In 2010, we developed a vision to describe what we wanted to achieve by the year 2015. For the past five years, that vision, contained in the paragraphs below, has served us well, guiding the development of our goals, objectives, and strategic plans. We are now looking ahead and developing a new vision—our “2020 Vision”—which will guide us through the remainder of the decade. That 2020 Vision, which is currently under review, will be included in our 2016 Annual Report.

**Customer Satisfaction and Customer Relationships**
The Kentucky Transportation Center (KTC) has developed and implemented tools for measuring our customers’ perceptions regarding the quality and value of the products and services we provide. These tools are consistently utilized for all projects, regardless of who the client is. Feedback provided by these tools is scrutinized on a regular basis to identify improvements that can be made in policies and/or procedures.

**Research Excellence / National Prominence**
KTC enjoys a strong national reputation in selected, high-priority areas of research and technology transfer. KTC researchers are widely known for their subject matter expertise, group facilitation skills, effective communications, and project management skills. KTC’s technology transfer professionals are nationally recognized for excellence in information delivery and workforce development. This reputation is reflected in strong name recognition at all applicable national and regional meetings and conferences.

**Size of Program and Diversity of Funding Sources**
The size of KTC’s research and technology transfer program has grown substantially over the past five years, primarily due to the identification and cultivation of new funding sources (federal, state, local, and private-sector) and the growth of non-SPR (State Planning and Research) funding. The Center has strategically targeted areas of research and technology transfer that are important to the Kentucky Transportation Cabinet (KYTC) and to the nation. KYTC receives substantial benefits from having direct access to KTC’s research results and technology transfer resources. The SPR program remains strong and vital.

**Work Environment / Employee Satisfaction**
KTC is a rewarding and enjoyable place to work. Employee retention is high, as is employee morale. KTC provides opportunities and support for all employees to continue learning and to grow professionally throughout their careers. Exceptional employee performance is recognized and rewarded. Employees are highly motivated and highly productive. Co-workers treat each other with courtesy and respect. The workforce includes a strong and increasing presence of minorities and women.

**Implementation and Value of Research**
Tools and processes have been put in place to promote, facilitate, and track the implementation of research results. Implementation is a priority for KTC and is accomplished through a team effort, involving practitioners, researchers, and technology transfer professionals. Implementation is considered from the earliest stages of each research project. The benefits resulting from the implementation of research findings are well-documented and well-disseminated. This information is used to promote the value of transportation research and technology transfer programs both within Kentucky and nationally.

The full version of the Vision can be found on our website at [www.ktc.uky.edu/vision.html](http://www.ktc.uky.edu/vision.html)
As Director of the Kentucky Transportation Center, it is my pleasure to present to you our Annual Report for the 2015 calendar year. Throughout 2015, we have had the privilege of working with many outstanding partners to carry out our mission, i.e., providing services to the transportation community through research, technology transfer, and education. In all of our efforts, we are guided by our vision of exemplary customer service, research excellence and national prominence, program growth and diversified funding sources, a delightful work environment, and research products that result in high-value implementation.

In fiscal year 2015, we brought in over $12 million in sponsored project awards, which is the highest total in our 35-year history. This ranked us number one in the College of Engineering and number four across the entire University. Our total program expenditures for the fiscal year were just over $11.5 million, which also reflected an all-time high. The Center’s funding provided support for over 50 full-time staff, more than 30 temporary employees, and nine faculty members. In addition, 38 students were employed by the Center in 2015, providing those students with vital funding support and practical, real-world work experience.

We continue to value our unique relationship with the Kentucky Transportation Cabinet and our role as their “research arm.” Throughout 2015, we worked closely with the Cabinet’s Innovation Engineer to improve management of the research program, streamline administrative processes, and heighten the visibility of and appreciation for the research program throughout the Cabinet. Key initiatives in 2015 included the identification and implementation of performance measures for the research program and the development of a Research Project Tracking System.

In close partnership with UK’s Department of Civil Engineering, we continue to play a vital role in the activities of the federal University Transportation Centers (UTC) program. Specifically, we are working closely with the Southeastern Transportation Center, a safety-focused consortium led by the University of Tennessee, and the NuRail Consortium, focused on rail transportation and led by the University of Illinois.

Our Technology Transfer Program, which is designated as Kentucky’s Local Technical Assistance Program (LTAP) by the Federal Highway Administration, provided over 320 training sessions in 2015, training 8,200 individuals. Over the past five years, our LTAP leads the nation in the number of training hours provided and the number of people trained.

The notable achievements of KTC faculty and staff in 2015, including publications, presentations, journal articles, committee selections, etc., are too numerous to mention. One, however, is particularly worthy of note. In July, the Kentucky Automated Truck Screening (KATS) project, conducted in partnership with the Kentucky Transportation Cabinet, was presented with the “President’s Award for Research” from the American Association of State Highway and Transportation Officials (AASHTO).

Within this report, you will find many examples of the exciting work going on here at KTC. I invite you to spend some time reviewing the information presented here. As always, we welcome your questions, comments, and suggestions on how we can best serve the citizens of our great Commonwealth.

Joe Crabtree, Ph.D., P.E.
BRIDGE END SETTLEMENT EVALUATIONS AND PREDICTIONS

Differential bridge end settlement refers to the bump at the bridge ends. Many research institutions and state transportation agencies have investigated settlement and developed methods to minimize its impacts and to eliminate the bump. Most previous work — conducted by KTC and other research institutions — has scrutinized the problem on a micro level, or case-by-case basis, and put forward new methods to eliminate or minimize the effects at specific locations.

Comparatively less work has modeled the life-cycle risks associated with settlement or has analyzed potential risks during project development. Conversely, the current project adopts a macro-level focus and will develop a predictive settlement model based on historic data obtained from a wide range of Kentucky roads and bridges. Model inputs will include project characteristics, such as design, geologic conditions, and geographic region. Once complete, the settlement model will give development stakeholders a tool to identify the most effective methods of historic design and construction for a given project based on its specific characteristics. Project data collection will involve gathering and integrating bridge plan data, Bridge Management System (PONTIS) records, and visual inspection logs. The resulting model will be a user-friendly tool that guides decision makers through the design process.

CURRENT PROJECTS
1. Safety Concepts for Workers from an OSHA Perspective
2. Effective Utility Coordination: Application of Research and Current Practices
3. Effective Practices for Establishing Contract Completion Dates for Highway Projects
4. Design-Build and Alternative Technical Concepts Process
5. Project Scoping to Improve Project Cost and Schedule Performance
6. Use of Mobile IT Devices in the Field for Design, Construction and Asset Management
7. Renovation of the Construction Guidance Manual and Resources
8. Streamlined Project Closeout for KYTC Construction Projects
Public-private partnerships (P3s or PPPs) offer the public sector agencies an innovative way to execute critical projects they would otherwise be unable to fund. Once a P3 has been established, the public and private sectors will collaborate to finance, develop, or maintain transportation infrastructure. As the demand for transportation infrastructure continues to rise, budgets have declined. Therefore, the Kentucky Transportation Cabinet (KYTC) can learn from other state transportation agencies that have experience with implementing P3 programs. The aim of KYTC is to identify optimal strategies to move forward with these partnerships. To establish a comprehensive understanding of how P3s function, this study itemized the benefits and drawbacks as well as the types of legislation that have been used to facilitate their implementation. This study conclusively demonstrated that P3s have become more widely used in recent years to procure needed transportation infrastructure projects around the United States. Policymakers should remain attentive of the benefits and risks when deciding the appropriateness of a P3 for a given project. Extensive private sector involvement carries risk, and policymakers must identify these and weigh possible drawbacks before entering into a P3 agreement.

**CURRENT PROJECTS**

1. Cost Benefit Analysis: Applications and Future Opportunities
2. Development of Knowledge Management Strategies
3. Boom and Bust Cycles: Making Smart Infrastructure Investments
4. Development of an Integrated Framework for Safety and Mobility Analysis
5. Marketing and Economic Development Analysis for the Maysville-Mason County Port Authority
6. Kentucky Petroleum Marketers Association Industry Study
COLLECTING COMMERCIAL VEHICLE TAXES AND FEES USING ITS TECHNOLOGY

The Kentucky Transportation Cabinet (KYTC) has received funds from several recent federal grants to install automated screening systems at weigh stations around the state. After successfully implementing a prototype of the Kentucky Automated Truck Screening (KATS) system at the Boone County Weigh Station, KYTC applied for funds to install them at other weigh stations. KTC has assisted KYTC with the installation of these systems around the state. As a result, every month KATS systems document over 1 million commercial vehicles passing through Kentucky.

KYTC has asked KTC to examine the KATS systems’ observation data and to identify which carriers are not paying appropriate taxes and fees. KTC is currently developing strategies to pinpoint and catch violators, estimate potential revenues from collections, identify legal barriers to collection, and determine implementation costs and labor costs. To accommodate required changes to the Division of Motor Carriers’ workflow, KTC must develop a method of documenting the procedural changes needed in the Division of Motor Carriers, Road Fund Audits, Office of Information Technology, and KYTC Call Center. KYTC personnel plan to use KTC’s findings to maximize the utility of data that KATS systems generate.

CURRENT PROJECTS
1. Collecting Commercial Vehicle Taxes and Fees Using ITS Technology
2. Synthesis of Available 511 Services and Other Non-Governmental Traveler Information Systems
3. Vehicle License Plate Study
4. Implementation, Monitoring, and Maintenance of Kentucky Automated Truck Screening at 12 Sites: I-71 Southbound Boone County, I-75 Northbound and Southbound Laurel County, I-75 Northbound Scott County, I-75 Southbound Kenton County, I-64 Westbound Rowan County, I-64 Eastbound Shelby County, I-65 Northbound Simpson County, I-24 Eastbound and Westbound Lyon County, KY 9 Southbound Carter County, and US 41 Southbound Henderson County.
5. Commercial Vehicle Information Systems and Networks (CVISN) Administrative and Technical Support
6. CVISN Data Quality Analysis
7. CVISN-related Training for Commercial Vehicle Enforcement
8. CVISN Project Evaluation and Performance Measures Development
FEDERAL RESEARCH TASK 211 — MONITORING EXPERIMENTAL DECK WATERPROOFING SYSTEMS ON THE OHIO RIVER BRIDGE PROJECT

As part of its work on the I-65 cable-stayed bridge structure, KTC’s Bridge Preservation Group oversaw application of the membrane, a spray-on thin film polymer coating. The Pavements, Materials, and Geotechnical Group executed the subsequent placement of the wearing course of rubberized asphalt directly over the membrane. The Bridge Preservation group work documented the steps required to apply the membrane, which included:

- Sampling and characterizing coating materials
- Measuring ambient/surface conditions
- Preparing the surface of the deck concrete and barrier wall edges
- Applying the concrete primer
- Mixing and applying the membrane
- Reviewing quality control documents related to coating thickness
- Monitoring the membrane cure times
- Applying the tack coat, which bonds to the asphalt, and monitoring relevant variables (e.g., tack coat temperature and the thickness and rate of application)
- Placement of the wearing surface (Figure 1)

The Bridge Preservation Group also placed moisture sensors under the membrane to determine how effective the membrane-polymer asphalt system was at keeping underlying concrete deck dry. The Pavements, Materials and Geotechnical Group performed other work related to the placement of the polymer asphalt. Activities included:

- Monitoring asphalt plant operations
- Recording ambient conditions
- Observing the transit of material from the plant to the jobsite
- Establishing onsite laydown and rolling temperatures
- Recording quality control findings
- Performing in-situ density tests
- Analyzing the permeability and density of compacted samples with laboratory tests

Figure 1. Workers applying the spray-on membrane to the primed deck concrete.

Figure 2. Spreading the polymer asphalt over the membrane during paving operations.
BRIDGE PRESERVATION
Ted Hopwood, Program Manager

- Monitoring asphalt application
- Determining pavement thickness, the amount of time required for placement, and quantities used (Figure 2)

KTC’s fieldwork began in October 2015, with researchers monitoring test patches on different structures. Work continued until crews had finished with the polymer deck placement (December 2015). The Bridge Preservation and Pavements, Materials, and Geotechnical Groups will collaborate on a report that documents the placement of the waterproofing system on the I-65 Abraham Lincoln Bridge. This report will summarize lessons learned, which KYTC can leverage on future projects to assist with the installation of waterproofing membranes.

CURRENT PROJECTS: BRIDGE PRESERVATION
1. Nondestructive Technology for Bridge Evaluation
2. Improved Joint Materials and Details
3. A Programmatic Approach to Long Range Preventive Maintenance
4. Assessment of Deteriorated Structural Concrete to Provide Durable Repairs
5. Long-Term Corrosion Protection of Bridge Elements
6. Use of Bridge Element Level Condition Rating Data to Determine Effective Maintenance Activity Life Cycles
7. Strain Gaging of Uplift Bearing Links on the I-65 JFK Bridge
8. AASHTO NTPEP Concrete Coatings Test Program
9. Spot Painting to Extend Highway Bridge Coating Lives

CURRENT PROJECTS: PAVEMENTS, MATERIALS AND GEOTECHNICAL
1. Density and Intelligent Compaction
2. Steep Slope Rock Channel Linings
3. Geosynthetically Confined Soil and Integrated End Bents
4. Bridge Deck Reinforcing Steel Cover Verification GPR
5. Coring and Evaluation of Bridge Decks
6. Construction Joint Failure: Synthesis of Past Work
7. MEPDG Implementation
8. Pavement Durability (RAP)
9. Lab Testing of Geogrid Materials
10. Bridge Deck Rapid Inspection Using Multi-GPR
11. Mobile Lidar Applications for Collecting Bridge Heights
12. Mobile Lidar Applications for QA/QC of Pavement Grades.
Kentucky was one of the eight states selected for Proof of Concept pilot for Round 4 of the SHRP2 Implementation Assistance Program. As part of this, KTC is assisting KYTC with pilot testing a suite of reliability analysis tools developed by several SHRP2 projects. The Center’s research team, through collaboration with KYTC engineers located in the central and district offices, as well as with the local MPOs, identified four test sites: I-471 corridor, I-71/75 & I-275 junction area, US-31W in Hardin County, and US-231/US-231X (Scottsville Road) corridor in Bowling green.

The tools being tested can be used to evaluate the reliability and wider economic benefits of highway improvement projects. They can also assist with establishing guidance on incorporating reliability performance measures into transportation planning and programming. The objective of this research is to use data for project decision support. The research team has collected data on infrastructure geometric configuration; traffic control; and speeds from GPS-based probe vehicles, Bluetooth devices, and fixed location speed sensors. Data on weather and traffic incidents have also been gathered, in locations where they are salient factors. Diagnostic analysis of current travel time reliability performance is underway.

CURRENT PROJECTS
1. Collection and Analysis of 2013-2014 Travel Time Data
2. Methodology Update for Estimating Volume to Service Flow Ratio
3. Southeastern Transportation Center: Big Data
4. Planning Study 26: Develop A Highway Inventory Data Quality Control Scheme
5. FRT 208, SHRP2 IAP: Pilot Testing of Reliability Data and Analysis Tools
6. KLS Engineering: Strategies for Using GIS in Advancing Highway Safety
7. SPR 16-527: Integrating Roadway Data with Crash Data While Optimizing Segmentation
IMPACTED PIER-COLUMN RETROFIT USING CATSTRONG CARBON FABRIC

On October 21st 2015, a semi-trailer truck traveling south on the William H. Natcher Parkway, veered off the road and impacted a pier-column of the overpass bridge on Elrod road (114B00057N) in Warren County, KY. The impact caused cracking and spalling of concrete in the column as well as cracking on the pier cap.

Needing a rapid retrofit due to the approaching winter season, the Kentucky Transportation Cabinet (KYTC), in cooperation with KTC, proposed the use of CatStrong Uniaxial and Triaxial Carbon Fabric (UCF and TCF) to retrofit the impacted bridge pier-column and pier cap. Due to the degree of strengthening required, CatStrong UCF 120 fabric, which can resist a minimum of 120,000 pounds of force per 1-ft wide section, was selected as the primary wrap to confine the column. The Structures Program at KTC analyzed and designed the retrofit in addition to overseeing the retrofit construction. The KYTC District 03 bridge crew, which had prior training and experience in the application of CatStrong Carbon Fabric, performed the retrofit construction.

It took six workdays to finish the retrofit, and the project was completed on November 23rd 2015, approximately a month after the impact. The coordinated efforts of personnel within KYTC, KTC, and the University of Kentucky enabled project setup and implementation to be carried out in a time-sensitive manner while achieving the desired level of success.

CURRENT PROJECTS
1. Load Rating Bridge Size Culverts
2. Bridge Load Testing vs. Bridge Load Rating
3. Rapid Bridge Repair Using High Performance Materials
4. Bridge Deck Rapid Repair
5. FRP for Bridge Substructure Retrofit
6. Truss Bridge Rehab Cost/Tools
7. Adjacent PPC I-Beams Bridge with High Performance Materials
8. Temperature Movement in Bridges
KTC’s Technology Transfer Program (T2) promotes efficiency in Kentucky’s transportation system by administering workshops and training events, producing newsletters and how-to manuals, implementing new and existing technology updates, providing legislative and regulatory news, and supplying on-site technical assistance. The Program is also designated as the Kentucky Local Technical Assistance Program (LTAP).

T2 had a number of significant accomplishments in 2015. T2 presented 323 workshops, which were attended by over 8,200 participants. There were 144 Roads Scholars and 122 Road Masters who graduated this year. They join the 2,582 Roads Scholars and 1,933 Road Masters that have graduated previously.

A key accomplishment in 2015 was conducting the Asphalt Qualification Program, which lead to the qualification of 81 new technologists and the requalification of 20 technologists. The Kentucky Erosion Prevention and Sediment Control Program (KEPSC) for Roadway Inspectors trained 155 participants, and the Pesticide Continuing Education courses trained over 800 participants. The Work Zone Traffic Control Employee Qualification Program had an outstanding year, qualifying and requalifying 580 flaggers, 380 technicians, and 360 supervisors.

Under the banner of the Accelerating Safety Activities Program, T2 conducted the Traffic and Safety Academy and the Horizontal Curve Alignment training. These were free courses available to all local governments. Participants also attended specialized training for Sign Retroreflectivity, Road Safety Audits, and Traffic Incident Management Responder Training.

T2 regularly produces material to promote its training programs, conferences and events, and services. It also publishes a quarterly newsletter, The Link, which offers valuable best management practices and insights on new and innovative approaches. The program’s website (www.kyt2.com) houses digital copies of most T2 resources. People can also stay informed on the latest news and information by following T2 on Facebook and Twitter.

SAFETY CIRCUIT RIDER PROGRAM

The Safety Circuit Rider Program (SCRP), managed by T2, is a free service to local governments. The program uses crash data to locate high-incident sites along roadways and assist communities in finding low-cost roadway safety improvements. SCRP works with local governments to remove fixed objects such as trees, brush, and stumps, and install signage consistent with guidelines found in the Manual on Uniform Traffic Control Devices (MUTCD). This program helps communities across Kentucky and saves lives every day.
Recently, after working with SCRP to implement low-cost safety improvements, Franklin County saw the number of crashes on nine of its country roads fall by 47 percent. The number of crashes on these roads dropped from an average of 21 per year (2007-2011) to an average of 11 crashes per year (2013-2014). Franklin County received technical assistance, training, and guidance to install the safety improvements. Examples of safety countermeasures included installation of signage per MUTCD guidelines, increasing the sight distance at intersections and horizontal curves, and removing or marking fixed objects in the clear zone.

![Pea Ridge Road Before](image1.jpg)

![Pea Ridge Road After](image2.jpg)

**DRONE: WHAT DO YOU KNOW? WHAT DO YOU NEED TO KNOW?**

The Technology Transfer Program with the Kentucky Transportation Center teamed with the University of Kentucky Unmanned Systems Research Consortium of faculty researchers and member companies to develop and offer a course on drone technologies and their use. The course goal was to provide decision-making knowledge to attendees considering the use of this emerging and rapidly changing technology for their business or operations. UK researchers contributed materials including an introduction to small drones (unmanned aircraft systems, UAS, less than 55 lbs), operations, sensors, applications, pilots, FAA regulations, and legislation. Offerings were held on June 25 and December 11 served more than 60 attendees with interest expected to grow even more in 2016.
The passage of SAFETEA-LU brought a renewed focus on the availability and location of commercial truck parking to state transportation agencies. This issue garnered more attention following the inclusion of Jason's Law in MAP-21. The Traffic and Safety Group’s work on commercial truck parking and safety examined information on parking demand, identified locations in Kentucky documented for potential safety issues, and focused on potential countermeasures to reduce the number of commercial vehicle crashes where driver fatigue was a contributing factor.

Traffic and Safety Program researchers conducted daytime and nighttime surveys to determine how frequently commercial vehicles used parking facilities on interstates in Kentucky. Of the 4,715 parking spaces surveyed during the day, 2,143 were in use (45 percent). Out of the 7,844 parking spaces surveyed during nighttime hours, 6,803 were in use (87 percent). Along with the survey, Kentucky crash data were analyzed from 2010 to 2013. These data revealed that 848 crashes were related to commercial vehicles being parked on roadway shoulders or involved commercial vehicle drivers suffering from fatigue. Of these, 239 crashes were related to commercial truck parking. Two-thirds of all crashes included in the analysis occurred on I-75, I-65, I-64, and I-71. Crash cluster locations appeared directly related to proximity and usage rate of parking facilities.

Observations of selected locations along Kentucky’s interstates revealed a number of locations that would benefit from increasing the number of commercial parking spaces, including segments on I-64, I-65, I-71, and I-75. Parking facilities with use rates at or above 90 percent would be candidates for expanding the number of parking spaces or for developing new sites to accommodate more parking.

CURRENT PROJECTS
1. Transportation System Preparedness and Resilience to Extreme Weather Events
2. Access Management Best Practices
3. Applicability of Zipper Merge Versus Early Merge within Kentucky Work Zones
4. Integrating Roadway Data with Crash Data while Optimizing Segmentation for Safety and Planning
5. In-Service Performance Evaluation of Crashes Involving Different High Tension Cable Barrier Systems
6. Optimization of SNIC Routes Utilizing GPS
# Financial Snapshot

## FY2015 Income by Funding Source

### Funding Sources

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<th>Source</th>
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<td>University Incentive Funds</td>
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<td>Other Income</td>
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<tr>
<td>Workshops</td>
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**Total** $11,543,867

![Funding Sources Diagram](Image)
### FY2015 EXPENDITURES

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<th>Category of Expenses</th>
<th>Research</th>
<th>Administration &amp; Program Support</th>
<th>Technology Transfer</th>
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<td><strong>$1,575,939</strong></td>
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**FY 15 Expenditures**

- **Research**: 74%
- **Admin and Support**: 14%
- **Tech Transfer**: 12%

**FY 15 Expenditures**

- **Personnel**: 54%
- **Operating**: 32%
- **Equipment**: 8%
- **F&A**: 7%
KTC TOTAL PROGRAM EXPENDITURES: 23-YEAR HISTORY

FY08-10 $9,393,582
FY09-11 $9,463,584
FY10-12 $9,919,052
FY11-13 $10,867,581
FY12-14 $11,043,091
FY13-15 $11,081,781
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<td>“Integrated Freight Network Model”</td>
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<td>“Highway Rail Crossing Prioritization”</td>
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<td>“Security and Supply Chain Risk for Shipments of Certain Dangerous Cargoes on the Inland River System”</td>
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<td>“Evaluation of Thermal Imaging Technology for CVS”</td>
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<td>KTC-15-20/SPR15-509-1F</td>
<td>“Online Driver’s License Renewal -- Synthesis”</td>
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<td>KTC-15-21/KSP2-13-1F</td>
<td>“Analysis of Traffic Crash Data in Kentucky (2010-2014)”</td>
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Intelligent Transportation Systems

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