

CAREER: Interactive and Explainable AI for Next-Gen Transportation Systems Management
([NSF Award No. 1912306](#))

Year-4 Formative Evaluation Report
February 2025

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EXECUTIVE SUMMARY

- The Interactive and Explainable AI for Next-Gen Transportation Systems Management project, in its fourth year of implementation at the University of Missouri (MU), uses futuristic technologies in Artificial Intelligence (AI) and Machine Learning (ML) to improve safety, mobility, and sustainability of Transportation Systems Management (TSM).
- Educational activities continued to be implemented online and in-person resulting in recruitment of eight (08) graduate students – five (05) of them are directly funded through the project— as well as 13 total undergraduate students. Moreover, two planned courses (Urban Transportation Data Science and Engineering & Advance Research Methods in Transportation Engineering) were redesigned and offered for a fourth consecutive year.
- The project's state and national level outreach and partnership efforts remained the strongest component in Year 4 (April 2024 – March 2025). Students participated in several competitions and conferences including the [2024 IEEE International Conference on Big Data](#) (Washington, DC); [the Transportation Research Board \(TRB\)](#) annual meeting (Washington, DC); and other prominent conferences throughout the reporting year. Students presented their research and were able to publish their research results in high impact conference proceedings and journals. Additionally, the PI continued efforts to initiate next generation explainable AI projects for transportation in partnership with the Missouri Department of Transportation, Federal Highway Administration, and internal grants from MU for strengthening outreach, research, and student experiential efforts.
- The ARC evaluation team employed a mixed-method approach using several tools to inform project processes and results, including a project fidelity checklist created specifically for this project and quarterly evaluation meetings with the PI. Participant evaluation surveys were conducted to assist the PI with refining courses designed through the proposed curriculum development model (CDM). Survey findings suggest an **overall satisfaction with the course topics and relevancy of final projects for firsthand application practice that helped students learn and fully understand the theory and application of AI related to Transportation Systems Management**. The evaluation team also conducted key informant interviews with project partners to assess project processes and milestones with regards to translational activities and collaborations with industry professionals. The interview results reaffirm the PI's contribution in developing efficient AI tools for transportation system management. Formative results, as reported herein, suggest *efficient achievement of project milestones and objectives*.

RECOMMENDATIONS

Recommendations to further strengthen the project:

- Expand outreach to a wider range of precollege students, especially in rural areas.
- Increase the frequency of interactions with transportation management and operations professionals, especially for the State of Missouri to facilitate mutual learning and transportation systems development.

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INTRODUCTION

Interactive and Explainable AI for Next-Gen Transportation Systems Management is a National Science Foundation (NSF) funded five-year (April 1, 2021 - March 31, 2026) project aimed at improving safety, mobility, and sustainability of transportation through AI, all leveraged via big data and machine learning. Several research, education, and outreach activities have been planned to achieve the project aims and objectives. This report focuses on the evaluation of educational and outreach goals and related activities.

The **planned educational activities** include conducting undergraduate bootcamps, teaching graduate Advance Research Methods in Transportation Engineering (ARMT) courses, piloting implementation of curricula, and launching a graduate Urban Transportation Data Science and Engineering (UTDSE) course. In Year 4, the PI continued teaching the redesigned graduate level ARMT course, as well as the masters-level and undergraduate-level UTDSE course, while running and strengthening [TITAN](#) and [ZOUTRANS](#) laboratories: TITAN laboratory was established in partnership with MoDOT; the ZOUTRAN laboratory was established with internal MU funds to support precollege students with hands-on experiential learning.

The **proposed outreach endeavors** include visits and recruitment at Historically Black Colleges and Universities (HBCUs), presenting at relevant conferences, publishing in science journals, and developing tutorials, workshops, and training modules for industry professionals to demystify AI and related topics. Year 4 outreach efforts included communicating research results on AI for transportation at different national and international forums (e.g. [2024 IEEE International Conference on Big Data](#) Washington, DC; [the Transportation Research Board \(TRB\)](#) annual meeting Washington, DC. The PI and project team hosted and facilitated Data Science and Pavement Symposium (DSPS) conference. Through this variety of forums, students had opportunities to communicate their research findings and learn from other participants.

BACKGROUND

The Assessment Resource Center (ARC) at the University of Missouri is the external evaluator for the CAREER project. The PI contracted with ARC to evaluate education and outreach activities for the duration of the project. An MOU for evaluation services was entered in February 2022, and ARC developed a detailed evaluation plan for the project. As per plan, the ARC team provides both formative and summative evaluation services for the educational and outreach components of the project.

Specific evaluation tasks for the CAREER project continue to include regular workplan reviews and progress monitoring through fidelity measures; support in gauging project impact for participants; and collecting valid and reliable data for continuous quality improvement. Importantly, the evaluation team communicated evaluation findings to the PI regularly through standalone reports of key informant interview, student surveys and verification of project milestones, as well as through yearly formative reports.

The CAREER project implementation team of MU consists of the PI, Dr. Yaw Adu-Gyamfi, one Graduate Research Assistant (Ph.D.), and two undergraduate research employees. The lead external evaluator and

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formative report author for ARC is Nahida Begum, Ph.D., senior evaluator, with team support from Steven Hennes, Ph.D., senior evaluator and team co-lead.

This second formative report incorporates results from Year 4 and is based on data collection and review from March 2024 to February 2025. The report begins by addressing the evaluation questions and methodologies employed to obtain results. Next, it presents progress and milestones achieved on project objectives for educational initiatives and outreach efforts. The concluding section discusses findings on formative evaluation questions, followed by recommendations aimed at achieving project goals and efficient completion.

EVALUATION QUESTIONS

The report addresses two formative evaluation questions including:

- 1) To what extent have CAREER project activities been implemented as intended?
- 2) To what extent have CAREER project students engaged in and benefitted from activities as anticipated?

The two summative evaluation questions to be addressed at the end of the project include:

- 1) Did the CAREER project increase the skills, readiness, and progression of underrepresented students toward TSM careers?
- 2) Did the CAREER project broaden engagement between transportation and data science communities, and facilitate transportation agency adoption of AI tools, methods, and resources?

EVALUATION METHODS

To answer the formative questions, a mixed-methods approach was utilized to collect data from primary and secondary sources. Primary data were collected during quarterly meetings with the PI, through key informant interviews with project partners, and via surveys of graduate and undergraduate students. Secondary data were gathered through review of project artifacts including student presentations at conferences and students' participation in national and international AI and TSM competitions, as well as information acquired from MU and project partner websites (e.g., [TITAN – An Interactive Web-based Platform for Transportation Data InTegration and ANalytics](#)). Specific details follow here.

Meeting with PI: ARC R&E (Research & Evaluation) team arranged PI meetings with Dr. Adu-Gyamfi. Five (05) meetings were conducted starting August 2023, with three (03) meetings held in Year 4. The first meeting was held on March 25, 2024, to discuss achievement of project milestones and targets, collect related project artifacts for review, and generate PI feedback on graduate and undergraduate student survey instruments.

The second meeting was held on May 5, 2024, giving evaluators the opportunity to discuss protocols developed for key informant interviews with partners. The project progress and milestones were also discussed within the context of emerging opportunities and challenges as the project evolved. The PI

shared project artifacts for review and triangulation purposes. The undergraduate and graduate curriculum development model evaluation modalities were also discussed with the PI.

The third and last meeting of the reporting period was held on January 22, 2025. The agenda included: updates on key evaluation activities; communication of project implementation deliverables including graduate and undergraduate studies; a review of broader impact activities including conference and publications; and discussion of Year 5 (final year of project) evaluation activities.

Key Informant Interviews with Partners: Two in-depth key informant interviews were conducted with partners from Missouri Department of Transportation and St. Charles County. Mr. Jacob Becher is a Program manager with Saint Charles County and Mr. Alexander Wassman works with Missouri Department of Transportation in the Central Office, Highway safety and Traffic Division as a Traffic Management and Operations Engineer. Both partners discussed the greater impact of the project on St. Charles County and the State of Missouri. Some important mentions include availability of detailed traffic information, a shift from conventional reactive approach to a proactive approach (represented by the project), and the creation of an ecosystem for research, development, and learning. Detailed findings are discussed in [Evaluation of Outreach Goals section](#).

Graduate Student Survey: The evaluation team conducted a survey with participating students to help the PI refine graduate level courses developed or redesigned through the proposed project curriculum development model. First, the evaluation team collaborated with the PI to develop a survey instrument that asked students to self-assess their learning and understanding of the course content before and after completing the class. Students were also asked how the final project went and were provided with a chance to suggest changes to the design and content of the course. The survey was distributed to eight (8) of the project graduate students; a total of four (4) project graduate students completed the survey. The survey findings showed student learning and understanding improved significantly, increasing from an average score of 2.8 to 4.2 on a five-point scale. Students also benefited in terms of learning more about the transportation industry and related career options. [Section A in the Evaluation of Educational Goals](#) provides comprehensive detail of the survey findings.

Undergraduate Student Survey: The Undergraduate Student Survey was another effort in evaluating the project's curriculum development model. A survey instrument was developed in collaboration with the PI and distributed to thirteen (13) undergraduates through Qualtrics. A total of five (05) undergraduate students completed the survey. Results showed that most students were in their senior year of undergraduate studies. Students reported an increase in their learning and understanding on the various course topics with a mean increase of 66% from a baseline of 22%. [Section B in the Evaluation of Educational Goals](#) provides a more comprehensive description of the survey findings.

Project Fidelity Checklist: Following the initial evaluation plan, the ARC team formulated a fidelity checklist to share with the PI to gauge project processes and milestones. The evaluation team updated the checklist quarterly to assess the project progress vis-à-vis the established implementation plan. The primary source of information for the update included PI meetings and review of project artifacts, which is discussed next.

Artifact Review: The evaluation team continued to gather secondary data from project artifacts as communicated by the PI through a project shared folder, as well as regular review of MU and project partner websites. For example, the project folder contains: CAREER project published papers; partnership details with the Missouri Department of Transportation; Urban Transportation Data Science

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(UTDS) graduate course syllabi; weblinks to Data Science for Pavement Symposium (DSPS); Transportation Research Board on Artificial Intelligence student competitions; IEEE BigData 2025 event; and links to student developed tutorials. These sources were extensively utilized to gather information on achievement of milestones and are referenced in footnotes or through links in specific sections of this report.

MAJOR CHALLENGES

No major challenges were reported this year, although precollege student outreach programs continue to lag behind the original project implementation timeline. As reported previously in Year 3 formative report, the PI had to make adjustments to the CAREER project implementation due to COVID-19, including university wide cancelation of in-person summer programs. Thus, the planning and implementation of summer undergraduate bootcamps and other precollege activities were delayed and reimagined for the remainder of the project.

In efforts to overcome this challenge, the PI has reached out to industry partners including Missouri Department of Transportation (MoDOT) and the National Highway Administration's National Summer Transportation Institute (NSTI). The PI has also been using internal MU efforts to finalize plans to bring high school students to an intensive training session "bootcamp" in Summer 2025.

Additionally, during interviews partners identified more interactions with greater frequency with the PI and team as an opportunity for improvement. We recommend that the PI planned workshops with industry professionals be the focus of implementation this coming calendar year.

PROJECT GOALS

This section discusses the various goals and objectives set under the education and outreach components of the program. The objectives are followed by planned activities (in *italics*) and accomplishments on each activity to illustrate the progress achieved to date.

EDUCATION GOALS

The goal of educational activities is to prepare, nurture, and grow a future transportation systems and infrastructure engineering workforce for supporting, creating, and utilizing AI to transform the management and operation of civil infrastructure systems. Two objectives attend the educational goal. Following are their specifics, related planned activities, and progress achieved to date.

Objective 1: Undergraduate student recruitment, teaching, and research

Planned Activities

*To achieve objective one, two key activities have been planned. One is **recruitment of students** through program advertising (campus publicity channels), presentations to student organizations and in-coming freshmen (National Society of Black Engineers (NSBE), Women in Engineering), information webinars, museum/TITAN laboratory tours, one-on-one interviews, student advising (NSBE, etc.), and PI visits and talks to minority institutions (Lincoln University (www.lincolnu.edu), and Howard University (www.howard.edu) etc.).*

*The second planned activity is **undergraduate student summer bootcamps**. The bootcamp sub-activities include curriculum development, 8-week summer bootcamp (collaboration with Connector, DEI division, Summers @ Mizzou), 5-week “virtual lab” (guided Zoom sessions), 3-week on campus interactions with engineers and planners, inquiry-based learning, and mentoring by PI laboratory instructors and graduate students.*

Following are descriptions of Year 4 progress and accomplishments.

Accomplishments

Undergraduate level course: The PI reoffered the redesigned undergraduate course on Urban Transportation Data Science ([CVENG 4160](#)) in Fall 2024. The course covered topics: Python programming; big data; application of programming interfaces; data visualization; reviewing urban transportation data sources; machine learning; cloud computing and services; and web development. Ten (10) undergraduate students completed the course.

This course was redesigned using the project funded curriculum development model (CDM): (1) understanding the content theory and concepts of AI, machine learning, big data, and Internet-of-Things; and (2) through bootcamps and coursework to (3) achieve outcomes of student idea pitching, capstone projects, and publications. The external evaluation team conducted a participant survey to assess the efficiency of this model for design, content, and student learning. The evaluation findings are detailed in the Educational Goal Evaluation section.

Bootcamps: In Year 4, the PI entered a partnership with Missouri Department of Transportation (MODOT) to conduct a summer bootcamp for ten to fifteen Missouri high school students, through the Federal Highway Administration's National Summer Transportation Institute. The aim is to introduce highschoolers to all modes of transportation careers and encourage them to pursue transportation related courses at the college or university level. The PI will use the career bootcamp modules and conduct the bootcamp at MU in Summer 2025.

Undergraduate student recruitment: Previously, in Year 1 through 3, although impeded by COVID-19, the PI recruited 12 MU undergraduates from underrepresented target audiences and offered them stipends to attend a Summer 2021 bootcamp. Notably, one student was recruited from an HBCU. However, coordination attempts did not work due to continuing disruptions from the pandemic in the lives of college and high school students. Nonetheless, implementation of this activity started with induction of one high school student in the summer lab in 2023. The student prepared a tutorial on assembling a Jetbot. The video tutorial is available on [YouTube](#).

Objective 2: Graduate student recruitment, teaching, and research

Planned Activities

*The primary tasks within objective two include **graduate student recruitment** through student advising and PI visits and talks to minority institutions (Lincoln University, Howard University, etc.), and **graduate student teaching and research** to ensure development, redesign, and teaching of various courses.*

Accomplishments

Graduate student recruitment: The program recruited 20 MU graduates from underrepresented target audiences and offered them stipends to attend the program. Student demographics show that most students came from diverse backgrounds with female students currently at 53% percent.

Graduate level courses: The PI reoffered the project redesigned graduate level course on Urban Transportation Data Science (CVENG 7160). The course covered topics included (1) Python programming for engineering, (2) intelligent transportation systems, (3) database management and cloud computing, (2) interactive data visualization, and (4) fundamentals of machine learning. Thus, students learned machine learning and AI; developing related cloud-based data warehousing platforms; and reviewed and implemented state-of-the-art machine learning projects. The UDTs course is taught asynchronously with Fundamentals of Transportation Engineering or an equivalent course as a prerequisite. The course was initially offered as a topics course. **Initially started as a one-time seminar, CVENG 7160 is now a permanent course taught in MU's Department of Civil Engineering.** In the reporting period (Year 4), this course was reoffered to graduate students in the Fall and Spring semesters

The second course redesigned through the project's curriculum development model (CDM) and reoffered was Advanced Research Methods in Transportation Engineering ([CVENG 8160](#)), a 3-credit hour graduate level course, covering advanced research methods in transportation. Other focused areas consisted of state-of-the-art approaches in traffic engineering, and mathematical and analytical models. A reading intensive course on diverse topics, CVENG 8160 encourages students to critically review articles and take part in interactive discussions in class. This course was offered for the fourth

consecutive year, with the participation of eight (8) students with a total of twenty (20) students enrolled thus far. The CDM model was evaluated through participants' survey. The findings are discussed next.

EVALUATION OF EDUCATION GOALS

Curriculum Development Model Evaluation

The student survey aimed to determine feedback on the graduate and undergraduate level courses including Advanced Research Methods in Transportation (CVENG 8160) and Urban Transportation Data Science (CVENG 4160 / 7160), to assess the curriculum development model used to design syllabus for the Interactive and Explainable AI (Artificial Intelligence) for Next-Gen Transportation Systems Management. The curriculum development model utilized up-to-date AI, machine learning, and big data content and applied it to transportation system management. The content was delivered to students through coursework for theoretical understanding and through virtual labs for a firsthand practice to achieve student outcomes consisting of idea pitching, capstone projects, and publications.

As part of ARC's commitment to help the PI refine the curriculum development model and to provide support in improving the curriculum, two participants surveys were conducted. The instruments were developed in collaboration with the PIPI and were distributed to all students who completed the courses. Two reminders were sent during the survey administration to encourage completion. Due to low response rate among the CVENG 4160/7160 participants, the survey was relaunched after a month via a single distribution.

a) Advanced Research Methods in Transportation (CVENG 8160)

Four students who responded to the survey are currently completing their Ph.D. degree.

Course Topics and Student Learning

Respondents rated their level of learning or understanding of the 10 course topics on a 5-point scale (1 = no understanding, 5 = thorough understanding). As illustrated next page in Figure 1, all respondents reported an increase in understanding across all topics included in the course syllabus. Specifically, the average student learning and understanding score rose from 2.8 to 4.2 on the five-point scale. The shaded area in Figure 1 represents topic understanding, with greater coverage indicating more topic understanding.

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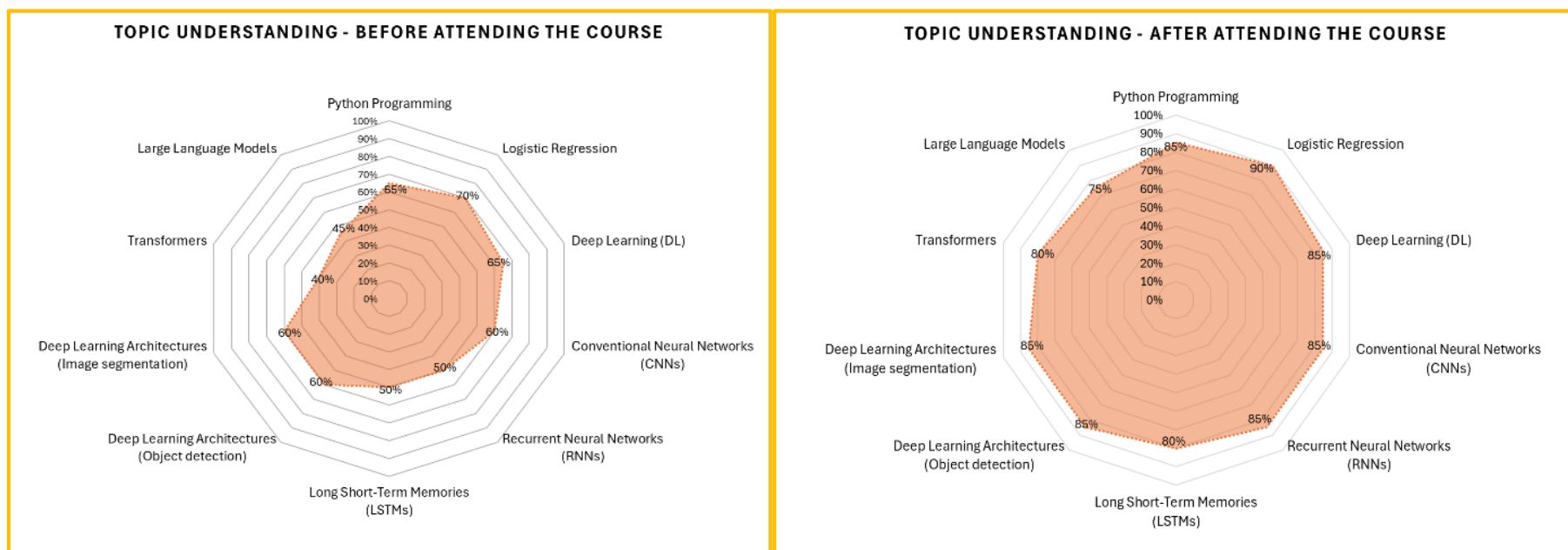


Figure 1: Student Learning Before and After Attending the Course (N=4). The shaded area represents topic understanding, with greater coverage indicating more topic understanding and learning.

Final Project Assignment

During the completion of the CVENG 8160 course, students also participated in a final project to apply their coursework knowledge. The survey asked students to rate their satisfaction with the final project process on a 5-point scale (1 = very unsatisfied, 5= very satisfied)). Three respondents (75%) rated all the final project processes either very satisfied (score of 5) or satisfied (score of 4). Figure 2 provides a detailed graphic illustration of these findings. Noticeably, step 3 and step 5 were rated as neutral (score of 3) by at least one student.

Students were also asked to provide suggestions (at least one and at most four) on how to improve the final project assignment. Two respondents suggested starting the project earlier in the course. Another respondent recommended enhancing the “group project involving two students.” Table 3 in Appendix 1 is the detailed student rating of the final project process.

Figure 2: Student Satisfaction Level with the Final Project (N=4)



Benefits and Impact for TSM Project Students

The NSF funded career project aims to prepare students to use Next Generation AI to solve future transportation issues. A set of questions assessed how the course is fulfilling this objective. One survey question inquired if students would pursue TSM-related jobs. Two students (50% of respondents) were certain they would work in the transportation sector, one was unsure, and one indicated they would not pursue a career in TSM (see Figure 3 and Figure 4 for a graphic presentation of the findings).

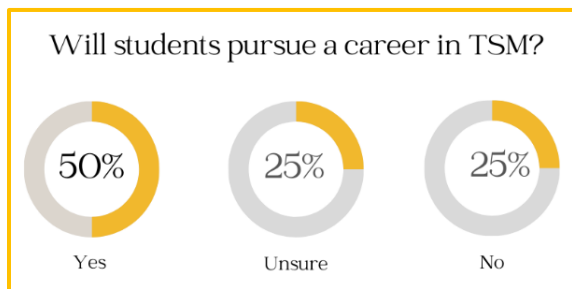


Figure 3: Students' Plan to Pursue a Career in TSM (N=4).

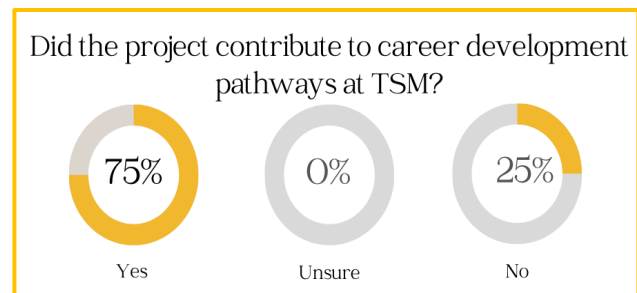


Figure 4: Project TSM Career Preparation (N=4)

A second survey question asked if the project is preparing students for future TSM and AI-related jobs. As depicted in figure 5 below, 75% of respondents agreed that the project is preparing them for a career

in TSM. A third survey question inquired if the project helped change student perception/awareness regarding TSM. Two respondents (50%) agreed that the project is a catalyst for improving student awareness and perceptions of transportation system management. For example, one respondent stated:



“Yes, because artificial intelligence changes rapidly. The course accurately depicted the changes happening in the real world and exposed us to many techniques and methods that are relevant in TSM.”

A second student said:



“Yes, it provided a platform to work with traffic data which I hadn't done before.”

A final survey question asked students to list one to four most impactful aspects of the course. Three students responded to this question and listed the following course aspects as the most impactful:

Table 1: Most Impactful Aspects of the Course

1. CNN	6. Course topics
2. DL	7. Homework
3. Listening to other students' final projects	8. LSTM
4. Project work	9. Reviews
5. Transformers	10. Working with traffic data

Challenges and Feedback

The survey asked students to identify parts of the course they found challenging, with the option to list one to four challenges. The challenges mentioned include (verbatim):



- *The projects*
- *Assignments sometimes*
- *Modify deep learning models*

Students also had the option to suggest improvements to the course. Three (75%) students gave no suggestions, whereas one student suggested (verbatim):



“Provide links to external sources/videos to learn beyond what was taught in the class.”

b) Urban Transportation Data Science (CVENG 4160 / 7160)

The student survey aimed to determine feedback on the undergraduate-level course Urban Transportation Data Science (CVENG 4160 / 7160), to assess the curriculum development model used to design syllabi for the Interactive and Explainable AI (Artificial Intelligence) for Next-Gen Transportation Systems Management project.

The survey instrument was developed in collaboration with the Principal Investigator and distributed to thirteen (13) students who completed the course in Fall 2024. The survey was launched twice, once in December 2024 and a second time in January 2025 to encourage participation, since the first survey distribution together with two reminders resulted in just 23% response rate. Between the two distributions, a total of 5 students (38% response rate) completed the survey. Most (60%) students were in their senior year of undergraduate studies.

Course Topics and Student Learning

Respondents rated their level of learning or understanding of the 13 course topics on a 5-point scale (1 = no understanding, 5 = thorough understanding). As illustrated in Figure 5, all respondents reported an increase in understanding across all topics included in the course syllabus. Specifically, the average student learning and understanding score increased from 23% to 66%.

Course Topics	Average Scores-Before	Average Scores-After
Python: Google Collab, Pandas, Loops, functions	20%	76%
Python: Object Oriented Programming	20%	64%
Python: Data Structures: XML, JSON, TOML, CSV and GEOJSON	16%	56%
Working with Big Datasets: Dask, Rapids, Modin	16%	52%
Working with Application Programming Interfaces (APIs - get, parse, save and visualize)	20%	68%
Data Visualization with Seaborn, Plotly	16%	72%
Reviewing Urban Transportation Data Sources: Traffic, Transit, Planning, Incidents and Traffic	56%	92%
Introduction to Databases: Sqlite, MongoDB, Spark	16%	52%
Introduction to Machine Learning: Regression and Classification	20%	68%
Shallow Machine Learning Models – Random Forests, Decision Trees, and Support Vector Machines	16%	64%
Image Processing and Computer Vision Fundamentals	20%	68%
Cloud Computing and Services	36%	64%
Web Development	20%	64%

Figure 5: Student Average Score Before and After Attending the Course (N=5)

Additionally, the survey asked students if they wanted to add or remove any topics from the syllabus. All respondents unanimously agreed not to add any more topics; however, one student suggested removing the website development component of the course, indicating an overall satisfaction with the course content and topic areas.

Final Project Assignment

During the completion of the CVENG 4160 / 7160 course, students also participated in a final project to apply their coursework knowledge. The survey asked students to rate their satisfaction with the final project process on a 5-point scale (1 = very unsatisfied, 5= very satisfied). All the respondents indicated

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they were *very satisfied* (5/5 on the 5-point scale) with Step A: Develop independent project workplan for data analysis and Step B: data analysis. All respondents were *satisfied* (4/5 on 5-point scale) with Step C: Review/synthesize paper. Figure 6 provides a detailed graphic illustration of the complete rating for the final project.

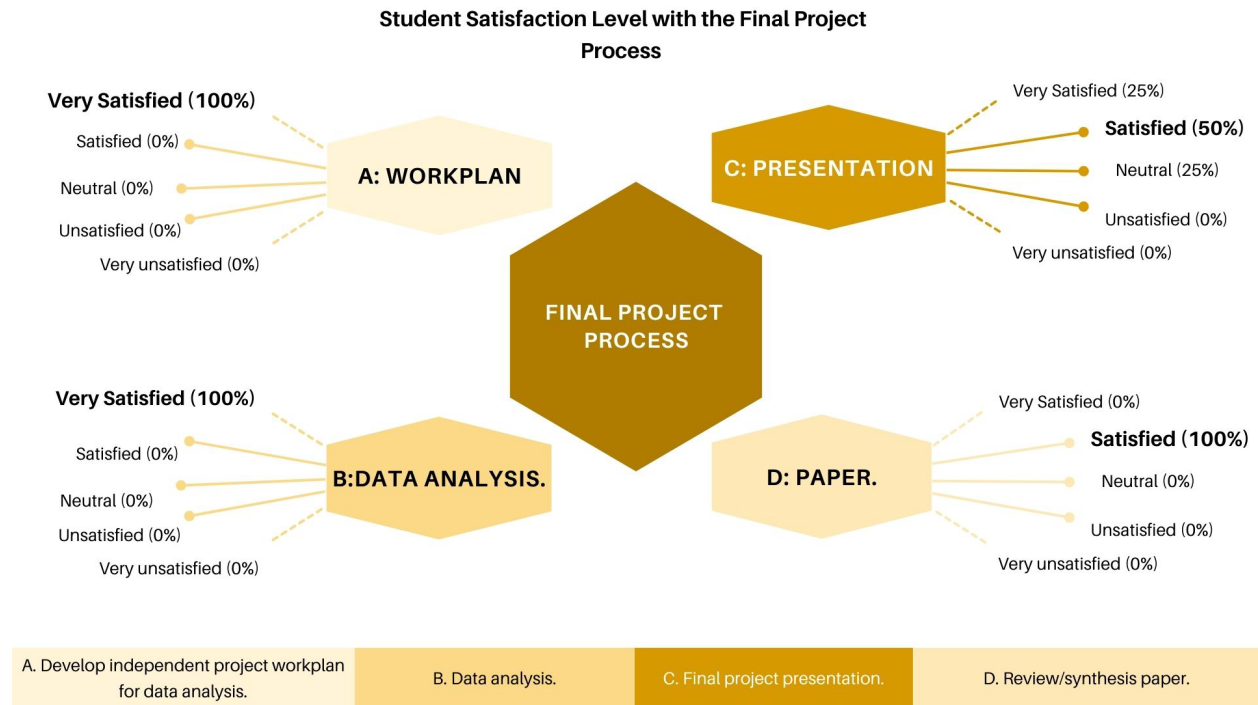


Figure 6: Student Satisfaction Level with the Final Project (N=5)

Students were also asked to provide suggestions on how to improve the final project assignment. One respondent suggested, “*Maybe could setup individual meetings with groups to talk about expectations in terms of amount of work expected.*”

Benefits and Impact for TSM Project Students

The NSF-funded CAREER project aims to prepare students to use Next Generation AI to solve future transportation issues. A set of questions were asked to assess how the course is fulfilling this objective. One survey question inquired if students would pursue TSM-related jobs. Four students (80% of respondents) were certain they would not work in the transportation sector, and one was unsure if they would pursue a career in TSM. Although the majority of undergraduate students would not pursue a career in TSM, 80% respondents agreed that the course better prepared them for a career in TSM. Similarly, 80% of respondents stated that the course changed their awareness/perception of careers in TSM. Following are the student testimonials (verbatim) about their awareness/perception:

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- *I learned more about TSM.*
- *It made me realize how much coding can be implemented.*
- *Yes, I learned many new things. I also learned that a lot of the things we did in class are a lot easier than they seem.*
- *Yes. Exposed how many career opportunities there are.*

A final survey question asked students to list the most impactful aspects of the course. Two students responded to this question, and stated,



- *Hands-on coding assignments & projects, learning how to incorporate and use AI, and being able to work on real world problems.*
- *“Learning to code and create visualizations. Also, working with a group to create the presentation.*

Challenges and Feedback

The survey inquired students to identify parts of the course they found challenging. The challenges mentioned included:



- *It was difficult not knowing all the coding "terminology" that became very important as the semester continued.*
- *Some assignments were challenging given my limited background working with Python.*
- *The assignment was hard towards the end of the semester very hard to eliminate some of the errors from the code.*

Students also had the option to suggest improvements to the course. Three (50%) students did not give any suggestions, whereas two students suggested:



- *I think this class was tough to bring together undergrad, grad, and PhD students together. As an undergraduate I felt like I could not contribute as much to the group and the material went way too fast for me to grasp the topics. But I can see how this was an awesome class for grad and PhD students who have knowledge on these topics already. But coming in with little to no knowledge it was hard to keep up. I would've also loved to start most codes from scratch and go line by line instead of editing codes given when I don't know what all of it means. But this class needs to be kept in the curriculum as this is what the future of the transportation industry is moving towards.*
- *Maybe a few more smaller assignments to have a better understanding of some of the more complex codes.*

Summary and conclusions

Student feedback received on the course was limited since not all the students completed the survey, but what feedback was received offered insights for the PI on the TSM curriculum development model. Students were overall satisfied with the course content, grew in their learning or understanding across

all 13 course topics, and felt the course was worthwhile in developing and connecting skills to TSM careers. Students were most satisfied with the project workplan, data analysis, and applying concepts learned in class. Students were slightly more neutral in their assessment of the final course project. Suggestions for course improvement were given on differentiated expectations for undergraduate and graduate students in the same course, and further breakdown of assignments involving complex codes.

OUTREACH GOALS

The goals of project outreach to academia and industry entailed dissemination of CAREER project products and research findings, and ensuring further improvements and use of AI tools, methods, and resources by transportation systems management (TSM) professionals. Specified as objective three (3) under the educational goal, outreach activities achievements are given below.

Objective 3: Outreach to industry and academia

Planned Activities

The TSM CAREER project will outreach to industry and academia to disseminate results through presenting and publishing in relevant conferences and scientific journals. More specifically, the project will release software, benchmark problems, and data via frameworks (i.e., GitHub) - including the release of software toolkits, documentations, and tutorials.

Moreover, the project will organize two workshops on visual data mining and facilitate student attendance at conferences and student competitions. The team will also develop training modules, organize workshops, and tutorial sessions for personnel and working professionals to help demystify AI, ML, and big data. Additionally, workshops will focus on support with implementation and will inform strategies to integrate outcomes of the project into daily operations.

Accomplishments

Conferences and Student competitions

1. IEEE International Conference on Big Data

The IEEE BigData Cup 2024 conference, a high-impact factor conference in computing science, was held in Washington DC from December 15 to 18, 2024. The project team of three students including Tanner Muturi, Neema Owor, and Ashkan Behzadian together with the PI attended the conference and presented their research findings. One of their papers was accepted for publication, another project student was the winner of the BigData competition.

2. Optimized Road Damage Detection Challenge

This year, the project students and PI also took part in the Optimized Road Damage Detection Challenge 2025 (ORDDC). The challenge targeted road maintenance and management in resource constraint contexts. Participants worked on data collected from six (6) countries, proposed algorithms for road damage detection, optimized the inference speed, and submitted a detail report of their proposed

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solution. Project scholar, Ashkan Behzadian, ranked fifth among the forty-three (43) entries. Please see Table 1 and [challenge 2024 website](#) for details.

Table 2: ORDDC 2025 Leaderboard

2.3 Leaderboard 2.3 (F1-Score and Inference Speed)				
Sorted based on Inference Speed (Qualifying Criteria for winners : F1 Score > 70%)				
Rank	Team ID	F1-Score (6 countries)	Inference Speed (6 countries) (sec/im...)	Date of Submission
1	T24_031_Fangjun_Wang	0.7927	0.0268	2024-09-09 10:20:54 UTC
2	T24_049_yinglong_du	0.7013	0.0328	2024-09-08 09:35:09 UTC
3	T24_010_Seon_Ho_Kim	0.7017	0.0432	2024-09-09 19:46:56 UTC
4	T24_009_Vung_Pharm	0.7027	0.0547	2024-09-10 23:57:46 UTC
5	T24_006_Ashkan_Behzadian	0.7073	0.2886	2024-09-05 23:17:34 UTC
Showing 1-5 of 5 rows				
First Prev 1 Next Last				

3. Data Science for Pavement Symposium (DSPS)¹:

The PI, Dr. Adu-Gyamfi, and other faculty from University of Missouri (MU), organize a yearly DSPS symposium in Washington D.C. in partnership with the Federal Highway Administration. Other key organizers include the University of New Hampshire and the U.S. Department of Energy. DSPS is a yearly student competition on applications of AI for pavement condition monitoring. Students use novel AI ideas to predict pavement conditions. MU's TITAN Laboratory provides data for the competition.

DSPS 2024 implementation started in December 2023, and the symposium was held from March 11 to March 15, 2024². Fifteen (15) teams from the U.S. and other parts of the world participated in the competition. The top three winners (as listed in Table 2) were funded to participate in the five-day symposium in Washington DC.

Table 3: Top three winners of DSPS

TEAM	RANK	MAPE	MAE	MAE + MAPE
Kirk O'toft 🍀	1	29.533	9.166	38.699
Outlier_i	2	33.784	8.509	42.293
Team Japa	3	32.609	11.955	44.564

As the PI and faculty members served as organizers, MU students did not participate in the DSPS competitions to avoid conflict of interest.

4. Transportation Research Board on Artificial Intelligence:

CAREER project students participated in TRBAI competitions where students were challenged in traffic forecasting and pavement crack classifications. This event is an initiative of the National Academies of

¹ [DSPS \(dsps-1e998.web.app\)](#)

² [Program](#)

Science, Engineering, and Medicine, organized through the AI and Advance Computing Committee and its partners, which include the University of Missouri. Teams from around the globe took part in this event. This year's TRBAI competition was held from January 7 to January 11, 2024, in Washington D.C. Three CAREER project students participated in the competition and were runner-up in the first competition.

5. Transportation Research Board Annual Meeting³:

The PI and CAREER project scholars continued their participation in TRB annual meetings held in Washington DC from January 5 to 9, 2025⁴. Four Engineering PhD students (Elizabeth Arthur, Tanner Muturi, Neema Jakisa Owor and Linlin Zhang), attended the conference and presented eight (8) papers on transportation safety improvement using artificial intelligence, big data analytics, and robotics. Two Project scholars Elizabeth Arthur and Linlin Zhang received the young scholar award for their co-authored research work. In addition, of the nine papers, six (06) were accepted for publication. The PI and team are extremely excited for this success. Examples of student presentations are detailed below.

During the January 2024 TRB Meeting, project scholars presented three research papers. As depicted in Figure 8, project scholars Arthur, Muturi and the PI explored how less data and active learning approach can be used in training models in vehicle detection and classification models. The paper contributed to broader research on how to use AI for transportation management systems improvement, including:

- Constructing an embedding space that effectively represents the diversity of a large image database, enabling efficient clustering based on inherent characteristics.
- Development of a novel iterative sampling strategy to score and select the most informative images for annotation, leading to improved model efficiency with reduced labeled samples.
- Pioneering the application of active learning for object recognition, tracking, and counting in the domain of transportation engineering, providing valuable insights into its potential for real-world applications with reduced annotation efforts.
- Conducting a comparative analysis between the developed active learning model and a baseline fully trained model, evaluating vehicle recognition, tracking, and counting performance and assessing generalizability to validate the active learning framework's efficiency.

Project scholars Owor, Du, and the PI also presented their research on estimating pavement condition indices using an Image2PCI multitask learning framework. This framework replaces the manual sample-based pavement condition indexing with a unified multi-tasking model that predicts the PCI directly from a top-down pavement image, thus making the task safe and efficient. The study recommends model use with a larger dataset to further improve efficiency training.

The presentation made by project scholars Zhang, Yu, and Aboah under the supervision of the PI was on making the use of Low-Resolution LiDAR data for 3D object detection and high-resolution traffic parameters more efficient, by: (1) proposing an innovative framework for obtaining full point cloud representations of partially occluded objects using just a single LiDAR system; (2) introducing a novel framework for generating 3D bounding box annotations without relying on human annotators; and (3) initiating the application of zero-shot learning techniques for vehicle and pedestrian detection,

³ [Mizzou Engineers recognized at Transportation Research Board meeting // Mizzou Engineering \(missouri.edu\)](#)

⁴ [Mizzou civil engineering students shine at Transportation Research Board Annual Meeting // Mizzou Engineering](#)

classification, and counting. For this, the student team used moving object detection such as background subtraction, point cloud completion, and zero-shot learning on segment anything model (SAM). The research revealed varying Intersection over Union (IOU) scores, with vehicles having higher accuracy compared to pedestrians due to point cloud density limitations. The team will further address calibration discrepancies and scale consideration to further improve the evaluative detecting models.

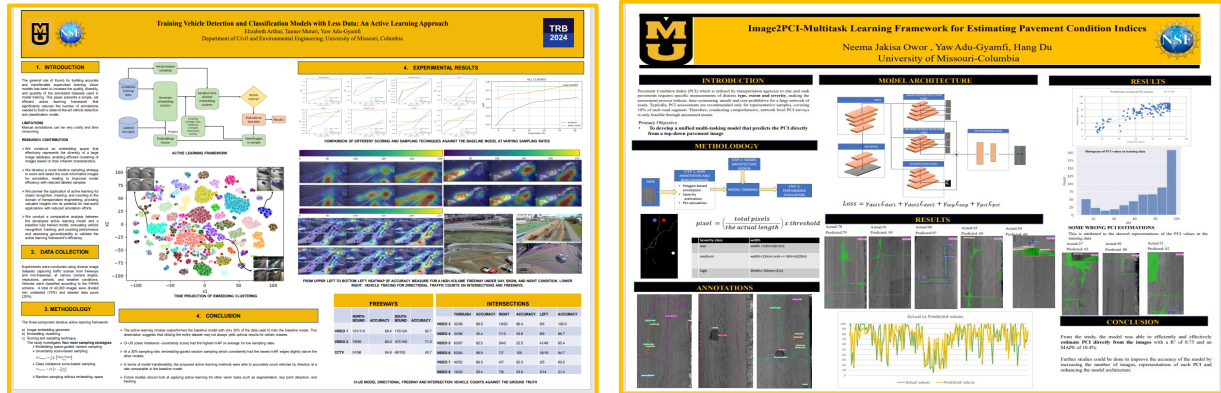


Figure 1: Poster Presentations at TRB 2024

Manuscripts and Publications

The PI and project scholars continued publishing in peer reviewed journals in their efforts to disseminate project research findings. In Year 4, the PI⁵ and project students wrote a paper on driving volatility in the context of St. Louis using connected vehicle data. The paper uses spatial and temporal correlations of volatility as proxy for driving behavioral and crashes. The primary finding was that during daylight hours, there are significant and strong spatial and temporal correlations between volatility and crash in the study areas.

A second paper⁶ was published on further improving warning systems of truck-mounted attenuations, using multi-task learning (MTL) to detect and classify vehicles, estimate distance zones, and perform lane and road segmentation. The results showed a reliable and accurate system of detection, classification, and real-time alerts that can reduce collisions and enhance work zone safety.

The 2024 IEEE International Conference on Big Data published the works of the PI⁷ and team on efficient road damage detection for timely maintenance and to reduce overall costs. The team used a novel YOLOv10 approach enabling professionals in scalable road damage detection in diverse contexts, with an overall accuracy of F1 score of 0.7073 and an inference speed of 0.2886. Acquiring this level of efficiency helped the team secure 5th place in the Optimizing Road Damage Detection Challenge (ORDDC).

Project scholars and the PI communicated their research findings on TitanBot, an advanced Large Language Models (LLM) agent to automatize transportation infrastructure data analysis helping

⁵ Mussah, A. R., & Adu-Gyamfi, Y. (2024). Extracting driving volatility from connected vehicle data in exploring Space-Time relationships with crashes in the city of Saint Louis. *Transportation research interdisciplinary perspectives*, 24, 101051.

⁶ Owor, N.J.; Adu-Gyamfi, Y.; Zhang, L.; Sun, C. Automated Audible Truck-Mounted Attenuator Alerts: Vision System Development and Evaluation. *AI* 2024, 5, 1816–1836. <https://doi.org/10.3390/ai5040090>

⁷ Behzadian, A., Muturi, T., Owor, N. J., & Adu-Gyamfi, Y. (2024, December). Optimizing Road Damage Detection with YOLOv10: A Resource-Efficient Approach Utilizing Augmentation, Data Sampling, and Hyperparameter Tuning. In 2024 IEEE International Conference on Big Data (BigData) (pp. 8439-8446). IEEE.

professionals in data analysis, visualization, and performing tailored calculations and reporting on infrastructure performance (highways, bridges, and transit systems) as needed.

Two manuscripts, prepared by the project scholars and PI, are under review for the TRB annual meeting. One paper is on a generative adversarial network for spatio-temporal travel time estimation and the second is on interactive data-driven real-time traffic data conflation and state estimation.

Industry Partnerships

Partnership with Missouri Department of Transportation

During this reporting period, the Missouri Department of Transportation (MODOT) and the PI continued the legacy of working on joint ventures. One venture included using an AI-enabled vision system for intersection analytics. In a year's time, the PI and team trained and deployed a vision system that can multi-task on three problem areas: (1) detect, classify, and count vehicles, pedestrians and cyclists at intersection by movement (turning movement counts), (2) flag wrong-way driving and alert TMC in near real-time, and (3) detect red-light running violations through SPAT integration. The team will continue training and evaluating the vision system for accuracy, reliability, and scalability. The PI and team will also identify future resource needs for scaling up the purpose.

A second venture with Missouri Department of Transportation was to develop and deploy a web-based stream management and analytics system for CCTV camera information on roadways in the St. Louis District. For this, the PI and team in collaboration with Missouri Department of Transportation partners gathered and documented system-specific requirements and defined technical specifications in a comprehensive project document. The team also developed security and access controls, reconfigurable dashboards, data integration and analytics systems, and system testing and quality assurances. Next in the process, the team will develop documentation and a user tutorial for Missouri Department of Transportation professionals. The Missouri Department of Transportation comprehensive stream management and analytics system helps address issues including:

- Providing a secure, easily accessible, user-friendly, and efficiently managed web platform.
- Centralizing data through the integration of real-time information from detectors, probed vehicles, Waze, and other ATMS feeds.
- Enabling video analytics by leveraging AI and other outputs from the TITAN system.

In the third venture, as already discussed under objective 1, the PI will work alongside Missouri Department of Transportation to host high school students at MU for a summer [ZOUTRANS](#) lab to explore AI and TSM related career paths as early as pre-college years. ZOUTRANS was established by the PI and colleagues from the MU Engineering Department. The lab also received an [MU internal grant](#) for upgrading new technologies including vehicle-to-vehicle and vehicle-to-infrastructure communication systems, drones, edge computing devices, autonomous Jetbots, and other accessories for workshops and training.

This year (Year 4), the partnership on TITAN was extended for another four years. The PI and his team have been working with the Missouri Department of Transportation since 2019 to leverage AI and machine learning to improve transportation system management. TITAN laboratory, one such partnership venture between University of Missouri and Missouri Department of Transportation, helped

use big data analytics, machine learning, and cluster computing to integrate transportation mobility and safety data on an interactive web-based platform for predictive analytics.

In 2020, Missouri Department of Transportation provided funds⁸ to add new features to the TITAN laboratory, enabling the lab to cater to the additional data analytics and visualization needs of different Traffic Management Centers (TMCs) in Missouri for proactive incident management. Nine activities were designed that the TITAN laboratory would have performed. The tasks revolved around transportation personnel coordination, review of existing systems, and redesign [if needed] of data collection, cleaning, documentation, and utilization mechanisms using machine learning and AI algorithms.

The next partnership between the two institutions started in 2022 to improve work zone safety using advances in AI and ML to develop an automated early warning alert system. The automated early alert system helps avoid potential truck-mounted attenuator (TMA) crashes by prompting and guiding road users in real-time, giving them enough time and safe distance to maneuver accordingly.

All these partnership ventures have resulted in developing proactive systems to avoid traffic collisions, thus furthering the current project objective of advancing and leveraging AI and machine learning for transportation systems management.

Missouri Work Zone Safety Center of Excellence⁹: With support from Missouri Department of Transportation and Federal Highway Administration (FHA), the MU College of Engineering established the Missouri Work Zone Safety Center (MOWZES)¹⁰. The center conducts research and outreach on developing behavioral, educational, engineering and technology solutions to achieve **zero fatalities and zero serious injuries** in work zones, a current rising phenomenon in Missouri. The center helps MU leverage its thirty-year research experience to increase work zone safety, and provides an ecosystem for academia, industry, and the public sector to advance research, technology transfer, and outreach initiatives.

EVALUATION OF OUTREACH GOALS

Key Informant Interview with Partners

The external evaluation team conducted two key informant interviews with project partners to understand their involvement and experience with the CAREER project, and their perspectives on the project's progress, opportunities, and challenges.

Both partners have been involved with the project's efforts to use AI in streamlining transportation issues. Mr. Becher works with the St. Charles County transportation department and oversees the ASTMS developed through the Regional Intelligent Transportation System RISDI App, which was launched by the PI and team in 2021. He had quarterly check-ins with the PI on RIDS between 2021 and 2022, meeting quarterly.

⁸ [University of Missouri engineers awarded US\\$1.5m DOT and government grant to develop real-time traffic management system | Traffic Technology Today](#)

⁹ [University of Missouri establishes Missouri Work Zone Safety Center of Excellence // Show Me Mizzou // University of Missouri](#)

¹⁰ [Missouri Work Zone Safety Center of Excellence \(MOWZES\) | Missouri Center for Transportation Innovation \(MCTI\)](#)

Mr. Wassman works with MoDOT, and his professional expertise revolves around traffic system management and operations (TSMO). He published the initial TSMO strategy for MoDOT, which are now under operations. Mr. Wassman noted that MODOT funds MU for various research initiatives and especially mentioned the use of the TITAN project platform.

a. **Project impacts:**

On enquiring about the impact of the TSM projects on the industry, the respondents stated the project has helped advanced traffic signal performance measures with the availability of information at the micro level and AI analytics alongside traffic engineers' perspective for more efficient decision making and proactive actions. Specific mentions included how the partnership helped to create **an ecosystem of Research & Development** where MODOT is informed of different advancements in AI and computational science and the PI receives guidance and direction from MODOT on the application part. Thus, the partnership provides a continuous opportunity for mutual updates, feedback, and learning among academia and industry.

Other specific achievements that respondents mentioned include: (1) the creation of dashboards through TITAN (with one click generation of different reports), (2) development of efficient and shareable data systems, (3) opportunity for out-of-the-box thinking and countermeasure improvements on local roads, (4) road safety measures--on the ground improvements that help reduce fatalities and accidents, (5) predictive models that leverage the use of multidisciplinary inputs of data science and computer science [together with civil engineering], and (6) leveraging smart young minds that are at MU for system designs and industry advancement.

The respondents expressed their appreciation for the systematic approach taken by the PI and team for research and development, noting how the project moved forward with utilizing AI for **a promised cab future**, fully automated transportation system. AI is the future, and the industry will have to learn a whole new way of doing things. Respondents also mentioned that the transportation industry is ever changing and diversifying, which in the past relied heavily on civil engineering. Currently, data scientists, computer programmers, electrical and mechanical engineers are being involved for more holistic systems operation.

In addition, respondents mentioned that the academic and professional partnership is helping to develop an ecosystem of learning and innovation, piloting different possibilities of how AI and machine learning can be used. One respondent said,



We look forward to meeting the PI since discussions are on what data sets are available and how other research can be applied to our system."

b. **Further advancements needed:**

Both partners acknowledged that the industry still needs to go further in developing a system where signal timings are monitored in real time to reduce congestion and to help reducing greenhouse gas emissions. Additionally, a goal is removing barriers to accessing aggregate information from various departments.

Specifically, Mr. Becher said that the TSMO industry needs a system that is **running 24/7 leveraging AI and ML**. Ideally, the system would be adaptive, rely less on human machine interface, use information from connected cars [e.g. heavy acceleration and heavy braking, adaptive traffic signal system that makes decisions about how to change traffic signal timing in real time], and use potential or high crash risk analysis to **predict accurately** and **give real time reporting**. He stressed that it would be a dream scenario if a system is integrated within the Missouri Highway Patrol or the CAD to give real time information (on a quarterly basis instead of yearly aggregate data). He also mentioned policy issues around data privacy, responsible use, and industry access, which need to be resolved at the policy level before thinking of implementation.

Mr. Wassman emphasized the need for a long-term implementation and integration of AI integration. For example, setting up regular communications with every vehicle on the roadway, and how to move from where we are currently to the **promised cab future** would be the goal.

Diversifying the industry was another topic mentioned, where other sectors such as computer sciences, electrical engineering and data sciences are well represented.



“Another important step would be diverse workforce issues: approaches to balance out or hiring diverse workforce (e.g. if not experienced, hire at a junior level and train them with the required skill sets).”

c. **Limitations that hinder AI and TSM advancement in the industry:**

The following limitations were mentioned by the partners.

- Resource intensity – resources are lacking for handling huge amounts of data, as well as a lack of specific funding or project categories for specifically targeted projects.
- Access to entry for minority students - a blend between the computer science and engineering space might resolve it.
- Big data – Departments are not sufficiently equipped to house and handle big data. Data are restricted and not freely available since being licensed or purchased or acquired through third party means.
- Challenges are ingrained in the utilization of past standards.

However, the respondents were optimistic that the partnership with MU will help design and implement different projects to try to make transportation space safer.

d. Recommendations:

Both partners recommended that the PI and team meet frequently with TSM professionals (on a quarterly basis) about product developments and possible applications [as during the initiation of the project]. They also suggested further collaborations with the university especially on the industry part. Other recommendations included thinking through how to keep this project rolling especially at the county to municipality levels and hiring students for internship opportunities [from county/municipality]. Both partners reaffirmed their appreciation of the project, recommending the PI “Keep the good practices on the project.”

CONCLUSIONS AND RECOMMENDATIONS

The Year 4 formative evaluation report seeks to answer two evaluation questions including:

- (1) To what extent CAREER Project activities have been implemented as intended?
- (2) To what extent have CAREER Project students engaged in and benefitted from activities as anticipated?

As evident from the following summary of key findings vis-à-vis each objective, the CAREER project is well underway, achieving its milestones and objectives.

Objective 1: Undergraduate student recruitment, teaching, and research

- *Undergraduate courses:* To date, the project has successfully recruited 26 undergraduate students, with a diverse representation that includes 53% female students. Additionally, the redesigned undergraduate course on Urban Transportation Data Science (CVENG 4160) was reoffered in Fall 2024, enrolling 10 new students. This course enhances student learning by utilizing current transportation data and applying AI for predictive modeling.
- *Laboratory immersive experience:* Student final projects and lab immersive experiences continued in Year 4. In addition, MU internal funds were acquired to strengthen the [ZOUTRANS](#) laboratory for preschool college preparation programs.
- *Summer Bootcamp:* A summer bootcamp is also being planned for Summer 2025 in collaboration with Missouri Department of Transportation for 10-15 highschoolers in MU ZOUTRANS lab. The program aims to introduce students to AI and TSM related career paths, providing early exposure to these fields before students enter college.
- *Curriculum Development Model Evaluation:* Student surveys were conducted to evaluate the undergraduate course, Urban Transportation Data Science (CVENG 4160). The results depict that average learning of the various topics increased from 23% to 66%. Additionally, a majority of students rated the final project either very satisfied (5 out of 5) or satisfied (4 out of 5). However, the undergraduates expressed uncertainty about pursuing a career in the TSM industry.

Objective 2: Graduate student recruitment, teaching, and research

- *Graduate courses:* The PI reoffered the project redesigned graduate level course on Urban Transportation Data Science (CVENG 7160). In the reporting period (Year 4), this course was reoffered to graduate students in the fall and spring semesters. A total of eight students attended the course. In its fifth year (Fall 2025), CVENG 7160 is now a permanent course taught in MU's Department of Civil Engineering.

The Advanced Research Methods in Transportation Engineering (CVENG 8160) course has been offered for the fourth consecutive year, with 8 students participating and a total of 20 students enrolled thus far.

- *Experiential learning:* The coursework training and laboratory immersive experience provided students with the required skill sets for employability and workforce readiness. The TITAN lab was extended for another four years in partnership with MODOT.
- *Curriculum development model evaluation:* Participant surveys were conducted to evaluate the graduate course, CVENG 8160. The results indicate that students learned at least 10 topics during the coursework, and their average learning of the various topics increased from 2.8 to 4.2 on a five-point scale. Additionally, a majority of students rated the final class project as either very satisfied (5 out of 5) or satisfied (4 out of 5). Participation benefits included increased awareness and preparation for careers in transportation system management.

Objective 3: Outreach to industry and academia

- *Conferences and student competitions:* Artifacts reviewed indicate successful implementation of this objective. The project outreach milestones are well in progress, with the PI and students actively disseminating research findings through conference presentations, publications in scientific journals, and networking meetings and webinars.

Students participated in the IEEE international conference on big data, achieving notable success of one project scholar winning the data competition and a second group of scholars securing a paper for publication in the high-impact journal of Data and Computer Science. Project scholars also attended the Optimized Road Damage Detection Challenge 2025, the PI-administered Data Science for Pavement Symposium, and continued their participation in the Transportation Research Board on Artificial Intelligence competition.

- *Manuscripts and publications:* The PI and project scholars disseminated their research findings through various publications addressing TSM issues, including driving volatility, improving warning systems of truck-mounted attenuations, efficient road damage detection, and automated transportation infrastructure data analysis. The team was also successful in securing a pipeline of eight (08) research proposals accepted for publication.
- *Industry Partnership:* The PI is managing several successful partnership ventures with the Missouri Department of Transportation (MODOT) to build a network of academia and professionals for student learning and workforce preparedness alongside applying AI to solve transportation issues. At least four partnerships were initiated in Year 4, in addition to those already being implemented.

The partnership efforts were evaluated through key informant interviews with two key partners to understand their perspectives on the project's progress, opportunities, and challenges. Respondents highlighted the project's efforts in advancing traffic signal performance measures using available microdata and AI analytics to support efficient decision-making and proactive actions. Additionally, the partners emphasized the need for more collaborative efforts to enhance traffic prediction efficiency and real-time reporting.

RECOMMENDATIONS

- In Year 3, the evaluation team recommended stronger implementation of key planned activities with regards to **undergraduate student recruitment, teaching, and research objective**. In response, the PI has (a) successfully started new undergraduate courses which focus on AI and machine learning model application to transportation data focusing on both theory and application, (b) initiated a new partnership with MODOT to bring 10 to 15 highschoolers to MU for a summer bootcamp in 2025, and (c) acquired internal MU funding to strengthen the [ZOUTRANS](#) Lab specifically for precollege preparation programs.
- This reporting year, our evaluation results indicate the need for more and frequent interactions with partners, namely the transportation management and operations professionals at the county and municipality level. The purpose of more frequent interactions would further demystify AI to the transportation system management and operations professionals.

APPENDIX 1

Table 4: Student Ratings of Final Project Process (N=4)

FINAL PROJECT PROCESS	VERY SATISFIED	SATISFIED	NEUTRAL	UNSATISFIED	VERY - UNSATISFIED
1. Research question/issue topic identification.	50%	50%	0%	0%	0%
2. Independent project workplan.	50%	50%	0%	0%	0%
3. Open data harvesting.	50%	25%	25%	0%	0%
4. Data analysis.	50%	50%	0%	0%	0%
5. Review/synthesis paper.	50%	25%	25%	0%	0%
6. Presentation	25%	75%	0%	0%	0%
7. Opting in to address data related challenges in transportation.	75%	25%	0%	0%	0%