOT will benefit from a program manual on STEM outreach: a how-to manual that supports the implementation of an agency-wide STEM Outreach Program composed of at least one long duration program (i.e., 2-4 weeks) and one short duration program (i.e., 1 day). Among other things, such a manual will detail how the program alternatives outlined in this report can be implemented within the existing organizational structure, culture and resources of GDOT, with specific details on who would champion and coordinate various aspects of the program; where various program elements can be most effectively housed within the agency including the districts; what mechanisms can be used in soliciting employee volunteers, e.g., what incentives aligned with the agency's personnel-related strategic goal can be used to promote employee participation; what are appropriate metrics for demonstrating progress toward achieving this strategic goal; where supporting educational resources can be found for different program elements; a list of funding sources with application deadlines, and specific strategies that have been applied to sustain STEM programs effectively in best practice state DOTs.

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STEM and Our Future Transportation Leaders

Appendices

STEM and Our Future Transportation Leaders

STEM and Our Future Transportation Leaders

Appendix A: State DOT Survey Instrument

Introduction

STEM and Our Future Transportation Leaders

According to the Council of University Transportation Centers, about 40 to 50 percent of the transportation workforce is expected to retire in the next 10 years due to the influx of the "Baby Boomer" generation to the retirement pool. In order to replenish the workforce pipeline, there is a need for transportation agencies to invest in K-12 science, technology, engineering, and mathematics (STEM) outreach programs with a focus on transportation. There is evidence that students are more likely to choose transportation as a specialization if they are informed and exposed to the profession (Agrawal & Dill, 2009).

The purpose of this survey is to uncover and highlight successful and effective K-12 STEM outreach programs that state Departments of Transportation (DOTs) are involved in. Providing this information will put a spotlight on your programming as an example to other state DOTs. The survey should only take about 10 minutes.

This research is being conducted by the Infrastructure Research Group (IRG) at the Georgia Institute of Technology and sponsored by the Georgia Department of Transportation (GDOT).

Please contact Margaret Akofio-Sowah at manas3@gatech.edu if you have any questions or concerns.

Thank you.

*Please enter your contact information. This information is for follow-up purposes only.

Name:

Company:

Email Address:

Phone Number:

*How many K-12 STEM outreach programs is your DOT (directly or indirectly) involved in each year?

- ◯ 0
- ◯ 1 to 5
- ◯ 5 to 10
- ◯ > 10

K-12 STEM Program Information

Please provide the following information for up to five (5) K-12 STEM outreach programs that your DOT is involved in now, or has previously been involved in.

*Program 1

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Does the DOT provide financial support? (Yes/No)

Briefly describe this program:

Program 2

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Does the DOT provide financial support? (Yes/No)

Briefly describe this program:

Program 3

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Does the DOT provide financial support? (Yes/No)

Briefly describe this program:

Program 4

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Does the DOT provide financial support? (Yes/No)

Briefly describe this program:

Program 5

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Does the DOT provide financial support? (Yes/No)

Briefly describe this program:

***Do you have additional programs you would like to tell us about?**

(You will be contacted for this additional information)

◯ Yes

◯ No

Finish Up!

Can you recommend specific STEM programs at other State DOTs that will be useful case studies for our work?

Any additional comments?

STEM and Our Future Transportation Leaders

Appendix B: UTC Survey Instrument

Survey on State DOT Involvement in K-12 STEM Outreach Programs

Introduction

STEM and Our Future Transportation Leaders

According to the Council of University Transportation Centers, about 40 to 50 percent of the transportation workforce is expected to retire in the next 10 years due to the influx of the "Baby Boomer" generation to the retirement pool. In order to replenish the workforce pipeline, there is a need for transportation agencies to invest in K-12 science, technology, engineering, and mathematics (STEM) outreach programs with a focus on transportation. There is evidence that students are more likely to choose transportation as a specialization if they are informed and exposed to the profession (Agrawal & Dill, 2009). A brief preliminary investigation has shown that state Departments of Transportation (DOTs) are typically involved in programs executed through partnerships with universities and University Transportation Centers (UTCs).

The purpose of this survey is to uncover and highlight some of these successful and effective K-12 STEM outreach programs that state DOTs are involved in. Providing this information will put a spotlight on your programming as an example to others in the field. The survey should only take about 10 minutes.

This research is being conducted by the Infrastructure Research Group (IRG) at the Georgia Institute of Technology and sponsored by the Georgia Department of Transportation (GDOT).

Please contact Margaret Akofio-Sowah at manas3@gatech.edu if you have any questions or concerns.

Thank you.

*Please enter your contact information. This information is for follow-up purposes only.

Name:

Company:

Email Address:

Phone Number:

*How many K-12 STEM outreach programs does your UTC conduct each year?

- ◯ 0
- ◯ 1 to 5
- ◯ 5 to 10
- ◯ > 10

K-12 STEM Program Information

Please provide the following information for up to five (5) K-12 STEM outreach programs that your UTC conducts, or has previously conducted, with DOT support.

Survey on State DOT Involvement in K-12 STEM Outreach Programs

*Program 1

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Which DOT is involved?

Does the DOT provide financial support? (Yes/No)

Who is the DOT contact person?

***Briefly describe this program, detailing the DOT's level of participation:**

Program 2

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Which DOT is involved?

Does the DOT provide financial support? (Yes/No)

Who is the DOT contact person?

Briefly describe this program, detailing the DOT's level of participation:

Program 3

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Which DOT is involved?

Does the DOT provide financial support? (Yes/No)

Who is the DOT contact person?

Survey on State DOT Involvement in K-12 STEM Outreach Programs

Briefly describe this program, detailing the DOT's level of participation:

Program 4

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Which DOT is involved?

Does the DOT provide financial support? (Yes/No)

Who is the DOT contact person?

Briefly describe this program, detailing the DOT's level of participation:

Program 5

Program Name:

Participant Demographic (Grade/Age):

Program Duration:

How long has this program been running?

Which DOT is involved?

Does the DOT provide financial support? (Yes/No)

Who is the DOT contact person?

Briefly describe this program, detailing the DOT's level of participation:

***Do you have additional programs you would like to tell us about?**

(You will be contacted for this additional information)

- ◯ Yes
- ◯ No

Finish Up!

Survey on State DOT Involvement in K-12 STEM Outreach Programs

Can you recommend specific STEM programs at other UTCs or State DOTs that will be useful case studies for our work?

Any additional comments?

STEM and Our Future Transportation Leaders

STEM and Our Future Transportation Leaders

Appendix C: Catalogue of STEM Programs with State DOT Involvement

	A	B	C	D	E	F	G	H	I	J	K
1	**Agency**	**Program Name**	**Description**	**Duration**	**Target Audience (Grade/Age)**	**Years Running**	**Support (Financial/Otherwise)**			**Partners (Other Orgs)**	**Employee Involvement (Description)**
2							**DOT**	**Federal**	**Other**		
3	Alabama DOT	National Summer Transportation Institute (NSTI)	The purpose of the NSTI is to create awareness and stimulate interest in middle and high school participants in career opportunities in the transportation industry; enhance Science Technology Engineering Math (STEM) skills; and attract and acquaint a broad and diverse selection of bright minds with the various aspects of the transportation industry.	2-4 weeks	Middle School or High School (cannot be both)			FHWA provides funding and program guidelines		US Department of Transportation, Federal Highway Administration, Colleges/Universities/Alabama State/Tuskegee University	
4	Alabama DOT	The Advanced Transportation Institute	10 students from underrepresented high schools in West Alabama came to The University of Alabama to learn about transportation careers.	3 days	High School students					University of Alabama's Transportation Center for Alabama, University Transportation Center for Alabama (UTCA),Southeastern Transportation Center (STC)	
5	Alaska DOT	Alaska Summer Research Academy (Civil Engineering Module)	ASRA is a two-week residential STEM camp for high school students. It usually consists of about a dozen modules like robotics, GIS, archeology, biomedicine, field geology, and civil engineering. Each module pairs experienced practitioners from the public and private sector with 8-10 high school students. Alaska DOT has sponsored the civil engineering unit for most of the past 12 years. The past three years we've focused on bridge design and construction, giving the kids an overview of the engineering process and then guiding them through the design and construction process to build a full size, modular, portable, ATV bridge with over a 2 ton capacity. They are allowed to use 6' 2x4 dimensional lumber, fasteners, cable and glue with a budget of $500. This forces them to use a truss or cable-stay design. Each year the students have successfully designed, built and tested a working bridge. Unfortunately due to budget cuts at UAF, and questionable management, the ASRA program will no longer be residential, compromising its statewide and nationwide student participation.	2 weeks	Grade 9-12	12 years	Yes			University of Alaska Fairbanks	
6	Alaska DOT	TRAC (Transportation and Civil Engineering) Program	Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields.							AASHTO	
7	Arizona DOT	Arizona State University Summer Transportation Institute	The students traveled across Arizona during the three-week program and experienced everything from bridge-building basics to lessons in space travel and water transportation. At ADOT, the students also learned about engineering survey and photogrammetry, traffic engineering and equipment services.	3 weeks	Middle School					Arizona State University Polytechnic	
8	Arizona DOT	Loop 303 Corridor Mentorship	Female STEM students are paired with female transportation professionals as part of the Women's Transportation Seminar Phoenix Chapter's Transportation YOU program, a hands-on, interactive mentoring program that offers young girls ages 13 to 18 an introduction to a wide variety of transportation careers.		Middle School and High School					Women's Transportation Seminar Phoenix Chapter's	Female engineers serve as mentors to program partcipants.
9	Arizona DOT	Real World Design Challenge	This annual competition gives high school students the opportunity to tackle actual engineering challenges. This annual competition gives high school students the opportunity to tackle actual engineering challenges.							Governor's Office of Education Innovation and the Arizona Department of Education	
10	Arizona DOT	TRAC (Transportation and Civil Engineering) Program	Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields.							AASHTO, Arizona State University	
11	CalTrans	Garrett Morgan Symposium on Sustainability	Middle school students create a project on sustainable transportation		Middle School					AASHTO, APTA	
12	CalTrans	Summer Transportation Institute (California State University, Los Angeles)	The objectives of the program are to improve STEM skills, provide awareness to middle and high school students about transportation careers, and encourage them to consider transportation-related courses of study in their higher education pursuits.	2-4 weeks	Grade 9-12/Age 15-18	Atleast 7 years	Yes				
13	CalTrans	Summer Transportation Institute (San Jose State University)	San Jose State University conducted its eleventh annual Summer Transportation Institute (STI) during the dates of June 30 and July 25, 2014. STI was offered as a 4-week/5 day non-residential class for high school students on the campus of San Jose State University, San Jose, California. The STI is organized and run by the Mineta Transportation Institute (MTI), a national transportation policy studies organization established by Congress in 1991. In 2014, the SJSU/MTI program involved a total of 26 high-school students officially enrolled in the program, 94% of which represented Hispanic and Asian ethnicities. San Jose State University is a large, urban university located in the heart of Silicon Valley. The STI is structured in the style and format of a pre-college internship with an emphasis on civic leadership and public policy, which are anchoring principles of the Mineta Transportation Institute. Thus, we seek to offer a balance between academic and field activities designed to motivate high school students to expand their horizons into the field of transportation and be connected to the University in a meaningful way. With a special focus on a college-level three unit environmental education course with an emphasis on science, the equivalent of one week of aviation-oriented learning and related activities, field trips (30% of the curriculum), short talks by experts, and a job skills component, the SJSU/MTI Summer Transportation Institute is designed to be both academically challenging and fun for its participants. Overall, the program's curriculum exposes students to key components of scientific inquiry, new frontiers in some of the major transportation-related topics of the day, and gives them the opportunity to see firsthand "behind the scenes" operations of major Bay Area transportation sites and agencies such as the San Francisco-Oakland Bay Bridge, BART, SamTrans (the San Mateo transit agency), the San Jose traffic control center and the Port of Oakland. Thanks to support from the California Department of Transportation and San Jose State University, the SJSU/MTI STI is again planning to offer students three college credits, the resources of a specialized teacher, and a comprehensive number of field trips.	Four weeks	High School (Grades: 9-12 / Age: 14-18 years-old)	12 years	YES			Mineta Transportation Institute	Caltrans employee is contract manager
14	CalTrans	UCR STEP Conference (Annual Student Conference on Science and Technology Education)	This is a major conference for over 1000 southern California middle and high school students to learn about science and technology. The 2014 event had a major focus on transportation technology. US DOT (and Caltrans) partially supported through UTC program, using NCST funding through UC Riverside.	8 hours	8th grade through 12th grade (13 years to 17 years old)	4 years straight	Yes (Tangential)				
15	Colorado DOT	National Summer Transportation Institute (NSTI)	Students will be introduced to careers in transportation through seminars, field trips, and hands-on activities. Participants will be introduced to engineering basics and a variety of transportation systems, learn about career opportunities in transportation and the relevant educational and skill requirements, and have the opportunity to meet people who work in the transportation industry. One overnight field trip may be offered as part of the program.	2-4 weeks	Middle School			FHWA provides funding and program guidelines		Colorado State University and Federal Highway Administration (FHWA).	
16	Colorado DOT	TRAC (Transportation and Civil Engineering) Program	Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields.							AASHTO	

	A	B	C	D	E	F	G	H	I	J	K
1	**Agency**	**Program Name**	**Description**	**Duration**	**Target Audience (Grade/Age)**	**Years Running**	**Support (Financial/Otherwise)**			**Partners (Other Orgs)**	**Employee Involvement (Description)**
2							**DOT**	**Federal**	**Other**		
17	Connecticut DOT	National Summer Transportation Institute	The Department's TRAC (Transportation and Civil Engineering) program partnered with Central Connecticut State University (CCSU) to host the National Summer Transportation Institute Program (NSTI), July 28th -August 1st , 2014 to introduce a wide range of transportation modes to high school students. NSTI is a FHWA initiative that gives students the opportunity to explore many modes of transportation (aviation, water, highway, transit). For additional program information and last years' highlights, please visit Central Connecticut State University's School of Engineering and Technology's webpage at http://web.ccsu.edu/nsti/. Twenty-one (21) students from all over Connecticut were selected to participate in the program this year, and CCSU is hosting these students this week for various workshops on campus. There were opportunities for students to examine how the complex transportation system upon which we all rely is designed, built and maintained through lectures, hands-on engineering laboratory experiments with CCSU professors, field trips to various DOT transportation hubs (i.e. New London State Pier, CT Fastrak), and presentations from public and private sector professional transportation speakers discussing current issues.	1 week	High School student (grades 9-12)	2 years		FHWA			
18	Connecticut DOT	Transportation and Civil Engineering (TRAC)	TRAC is AASHTO's educational outreach programs, are designed for use in Science, Technology, Engineering, and Math (STEM) classes. The hands-on activities introduce students in grades K-12 to the work world of transportation and civil engineering and inspire them to consider careers in those fields. Both programs are aligned with national standards and are currently being aligned with Core Curriculum Standards of Learning. State departments of transportation work with schools in their state by providing the curricula and resources for the schools and providing engineers to visit the classrooms to serve as speakers, teach a hands-on activity, and/or talk to students about the importance of math and science in preparing for their future. go to http://mmsd.transportation.org/trac_rides/	Ongoing	Middle and High School Students			Federal Highway Administration provides funds for yearly membership			
19	Delaware DOT	Engineer in Your Classroom	This feature allows students in grades K-4 to learn about the bridge's construction, without the safety concerns of bringing younger students to the construction site.	1 day	K-4	2010 (4 years)				Public Officials	Engineers visit schools to discuss bridge design/construction
20	Delaware DOT	Indian River Inlet Bridge Construction Tour	Students from across the state have made their way to the Indian River Inlet Bridge construction site for the two hour presentation/site tour, where they participate in an interactive presentation which teaches them about the math, science, technology and overall uniqueness of the bridge structure. Following the presentation students go on a tour of the construction site, where they have the once-in-a-lifetime opportunity to see history being made as crews work to build one of the biggest cable stay bridges on the East Coast.	2 hours	Grades 5-12 and college	2010 (4 years)				Delaware Department of Education, Skanska	
21	Florida DOT	PAEC	Preview of all aspects of DOT and some hands on activities.	two weeks	10th thru 12th grades	5 years					
22	Florida DOT	TRAC (Transportation and Civil Engineering) Program	Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields.							AASHTO	
23	Florida DOT District 3	FloridaLearns STEM Scholars (FLSS) program	The Science, Technology, Engineering and Math (STEM) program includes the STEM Field Site/ Workplace Experiences that increase opportunities for real-world STEM problem-solving and research, and academic and career guidance	8 days	High School (Grades 10-12)					Panhandle Area Educational Consortium (PAEC)	FDOT served as a Work-place Experience site, playing host to eleven students and four teachers from school districts within District Three's borders: Calhoun, Holmes, Jackson and Washington counties
24	Hawaii DOT	TRAC (Transportation and Civil Engineering) Program - Summer Transportation Institute	Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields.	10 days	High school (9-12)					AASHTO, University Hawaii Manao	
25	Hawaii DOT	Construction Career Day	This program is designed to provide high school and college students with a first-hand look at career and educational opportunities that are available in Hawaii's construction industry. Students get hands-on experience with heavy equipment, tools, and vehicles. Students also visit various booths with educational and interactive activities related to the construction field, such as electrical and hydraulic systems.	2 days	High school and college	8 years	Yes				
26	Hawaii DOT	National Summer Transportation Institute (NSTI)	The purpose of the NSTI is to create awareness and stimulate interest in middle and high school participants in career opportunities in the transportation industry; enhance STEM skills; and attract and acquaint a broad and diverse selection of bright minds with the various aspects of the transportation industry.	2 weeks	High school	1 year	Yes				
27	Idaho DOT	Engineering Girls Day	Introduce girls to engineering encouraging them to study STEM-related subjects and learn how those classroom lessons are applied to real-world problems.		Middle School						The department's female transportation professionals encouraged the students and serve as role models.
28	Idaho DOT	National Summer Transportation Institute (NSTI)	Summer camp to deliver professional and STEM (Science, Technology, Engineering, and Math) based skills and activities to incoming seventh graders.	2-4 weeks	Middle school			FHWA provides funding and program guidelines		University of Idaho and Northwest Nazarene University	
29	Idaho DOT	STEM Mobile Discovery Lab	STEM Mobile Discovery Lab, a refurbished, public-transit bus equipped with the latest technologies enabling up to 22 students at a time to work on STEM projects.							Discover Technology Inc.	
30	Idaho DOT	Summer Science Camp	Students participated in demonstrations and hands-on projects. The experience helped them explore STEM subjects in new and interesting ways..								ITD volunteers put on chemistry, geotechnical and structure demonstrations and served as guides for small groups of students
31	Illinois DOT	Engineering Academies	Engineering Academies are designed to provide realistic application of math and science through instruction and hands on projects that encourage teamwork and problem solving. Engineers from IDOT and the transportation industry volunteer their time to instruct and mentor each academy participant during the sessions.		Middle School and High School					Educational institutions and industry partners across the state	Engineers from IDOT and the transportation industry volunteer their time to instruct and mentor each academy participant during the sessions.
32	Illinois DOT	Engineering Explorer Post Program	Provides students practical hands-on experience in the engineering field with additional opportunities to spend time with and be mentored by engineering professionals.		young men and women from diverse backgrounds between the ages of 14 to 20						IDOT volunteers, mainly engineers and technicians.

	A	B	C	D	E	F	G	H	I	J	K
1	**Agency**	**Program Name**	**Description**	**Duration**	**Target Audience (Grade/Age)**	**Years Running**	**Support (Financial/Otherwise)**			**Partners (Other Orgs)**	**Employee Involvement (Description)**
2							**DOT**	**Federal**	**Other**		
33	Illinois DOT	Illinois Innovation Talent (ILIT) program.	The goal of the ILIT program is to demonstrate how industry-sponsored problems can exemplify the Race to the Top STEM Learning Exchange functions at the middle and high school level where interdisciplinary teams of students collaborate on real-world problem-based learning (PBL) challenges designed to improve student achievement and increase college and career readiness.		Middle School and High School	Since 2008 (6 years)				The Illinois Department of Commerce and Economic Opportunity, the Illinois State Board of Education	
34	Illinois DOT	National Summer Transportation Institute (NSTI)	NSTI is designed to introduce secondary school students to all modes of transportation careers and encourage them to pursue transportation-related courses of study at the college or university level. This program promotes academic excellence and prepares future leaders in society. The purpose of NSTI is to promote awareness of Science, Technology, Engineering and Math (STEM) educational and career opportunities among disadvantaged and at-risk middle and high school students around the country.	2-4 weeks	High school			FHWA provides funding and program guidelines		University of Illinois at Chicago (UIC), Southern IL - Carbondale	
35	Illinois DOT	Real World Design Challenge	The Real World Design Challenge (RWDC) is an annual competition that provides high school students, grades 9-12, the opportunity to work on real world engineering challenges in a team environment. Each year, student teams will be asked to address a challenge that confronts our nation's leading industries. Students will utilize professional engineering software to develop their solutions and will also generate presentations that convincingly demonstrate the value of their solutions. The RWDC provides students with opportunities to apply the lessons of the classroom to the technical problems that are being faced in the workplace.		High school						
36	Illinois DOT	TRAC (Transportation and Civil Engineering) Program	Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields.	2 weeks	Middle School					AASHTO, Southern IL - Carbondale	
37	Iowa DOT	AASHTO TRAC & RIDES program	You can find program details on the AASHTO TRAC & RIDES website. We are joining the AASHTO program and are coordinating with our university transportation center, InTrans at Iowa State University to launch this program at a few area schools as a first step pilot.	school year	High school age	1 month	Yes				
38	Iowa DOT	ad hoc presentations to area schools from DOT employees	DOT employees have given presentations at nearby schools on various aspects of the DOT's business and STEM careers for many years.	ongoing, primarily school year	k-12, plus college students	more than 26 years					DOT employees have given presentations at nearby schools on various aspects of the DOTs business and STEM careers for many years.
39	Iowa DOT Office of Aviation	Change the Equation (CTEq)	To improve science, technology, engineering and math (STEM) teaching, inspire student appreciation and excitement for STEM programs and careers, and achieve a sustained commitment to improving STEM education from leaders in business, government and education								
40	Kansas DOT	Flying Classroom	Program discusses how STEM (Science, Technology, Engineering and Mathematics) is used in aviation. The Flying Classroom event includes a career fair at which hundreds of high school students will learn about all the options aviation has to offer.	1 day	High School					Kansas Commission on Aerospace Education	
41	Kansas DOT	TTMaSA	Donnelly College, located in Kansas City, Kansas, introduces high school students to diverse modes of transportation (water, air, land) and the array of career opportunities within the industry.	5 weeks	Grades 9-12	6 years					
42	Kansas DOT Aviation Division	Fly Kansas Air Tour	The Air tour flew to nine communities in three days to highlight aviation education and career opportunities to approximately 600 students in the three day period.	3 days	Primarily grades 7-12 with some younger students	1 year	Not direct financial support, but extensive support through time and resources				
43	Kansas DOT Aviation Division	Flying Classroom Career Exploration Fair	Working with Barrington Irving's Flying Classroom, we hosted 300+ students at the National Center for Aviation Training for a career exploration fair that featured motivational speakers and 35 aviation and STEM companies for an interactive career fair.	full school day	grades 11 & 12	1 year	Not direct financial support, but extensive support through time and resources				
44	Kentucky Transportation Cabinet	Kentucky Engineering Exposure Network	KEEN is a unique partnership between the Commonwealth of Kentucky's school system and the Kentucky Transportation Cabinet. The KEEN Program places engineers employed with the Cabinet in classrooms all across Kentucky. Engineers visit schools throughout the state to discuss the applications of math and science in real world situations. They provide insights into the opportunities and challenges available to students pursuing studies in the field of engineering. http://transportation.ky.gov/Education/Pages/KEEN.aspx	annual	grade school to college	Since 1991 (23 years)	Yes			Commonwealth of Kentucky's school system	KEEN provides an opportunity for the Cabinet and local schools to work together, allowing Transportation Cabinet engineers to interact with students in their own communities. In addition, the KEEN Program follows many
45	Kentucky Transportation Cabinet	TRAC (Transportation and Civil Engineering) Program	Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields.	4 weeks	High school					Kentucky State University - Frankfort, KY	
46	Louisiana DOTD	RIDES	RIDES (Roadways Into Developing Elementary Students) is an AASHTO/Mississippi education outreach program designed to interest K-8 students in transportation careers while improving their math and science skills. Students utilize critical thinking skills to solve real world problems and learn about careers in the transportation industry especially civil engineering. The curriculum is aligned with the National Standards for Math and Science. STEM, 21st Century Skills and Core Curriculum Standards. Teachers attend two days of high energy training conducted by National Board Certified Teachers. This module contains a curriculum as well as a large trunk of resources for the teacher to use in the classroom to conduct the activities.	Two Days of Training and the teachers then implement in their schools	Elementary and Lower Middle School Teachers	Three years in Louisiana	Yes	FHWA			
47	Louisiana DOTD	TRAC	TRAC™ (Transportation and Civil Engineering) is a hands-on, educational outreach program of the American Association of State Highway Transportation Officials (AASHTO). The TRAC™ program is designed for integration into science, technology, engineering, and math (STEM). State Departments of Transportation provide the program free of charge to middle and high schools in their state. Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields. TRAC has eight modules which engage students in solving real-world problems while connecting them to the work world of transportation. Students design bridges, build magnetic-levitation trains, plan a city or learn about environmental issues that impact transportation. In addition to providing a tool for teachers to improve math and science instruction in middle and secondary schools, TRAC improves work force diversity which helps to resolve one of the most pressing problems faced by the transportation today: a critical shortage of civil engineers.	Two Days of Training and the teachers then implement in their schools	Upper Middle and High School Teachers	Three years in Louisiana	Yes	FHWA			

	A	B	C	D	E	F	G	H	I	J	K
1	**Agency**	**Program Name**	**Description**	**Duration**	**Target Audience (Grade/Age)**	**Years Running**	**Support (Financial/Otherwise)**			**Partners (Other Orgs)**	**Employee Involvement (Description)**
2							**DOT**	**Federal**	**Other**		
48	Maryland State Highway Administration (MSHA)	TRAC (Transportation and Civil Engineering) Program	Vision: To deliver educational outreach programs that connect students to the world of transportation while enhancing math, science, and technology skills. Mission: To introduce students in grades K-12 to the working world of transportation, especially civil engineering, and inspire them to consider careers in those fields.		Middle school and high school	Since 1992	Yes			American Council of Engineering Companies; Maryland Asphalt Association; Johns Hopkins University; Morgan State University	DOT Official serves as program director
49	Maryland State Highway Administration (MSHA)	Summer Transportation Institute	The program introduces students to STEM careers in transportation and related fields. MSHA provides and facilitates visits to sites and provides speakers from the transportation industry to speak with youth.	4 weeks	High School	17 years					
50	Michigan DOT	STEM in Flight	A professional development workshop for teachers demonstrating how Aviation can support STEM curriculum.	1 day	K-12 Teachers					Square One Education Network	
51	Michigan DOT	Youth Development and Mentoring Program (YDMP)	The mission of the Michigan Department of Transportation Youth Development and Mentoring Program (YDMP) is to prepare a diverse workforce for the future by providing participants with opportunities to pursue higher education, personal growth, and transportation careers. Teens will be assigned to a crew, which is made up of one supervisor and two to three workers. Some of the expected responsibilities include litter pickup, erosion control, park and rest area maintenance, weed and brush cutting.		High School					Federal Highway Administration (FHWA), Private engineering firms	Serve as mentors to offer mentoring activities and sessions to teach job and life skills
52	Michigan DOT	Transportation and Civil Engineering (TRAC)	Hands on math/science/social science program designed to interest students in the engineering curriculum.	continued	6th - 12th grade	9 years	Yes				
53	Michigan DOT	Youth Development Mentoring Program	Hiring high risk students & proving them with the tools to obtain a successful career.	summer months	Grade 10-12	6 years	Yes				
54	Minnesota DOT	National Summer Transporation Institute's Tribal Summer Transporation career awareness	The NSTI mission is an educational initiative designed to prepare students (particularly, minorities and women), to become an important part of the transportation workforce of the 21st century by focusing on science, technology, engineering, and mathematics through curriculum development and other enrichment activities. Administers a Tribal Summer Transportation career awareness four- and three-week non-residential overnight camp at Fond du Lac Tribal Community College and Leech Lake Tribal College Primary goal in Minnesota is to introduce Native American youth from Grades 8 to 11 to careers in the transportation industry.	3 or 4 weeks	Grades 8 -11	7 years				U.S. Department of Transportation, FHWA, Mn/DOT's Office of Civil Rights	
55	Minnesota DOT	Phoenix Internship Program	The Minnesota Department of Transportation's (MnDOT) Phoenix Internship Program partners with area Project Lead The Way high schools (www.pltw.org) providing internship opportunities for high school students juniors and seniors enrolled in pre-engineering courses. Phoenix interns gain on-the-job work experience in a variety of areas like highway design, traffic, surveys, materials, data analysis, etc. in various MnDOT offices and districts statewide. They work full time in the summer and part-time during their senior year earning $11.20 per hour. If a Phoenix intern chooses to pursue engineering as their major in college they maybe eligible to transfer to MnDOT's student worker program for college students. Minimum qualifications of the internship are students must be taking pre-engineering courses at a certified PLTW school and have a minimum GPA of 3.0.	1 year	11th and 12th graders	9 years	Yes. 11.20/hour			Project Lead The Way (PLTW) High Schools	
56	Mississippi DOT	RIDES (Roadways In Developing Elementary Students)	Education outreach program designed to interest K-8 students in transportation careers while improving their math and science skills. Students utilize critical thinking skills to solve real world problems and learn about careers in the transportation industry especially civil engineering. The curriculum is aligned with the National Standards for Math and Science. STEM, 21st Century Skills and Core Curriculum Standards. Teachers attend two days of high energy training conducted by National Board Certified Teachers.	Teachers attend two days of hands-on training	K-8					AASHTO/Mississippi Department of Education, Private sector professionals	Volunteer transportation professionals and civil engineers from the DOT work directly with teachers and students in the classroom to support the TRAC Curricula,
57	Mississippi DOT	Mississippi Summer Transportation Institute (MSTI)	MSTI program at JSU has been evolved and growing over the years. Currently MSTI is a 3-week on-campus residency program enrolling 25-30 highschool students each year. The program exposes the students in STEM environment and career opportunities in transportation.	3 weeks in June	highschool students	6 years					
58	Missouri DOT	Annual Youth Transportation Conference	The conference exposes students from across Missouri to the numerous career opportunities in the field of transportation and is packed with fun and exciting academic, career development and social activities. Students apply math, science, and computer concepts learned in school to transportation related problems. The academic curriculum includes sessions on math modeing, applied physics, magnetic levitation, public administration, and safety. Other activities include field trips, office/site tours, and speakers from various divisions within MoDOT and related organizations.	6 days	Middle School and High School					Lincoln University	
59	Montana DOT	Summer Transportation Institute	The 2014 Summer Transportation Institute at MSU involved students in a comprehensive academic program. Topics covered included traffic engineering and planning, infrastructure design, aviation, safety and human factors. STI participants learned about career opportunities from professionals representing public and private sector transportation organizations as well as academia. Hands-on activities related to each topic helped to develop students' problem-solving skills and reinforced what they had learned. In addition to classroom activities, students participated in a number of team design/build projects, including crash attenuator, glider, and balsa wood bridge competitions. The team projects served to build teamwork and communication skills while fostering creative problem solving.	2 Weeks	High School Sophomore, Junior, Senior	7 years	Yes				
60	Nebraska Department of Roads (NDOR)	Engineering Education Excellence Institute	Teachers develop lessons with engineers and present them to the students. There are also site tours and interactions with professionals.	1 or 2 days	Middle and high school	6+		USDOT	Nebraska's Coordinating Commission for Postsecondary Education, Mid-America Transportation Center; Nebraska Dept of Ed; Central Community College; Center for Research on Children, Youth, Families & Schools	University of Nebraska-Lincoln	
61	New Hampshire DOT	Disability Mentoring Day	Students with disabilities (mentees) are matched with workplace mentors according to expressed career interests. Mentees experience a typical day on the job and learn how to prepare to enter the world of work. Employers gain an increased awareness that people with disabilities represent an overlooked talent pool. Disability Mentoring Day is a program of the American Association of People with Disabilities.	1 day	High School	First Year	Yes				Employees serve as mentors for the day
62	New Hampshire DOT	Inside the DOT	Inside the DOT tour allows high school students the opportunity to tour a few of our buildings. They will also be able to listen to presentations in about ten different bureaus and learn more about the transportation industry.	1 day	High School	1 year	Yes				Employees present to students

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1	**Agency**	**Program Name**	**Description**	**Duration**	**Target Audience (Grade/Age)**	**Years Running**	**Support (Financial/Otherwise)**			**Partners (Other Orgs)**	**Employee Involvement (Description)**
2							**DOT**	**Federal**	**Other**		
63	New Hampshire DOT	Stormwater Table Presentation	The Stormwater Education Program was developed to educate students, municipalities, the community, and NHDOT employees on stormwater pollution. It is a great way for individuals to learn more about pollution and stormwater and a chance for everyone to become more involved in doing their part to keep our water clean. During the presentation, participants will have an opportunity to interact with our two hands-on water table demonstrations.	1 hr	Elementary and Middle School	5-10years	Yes				
64	New Hampshire DOT	Strategic Highway Safety Plan	The SHSP is a statewide-coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and severe injures on all public roads. One of the nine critical emphasis areas of the SHSP is adolescent drivers. This project will address outreach and education of teen drivers and their parents in an effort to reduce teen crashes. This outreach will include development of peer to peer teen safety groups in fifteen schools as well as a tool box and web site to provide resources to parents and teens	Unsure	High School	First Year	Yes				
65	New Hampshire DOT	TRAC	TRAC (TRAnsportation and Civil engineering) is a hands-on education program designed for use in science, math, and social science classes. By engaging students in solving real-world problems such as bridge building, TRAC connects students to the work world of transportation and inspires them to consider careers in transportation and civil engineering.	Competition is 1 day, program is a couple months	High School	Many years, unsure of how long	Yes				
66	North Carolina DOT	Model Bridge Building Competition	The competition is designed to create a greater awareness of careers in transportation, construction, engineering and the services provided by the NCDOT. Working in teams, students will look at the methods of brainstorming ideas, designing a diagram, constructing the model and will have the satisfaction of presenting the results of their ideas to a panel of judges.	Nov-April	Middle school and high school				Carolina Associated General Contractors sponsor awards	Carolina Associated General Contractors	
67	North Carolina DOT	Introduce a Girl to Engineering Day	A national movement to help girls understand the creative and collaborative nature of engineering and how engineers contribute to changing the world. "Introduce a Girl to Engineering Day" strives to promote engineering as a desirable career option to young adults. Students have the opportunity to participate in hands-on transportation related engineering activities and also participate in a question and answer session with some of the department's female engineers from various disciplines. NCDOT engineers also share the daily duties and skills necessary for their jobs while encouraging young women to maintain their math and science skills, which are necessary to enter programs in college.	~5 hours	K-12					Center for Transportation and the Environment (CTE) at North Carolina State University	Lead hands-on activities; share daily duties and skills necessary for their jobs
68	Oregon DOT	Investigations In Transportation: Oregon Transportation Research and Education Consortium (OTREC)	Through an Oregon Transportation and Research Consortium Grant, the Elementary Investigations in Transportation project seeks to harness the professional expertise, experience, and enthusiasm of transportation sector STEM workers by creating a mechanism and set of protocols by which they will engage with elementary school teachers to develop and implement instructional units. These STEM connected instructional units and lessons will allow students to explore and investigate issues central to transportation. Units will incorporate and enhance the content and practice standards outlined by the Common Core State Standards-Math and Next Generation Science Standards, and rely heavily on the instructional and curriculum expertise and experience of classroom teachers to develop age and interest appropriate units of study. This collaboration will result in the development of Investigations in Transportation instructional units that provide students with rich, engaging learning opportunities set in the context of real-world problems such as sustainability, health, and safety. ODOT provided expertise during the unit planning and will be providing transportation professionals as content expertise support and unit implementation for 6 different classrooms.	18 months	5th Grade	9 months					ODOT provided expertise during the unit planning and will be providing transportation professionals as content expertise support and unit implementation for 6 different classrooms.
69	Pennsylvania DOT	STEM (High School)	The students were exposed to Geopatial Technologies and Microprocessor and their role in Transportation Systems.How nanotechnologies are fueling advancements in transportation. Field trips included Philadelphia Airport Hub and PennDot Material lab	2 weeks	High School	First year					
70	Pennsylvania DOT	STEM (Middle School)	Science, Technology, Engineering, and Mathematics through activities. Classroom curriculum include highway design, transportation planning, traffic signal timing, transportation logisitices, public transit, reailroad transportation and traffic flow. There were trips to National Crash Analysis Center, National Highway Traffic Safety Administration for automobile and highway safety research.	3 weeks	Middle School	5+yrs					
71	Pennsylvania DOT	STEM/ ACE	Students received weekly instruction in ecology and environmental biology. The ACE Academy was offered the 2nd week of the program. There were planned trips to Philadelphia International Airport, Dover Air Force Base, SEPTA and the Independence Seaport Museum	3 weeks	High School	5+yrs					
72	South Carolina DOT	Summer Transportation Institute (STI)	Program introduces high school students to transportation modes and encourages them to pursue related courses in college. The NSTI provides career orientation and educational experiences to motivate secondary school students toward professions in the field of transportation.	1 month	High School	1993 -		FHWA provides funding		FHWA South Carolina Division Office; South Carolina State University	
73	South Dakota DOT	Aviation Art Contest	Each year the Federation Aeronautique Internationale (FAI) Association creates a theme for an art contest in an effort to motivate and encourage young people to become more familiar with and participate in aeronautics, engineering and science. The FAI then invites its member nations to submit their best artwork for international recognition. In the United States, the National Association of State Aviation Officials (NASAO) is the main organizer of the contest. Every Fall, South Dakota schools will receive an invitation to participate in the contest by submitting their interpretation of the aviation theme. The South Dakota winners are announced and displayed every spring at the SD Airports Conference, in the South Dakota Pilots Association newsletter and on this website. Every child receives a certificate of participation and the winners receive prizes with an aviation or art theme and a laminated copy of their work.			8+		National Association of State Aviation Officials		Federation Aeronautique Internationale (FAI) Association through the eNational Association of State Aviation Officials (NASAO); Ssouth Dakota Pilots Association	
74	Nevada DOT	TRAC (Carson School District)	The Carson School District has developed a pre-engineering curriculum for high school students that includes interaction with NDOT engineers and using TRAC moduals. They also complete in the AASHTO Bridge Buidling Competition.	school year	9-12 grades	2 years	NDOT purchases TRAC PAC's				
75	Nevada DOT	Carson School District - GATE	5 two hour moduals are presented to students by various engineering and technical personnel. Students are exposed to both math, science and engineering principles that are incorporated into fun, hands-on activities.	school year	3-5 grades	8 years					We conduct a series of classroom presentation of various civil engineering functions that apply to transportation. i.e. materials testing; bridge design; mapping; safety, roadway design.

	A	B	C	D	E	F	G	H	I	J	K
1	**Agency**	**Program Name**	**Description**	**Duration**	**Target Audience (Grade/Age)**	**Years Running**	**Support (Financial/Otherwise)**			**Partners (Other Orgs)**	**Employee Involvement (Description)**
2							**DOT**	**Federal**	**Other**		
76	Nevada DOT	Carson School District - Project Challenge	Middle school students select a project that involves engineering principles. NDOT staff help with the basic design and review of project and provide supplemental field trips to explore both research and construction of engineering design projects.	school semester	7-8 grades	3 years	Provide transportation for field trips and interacts with students in the classroom.				NDOT staff help with the basic design and review of project and provide supplemental field trips to explore both research and construction of engineering design projects.
77	Nevada DOT	Summer Transportation Institue	The STI is part of an FHWA grant that NDOT supports and provides funding up $65K per summer. It is a two-day program that provides high school students with experience living on a college campus and attending lecture/field trips. All expenses are paid through the grant.	2 weeks	9-12 grades	4 years	Yes				
78	Texas DOT	Banquette On The Move!	Hosted by the Banquette Independent School District (ISD), this program of interactive modules was designed to provide a visual understanding of mathematics and encourage teamwork. Students were divided into teams of four and participated in four modules.	1.5 hours	6th - 8th Grade At Risk Students	2006				Texan A&M University Kingsville; American Society of Civil Engineers (ASCE); Banquette Independent School District (ISD); Southwest University Transportation Center (SWUTC)	
79	Texas DOT	Houston National Summer Transportation Institute	This four week program is designed to attract secondary students to and enhance their interest in careers in transportation and improve mathematics, science, communication and technology skills. Through the course of the program, all modes of transportation are addressed and augmented with hands-on technical activities, lectures by transportation professionals and field trips to such places as TxDOT District Offices, TranStar, Houston METRO, Port of Houston, airport operation and maintenance facilities, and the Texas Transportation Institute research facilities.	2-weeks	Secondary students	1999 thru 2010	Yes		Southwest Region UTC & NSF funding	Center for Transportation Training and Research at Texas Southern University (TSU); Advisory Board includes representatives from government and public agencies, academic institutions, and industrial partners; Southwest University Transportation Center (SWUTC)	
80	Texas DOT	North Texas Girl Scout Council On the Move!	A "Girl Scout Council Badge" was created as a troop level activity that would cover local and regional transportation and transit. The first phase involved learning about transportation in their community during a troop meeting by reading news and books. The second phase was a learning field trip to key places in Dallas attended by 62 Brownies and Girl Scouts.	~1 day	3rd and 4th Grade Girl Scouts	2007				North Texas Girl Scout Council; Dallas Area Rapid Transit (DART); Texas Transportation Institute (TTI)	
81	Texas DOT	Prairie View A&M Summer Transportation Institute	Classroom lectures, hands on activities, educational and recreational field trips in addition to evening and weekend enhancement and recreational activities. The ATLAS Center at TTI provides support for existing STI programs. These include one program established more than a decade ago to help minority, female, first generation to college, and other underrepresented high school students entering 11th and 12th grade develop an interest in attending college, choosing STEM majors and ultimately choosing transportation careers. The program serves approximately 30 students each year. The STI Scholars program – developed with UTC for Mobility (UTCM) funding – provides a second-year experience for invited students to receive more in-depth programming and career counseling. The ATLAS Center at TTI hosts STI students by offering tours of TTI and TAMU facilities, interactive discussions, and hands-on activities with researchers and graduate students. The ATLAS Center also provides support for further developing the recruiting network and follow-up with graduates of the program. Each year as part of the STI program, TTI guides a group of 11th and 12th grade students on a tour of the Institute, conducting presentations and demonstrating various facilities including the Environmental and Emissions Chamber, the Hydraulics, Sedimentation and Erosion Laboratory, the Driving Simulator and the Visibility Research Laboratory. The students also witnessed a crash test, conducted at the Riverside Campus. In addition, the program also includes a visit to NASA and a highway construction company, as well as, classroom lectures that introduce the students to highway planning, the railway industry, water transportation and traffic control.The program is free to the students, funded and supported by Federal Highway Administration (FHWA) through Texas Department of Transportation and Department of Civil & Environmental Engineering at Prairie View A&M University.	2 weeks	11th-12th grade/16-18 years	15 years	Yes	FHWA		Prairie View A&M University	DOT provided guest speakers; hosted field trips
82	Texas DOT	Texas Summer Aviation Institute	This program ran from summer 2005 to summer 2006. To attract students in to aviation careers. This core curriculum included speakers, field trips, videos, and hands on activities highlighting the importance of aviation and exposure to aviation career opportunities.	2 weeks	10 & 11th grade	Ran for two years (2005 & 2006)	Yes				
83	Utah DOT	Bennion Elementary Afterschool Program	teaching STEM based topics twice a week to 10-12 students. lesson plans come from The American Association of State Highway and Transportation Officials (AASHTO) Roadways into Developing Elementary Students (RIDES) education outreach curriculum support program		Elementary school		Provides material to support program		Some private sector funding	Bennoin Elementary School	Employees teach lessons
84	Utah DOT	Girls in Transportation Workshop	UDOT is partnering with the Women's Transportation Seminar (WTS) to facilitate a one day workshop on May 22, 2014 at the Region 2 Headquarters. The workshop will focus on helping grade school age girls on becoming excited about a career in Transportation related STEM fields.	1 day	Elementary school					WTS	
85	Utah DOT	AASHTO TRAC and Rides	These are two programs sponsored and coordinated through the American Association of State Highway Transportation Officials. more info can be found at transportation.org	School Year	K-12	Unknown	Yes				
86	Utah DOT	WTS Transportation YOU Program	Program Information can be found through contact with WTS.	monthly during school year	Young Women - elementary age	several years	In kind support				
87	Vermont Agency of Transportation	National Summer Transportation Institute	NSTI - In Vermont this is a two week residential program DOT sets the agenda, and aligns it with their EO program interests. The UVM TRC ran the program under contract from 2009 - 2012; The DOT now operates it independently.	two weeks	grades 10-12	a number of years					
88	Vermont Agency of Transportation	Transportation Systems Academy TEDPP (TSA)	http://transctr.w3.uvm.edu/wd-pages/transportation-systems-academy-tsa/ Pilot project under TEDPP in partnership with CTE programs, Community High School of Vermont and VTrans. Resulted in certificate recognized by VTrans as a credential valid for employment consideration. DOT worked cooperatively to design curriculum and align it with internal DOT training; provided trainers; provided field site visits and job shadowing.	90+ hour certificate program integrated into regulary curriculum	Grades 11-12 primarily	2009-2013					
89	West Virginia Department of Transportation (WVDOT) - Division of Highways	West Point Bridge Design Competition	Statewide contest; Realistic, hands-on, engaging introduction to engineering, bridges and transportation design concepts	~ 6 months	Middle school, high school		Yes		WV Section of ASCE (Young Member Forum); Nick J. Rahall Appalachian Transportation Institute; Society of American Military Engineers; Bridge Walk	West Virginia Younger Member Forum of ASCE; WV Department of Education; Nick J. Rahall Appalachian Transportation Institute	

STEM and Our Future Transportation Leaders

STEM and Our Future Transportation Leaders

Appendix D: Examples of STEM Program Impact Assessment Approaches

1. Prairie View A&M University STI Scholars Program

The PVAMU STI has been occurring annually for about 14 years, supported by the Texas DOT. The PVAMU STI Scholars program is an extension of the STI that takes previous STI participants through a more detailed pre engineering curriculum with the objective of creating interest in the field of transportation engineering among high school students in underrepresented groups and producing highly qualified transportation professionals. The four core objectives of the program were to: (i)increase the number of students who would pursue careers in the transportation industry; (ii) attract a diverse group of students from the underrepresented population; (iii)expose students to research and real world engineering issues related to the transportation industry; and (iv)provide educational enrichment by offering science, math, engineering, and technology courses that will assist students in their academic studies (Kommalapati, Ramalingam, & Stockton, 2012). Several methods were employed to capture data to measure the program's effectiveness, including journal entries, academic quizzes, and evaluation surveys.

A program report by the University Transportation Center for Mobility at the Texas A&M Transportation Institute (Kommalapati et al., 2012) shows that while academic quizzes evaluated the effectiveness of providing educational enrichment in STEM courses, journal entries were used to measure how well the program objectives of exposing students to research and real world engineering issues, and attracting a diverse group to the transportation industry were achieved. However, data from these two evaluation methods were not presented to show the impact that these elements of the program had on participants. On the other hand, evaluation surveys completed weekly and at the end of the four week program produced quantitative results to measure the program's effectiveness. A 4 point Likert scale (where 4 is "strongly agree" and 1 is "strongly disagree") was used to measure participants' attitudes toward the classroom, recreational, and educational enhancement activities, the field trips, guest speakers, and staff. Average scores of the end of program evaluation ranged from 3.14 to 3.82, indicating that students felt that the activities presented were worthwhile (Kommalapati et al., 2012).

Taking program evaluations a step further, efforts were made to track the progress of former graduates of the STI Scholars program to monitor their education and careers beyond the program. The results of the evaluation found that 100 percent of the program graduates that were tracked (seven of eight) were pursuing higher education and more than 70% (five of seven) were pursuing STEM related fields of study (Kommalapati et al., 2012).

2. Montana Summer Transportation Institute

The Montana STI is a two week residential education program designed to increase high school students' interests in careers in the transportation industry. The 2013 program, which was held on the campus of Montana State University (MSU), included eighteen students from ten counties and three states. The objectives of the program were to expose high school students to transportation careers, increase students' awareness of the significance of transportation, improve participants' understanding of the impacts that transportation professionals make in our society, increase students' understanding of the need for innovative ideas in transportation, and help to develop communication and collaboration skills through team building, recreational, and classroom activities; and provide college and career advice (Gallagher, 2013). Similar to the PVAMU program, the Montana STI program's effectiveness in meeting the established objectives was measured using daily journals and program evaluation surveys, which were conducted daily and at the end of the program.

The daily journals included both a narrative section for the students to convey their feelings about the program activities and a section with questions on the specific topic and the knowledge gained from the course materials covered in that day's activities. This mixed method approach provided quantitative data to evaluate the program's effectiveness, as opposed to the narrative only method of the PVAMU program. The Montana STI daily evaluation surveys assessed how effective the program curriculum was in covering all of the given topics and how effective each activity was in meeting the program's objectives. An end of program survey, which used a 5 point Likert scale (where 5 is strongly agree and 1 is strongly disagree) was also conducted to evaluate the success of the overall program in meeting the objectives. This survey also provided insight on the impact the program had on students' attitudes toward engineering, MSU, and college and career choices. With average scores ranging from 4.18 to 4.72, it was clear that the program was relatively successful in meeting its objectives (Gallagher, 2013).

Seventeen of the eighteen participants completed the overall program evaluation. Seventy six percent reported increased confidence in handling college courses and agreed that they improved their ability to work on team projects. In addition, 88% agreed that the STI helped improve their problem solving skills and helped them prepare for college, and that they had better understood the significance of transportation professionals' impacts on society and the importance of innovation in transportation. Furthermore, 94% reported increased understanding of the importance of various transportation modes, and increased confidence in making college and career choices. All the participants surveyed (100%) agreed that they learned more about transportation careers, MSU, and engineering as a field overall (Gallagher, 2013). The results of the evaluation showed that the program was effective in achieving its objectives.

3. University of Memphis Transportation Engineering Careers (TREC) Program

The University of Memphis Transportation Engineering Careers (TREC) Program, an outgrowth of the Girls Experiencing Engineering (GEE) program, is a weeklong non residential education program designed to increase high school students' interests in careers in the transportation industry. Since its inception in 2010, 216 students (both male and female) have participated in the program, which is held on the University of Memphis campus. The objectives of the program were to expose high school students to transportation careers; increase students' awareness of the significance of transportation; show links between mathematics, science, and engineering by providing hands on, interactive activities in the transportation industry; increase students 'understanding of the coursework necessary to pursue a career in the transportation industry; and help to develop communication, collaboration, and leadership skills through team building, recreational, and classroom activities (Ivey et al., 2014). The program's effectiveness in meeting these objectives was measured using introductory and exit program evaluation surveys, daily journals entries, focus group studies, and a longitudinal survey.

The introductory and exit surveys assessed participants' changes in perceptions and attitudes toward engineering, while daily journal entries and focus group studies were used to provide information concerning the effectiveness of daily activities and other program components. A longitudinal study was conducted to provide data concerning the long term effects of the program on the participants' educational and career choices (Ivey et al., 2014).

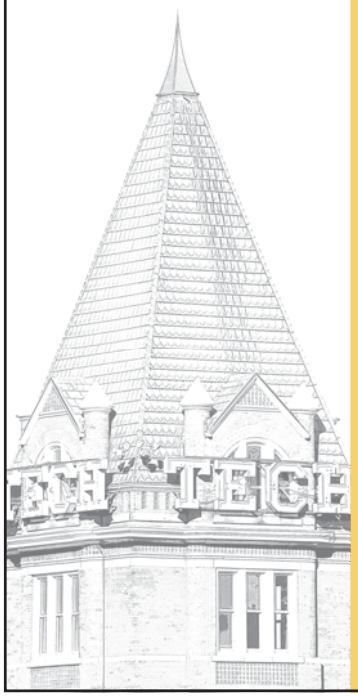
The exit program survey used a 5 point Likert scale (where 5 is "strongly agree" or "very important" and 1 is "strongly disagree" or "not important"), providing insight on the impact the program had on participants. The survey was completed by 149 participants with the following results: 45% reported that programs such as TREC help to influence college major and career choices; 76% indicated that they are more likely to major in engineering because of the program; 88% agreed that TREC improved their problem solving skills; and 93% agreed that TREC helped them understand links between real world problems and math and science skills (Ivey et al., 2014).

The on line longitudinal survey included a series of multiple choice and Likert scale questions, which discussed current grade level; intended or current major; influential factors in college/career decision; impact of TREC on STEM awareness; and importance of types of programs offered by TREC, to name a few. Of the 44 participants that responded, 21 stated that programs such as TREC played a very important role in their decision to pursue a STEM career. Twenty one of the 44 respondents were enrolled in college at the time of the survey, and 90% of that number were enrolled in a STEM major (Ivey et al., 2014).

These results indicated that the TREC program was very effective in meeting its objectives and made a significant impact on those participating in the program. Furthermore, the program successfully exposed participants to transportation careers, increased their awareness of the significance of transportation, and increased their understanding of the coursework necessary to pursue a career in the transportation industry (Ivey et al., 2014).

STEM and Our Future Transportation Leaders

Appendix E: GDOT STEM Panel Meeting PowerPoint Slides



STEM and Our Future Transportation Leaders

GDOT STEM PANEL MEETING

Adjo Amekudzi-Kennedy, Ph.D., Ann Xu, Ph.D.,
Audrey Leous, Margaret Akofio-Sowah,
Stefanie Brodie, Valerie Curtis

November 21, 2014

Georgia Department of Transportation

Georgia Institute of Technology

AGENDA

Georgia Tech

- Overview (Presentation)
- Review national and state findings (Presentation)
- Identify resources and capabilities within GDOT (Discussion)
- Identify program alternatives for GDOT – long/short-term (Discussion)
- Identify internal owners/external stakeholders for developing and sustaining STEM (Discussion)

2

OVERVIEW

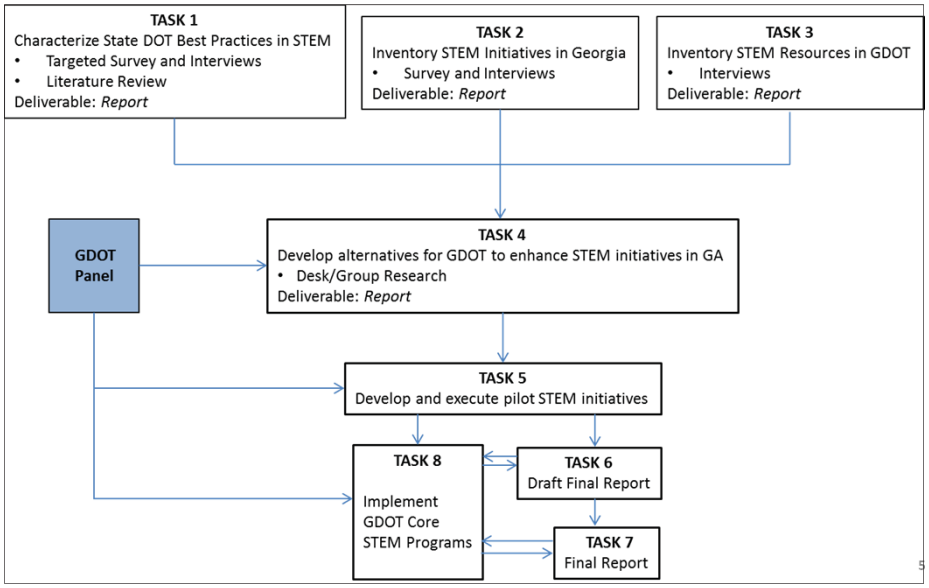
3

RESEARCH GOALS

- Provide overview of state of practice DOT involvement in STEM outreach
- Develop catalogue of DOT STEM programs across the nation
- Develop alternatives for GDOT to encourage K-12 participation in transportation related fields
- Identify best alternatives with resources to support continuing program at GDOT, including partnerships

4

RESEARCH APPROACH

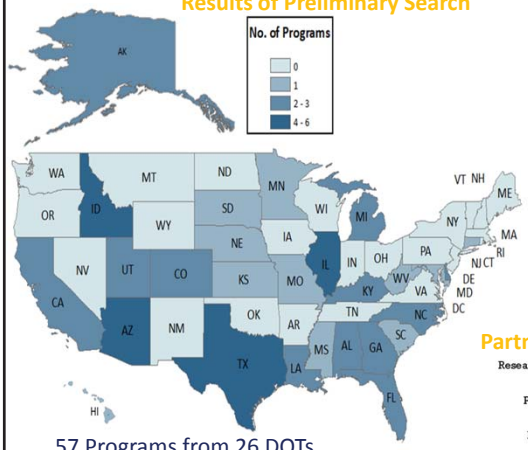


FINDINGS

NATIONAL FINDINGS (PRELIMINARY SEARCH)

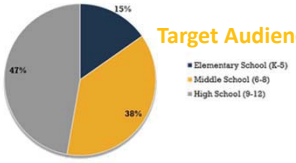
Georgia Tech

Results of Preliminary Search

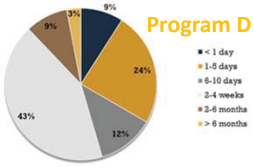


57 Programs from 26 DOTs

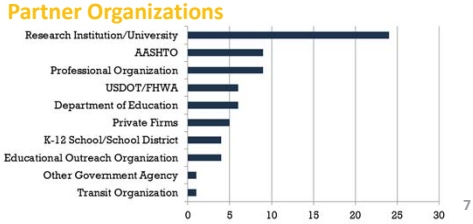
Target Audience



Program Duration



Partner Organizations

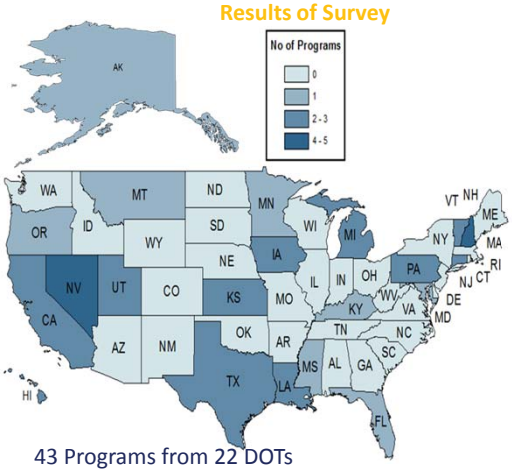


7

NATIONAL FINDINGS (SURVEY RESULTS)

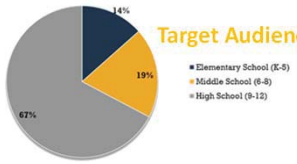
Georgia Tech

Results of Survey

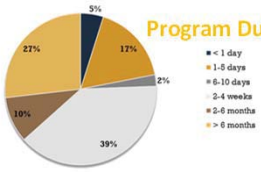


43 Programs from 22 DOTs

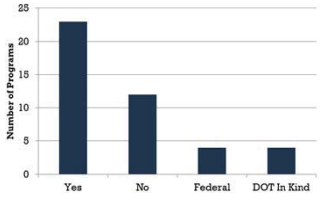
Target Audience



Program Duration



Financial Support



8

PROGRAMS ACROSS THE NATION

Caltrans Summer Transportation Institute

- Free, 4-week, non-residential program at San Jose State University
- Organized by Mineta Transportation Institute
- Caltrans program contract manager
- Funding reimbursed by FHWA

LaDOTD TRAC & RIDES

- Free, two-day training workshops for upper middle and high school (TRAC) & lower middle and high school (RIDES) teachers
- AASHTO provides curriculum instructors and trunk of resources
- Funding support from FHWA

9

PROGRAMS ACROSS THE NATION

MnDOT Phoenix Internship Program

- Year-long paid internships for high school juniors and seniors in pre-engineering/STEM courses
- Partnership with Project Lead The Way schools
- 5-12 students employed per year
- Interns participate in tours, seminars, etc.

Kentucky Engineering Exposure Network

- Partnership between KY Transportation Cabinet & statewide school system
- Engineers visit schools to discuss STEM applications in their jobs
- Schools schedule presentations by contacting KEEN Coordinators in each district

10

PROGRAMS ACROSS THE NATION

Kansas DOT Flying Classroom
Career Exploration Fair

- Hosted by KDOT Aviation Division
- One-day program for high school juniors and seniors
- In collaboration with National Geographic's Emerging Explorer Barrington Irving

11

STEM EDUCATION IN GEORGIA

- Definition:
  - An integrated curriculum (as opposed to science, technology, engineering and mathematics taught in isolation) that is driven by **problem solving**, **discovery**, **exploratory project/problem-based learning**, and **student-centered development of ideas and solutions** (stemgeorgia.org)
- Status of Schools:
  - 46% (90 out of 195) of GA's school districts have at least one school working on STEM certification
  - Over 400 GA schools are working toward STEM certification

[October 2014]

12

STEM AWARENESS EVENTS IN GA

- STEM Day (annual event in May)
  - A day for schools, students, teachers and companies to raise awareness, celebrate and engage in activities involving STEM
- STEM Festivals
- Teacher development initiatives
  - GA STEM Institute, STEM without Borders, STEM Georgia Teachers Academy, STEM GA Teacher Laureates
- Georgia STEM Forum
- Others
  - Professional/agency-specific initiatives to promote STEM in GA, etc.

13

STEM FUNDING IN GA

- Race to the Top Innovation Fund
  - $19.4 million fund, competitive grant program
  - Encourages new and innovative partnerships among K-12 schools, colleges and universities, non-profit organizations and businesses
  - Projects to improve student educational achievement
  - Over 20 initiatives, several STEM-related, including charter program development and teacher training/development
  - CEISMC involvement

14

CEISMC – CENTER FOR EDUCATION INTEGRATING SCIENCE, MATHEMATICS & COMPUTING

- CEISMC : Partnership uniting the Georgia Institute of Technology with educational groups, schools, corporations, and opinion leaders throughout the state of Georgia.
  - Vision: Ensure that K-12 students in Georgia receive the best possible preparation in science, technology, engineering, and mathematics (STEM) as they seek their place in the modern world.
  - Mission: Enhance STEM education in the schools based on the enormous scholarly accomplishments of GT faculty. CEISMC advocates and participates in efforts for systemic changes that lead to improved appreciation and performance in STEM for all students at the level of K-12, especially those under-represented in STEM education, and to disseminate best practices to districts and through scholarly works.

15

TRANSPORTATION-STEM IN GA - EXTERNAL STAKEHOLDERS

- UTCs
- CEISMC
- Universities and Colleges
- Private Industry
- Professional Organizations
- Federal Highway Administration
- Georgia Department of Education
- Others

16

GDOT INITIATIVES/ACTIVITIES

Georgia Tech

Individual partnerships with WTS, ASHE and other organizations

17

PROGRAM ALTERNATIVES

18

RECOMMENDATIONS

Goals: **Increase** pipeline of future transportation leaders and officials
Foster STEM culture within GDOT

- For effectiveness:
  - **Think long-term extended STEM programs** versus short-term STEM awareness events
  - **Target STEM schools**
  - Design initiatives with **exclusive/in-depth focus on transportation** (student education/teacher training)
  - Design **long-term extended initiatives focused on high schools**
  - Design **T-STEM awareness programs for K-12**
  - **Leverage existing resources** and **build partnerships** with **T-STEM stakeholders**

19

PROGRAM OPTIONS

- Residential or non-residential summer programs like the STI
- Teacher-training and curriculum development programs like AASHTO's TRAC and RIDES
- Relationship builder programs
  - e.g., Build long-term relationships with students through internships in high school and college
- One-day, high-publicity workshops
- Occasional employee visits to schools to present on STEM applications in their jobs

20

LONG-TERM EVENT (DISCUSSION)

- What should the program look like?
- Who should be involved?
- What resources will be needed/available?
  - Internal
  - External

21

SHORT-TERM EVENT (DISCUSSION)

- What should the program look like?
- Who should be involved?
- What resources will be needed/available?
  - Internal
  - External

22

OWNING & SUSTAINING STEM IN GDOT

- STEM Champion
- STEM Steering Committee
- Human Resources

23

EXPANDING STEM PANEL: EXTERNAL T-STEM STAKEHOLDERS

- Additional Partners
  - CEISMC
  - Universities and Colleges
  - Private Industry
  - Professional Organizations
  - FHWA
  - GA Department of Education
  - Others

24

STEM and Our Future Transportation Leaders

Appendix F: GDOT Survey Instrument

GDOT STEM Outreach Employee Survey

The Georgia Department of Transportation (GDOT) is exploring avenues to engage K-12 students in transportation through STEM programming as an effort to replenish the workforce pipeline. **The purpose of this survey is to gauge interest of GDOT employees for involvement in STEM outreach activities that the department may engage in.** The results will be used to inform future STEM outreach programming for GDOT.

This research is being conducted by the Infrastructure Research Group (IRG) at the Georgia Institute of Technology and is sponsored by GDOT.

Please contact Stefanie Brodie at sbrodie3@gatech.edu if you have any questions or concerns.

Thank you.

* 1. Have you participated in STEM outreach through GDOT previously?

- ◯ Yes
- ◯ No

2. Why or why not?

3. If yes, which outreach activities? (up to five)

Activity 1:

Activity 2:

Activity 3:

* 4. On a scale of “not interested” to “very interested”, how interested are you in participating in STEM activities through GDOT?

Not Interested	Neutral	Somewhat Interested	Very Interested
◯	◯	◯	◯

GDOT STEM Outreach Employee Survey

*** 5. What type of STEM activity would you be interested in participating in through GDOT? Options (choose all that apply):**

- [ ] Mentor a team for an on-going competition (such as Future City or First LEGO League)
- [ ] Serve as judge for a competition
- [ ] Participate in a summer program lasting 4 - 6 weeks
- [ ] Serve on a committee to plan an event lasting 2 - 6 hours (such as Introduce a Girl to Engineering)
- [ ] Participate in a event lasting 2 - 6 hours (such as Introduce a Girl to Engineering)
- [ ] Attend a Career Day/Give a talk at middle or high school
- [ ] Host a shadow student
- [ ] Not interested

Other (please specify)

*** 6. How would you like to hear about STEM outreach opportunities offered through GDOT? Options (choose all that apply):**

- [ ] Via email
- [ ] In a newsletter
- [ ] On bulletin boards in the office

Other (please specify)

7. On a scale of "not likely" to "very likely", how likely are you to consider serving on a STEM advisory/planning board at GDOT?

Not Likely	Neutral	Somewhat Likely	Very Likely
○	○	○	○

*** 8. Are you currently involved in STEM outreach outside GDOT?**

- ○ Yes
- ○ No

9. What types of outreach activities do you participate in?

GDOT STEM Outreach Employee Survey

10. How often (choose one)?

- ◯ Annually
- ◯ Semi-annually
- ◯ Every 3 or 4 months
- ◯ Monthly
- ◯ More than once a month
- ◯ Weekly
- ◯ Occasionally

11. Additional Comments:

*** 12. Name:**

13. Email (if you are interested in being contacted further):