KTC FY 2024 ANNUAL REPORT

KENTUCKY TRANSPORTATION CENTER

ADVANCING TRANSPORTATION THROUGH INNOVATIVE RESEARCH AND EDUCATION

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OPENING REMARKS

MESSAGE FROM OUR **DIRECTOR**

DOUG KREIS

I am thrilled to report that FY 2024 was a year of impressive growth at KTC. In addition to formally publishing 21 research reports, many additional reports were completed and are under review at the Kentucky Transportation Cabinet (KYTC). The publications cast a wide net and focus on a range of topics, from project management and multimodal-oriented road design to performance measurement, pavement striping, and structural preservation. Because our research and technology transfer programs are thoroughly interdisciplinary, it is challenging to sum up all of the Center's research accomplishments in a sentence or two! But KTC's webpage on UKnowledge provides easy access to all of our reports and other publications. We also added a new program area during the past year — Resilient Systems. As the past few years have demonstrated, the number of hazardous events that damage critical infrastructure is increasing. Because transportation agencies, including KYTC, need robust strategies to ensure the roads and bridges people depend on stand up to the perils of extreme weather, establishing a dedicated program area is a timely intervention.

The pages which follow highlight major contributions from our team over the past year. Along with publishing reports and articles, as well as speaking at academic and industry conferences, KTC staff were hard at work growing the Highway Knowledge Portal (HKP) database and delivering technical training that helps transportation professionals build the expertise they need to be more effective practitioners of their craft.

On the financial side of the ledger, FY 2024 was another excellent year for the Center. Both annual expenditures and project awards totaled approximately $11.5 million. As I stress every year in my annual letter, we do not quatify KTC's success only in terms of project awards and revenues. These are no doubt important metrics that provide evidence of the Center's financial health, and by extension the quality of service we deliver to KYTC and other clients. Yet they are imperfect indicators because they do not fully capture the real-world impacts of research implementation. With our work on implementation accelerating by the day, I believe KTC's expenditures represent only a small fraction of the true value our work brings to Kentucky.

In last year's annual report, I touched on initiatives KTC had planned to increase public awareness of its research and technology transfer activities. Our efforts to produce 3 – 5 minute video summaries of projects, deepen engagement on social media (e.g., LinkedIn, Facebook), distribute research notes, and shorten report lengths have proven successful. KYTC has embraced this approach and encouraged us to further explore innovative ways to deliver research findings to its staff. Although widespread public distribution of research products is critical, we also know that it is important for the Center's staff to be conscious of what their colleagues are working on. With this in mind, last fall we launched the KTC Research Spotlight Series, a monthly lunch-and-learn series. During each session one program area presents an overview of its research and technology transfer activities. The KTC Research Spotlight Series is a critical tool for de-siloing the Center and encouraging more collaborations across program areas. Building this awareness across KTC is critical for pursuing new grant opportunities and attracting new clients. The success of this series will provide a springboard so that in the coming year we can explore ways to reach a wider audience, most likely through a colloquium series.

Take a few moments to review this report and read about KTC's achievements over the past year. Much more is to come in FY 2025 as we continue to grow our staff and research capabilities. Next year, I hope to report back that we have further strengthened our partnership with KYTC and gained a firmer foothold at the national level. Until then, be confident that all our staff will be working diligently on projects that help our partners deliver safe mobility to all road users.

ABOUT KTC

For over 80 years, KTC has delivered practical solutions to critical transportation problems, stellar technology transfer, and unparalleled customer service. Founded as a small materials research division in 1941, today KTC's multidisciplinary researchers address practically every aspect of our transportation system, including all modes and user types. KTC addresses dynamic and emerging challenges faced by our clients through research and education that enhances the safety, efficiency, and sustainability of transportation systems. Our research products and trainings help us deliver on our mission of advancing transportation through innovative research and education.

We have established a strong partnership with the Kentucky Transportation Cabinet while building relationships with other state transportation agencies, private firms, and leading transportation organizations. Spread across 16 program areas and located in the University of Kentucky's College of Engineering, the Center's staff collaborates with expert faculty and conducts research in labs equipped with the most advanced technologies. As KTC continues to grow, we will remain committed to delivering transformative solutions that address the urgent problems facing local, regional, state, and national transportation systems.

KTC HISTORY

1941 Kentucky Highway Department opens a Division of Research at UK.

1979 KTC formally established.

1980 Assumes KYTC's research function.

1988 Merges research and technology transfer activities.

1993 Manages the Advantage I-75 Operational Test Project.

2000 Leads nationwide development of context sensitive design training.

2007 Receives federal grants for Fedtrak and Section 1554 evaluations.

2012 Partners on the Multimodal Infrastructure and Transportation Consortium.

2015 Launches Project Manager's Boot Camp and Boot Camp Xpress.

2019 Introduces the KYTC Highway Knowledge Portal.

2022 Begins multiyear pavement forensics project for KYTC.

2023 Partners on the Center for Regional & Rural Connected Communities.

2024 Career path established for Technology Transfer Staff and Technicians

STRATEGIC PLAN

MISSION

Advancing Transportation Through Innovative Research and Education

VISION

KTC addresses the dynamic and emerging challenges faced by our stakeholders through research and education that enhances the safety, efficiency, and sustainability of transportation systems.

VALUES

RELATIONSHIPS

Enduring relationships with the Kentucky Transportation Cabinet (KYTC), U.S. Department of Transportation, local agencies and governments, research and industry organizations, and other clients make our work possible. Equally instrumental are strong relationships with colleagues and collaborators in departments and colleges across the University of Kentucky. Each day, through research and technology transfer activities, we strive to expand and strengthen these partnerships.

INNOVATIVE RESEARCH SOLUTIONS

Our high-value research and technology transfer are transformative, responsive, and practical. KTC is helping clients reimagine and reshape their transportation futures by delivering cost-conscious solutions that can be efficiently implemented and integrated into operations.

DEDICATION & INTEGRITY

Our dedicated team adheres to the highest professional and ethical standards. We are fully invested in the promise of knowledge and expertise to create safer, more efficient, and more resilient transportation systems.

OUR PEOPLE

Researchers, technology transfer professionals, and administrative personnel are the engine that drives KTC. Our culture is built on investing in the Center's employees so they can acquire the knowledge, skills, and proficiencies needed to flourish professionally and deliver the service our clients expect.

DIVERSITY & TEAMWORK

Diversity in people. Diversity in thought. Not only does the Center prioritize recruiting women and members of underrepresented groups, we embrace a holistic approach to research and instruction that dismantles disciplinary silos. Building an inclusive environment that facilitates cross-disciplinary work strengthens the critical faculties of all employees and bolsters our capacity to collaborate with external stakeholders.

FAST DELIVERY OF HIGH-QUALITY PRODUCTS

Our team is committed to delivering research and training products of unsurpassed quality to KTC's clients quickly and efficiently. No deadline is too short. No request is too arduous. Regardless of the timeline, we collaborate with our clients through respectful engagement, work to understand their needs, and furnish solutions on time and on budget.

STRATEGIES

FORGE LONG-TERM MULTIDISCIPLINARY RESEARCH PARTNERSHIPS

KTC enjoys thriving partnerships with KYTC and its other clients. Along with nurturing and building these relationships, our team will work aggressively to increase its portfolio of research and technology transfer services, pursue new clients and funding, and explore opportunities for partnerships with stakeholders throughout the transportation industry. KTC enjoys thriving partnerships with KYTC and its other clients. Along with nurturing and building these relationships, our team will work aggressively to increase its portfolio of research and technology transfer services, pursue new clients and funding, and explore opportunities for partnerships with stakeholders throughout the transportation industry.

STRATEGIES

- **Engage prospective clients the Center has not traditionally worked with**
- **Grow research portfolio by engaging all KYTC departments and soliciting agencywide input for the SPR process**
- **Increase partnerships and expand dialogue with colleges and departments at the University of Kentucky**
- **Invite young KYTC staffers to participate in the research process and serve on study advisory committees**

DELIVER INNOVATIVE PRODUCTS THAT TRANSCEND EXPECTATIONS

We have an exemplary track record of delivering outstanding and timely research and technology transfer services. Moving forward, KTC will continuously improve the efficiency and quality of research and instruction while becoming an industry leader in delivering practical yet innovative solutions.

STRATEGIES

- **Complete projects on time and on budget**
- **Measure and track client satisfaction**
- **Pursue new opportunities for innovative applied research**
- **Explore non-traditional research delivery methods (e.g.,video, apps, social media)**
- **Encourage and finance continuing education and professional development**

STRENGTHEN KNOWLEDGE TRANSFER & RESEARCH IMPLEMENTATION

Implementation is how knowledge and research make a difference. Our team excels at developing implementation strategies and communicating findings to stakeholders and partners. The Center will deepen its focus in this area by helping clients accelerate implementation and measuring the real-world impacts of its activities.

STRATEGIES

- **Refine and continue tracking research implementation metrics**
- **Hold outreach events for new and existing clients to share research findings and implementation efforts**
- **Create a multi-platform approach to disseminate project results**
- **Collaborate with KYTC marketing and public relations staff and other clients to facilitate implementation**

ENHANCE KTC'S VISIBILITY ON THE NATIONAL STAGE

Within Kentucky and at the regional level KTC is acknowledged as a leader in applied transportation research and technology transfer. Enlarging the Center's footprint on the national stage demands that we tap into new funding sources. Gaining national visibility requires our team members to bolster their participation in and contribute to national organizations (e.g., AASHTO, TRB) while continuously growing research and instructional capabilities in response to emerging client needs.

STRATEGIES

- **Increase presence on committees and sub-committees of organizations**
- **Partner with other universities to pursue UTCs, NCHRP projects,and new external clients**
- **Recruit high-profile researchers and technology transfer specialists**
- **Market products to showcase their innovation and wide ranging applications**

GROW AND RETAIN A DIVERSE TEAM

Achieving national prominence requires the development of an ambitious staffing plan and a commitment to building an open, respectful work environment that fosters diversity and multidisciplinary collaborations. We must leverage creative strategies and provide incentives (e.g., hybrid and flexible work arrangements) to attract and permanently retain staff. With competition for talented professionals growing fiercer by the day, our goal is to make KTC a place where people want to build meaningful, long-lasting careers.

STRATEGIES

- **Increase KTC's visibility on UK's campus and in Kentucky's communities**
- **Develop recruitment methods and outreach strategies that successfully attract diverse professionals**
- **Work across campus to deepen engagement with underrepresented groups**
- **Create programs and financial incentives (e.g.,scholarships, internships) to target and recruit students interested in transportation careers**

FY 2024 | KTC ADVISORY BOARD

The KTC Advisory Board met twice this fiscal year – on December 11 at Malone's Prime Events and on May 13 on UK's campus. The KTC Advisory Board was established by the Kentucky General Assembly in 1984 to assist in policy formation and to provide direction to the Center. The composition and duties of the Board are outlined in KRS 177.375.

The Board consists of nine members appointed by the Governor with the following representatives: the Secretary of the Transportation Cabinet, the State Highway Engineer, the Dean of UK's Pigman College of Engineering, one member each from a list submitted by the Kentucky Association of Counties, the Kentucky County Judge/Executives Association and the Kentucky League of Cities, and three members at large. The Secretary of Transportation serves as chair and the Board meets at least twice per year. Board meetings primarily concern policy matters relating to the Center's technical assistance, research programs and financial plans.

CURRENT BOARD MEMBERS

Jim Gray | Secretary, Kentucky Transportation Cabinet, Chairperson

James Ballinger | State Highway Engineer, Kentucky Transportation Cabinet

Rudy Buchheit | Dean, Pigman College of Engineering, University of Kentucky

Alex Barnett | Harrison County Judge/Executive, Kentucky Association of Counties

Pamela Smith-Wright | Kentucky League of Cities

Casey Ellis | Owen County Judge/Executive, Kentucky County Judges Association

John Dougherty | Louisville Paving, At-Large Member

Mike Law | Scotty's Contracting & Stone, At-Large Member

Brian Billings | ATS Construction, At-Large Member

PROGRAM AREAS

BRIDGE PRESERVATION

Program Manager Sudhir Palle (sudhir.palle@uky.edu)

- Assess methods/materials to extend bridge service lives
- Perform nondestructive testing
- Evaluate concrete and steel protective coatings
- Monitor structure preservation activities

COMMERCIAL VEHICLE TECHNOLOGY & POLICY

Program Manager Andrew Martin (a.martin@uky.edu)

- Assess vehicle and driver regulation policies
- Manage commercial vehicle technology deployment projects
- Support Kentucky's Innovative Technology Deployment (ITD) program
- Evaluate CMV data quality
- Facilitate strategic planning for CMV-focused organizations

CONSTRUCTION ENGINEERING & PROJECT MANAGEMENT

Program Manager Steve Waddle (steve.waddle@uky.edu)

- Improve highway construction project management
- Assess technologies that improve construction efficiency
- Develop construction guidance and risk assessments
- Strengthen knowledge management and workforce development

EDUCATION, PLANNING & DECISION ANALYTICS

Program Manager Reginald Souleyrette (souleyrette@uky.edu)

- Assist KYTC with SHIFT and Strategic Highway Safety Plan
- Assess transportation network performance
- Facilitate long-term planning and investment decisions
- Analyze big data and link complex data sets

EMERGING VEHICLE TECHNOLOGIES

Program Manager Chris Van Dyke (chrisvandyke@uky.edu)

- Analyze the policy implications of electric vehicles (EVs) and connected and automated vehicles (CAVs)
- Assist local governments and KYTC with strategic planning and educational outreach
- Identify opportunities for EV and CAV pilot projects in Kentucky and facilitate their implementation
- Coordinate work on KTC's portfolio of EV- and CAV-related projects

INTELLIGENT TRANSPORTATION SYSTEMS

Program Manager Jennifer Walton (jennifer.walton@uky.edu)

- Leverage strategic planning and novel communication technologies to improve highway safety and efficiency
- Evaluate ITS/Transportation Systems Management and Operations (TSMO) technologies
- Deliver Traffic Incident Management (TIM) training and promote safe TIM policies and practices
- Analyze safety practices and information technology for work zones

MARKETING, MEDIA, & TECHNICAL REVIEW

Program Manager Robin Baskette (robin.baskette@uky.edu)

- Publish reports, posters, and booklets
- Design, build, and maintain customized websites for KTC/KYTC
- Complete editorial reviews of all KTC research
- Graphic design, video production, and photography

OCCUPATIONAL SAFETY & HEALTH

Program Manager Gabriel Dadi (gabe.dadi@uky.edu)

- Analyze agency and industry safety records to detect trends
- Develop guidelines to improve organizational safety and health
- Create tools to build and sustain proactive safety cultures
- Document the safety-related experiences of field personnel

PAVEMENTS, MATERIALS, GEOTECHNOLOGY, & INFRASTRUCTURE ASSESSMENT

Program Manager Kean Ashurst (kean.ashurst@uky.edu)

- Conduct nondestructive pavement forensic analyses
- Evaluate construction methods and asphalt material properties
- Inspect pipes, bridges, and other hazardous locations
- Recommend design solutions and prepare special notes

POLICY, FINANCE, & ECONOMICS

Program Manager Bryan Gibson (bryan.gibson@uky.edu)

- Strengthen project development workflows
- Develop transportation revenue, funding, and budget forecasts
- Organize and facilitate consensus workshops
- Enhance agency knowledge management practices

RESILIENT SYSTEMS

Program Manager Benjamin Blandford (benjamin.blandford@uky.edu)

- Establish guidance to protect transportation assets and improve system resilience
- Identify higher-grade materials for winter road maintenance and pavement markings
- Determine how extreme weather and natural hazards impact transportation systems
- Evaluate pavement striping installation and maintenance practices
- Develop optimized routes for winter weather operations

PROJECT DEVELOPMENT

Program Manager Jeff Jasper (jeff.jasper@uky.edu)

- Assist agencies with all transportation project phases
- Design and deliver technical trainings
- Conduct process improvement studies and develop guidance
- Improve roadway design and roadside safety

SPECIAL PROJECTS & INITIATIVES

Program Manager Rachel Catchings (rachel.catchings@uky.edu)

- Coordinate Center-wide multidisciplinary projects
- Help agencies adopt new technologies
- Establish best practices across multiple transportation domains
- Perform regulatory analysis and legal reviews

STRUCTURES

Program Manager Abheetha Peiris (abheetha.peiris@uky.edu)

- Monitor the structural health of bridges
- Develop high-performance materials to repair infrastructure
- Perform bridge load tests and develop load ratings
- Provide onsite technical assistance with structure repairs

TECHNOLOGY TRANSFER PROGRAM (T2)

Program Manager Martha Horseman (martha.horseman@uky.edu)

- Organize and deliver trainings and conferences
- An FHWA-designated Local Technical Assistance Program
- Administer Kentucky's Safety Circuit Rider Program
- Publish training documents, newsletters, and other materials

TRAFFIC & SAFETY

Program Manager Eric Green (eric.green@uky.edu)

- Apply GIS and statistical modeling in highway safety analysis
- Conduct driving simulation studies and recommend best practices
- Strengthen the resiliency of assets exposed to climate hazards
- Develop user-friendly tools for complex traffic/safety analysis

FY 24 HIGHLIGHTS

SWEET 16 HIGH VALUE RESEARCH AWARD

AASHTO recognized the project, *Best Practices for Highway Project Scoping* as a high-value research project as part of its Sweet 16 competition. The authors distributed one page research briefs at this year's RAC meeting in Columbus, Ohio, and will present at a session at the TRB annual meeting. Congratulations to the authors: Jeff Jasper, Samantha Wright, John Wilcoxson, Robin Baskette and Chris Van Dyke.

The Sweet 16 consists of the top four identified projects from each of the four national AASHTO regions. The national competition emphasizes the benefits of research and implementation strategies by state departments of transportation.

As part of this initiative, researchers examined pre-construction activities and recommended that a detailed project description be prepared which addresses the project purpose and need. Researchers investigated scoping processes for several project types — Capital Improvement Projects, Safety, Asset Management, and Maintenance and Operations — and looked at how scoping should vary based on a project's scale. Guidance developed by researchers encourages project managers to clearly communicate what a project will and will not deliver before it is incorporated into the Highway Plan.

KTC last had a Sweet 16 winner in 2019 with the project *Snow and Ice Removal Route Optimization in Kentucky.* KTC was named as supplemental winner in 2022 with *Integration of Utility Coordination and Highway Design* and in 2023 with *Bridge Project Prioritization.*

UTILIZATION OF UAS (UNCREWED AERIAL SYSTEM) FOR KYTC OPERATIONS AND DRONE PILOT TRAINING

Uncrewed aircraft systems (UAS), or drones, can quickly and safely perform tasks that would expose onsite staff to on-the-job hazards. KYTC has been incorporating drones into its workflows, particularly in bridge maintenance and inspection. Using drones offers many safety benefits by allowing operators to work at a distance from traffic and active construction. However, the technology is changing rapidly and few pilots are certified to fly drones at KYTC. To keep pace with the growing demand for drone usage, researchers from Special Projects and Initiatives; Policy, Finance, and Economics; and the Department of Mechanical and Aerospace Engineering came together to help the Cabinet develop and grow its UAS program in a way that allows for quick response as drone technology changes occur.

Through interviews and an evaluation of organizational structure the research team found many use cases for drones in the Division of Highways as well as in Project Delivery and Preservation. The construction project inspection workflow held the most immediate potential for efficiency gains at the time of research. Drones can map details of a construction project, providing a valuable source of digital project data and furthering KYTC's digital project delivery initiative. This research recommended a drone pilot training program to allow KYTC to have drone pilots across several districts and divisions. The project also recommended UAS data storage, information, and forms be centralized in one location and to allocate a dedicated funding stream for drone equipment. To learn more about the research and KYTC's drone pilots who are working hard to further the UAS program watch the research video summary here: https://www.youtube.com/watch?v=F6ieGrTnXjM

Due to the high demand to certify drone pilots across many KYTC divisions, KTC's Technology Transfer group worked with KYTC drone pilots and the research team to develop a two-part drone training. The collaboration among T2, researchers, and KYTC staff produced an efficient and effective training that is a blend of classroom instruction, self study, and hands-on learning. The pilot course took place on March 19–20, with four additional sessions scheduled for throughout the remainder of 2024. The KYTC Unmanned Aircraft Systems Pilot Training prepares staff to pass their FAA section 107 exam and obtain their pilot certification. The second day of training has more outdoor, hands-on activities where students apply drone technology to their individual responsibilities. New pilots fly their new drone, capture data, and learn how UAS can create efficiencies across construction inspection, design, incident management and other Cabinet processes. To learn more about T2 and register for a training course visit: https://kyt2.uky.edu/training/kytc-unmanned-aircraft-system-uas-pilot-training.

AWARDS AND ACCOLADES

PROJECT DEVELOPMENT

- Jeff Jasper received the NHI Instructor of Excellence 2023.
- Jill Asher presented at a statewide webinar for KYTC on Intersection Control Evaluation.

STRUCTURES

Journal Publications:

- Nadir, W., Kadhim, M.M.A., Jawdhari, A., Peiris, A., and Majdi, A., "Experimental investigation on UHPC NSC composite beams." Structures. 2024, Vol. 60, 105885. https://doi.org/10.1016/j.istruc.2024.105885

Awards:

- Undergraduate research assistant Rachel Barber won the 2024 Maurice A. Clay Award for outstanding graduating senior.

INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

- ESGR (Employer Support of Guard and Reserve) presented KTC with the Pro-Patria Award, which recognizes employers that go above and beyond to support military employees before, during, and after their deployment. Brian Howell nominated KTC while deployed in Djibouti, and KTC was honored to receive the public sector employer award for Kentucky.

COMMERCIAL VEHICLE TECHNOLOGY AND POLICY

- KTC was awarded a contract in partnership with the Kentucky Transportation Cabinet and The Eastern Transportation Coalition to conduct a Mileage Based User Fee (MBUF) Study based on Kentucky's weight-distance tax. The contract value is $149,994.
- KTC was awarded a contract by the International Fuel Tax Association to conduct a facilitated strategic planning process. Candice Wallace and Andrew Martin were the lead authors of the winning proposal. The project was officially kicked off in April 2024. The contract value is $105,029.

Recent Publications:

- Mallory Brown, Andrew Martin, Xiaobing Li, David Leddy, and Jennifer Walton. "Illegal Weigh Station Bypassing." In Transportation Research Record: Journal of the Transportation Research Board (Forthcoming, accepted for publication).
- "Online Instructional Tools for Motor Carriers," Brian Howell, Jennifer Walton, Paul Ross, and Andrew Martin. KTC-24-17.
- "Tire Anomaly Classification System (TACS). Brian Howell, Jennifer Walton, Andrew Martin, Xiaobing Li, and David Leddy." KTC-24-20. (Unpublished)
- "Advancing Universal ID Through Demonstration of Enabling Technologies." Joe Crabtree, Andrew Martin, Jeeyen Koo, and Brian Beaven. KTC-24-22.

COMMERCIAL VEHICLE TECHNOLOGY AND POLICY

Recognitions:

- Brian Howell was recently promoted to the rank of Colonel in the U.S. Army Reserves.
- KTC's CVTP Program and KYTC's Division of Motor Carriers spearheaded the inaugural state programs presentation for Kentucky as part of FMCSA's new Innovative Technology Deployment (ITD) Research Spotlight series in March.
- KTC's CVTP Program created and delivered a presentation for FHWA's National Coalition on Truck Parking.
- KTC's CVTP Program delivered two presentations at the MCSAP/ITD/PRISM in Chicago on April 30 May 2, 2024. Jennifer Walton presented on Kentucky's TPIMS Pilot Study/Truck Parking Efforts and Andrew Martin presented on ITD Performance Measures.

CONSTRUCTION ENGINEERING AND PROJECT MANAGEMENT

Notable Events & Publications:

- In collaboration with T2, facilitated a Formal Partnering Workshop for a KYTC construction project in District 2.
- In collaboration with T2, scheduled delivery of 3rd CPMA for fall 2024.
- Microsurfacing Estimation Program and the Asphalt Estimation Program were finalized and running.
- Assisted in drafting IDIQ (indefinite delivery/indefinite quantity) guidelines for KYTC and obtained FHWA approval. First IDIQ project is scheduled to be let in June.
- In collaboration with Project Development and T2, delivered Pilot Course for Roadside Barrier Installation and Inspection.

Awards and Recognitions:

- Steve Waddle inducted into Kentucky Transportation Hall of Fame.

PLANNING AND TRAFFIC & SAFETY

Award:

- Antwi Boasiako, Eugene, Zhang, Xu, and Chen, Mei won the 2024 Best Paper Award from the TRB Urban Transportation Data and Information Systems Committee (AED20).

Publications:

- Antwi Boasiako, Eugene, Zhang, Xu and Chen, Mei. 2024. "Estimating Urban Arterial Traffic Speed Distributions Using XGBoostLSS," Transportation Research Record, In Press.

- Karimi, Sajjad, Aryan Hosseinzadeh, Robert Kluger, Teng Wang, Reginald Souleyrette, and Ed Harding. "A systematic review and meta-analysis of data linkage between motor vehicle crash and hospital based datasets." Accident Analysis & Prevention 197 (2024): 107461.

Presentations:

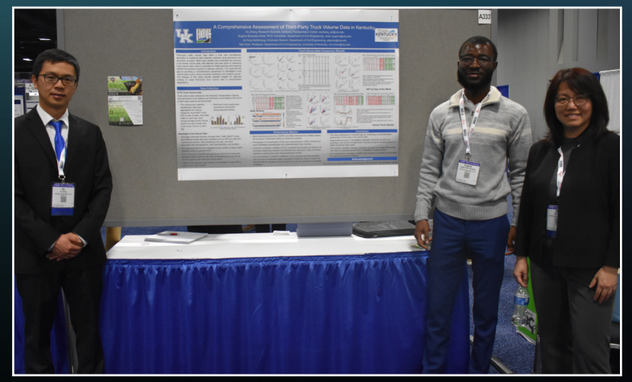
- Zhang, Xu, Antwi Boasiako, Eugene, Gorji-Sefidmazgi, Ali, and Chen, Mei. "A Comprehensive Assessment of Third-Party Truck Volume Data in Kentucky." Poster presented at the 103rd Transportation Research Board Annual Meeting 2024, Washington, D.C.

- Antwi Boasiako, Eugene, Zhang, Xu, and Chen, Mei. "Estimating Urban Arterial Traffic Speed Distributions Using XGBoostLSS." Presented in lectern session at the 103rd Transportation Research Board Annual Meeting 2024, Washington, D.C.

- Rahman, Fahmida, Zhang, Xu, Antwi Boasiako, Eugene, and Chen, Mei. "Utilizing Random Forest Regression in Crash Prediction of Rural Two-Lane Highways." Poster presented at the 103rd Transportation Research Board Annual Meeting 2024, Washington, D.C.

- Wang, Teng. "Strategic Highway Investment Formula for Tomorrow (SHIFT)." Lectern presentation presented at the 26th Chinese Overseas Transportation Association (COTA) TRB Winter Symposium 2024: Washington, D.C.

- Korostina, Daria, Nikiforos Stamatiadis, Teng Wang, and Reginald Souleyrette. "Incorporating Bike/Ped Criteria in Project Ranking and Selection." Poster presented at the Transportation Research Board Annual Conference 2024: Washington, D.C.



POLICY, FINANCE, AND ECONOMICS

TRB:

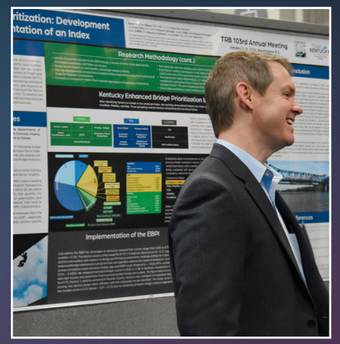
- "Bridge Project Prioritization: Development and Implementation of an Index" (with Chris Van Dyke, Sudhir Palle, Ryan Griffith, and Doug Kreis). Poster presented at the Transportation Research Board Annual Conference 2024: Washington, D.C.

- "Identification and Preservation of Core Competencies and Risk Management" (with Jeff Jasper). Poster presented at the Transportation Research Board Annual Conference 2024: Washington, D.C.

- Bryan Gibson co-presided over two poster sessions at TRB.

Other:

- Candice Wallace attended the ToP Network Annual Gathering in February 2024 (for facilitators).



OCCUPATIONAL SAFETY AND HEALTH

- In April, Josh Withrow, a Transportation Engineer Specialist at KYTC and Digital Project Delivery Lead, successfully defended his Ph.D. dissertation entitled "Impact of Augmented Documentation Workflows on Transportation Agency Asphalt Paving Operations: A Qualitative and Quantitative Study." Dr. Withrow was advised by Drs. Gabe Dadi, Hala Nassereddine, and Tim Taylor and published two papers in leading journals with an additional one under review from his dissertation.

- Drs. Roy Sturgill, Tim Taylor, and Gabe Dadi received a 3rd place Best Poster Award at TRB for their poster entitled "A Review of One Call Operator Membership and Exemptions for State Departments of Transportation."

SPECIAL PROJECTS AND INITIATIVES / T2

- In March, T2, working with Special Projects and Initiatives, conducted the UAS Pilot course in Somerset. This course will be offered at numerous sites across the state.

TECHNOLOGY TRANSFER

- At the TRB Annual Meeting, Dr. Adam Kirk won the best paper award from the TRB Performance Effects Geometric Design Committee. Dr. Kirk also presented a paper on Contextual Roadway Planning and Design.
- In February, Dr. Adam Kirk presented on a national webinar with FHWA on Grant Funding for Local Agencies.
- In February, T2, working with KYTC Division of Construction and Maintenance, organized the Project Delivery and Preservation Conference. Attendance continues to grow, and the conference had over 400 participants. There were 33 breakout sessions.
- In March, Martha Horseman delivered the Work Zone Flagger course with Ron Albritten at the Kentucky League of Cities Risk and Safety Conference.
- T2 partnered with Construction Engineering and Project Management to conduct a Formal Partnering session with KYTC, contractors, and local governments.
- In April, Dr. Adam Kirk and Martha Horseman presented to the Southwest Region of NLTAPA on Kentucky's Road Safety Champion Program.
- At the National Association of County Engineers (NACE) Meeting in April, Dr. Adam Kirk presented on Kentucky's work with SS4A and Martha Horseman presented on the partnership of NACE and NLTAPA.
- In May, T2, working with Construction Engineering and Project Management and Project Management, conducted the pilot Roadside Barrier Installation and Inspection course. This course will be held around the state at District Offices.
- T2 hosted the Kentucky Safety Summit, alongside the Kentucky Office of Highway Safety and the Secretary's Office of Safety. There were over 350 participants and 40 breakout sessions held over three days.
- T2 is working with Traffic and Safety to organize the Road Safety and Simulation Conference in October 2024.

INTRODUCTION TO KTC'S NEW PROGRAM AREA: RESILIENT SYSTEMS

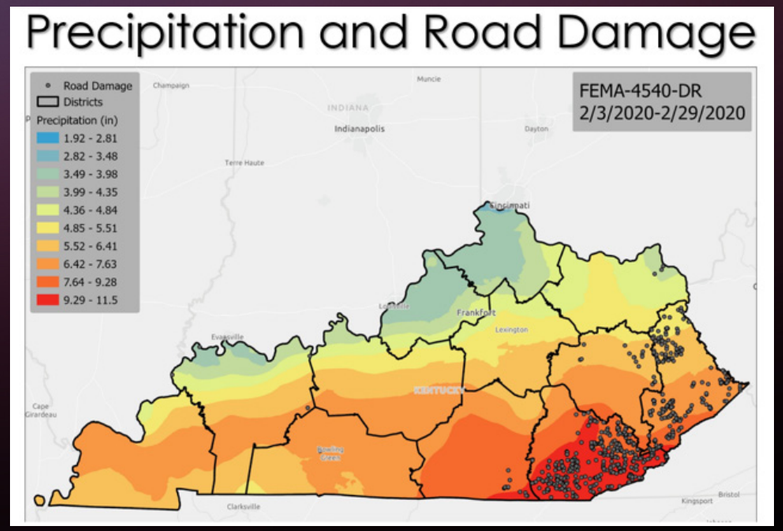
The Resilient Systems program, led by Ben Blandford, studies vulnerabilities in transportation systems and evaluates innovative strategies and technologies to make transportation assets more resilient over their entire service lives. Transportation infrastructure was designed to handle a broad range of climate impacts based on historical observations and trends, but less is known about how systems will perform amid the increasing frequency of extreme weather events. Disruptive events — whether they stem from natural disasters, infrastructure failures, or other emergent challenges — pose a threat to the safety, reliability, effectiveness, and sustainability of transportation infrastructure and operations. By integrating principles of sustainability, risk management, and systems engineering, KTC aims to fortify Kentucky's infrastructure against vulnerabilities, ensuring safety, reliability, and continuous service during both routine and unforeseen disruptions.

Key research topics include resilience planning, modeling the relationship between weather events and infrastructure damage, system and route optimization, and evaluating materials that come into contact with concrete and asphalt.

Areas of focus for the Resilient Systems program include:

Disaster Response and Recovery: Developing frameworks for rapid response and recovery after disasters to minimize downtime and economic impact. A recent project is snow and ice removal route optimization, a GIS-based tool that identifies routing for trucks and shows where resources are needed.

Sustainable System Design: Implementing cutting-edge technologies and practices to create systems that are both eco-friendly and capable of adapting to changing societal needs. Project examples include "Developing Criteria to Inform Resilience Improvement Project Selection and Prioritization" and "Transportation Resiliency Improvement Plan."



RESEARCH SPOTLIGHT SERIES: FOSTERING COLLABORATION AND INNOVATION AT KTC

The KTC Research Spotlight Series is an ongoing seminar series that showcases the cutting-edge research and developments taking place across the Center's program areas. Launched with the goal of enhancing collegiality and fostering interdisciplinary collaboration, this lecture series provides a space for researchers, staff, and stakeholders to come together, share insights, and explore innovative approaches to solving the complex challenges facing Kentucky's transportation systems and infrastructure.

KTC holds one session per month during the fall and spring semesters. Each session focuses on a specific program area within KTC, offering an in-depth look at the latest research initiatives, methodologies, and findings. Topics range from emerging technologies in transportation and infrastructure resilience to sustainability practices and advances in traffic safety. By featuring a broad spectrum of topics, the series encourages cross-pollination of ideas and fosters new approaches to problem solving that cut across traditional disciplinary boundaries.

Key objectives of the Research Spotlight Series include:

- Promoting Knowledge Sharing: Providing a forum for KTC researchers to present their work, exchange insights, and receive feedback from peers and collaborators across the organization.

- Encouraging Interdisciplinary Collaboration: By highlighting the intersections between different program areas, the series creates opportunities for researchers from multiple fields to identify common challenges, share resources, and work together on important initiatives.

- Building Organizational Cohesion: The series helps strengthen a sense of community within KTC by fostering an open dialogue, mutual support, and intellectual curiosity, ultimately promoting a culture of innovation and excellence.

- Supporting Career Development: Junior researchers and new staff members are given the chance to present their work and engage with senior colleagues, enhancing their professional development and contributing to the broader organizational knowledge base.

- Through these seminars, KTC continues to build on its commitment to advancing research excellence while encouraging a collaborative culture that thrives on the exchange of ideas. The Research Spotlight Series not only illuminates the groundbreaking work being done at KTC but also sparks new collaborations that drive further innovation and success.

KTC RESEARCH VIDEO SERIES

This year KTC's marketing team began producing video summaries of SPR projects as an innovative way to deliver research results. The team chose several projects to highlight and plans to continue this effort in the upcoming fiscal year. Each video is as different as each project, and the process of writing and producing video summaries is being continually refined. The four projects chosen to be summarized in video format are:

- SPR 21-612 Digital Project Delivery

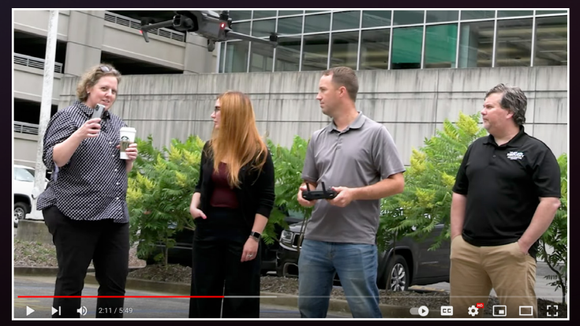
- SPR 22-615 Evaluating the Use of a Near-Miss Reporting Program to Enhance Employee Safety Performance

- SPR 22-621 Strengthening the Deployment of Uncrewed Aerial Systems (UAS) at KYTC

- SPR 24-651 Digital Project Delivery for Construction

Video Link: Digital Project Delivery

Video Link: Digital Project Delivery Construction



Video Link: Strengthening the Deployment of Uncrewed Aerial Systems (UAS) at KYTC:

Video Link: Evaluating the Use of a Near-Miss Reporting Program to Enhance Employee Safety

RESEARCH PUBLICATIONS

REPORT NUMBER	AUTHORS	TITLE/UK KNOWLEDGE LINK
KTC-23-22	Kreis, Wallace, Gibson, McCormack	Fiscal Year 2021 FHWA-536 Report for the Kentucky Transportation Cabinet
KTC-23-11	Jasper, Wolfe, Baskette, Ross, Van Dyke	2+1 Roadway Design Guidance Update
KTC-24-03	Dadi, Wilcoxson	Evaluating the Use of a Near-Miss Reporting Program to Enhance Employee Safety Performance
KTC-23-10	Lammers-Staats, Staats	Evaluation of Durable Pavement Striping
KTC-24-05	Ross, Green, Blackden, Van Dyke, Agent	Kentucky Traffic Collision Facts 2022 Report
KTC-23-07	Ross, Green, Blackden, Van Dyke, Agent	Analysis of Traffic Crash Data in Kentucky 2018-2022
KTC-24-13	Souleyrette, Wright	2023 Final Report for Databases in the 2022 Traffic Records Improvement Plan: Facilitating the Development of Projects to Attain the Goals in the Implementation Plan for the 2022-26 Traffic Records Strategic Plan
KTC-24-06	Marks, Jasper	Innovative Methods to Strengthen Internal KYTC Communications
KTC-24-15	Wallace, Wilcoxson	Facilitated Identification of KYTC Performance Measures
KTC-24-18	Jasper	Safety Evaluation of 2+1 Roadway Design
KTC-24-11	Paris, Marks, Gibson	KYTC Department of Aviation Aircraft Maintenance Technician (AMT) Program Optimization
KTC-24-17	Fields, Green, Zhang	Pilot Study on Improving Crash Data Accuracy in Kentucky through University Collaboration
KTC-24-21	Howell, Walton, Ross, Martin	Online Instructional Tools for Motor Carriers

RESEARCH PUBLICATIONS

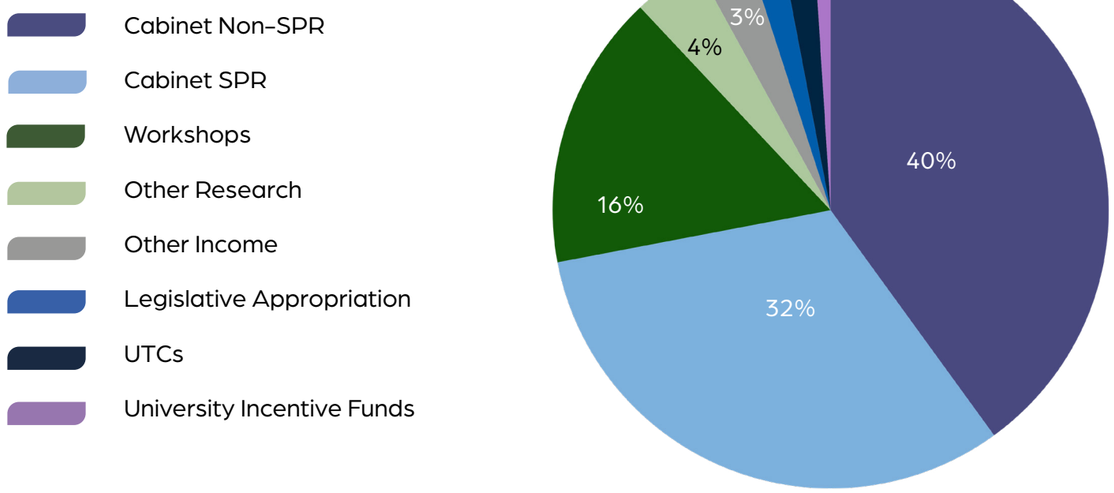
REPORT NUMBER	AUTHORS	TITLE/UK KNOWLEDGE LINK
KTC-24-31	Souleyrette, Wang, Staats, Stamatiadis, Tzamakos	Estimation of Benefits from Pedestrian and Bicycle Improvements
KTC-24-07	Catchings, Marks, Smith, Wallace, Van Dyke	Strengthening the Deployment of Uncrewed Aerial Systems (UAS) at KYTC
KTC-24-19	Sandlin, Asher, Jasper, Stamatiatis, Catchings, Van Dyke	Impact of the New Context Functional Classifications for KYTC
KTC-24-12	Wells, Palle	Inspection Training Course on Bridge Preventive Maintenance Activities
KTC-22-09	Asher, Caudill, Thompson, Jasper, Van Dyke, Wright, Gibson, Clay-Young, Wallace	Guidebook for Project Management
KTC-24-33	Dadi, Nassereddine	Development of a SMS Rollout Plan and Evaluation
KTC-24-29	Souleyrette, Wang, Staats, Stamatiadis,	Addressing Multimodal Transportation Needs Through Complete Streets Implementation
KTC-24-27	Sun, Ashurst	Developing Guidelines for the Use of Lightweight Materials in Culvert Preservation

FINANCIAL REVIEW

Although the Center receives most of its funding from the KYTC, researchers often compete for and win awards from the NCHRP, FHWA, and from other organizations. Another major source of income is the workshops and trainings T2 delivers throughout Kentucky. A small portion of KTC's funding comes from legislative appropriations and university incentive funds.

FY 2024 FUNDING SOURCES	
Cabinet Non-SPR	$4,623,810
Cabinet SPR	$3,643,454
Workshops	$1,828,321
Other Research	$442,759
Other Income	$407,161
Legislative Appropriation	$290,000
UTCs	$200,105
University Incentive Funds	$104,563
TOTAL	**$11,540,173**

FY 2024 EXPENDITURES BY FUNDING SOURCE

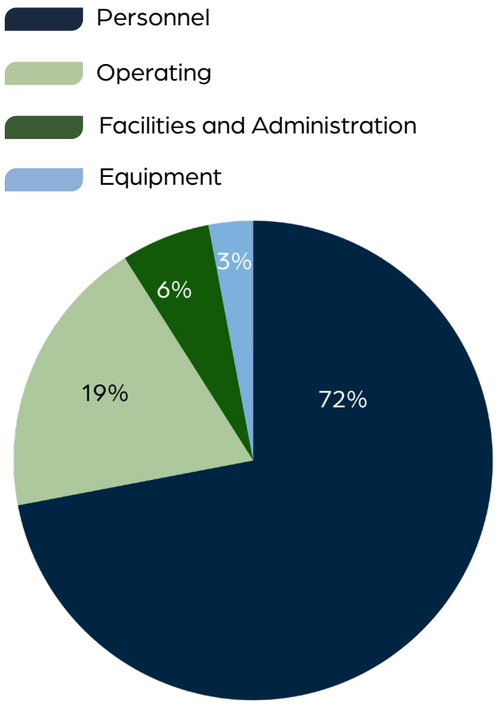


FY 2024 EXPENDITURES

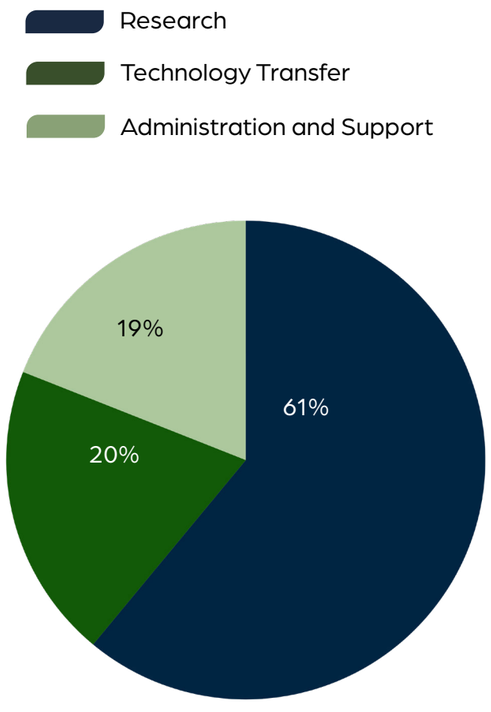
	RESEARCH	ADMINISTRATIVE & RESEARCH PROGRAM SUPPORT	TECHNOLOGY TRANSFER	TOTAL EXPENDITURES
Personnel	$ 5,519,756	$ 1,558,564	$ 1,194,785	$ 8,273,106
Operating	$ 488,324	$ 563,002	$ 1,124,344	$2,175,670
Equipment	$ 399,550	$ 0	$ 0	$ 399,550
F & A	$ 630,556	$ 61,290	$ 0	$ 691,846
TOTAL PROGRAMS	**$ 7,038,187**	**$ 2,182,857**	**$ 2,319,129**	**$ 11,540,173**

KTC classifies expenditures by category and functional group. The three functional groups are research projects, administrative support, and technology transfer. The four categories are personnel, operating costs, facilities and administrative expenses (paid to UK), and equipment. Looking at expenditures by category, nearly 72 percent of the funds KTC spends go toward personnel salaries, while much smaller percentages are dedicated to operating and equipment costs. In terms of functional groups, 61 percent of expenditures are directed toward research projects and 20 percent to technology transfer. Nineteen percent of KTC's expenditures support research and administrative costs.

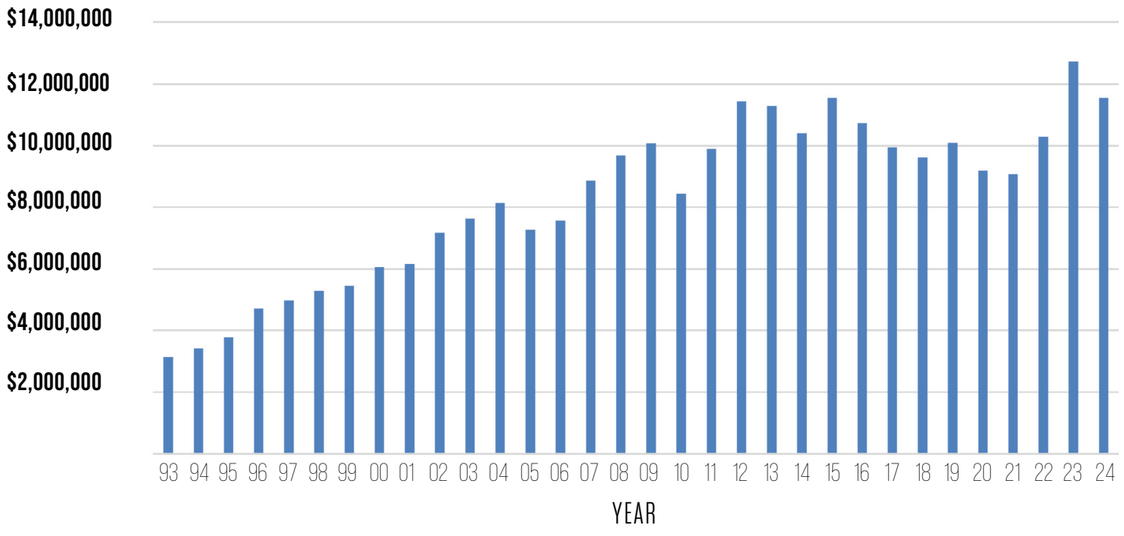
EXPENDITURES BY CATEGORY



EXPENDITURES BY FUNCTION



ANNUAL BUDGET EXPENDITURES TOTALS SINCE FY 1993



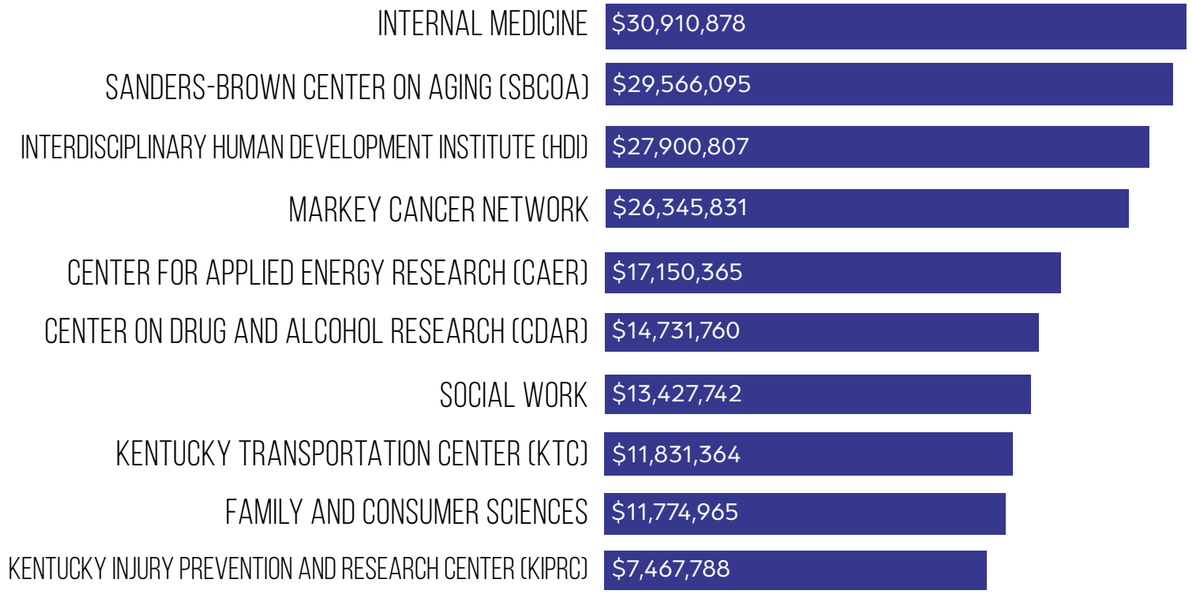
PIGMAN COLLEGE OF ENGINEERING DEPARTMENTAL AWARDS FY 2024

COLLEGE OR UNIT DEPARTMENT	NUMBER OF AWARDS	NUMBER OF SPONSORS	NUMBER OF PIS	TOTAL AWARDS($)	% OF TOTAL($)
KENTUCKY TRANSPORTATION CENTER (KTC)	**59**	**15**	**17**	**$ 11,831,364**	**26.96%**
INSTITUTE FOR SUSTAINABLE MANUFACTURING	3	3	3	$ 8,035,093	18.31%
MECHANICAL ENGINEERING	20	10	9	$ 5,417,217	12.34%
INSTITUTE FOR DECARBONIZATION & ENERGY	13	9	4	$ 4,281,921	9.76%
ELECTRICAL AND COMPUTER ENGINEERING	25	14	10	$ 3,747,332	8.54%
COMPUTER SCIENCE	13	6	6	$ 2,890,858	6.59%
MINING ENGINEERING	14	10	4	$ 2,446,003	5.57%
BIOMEDICAL ENGINEERING	8	5	3	$ 2,346,281	5.35%
CIVIL ENGINEERING	8	7	7	$ 1,823,198	2.70%
CHEMICAL AND MATERIALS ENGINEERING	15	11	10	$ 1,183,401	0.01%
			TOTAL	$ 43,890,857	

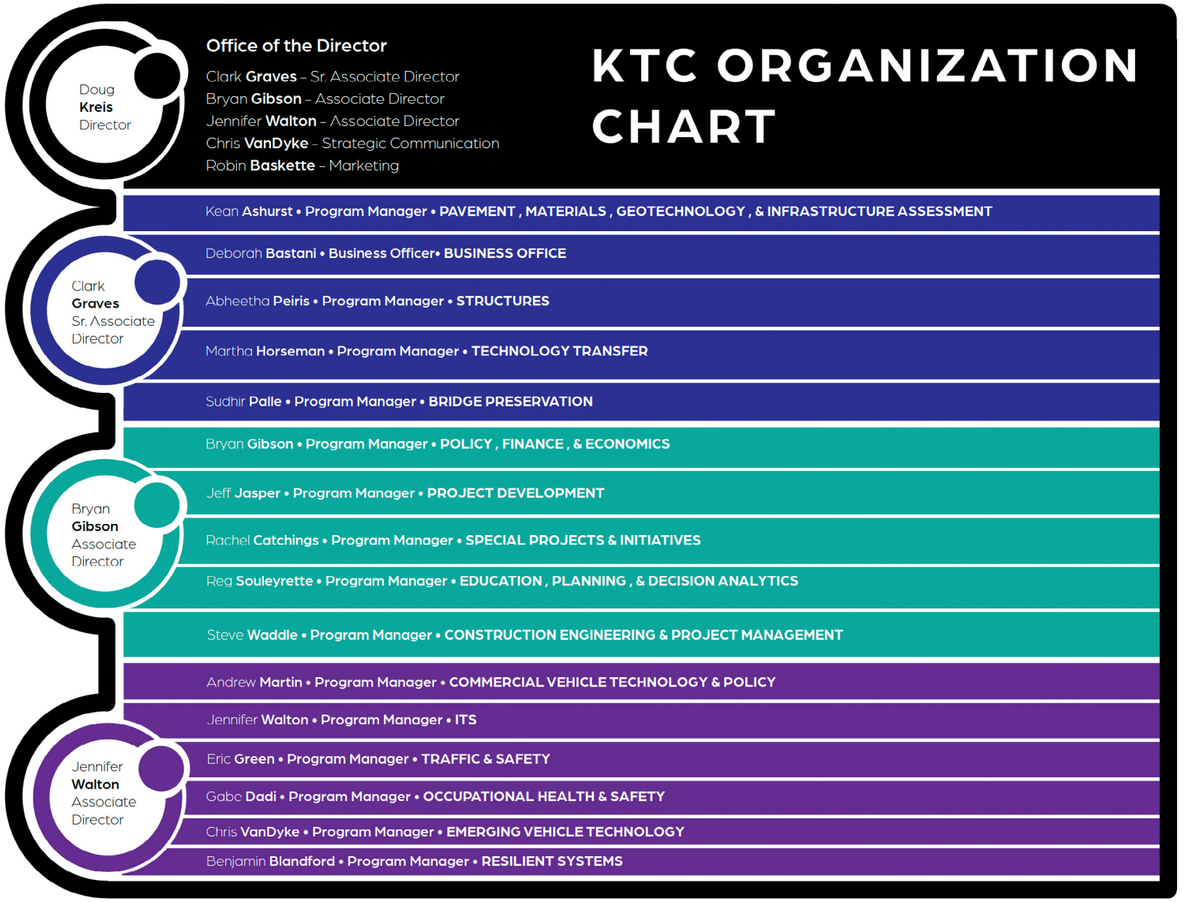
FINANCIAL REVIEW

Although expenditures dipped slightly in FY 2024, with over $11.8 million in project awards, KTC secured more external funding than any other unit in the Pigman College of Engineering and accounted for just under 27 percent of the college's award dollars. Among all units at UK, KTC ranked 8th in research awards.

TOP 10 UK CAMPUS RESEARCH AWARDS FOR FY 2024



KTC ORGANIZATION CHART



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RESEARCH SUMMARIES

RESEARCH NOTE

SPR 23-643 MARCH 2024

BEST PRACTICES FOR MAINTENANCE OF TRAFFIC ON INTERSTATE PAVEMENT REHABILITATION PROJECTS

THE CHALLENGE

State transportation agencies around the country are increasing their focus on pavement rehabilitation projects due to aging roadway infrastructure. These types of projects upgrade existing infrastructure to meet the current levels of vehicle use. KYTC increased the amount of spending on interstate pavement rehabilitation from $162 million in 2022 to over $250 million in the first 9 months of 2023. The Cabinet has a goal of keeping 50 percent of interstate pavement in good condition, meaning the number of pavement rehabilitation projects will continue to increase. The biggest challenge with these projects is maintaining adequate lanes of traffic in each direction. A good maintenance of traffic (MOT) plan is needed in order to ensure the safety of the traveling public and construction staff. KTC researchers explored the MOT approaches used by the Cabinet and other DOTs to find the best practices.

Principal Investigators

Catherine Keathley, P.E.
Research Engineer

Ryan Griffith, P.E.
Research Engineer

Rachel Catchings, P.E., MSCE
Program Manager

METHODS

- Summarized MOT guidance being used on interstate pavement rehabilitation projects at KYTC
- Surveyed other state DOTs and summarized their approaches to MOT
- Interviewed construction personnel at KYTC to gather their ideas for improving MOT

FINDINGS

The most common traffic control configuration mentioned by interviewees was a single lane closure. The standard practice is to use a full-width shoulder as a through lane to maintain the existing number of lanes while work is performed on adjacent lanes. Median crossovers and chutes were also discussed as temporary traffic control configurations, though chutes were less preferred. Difficulties arise when the existing shoulder is not wide enough to use as a through lane, or has not been built with full pavement depth and cannot structurally maintain the traffic. Designers may also face challenges creating maintenance of traffic (MOT) at interchanges due to the width of mainline bridges, lateral clearance of crossroad structures, and ramp lengths. Construction staff described positive experiences with portable queue warning alert systems (PQWAS) that deliver real-time traffic information.

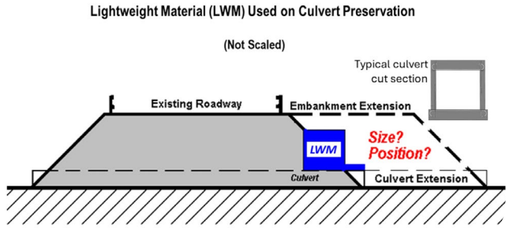
RECOMMENDED MOT BEST PRACTICES

1. On interstate pavement rehabilitation projects with an AADT < 25,000, consider the use of daytime lane closures for construction activities.
2. Collect and measure asphalt cores of the existing shoulder within the project limits during the Project Development phase if MOT plans involve shifting traffic to the shoulder. *(Note: Could apply to all multi-lane divided highways.)*
3. During the Project Development phase, decide if the long-term benefits of installing full-depth pavement on shoulders outweigh the initial cost of installation. *(Note: Could apply to all multi-lane divided highways.)*
4. In all instances where an existing shoulder has a rumble strip and the temporary traffic control designates the shoulder for use as a through lane, mill the rumble strip and replace with asphalt so the pavement can withstand temporary traffic loads.
5. During the Project Development phase, measure the existing structure width to determine if adequate width exists to maintain proper traffic lane widths during MOT phases.
6. Evaluate if traffic control and site safety improvements are visible to all motorists by piloting the use of sequential lighting on temporary traffic control barrels in lane closure tapers. *(Note: Could apply to all highway projects requiring nighttime lane closures.)*
7. In addition to the portable queue warning alert system currently used by KYTC, pilot the use of signage to limit the reduced speed limit to an active work zone while workers are present.
8. Participate in American Traffic Safety Services Association (ATSSA), whose core focus is advancing roadway safety.
9. Develop and implement law enforcement officer (LEO) traffic control training.

RESEARCH NOTE

SPR 22-625 MAY 2024

DEVELOPING GUIDELINES FOR THE USE OF LIGHTWEIGHT MATERIALS IN CULVERT PRESERVATION



THE CHALLENGE

Transportation agencies often preserve existing culverts during highway embankment construction projects. During road widening projects, placing additional fill above existing culverts causes higher loads to be placed on the culvert. Lightweight materials (LWM) can be used as fill material to mitigate the impacts of higher loads. KTC was asked to provide guidance on LWM installation profiles for culverts that can help practitioners during highway widening projects.

Principal Investigators

Charlie Sun, Ph.D., P.E.
Research Engineer

Kean H. Ashurst Jr., P.E.
Program Manager

KYTC Contributors

Erik Scott
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Division of Structural Design

METHODS

- Conducted scaled-down lab tests to simulate culvert behavior under different loading conditions
- Tested various lightweight materials' performance under the influence of loading conditions
- Performed over 12,000 numerical simulations to analyze culvert behavior, leading to empirical formulas that design LWM profiles above culverts
- Developed a user friendly web application to help practitioners design the LWM installation profile for culverts

FINDINGS

Researchers lab-tested the impacts of dry play sand, brown silty clay, Pudgee, Geofoam, cellular concrete blocks, and lightweight aggregates on the maximum bending strain of culvert ceilings and walls. Pudgee resulted in greater culvert ceiling strain reductions compared to Geofoam. The proximity of the material to the culvert's top surface showed a strong effect; placing LWM's closer to the top surface leads to greater strain reductions. In most installation profiles, Pudgee and Geofoam increased culvert wall strain. Cellular concrete and lightweight aggregates generally increased both culvert ceiling and wall strains.

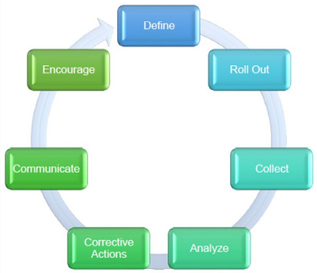
RECOMMENDATIONS

The proposed design method uses a systematic approach for assessing culvert loads and load ratios and achieves optimal load reduction on designated regions. The web based application has a user friendly interface and features that make it a valuable tool for all engineers, researchers, and transportation professionals who work on LWN installation profile design. Users specify details such as the existing fill height, culvert size, and soil properties. The output includes multiple option sets for parameters like fill height above LWM, thickness of LWM, length of LWM, and distance between culvert top and LWM bottom. Future efforts can focus on few areas to improve LWN installation profile design including investigating the behavior of new LWMs and innovative construction techniques.

RESEARCH NOTE

SPR 22-615 AUGUST 2023

EVALUATING THE USE OF A NEAR-MISS REPORTING PROGRAM TO ENHANCE EMPLOYEE SAFETY PERFORMANCE



THE CHALLENGE

Improving safety performance by tracking safety incidents is an outdated and reactive approach. A more modern tool now being used by safety and health programs is to implement a near-miss reporting program. Employees at all levels of an organization are encouraged to report close calls or near misses that do not result in an incident or crash, yet may be an early indicator of a safety issue. Most construction companies, including construction professionals at KYTC, have implemented procedures for reporting near-misses. KYTC has rolled out a Safety Opportunity Reporting tool, but the challenge is encouraging all employees to report near misses. This research helped enhance near miss reporting and sought to understand barriers to reporting among KYTC employees.

Principal Investigators

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METHODS

- Performed a literature review to find factors leading to a lack of reporting
- Examined the near-miss programs at other transportation agencies
- Surveyed KYTC district maintenance superintendents
- Examined survey responses to look for common themes that prevent reporting
- Developed a near miss evaluation tool to measure continuous quality of the program

FINDINGS

About 60% of the survey respondents have experienced a near miss once or twice, and while most consider it extremely important to report, 20% don't know how to report a near-miss and nearly 30% are not aware of KYTC's web-based reporting tool. Many of the barriers that lead to a lack of near-miss reporting stem from the management level. Survey responses pointed out that often, no corrective action is taken after reporting a near-miss. KYTC's web-based reporting tool is not well known, and thus, not easily accessible to all employees. To improve reporting rates, management must train staff about how to report a near-miss and become more responsive to correcting conditions that cause near misses and hazards.

RECOMMENDATIONS

The Secretary's Office of Safety as well as district safety coordinators, superintendents, and maintenance crews will be involved in implementing the results of this study. KTC recommends the following actions:

- Employees of every level must receive training about the importance of near-miss reporting, how to report an incident, and receive incentives and recognition for their efforts.
- Management should provide access to the web-based reporting tool on employee KHRIS accounts, which are used to perform many other routine tasks.
- KYTC should adopt a Safety Opportunity Reporting Framework for executive-level communication.
- The success of the Safety Opportunity Report tool should be tracked, measured and publicized using the new BOOTS Boosting Occupational Outcomes in Transportation Safety Management System.
- Management should inform employees of what happens once they provide information. Stress that reporter anonymity is maintained.
- Future work should concentrate on high-engagement training and consider employee literacy, language barriers, and the amount of time required to report incidents.
- KYTC should assess the effectiveness of all safety activities to ensure that additional tasks are making a difference.

RESEARCH NOTE

SPR 22-57-2 JUNE 2022

EXTENDED WEIGHT SYSTEMS PAVEMENT ANALYSIS

THE CHALLENGE

In 1986 Kentucky established its Extended Weight Coal or Coal Byproducts Hall Road System (EWCHRS). This road network includes roads on which more than 50,000 tons of coal or coal byproducts were transported. Kentucky has also introduced extended weight (EW) systems for petroleum products and metal commodities. Trucks are allowed to operate above posted weight limits on the EWCHRS if the carrier pays annual fees. Despite efficiency gains from running heavier loads on fewer trucks, vehicles that exceed weight limits can damage pavement and reduce its service life. To help KYTC improve the support of commodity-specific EW routes, KTC researchers studied the relationship between pavement age and condition on EWCHRS routes.

Principal Investigators

P. Gayle Marks, Ph.D.
Senior Research Scientist

Jon Wilcoxson, P.E.
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Bryan Gibson, Ph.D.
Program Manager

METHODS

- Reviewed EW laws and methods used to estimate damage to pavement caused by heavy truck traffic
- Examined pavement data, including Pavement Distress Index (PDI) and International Roughness Index (IRI), during the study period of 2008 to 2020
- Calculated Percent EW Exposure - the measure of length and time a pavement section was part of the system during the study period (excluding 2016, due to a lack of EW details for that year).
- Modeled the relationship between PDI values and pavement age for routes on the EWCHRS to estimate service lives

FINDINGS

Researchers compared pavement distress of EWCHRS segments to state primary roads that had a similar AADT. Routes on the EWCHRS that had at least 20% EW exposure over the study period demonstrated a pavement life decline by one and a half to two years (or 11.8% to 13.2%). Transporting commodities using more trucks with less weight would employ more drivers, register more vehicles, and very likely cause less damage to infrastructure and reduce maintenance costs.

RECOMMENDATIONS

KYTC can adopt the following data management strategies to improve support of existing and future EW networks.

- Offer maintenance data on pavements and bridges in a form so costs can be allocated based on vehicle consumption
- Utilize more comprehensive structural testing to examine pavement thickness design loads
- Document annual EWCHRS data in an electronic database instead of pdf form
- Expand WIM data collection to EW and include the type of truck in AADT counts
- Improve timing on filing transportation plans on roads near mines so that pavement damages are reported

KTC RESEARCH NOTE

SPR 22-619 APRIL 2024

GUIDEBOOK FOR PROJECT MANAGEMENT

THE CHALLENGE

Project development involves all activities required to advance a transportation project from its initial concept to construction. The task of delivering projects successfully on schedule and within budget is becoming more demanding for Kentucky Transportation Cabinet (KYTC) project managers due to staff turnover and the subsequent loss of institutional knowledge. To address this issue, KYTC and the Kentucky Transportation Center (KTC) collaborated to produce a comprehensive project management guidebook tailored for KYTC project managers responsible for developing transportation projects. This guidebook synthesizes the knowledge of experienced project managers and integrates best practices in project management.

Principal Investigators

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Associate Director

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Research Associate

Candice Wallace, Ph.D.
Principal Research Scientist

METHODS

- Reviewed project management resources available at other state transportation agencies
- Evaluated KYTC's existing project management resources
- Interviewed and requested feedback from KYTC project managers on tools that would help them deliver projects more successfully

FINDINGS

The knowledge gained from other state transportation agencies as well as KYTC project managers was incorporated into a guidebook that documents strategies for navigating a variety of project types: capital improvement, safety, asset management, and maintenance. The guidance can be used by project managers to develop and follow an effective project workflow.

RECOMMENDATIONS

The project management guidebook produced here is also published on KYTC's Highway Knowledge Portal website as a series of 31 articles. This information is public facing and can not only be accessed by entry and mid-level project managers, but by any KYTC staff member. The web based format allows for changes in policy and practices to be updated quickly.

KTC: ADVANCING TRANSPORTATION THROUGH INNOVATIVE RESEARCH AND EDUCATION

KTC addresses the dynamic and emerging challenges faced by our stakeholders through research and education that enhances the safety,efficiency, and sustainability of transportation systems.

KTC RESEARCH NOTE

SPR 22-629 APRIL 2024

IMPACT OF THE NEW CONTEXT FUNCTIONAL CLASSIFICATIONS FOR KYTC

THE CHALLENGE

Transportation agencies have typically tied decisions about road designs to a facility's functional classification. Functional classification categorizes roads according to the type of service they provide and their position in the transportation network, but the classification does not speak directly to the needs of multimodal users such as pedestrians and, cyclists. NCHRP 855 – An Expanded Functional Classification System for Highways and Streets formally introduced the concept of context classification on a national level. Context classification offers an improved indicator of mobility and access while considering all modes of travel and users, and offers flexibility in designing more appropriate solutions. This research documents the impacts of context classification on KYTC practices and forwards recommendations on how KYTC can use an expanded classification system.

Principal Investigators

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Jeff Jasper, P.E.
Program Manager

Chris Van Dyke, Ph.D.
Program Manager

METHODS

- Reviewed and summarized national research recommendations and context-related guidance from other states
- Reviewed and documented KYTC's current use of and reliance on context and functional classification
- Provided recommendations for KYTC's implementation of the five contexts (rural, rural town, suburban, urban, and urban core) into the project development processes

FINDINGS

KYTC relies on the functional classification system in many of their processes. Although the expanded context classification is not widely used, KYTC considers the following contexts for highway design: rural, rural town, suburban, urban, and urban core. This expanded classification system supplements the functional classification system. The research identified several KYTC processes and practices where a more deliberate incorporation of context classification would be beneficial.

RECOMMENDATIONS

Broaden KYTC's use of the five contexts described in the Green Book and NCHRP Report 1022 – rural, rural town, suburban, urban, and urban core, and coordinate implementation with other recent KYTC initiatives (e.g., Complete Streets, Safe System Approach, Human Factors in Design, Intersection Control Evaluation).

Implement the broader use of context classification in three phases:

PHASE 1:
- Complete network-level context classification.
- Encourage the deliberate use and incorporation of context classification into planning and design processes at the project level.

PHASE 2:
- Introduce context classification agency-wide.
- Determine which agency processes can benefit from using context classification.

PHASE 3:
- Fully implement, following the release and adoption of the 8th editions of the Green Book.

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RESEARCH NOTE

SPR 23-644 AUGUST 2023

INNOVATIVE METHODS TO STRENGTHEN INTERNAL KYTC COMMUNICATIONS

THE CHALLENGE

Effective internal communication strategies are an asset to any organization. Poor communication practices can lead to inefficiencies, frustrated staff, and employee disengagement. Organizations too often do not give internal communications the attention they deserve. Developing a comprehensive communications plan provides an organized framework for internal processes, gives employees a shared sense of purpose, clarifies responsibilities, maps information flows, boosts productivity, and forges trust among employees. KTC researchers examined strategies KYTC can use to develop a strategic communications plan and strengthen their internal communications.

Principal Investigators

P. Gayle Marks, Ph.D.
Senior Research Scientist

Jeff Jasper, P.E.
Program Manager

METHODS

- Defined internal communications and described its function within state transportation agencies
- Performed a literature review on communication models and the relationship between leadership and organizational communication
- Reviewed best practices for internal communications within state transportation agencies.

FINDINGS

The best practices for improving internal communications require buy-in from leadership. Organizations benefit from treating communication as a core competency and from leadership fostering a culture of open communication. Before developing a strategic plan, a communication audit can set benchmarks, examine how work processes impact communication, identify communication issues, and collect data on the flow of information. Part of the audit should include employee feedback with a focus on what's important to employees and what their needs are. A good communications plan will include goals, target audiences, communication strategies, action items, and a method to evaluate the plan's success.

RECOMMENDATIONS

The research team recommended that KYTC conduct a communications audit as a first step to strengthen internal communications at the agency. Once a communications plan is in place, KYTC can introduce a toolkit to help build employee engagement. Specific tactics that can strengthen internal communications at KYTC are:

- Treat communication as a core competency
- Improve mentorship opportunities to bridge knowledge gaps
- Minimize clutter by keeping information in one place
- Create opportunities to build employee engagement throughout the agency

RESEARCH NOTE

SPR 20-580 SEPTEMBER 2023

INSPECTION TRAINING COURSE ON BRIDGE PREVENTIVE MAINTENANCE ACTIVITIES

THE CHALLENGE

Most State Departments of Transportation (DOTs) lack the funding needed to replace bridges that have exceeded their design lives. In response, these agencies are using cost-effective bridge preventive maintenance strategies to prolong bridge service lives. Preventive maintenance (PM) programs slow the deterioration of bridges and improve their functional condition. Because the Kentucky Transportation Cabinet (KYTC) has become reliant on preventive maintenance, they are in need of training resources to educate current and future bridge inspectors. KTC researchers were asked to develop training modules for KYTC supervisors, field crews, inspectors, and contractor personnel.

Principal Investigators

Danny Wells
Transportation Technician

Sudhir Palle, P.E.
Program Manager

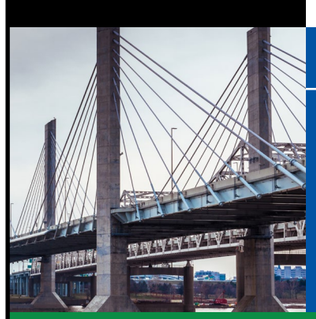
METHODS

- Performed a literature review on asset management, bridge maintenance, bridge preservation, and PM
- Reviewed training programs on bridge PM activities from other state DOTs
- Compiled the knowledge from a previous project: *A Programmatic Approach to Long-Term Bridge Preventive Maintenance*
- Interviewed nine KYTC District Bridge Engineers about district-level maintenance practices

FINDINGS

KTC has developed training based on eight bridge PM activities and plans to implement the modules for bridge inspectors:

- Bridge Deck Patching
- Clean and Paint Pier Caps and Abutments
- Clean and Seal Bearings
- Bridge Deck Expansion Joints
- Bridge Deck Sealing
- Bridge Washing
- Erosion and Sediment Control
- Spot Painting



RECOMMENDATIONS

The training modules focus on understanding contract documents and specific tasks involved in the inspection process. Modules were developed as standalone sessions using Powerpoint, and can be easily combined to suit specific assignments.

KYTC has successfully implemented several PM activities, with many combined under one contract. The new training modules can benefit many stakeholders and other professionals in the transportation industry.

RESEARCH NOTE

SPR 20-588 JUNE 2023

MERGING MULTIPLE EXISTING GEOTECHNICAL DATABASES

THE CHALLENGE

Geotechnical information such as data on rock falls, landslides, soil and rock properties, and engineering characteristics is critical for KYTC's planning, design, and maintenance processes. Thorough knowledge of geotechnical information during the design phase is crucial for optimizing designs, minimizing costs, and ensuring the safety and performance of highways. The data sources that KYTC uses are scattered across KYTC District and Central offices, the Kentucky Transportation Center (KTC) and the Kentucky Geological Survey (KGS). KTC researchers created a comprehensive geotechnical database that consolidated multiple data sources and could be easily accessed by all KYTC staff.

Principal Investigators

Charlie Sun, Ph.D., P.E.
Research Engineer

Brad Rister, P.E.
Program Manager

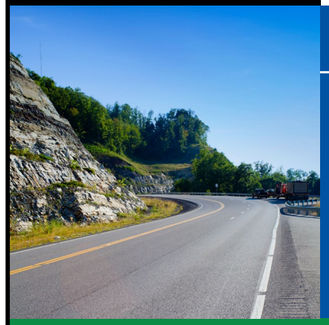
Eileen Grady
Research Scientist

METHODS

- Used the arcGIS suite, Microsoft Visual Studio and Microsoft SQL Server to build and manage the database and continually collect field data
- Developed a geotechnical data collector app to collect data in the field
- Created a rock fall rating app and landslide hazard rating system

FINDINGS

All apps and tools can operate in an offline mode which allows users to access and collect data in locations with limited or no Internet connectivity. Once users regain Internet connectivity the data collected can be synchronized and viewed within arc GIS or arc GIS online. At that point the user can overlay data on maps, perform spatial analysis, and make comparisons to historical geotechnical data.



RECOMMENDATIONS

The new database facilitates field data collection and data analysis as well as strengthens the Cabinet's geotechnical investigations, risk assessments, and mitigation strategies. The results of this project promote the efficient use of resources and encourage proactive risk management. Continuous updates, improvements to the user interface, and integration with other geotechnical tools and resources will ensure the application remains accessible and valuable to a wide range of stakeholders.

RESEARCH NOTE

SPR 22-618 MARCH 2024

ONLINE INSTRUCTIONAL TOOLS FOR MOTOR CARRIERS

THE CHALLENGE

Commercial motor carrier customers must obtain appropriate licenses and credentials and pay associated taxes prior to operating on Kentucky highways. The Kentucky Transportation Cabinet (KYTC) provides a web-based Motor Carrier Portal that offers information and online applications to meet these requirements, but customers have increasingly resorted to calling into KYTC's motor carrier help desk. High call volumes and limited customer service personnel resources have led to increased help desk delays for motor carrier customers. To improve customer service, KYTC asked the Kentucky Transportation Center to determine the feasibility of creating online instructional videos to assist customers using the Motor Carrier Portal.

Principal Investigators

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Program Manager

METHODS

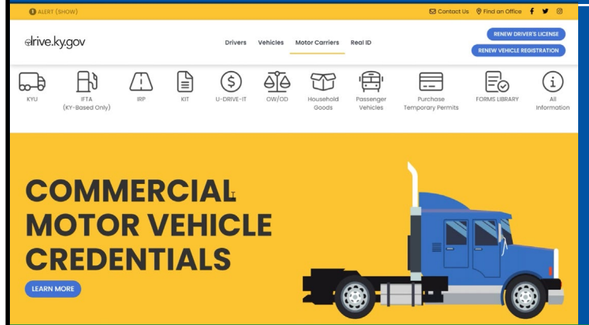
- Investigated other state transportation agencies' use of online videos for motor carrier customers
- Collected and analyzed over 305,000 customer service records to better understand the tax categories and key themes most associated with call volumes by frequency and duration
- Interviewed KYTC customer service representatives to learn about common customer challenges and key themes

FINDINGS

The motor carrier help desk received both its highest call volume and longest call times for calls involving KYU and IRP. These calls most often involved questions related to account registration and reactivating an existing account. The study advisory committee was then able to prioritize three topics for instructional videos.

IMPLEMENTATION

KTC successfully developed three priority instructional videos for KYTC including (1) IRP Requirements and Account Creation, (2) KYU Account Creation, and (3) KYU Account Reactivation.



RECOMMENDATIONS

- KYTC should evaluate the feasibility of providing instructional videos on IFTA, its third highest tax category by call volume, to further reduce motor carrier customer calls.
- KYTC should evaluate the feasibility of providing instructional videos for non-motor carrier customers calling into the Division of Driver Licensing, which receives 59% of all customer calls.

RESEARCH NOTE

SPR 22-623 MARCH 2023

PEDESTRIAN AND BICYCLE IMPROVEMENT SCORING METHOD FOR SHIFT – 2024

THE CHALLENGE

State transportation agencies have limited funding to deliver projects that address the needs of all users, including pedestrians and bicycles. The Strategic Highway Investment Formula for Tomorrow (SHIFT) program is used by KYTC to allocate project funding in an impartial and objective manner. However, SHIFT evaluates projects based on five core variables that allow for 70% of the score – congestion, safety, benefit-cost ratio, asset management, and economic growth, and has not been able to address pedestrian and bicycle improvements in its scoring formula. SHIFT allocates points within their scoring system that address local needs, thus increasing the chances for funding for Metropolitan Planning Organizations (MPOs) and Area Development Districts (ADDs). The Kentucky Transportation Center proposed a method of scoring pedestrian and bicycle improvements for SHIFT - 2024, so that local transportation systems can receive funding that benefits all users.

Principal Investigators

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Program Manager

METHODS

- Reviewed funding allocation practices adopted at other state DOTs
- Experimented with applying three different methodologies to the SHIFT scoring system

FINDINGS

Researchers reduced the number of available points for the SHIFT program's five main components, kept the point values for MPOs and ADDs, and added five points each for pedestrians and bicycle improvements. The new proposed scoring system awards more points to existing bicycle and pedestrian facilities that are in good condition and adjusts scoring of pedestrian and bicycle projects.

RECOMMENDATIONS

Along with revised scoring methods, KTC proposed a list of general project types that can be used to classify pedestrian and bicycle improvements, shown in the table below.

• New shared use path (off road)	• Add sharrows
• New shared path (on road)	• Add bike amenities (e.g., parking, signing)
• New bike path (off road)	• New pedestrian trail
• New bike lane (buffered)	• New sidewalk
• New bike lane (separated)	• Improve sidewalk (e.g., add buffer, repair condition connectivity, widen, add curb extensions)
• New bike lane (shoulder)	• Add crossing island or streetscape
• Improve bike facility (e.g., add a buffer, widen the lane, pave shoulders, etc.)	• Add signalization for pedestrians
• Add signalization for bikes	• Add pedestrian amenities (e.g., wayfinding, signing)

These categories can improve benefit cost analysis and inform continual refinement of the SHIFT process. Integrating more detailed descriptions of bicycle and pedestrian projects will allow for more systematic evaluation of projects.

RESEARCH NOTE

SPR 22-630 FEBRUARY 2024

PILOT STUDY ON IMPROVING CRASH DATA ACCURACY IN KENTUCKY THROUGH UNIVERSITY COLLABORATION

THE CHALLENGE

The information used for traditional safety analysis relies heavily on structured tabular data from collision reports. While this data source is rich in facts, it sometimes lacks the level of descriptive detail needed to confidently determine the characteristics of a traffic collision. Crash narratives supplement coded data and give a better account of incidents, however, conducting manual reviews of the 150,000+ crash reports was not feasible. To address this challenge, reviewers examined approximately 8,000 crash narratives from 2020 using a proprietary web-based quality control tool to find patterns of miscoded data and discrepancies between the structured tabular data and the unstructured crash narrative text.

Principal Investigators

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METHODS

The research team developed a web-based quality control tool to maximize the efficiency of the data coders who read though crash narratives. The tool classified each crash according to several attributes. The results of the manual review were compared to the existing tabular data and also used to train a machine learning algorithm to automatically classify the crashes according to the attributes of interest. A similar, newer model based on Google AI technology was also employed to perform the classification task.

FINDINGS

Some attributes are more clearly defined than others, such as travel direction, crash types (median crossover, angle crash, and roadway departure) and location. Attributes related to behavior-based factors (impaired, aggressive, and distracted driving) have a high rate of disagreement when only looking at human factor codes versus including the contextual details of the narrative.

RECOMMENDATIONS

- It is beneficial to include the contextual details of crash narratives alongside traditional crash data while doing safety analysis
- Safety professionals across Kentucky will be given access to the additional data set based on crash narrative text
- The tools and methodology developed in this project can continue to be implemented to increase the accuracy of future crash data
- The tools can continue to improve by integrating the latest advantages in AI technology as they are developed

RESEARCH NOTE

SPR 22-613 JUNE 2024

SPOT, ZONE, AND OVERCOAT PAINTING OF STEEL BRIDGES

THE CHALLENGE

Preventive maintenance, particularly corrosion prevention for steel, is employed by many transportation agencies to extend the service lives of bridges. Placing protective coatings represents a major portion of bridge maintenance expenditures and many agencies have backlogs of steel bridges in need of painting. When bridge coatings and patinas age they deteriorate, leaving the underlying steel unprotected and susceptible to corrosion. Repainting an entire bridge takes time and comes at considerable cost. To more effectively address localized coating and patina failures there are three maintenance options for KYTC to consider: spot painting, overcoating and zone painting. KTC researchers were asked to accumulate guidance and best practices to determine the situation where each maintenance method can be used.

Principal Investigators

Sudhir Palle, P.E.
Program Manager

KYTC Contributors

Tom Matthews

METHODS

- Interviewed KYTC subject matter experts to determine their maintenance painting methods
- Reviewed other state DOT best practices for coating repair and bridge painting
- Detailed the steps in the contract bridge painting process

FINDINGS

Currently KYTC relies on remove-and-replace maintenance painting for bridges. This method might not be the most cost effective when performing maintenance. Optimizing the planning of bridge projects will require more investigation into candidate bridge painting projects and choosing the ideal maintenance painting option – spot painting, overcoating, zone painting, or a combination of methods. Practitioners can use the KYTC BrM database to screen candidate bridges and program projects based on criticality of repair, current coating conditions, number of bridges impacted, and life-cycle years per unit coating area.

RECOMMENDATIONS

KYTC should consider performing some spot and zone painting projects using in-house personnel, with the exception of cases that involve lead-based coatings. Since coatings would need to be stored at district garages prior to their use, KYTC would need to develop guidance on how to inspect and handle coating materials. Special notes should be written that describe preparing the jobsite, inspection, field operations, waste handling, monitoring surface conditions, applying the coatings, and cleanup.

RESEARCH NOTE

SPR 22-621 MARCH 2024

STRENGTHENING THE DEPLOYMENT OF UNCREWED AERIAL SYSTEMS (UAS) AT KYTC

THE CHALLENGE

Uncrewed aerial systems (UAS), or drones, can quickly and safely perform tasks that would expose on-site staff to on-the-job hazards. Many divisions within KYTC are interested in using drones for a variety of tasks. The Cabinet has incorporated drones into their workflows, particularly in bridge maintenance and inspection, however, limited equipment inventory exists and few pilots are certified within KYTC. Since drone technology is fast moving and ever changing, the Cabinet would like to further develop and grow their UAS program in a way that allows for quick response as drone technology changes occur.

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KYTC Contributors

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Luke Turner, KYTC

METHODS

The Kentucky Transportation Center worked with the Cabinet to assess existing drone equipment and its usage. Regular interviews with drone pilots and meetings with Central Office and District staff revealed that drones could be used widely and produce efficiencies in many divisions. Researchers also surveyed other state transportation agencies to learn about UAS guidance and practices adopted in other states.

FINDINGS

KYTC interviews and an evaluation of organizational structure revealed many use cases for drones in the Division of Highways as well as in Project Delivery and Preservation. Currently, drones are used for monitoring and inspecting construction projects, geotechnical site tracking, bridge inspection, and emergency management. The construction project inspection workflow is the most complete process. It begins with the request, moves through flight scheduling and data retrieval, and ends with data processing using multiple software tools that aid data visualization and sharing. The way that drones map details of a project can assist with the Digital Project Delivery initiative - drones are another tool to gather and use digital project data.

RECOMMENDATIONS

- Form a UAS oversight committee comprised of KYTC staff across multiple KYTC divisions
- Hold regular peer exchanges among districts to inform on drone uses and technology
- Hold an in-person annual meeting of KYTC stakeholders, industry partners and agency officials from adjacent states
- Establish a dedicated funding stream for new UAS-related equipment and software
- Develop and deliver training for drone pilots
- Establish job position descriptions for UAS program leads
- Introduce post-flight data processing procedures and centralized storage solutions
- Centralize UAS information, policies, forms, and materials

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KTC addresses the dynamic and emerging challenges faced by our stakeholders through research and education that enhances the safety,efficiency, and sustainability of transportation systems.

Identification and Preservation of Core Competencies and Risk Management
SPR 19-574

Principal Investigators

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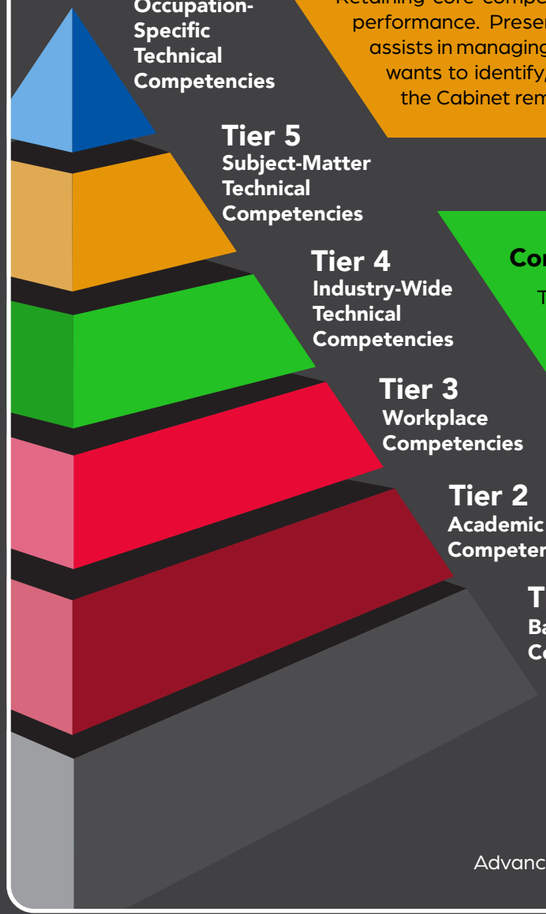
Steve Waddle, PE (Program Manager) • Chris Van Dyke, PhD, PMP (Program Manager
Robin Baskette, MA (Program Manager) • Doug Kreis, PhD, PE, PMP (Director)

SAC CHAIR

Jarrod Stanley, (KYTC Research Coordinator)

The Challenge

Retaining core competencies in-house is critical for an organization's success and performance. Preserving core competencies mitigates organizational risks and assists in managing the activities of consultants and contractors. KYTC leadership wants to identify, develop, and maintain a set of core competencies to ensure the Cabinet remains able to fulfill its mission.



Competency Tiers

The competency pyramid describes the knowledge and skills an employee should already have or be in the process of learning. The base of the pyramid starts with basic competencies such as professionalism and interpersonal skills. Moving up to the top tiers, those competencies are described as subject matter related and occupation specific. While this research focused on Tier 6 – the competencies tied to each job function, researchers also documented Tiers 4 and 5. Tier 6 competencies were given a risk rating indicating the impact on safety, resources and compliance if the competency did not exist. Core Competencies are those that have both a high risk ranking and are designated as core by KYTC leadership.

Advancing Transportation Through Innovative Research and Education

Research Method

- Performed literature review of core competencies and risk management practices used at other transportation agencies.
- Department of Highways-Wide technical competencies were identified (Tier 4). These are core competencies that KYTC staff need to deliver a highway network consistent with the Cabinet's Mission Statement.
- Researchers conducted interviews and focus groups with subject-matter experts across 19 Branches, Divisions, and Offices to identify the knowledge, skills, and abilities required to generate major work products and deliver services.
- Using this information, researchers drafted Tier 5 and 6 competencies which were vetted by KYTC subject matter experts.
- Subject-matter experts then completed a qualitative risk assessment for each Tier 6 competency that accounted for factors such as safety, quality, time, expense, programmatic fiscal impact, and compliance and how the loss of a competency would impact the organization.

Core Competency Guidebooks

After completing interviews and focus groups, researchers developed guidebooks for each Division, Office, or Branch. Guidebooks document competencies for each technical job role and the qualitative risk rankings assigned by subject-matter experts. The study of core competencies was performed for the following KYTC Divisions, Branches, and Offices:

Construction
Construction Procurement
Environmental Analysis
Equipment
Geotechnical Services
Highway Design
Office of Highway Safety
Incident Management
Maintenance Materials
Permits
Planning
Professional Services
Program Management
Right of Way
Structural Design
Traffic Operations
Utilities and Railroad Coordination

The Guidebooks will be presented to KYTC leadership to help inform their decision making about organizational improvements. Methods to mitigate and manage risk to improve efficiency have been proposed, such as building redundancy, training, and other ways to ensure that core competencies remain in the organization.

Recommendations

KYTC leadership will be part of determining which core competencies are essential to the organization. For core competencies that are deemed essential, KYTC must make efforts to ensure they are maintained in-house. Future efforts can be aimed at training to improve core competencies and at methods to retain core competencies. Implementing management of core competencies agency-wide will improve efficiency in project delivery and other processes across KYTC.

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