Demonstration of the United States Road Assessment (usRAP) as a Systematic Safety Tool for Two Lane Roadways and Highways in Kansas

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The United States Road Assessment Program (usRAP) is a systematic tool that determines areas of risk based on roadways characteristics. To determine the effectiveness of the usRAP tool, three rural two-lane corridors, a US highway, a Kansas highway, and a rural secondary road, were selected for this study. Data collection for the usRAP software included manual speed data collection, system-wide centerline miles and crashes, crash costs, countermeasure costs, and manual roadway coding data every 100 m. The usRAP software evaluated and developed a star rating and a Safer Roads Investment Plan for each corridor.

BACKGROUND

According to the National Highway Traffic Safety Administration (NHTSA), in 2012, approximately 19% of the United States population lived in a rural area, but crashes in rural settings accounted for 54% of all traffic fatalities (National Highway Traffic Safety Administration [NHTSA] 2014). Due to the high percentage of rural fatalities compared to the population, rural road and highway vehicle crash prevention are topics of serious concern for state transportation agencies, counties, and local jurisdictions (Kansas included). During the 2013 calendar year, the 2013 Kansas Traffic Accident Facts developed by the Kansas Department of Transportation (KDOT) reported 36.4% of the approximately 5,525 crashes occurred on rural roads (KDOT 2014). The 2,011 crashes on rural roads accounted for 231 fatal crashes, or 70.6% of the total number of fatal crashes in Kansas (KDOT 2014).

Between 2005 and 2013, the total number of fatal crashes decreased from 276 to 231, respectively, while urban fatal crashes have remained relatively unchanged (KDOT 2014). The reduction in fatal rural crashes could be in part from the implemented safety programs, including a primary seat belt law, implementing FHWA Every Day Counts (EDC) programs, updating the Kansas Strategic Highway Safety Plan (SHSP), and identifying and improving high risk rural roads (HRRR).

The state of Kansas has a population of 2.85 million and a total of 714 cities (most under 5,000 population) over 82,278 square miles (United States Census 2010). Many rural Kansas residents use the state highway or paved secondary system to travel to larger communities. The Kansas road network comprises a significant amount of rural paved two-lane roads with posted speed limits of 55 mph. Due to the remote locations of rural roadways and minimal traffic, response time from emergency medical services (EMS) is often longer because crashes may go unnoticed for extended periods of time. Therefore, identification, prioritization for safety improvements, and implementation of roadway safety countermeasures before vehicle crashes occur is crucial to increasing rural roadway safety.

Identification of safety improvement locations on roadways have traditionally used hot spot or mass-action area determination from past crash data. However, crash data in rural settings tend to be sparse because of the low traffic volumes associated with rural roadways and crashes that may occur once every five years or more. To identify the locations of a probable crash location, a systemic and systematic approach that utilizes the roadway and intersection characteristics, opposed to crash data, should be used.

LITERATURE REVIEW

Since the late 1980s, data about crashes and roadway characteristics have been collected and used by the Federal Highway Administration (FHWA) to help make policy decisions and by engineers researching highway safety (Tan 2011). One such database, in 1987, was the Highway Safety Information System (HSIS). HSIS collected crash, roadway, and traffic volume data from Illinois, Maine, Michigan, Minnesota, and Utah based on the availability, quantity, and quality of the data (Tan 2011).

With the creation of the databases, two different approaches have been traditionally used to determine safety concerns on roadways: crash mass action areas and systematic analysis of roadway characteristics. Crash hot spot analysis identifies locations that result in a high number of crashes based on previous crash data. Whereas, a systematic analysis of roadway characteristics identifies locations where crashes could potentially occur based on different variables associated with the roadway. SafetyAnalyst and FHWA geographical information system (GIS) using HSIS data are being used to identify crash hot spots, while road assessment programs and run-off-road models are used to identify safety concern locations.

SafetyAnalyst

Harwood et al. (2010a) developed *SafetyAnalyst,* an analytical tool to assist in the decision-making process when identifying and managing site-specific, system-wide improvements. To determine where crash spot locations are, a network-screening tool uses traffic volumes and other roadway characteristics to identify sites with higher-than-expected and expected levels of crash frequencies. The tool can also identify sites with severe crashes and a high percentage of specific crash types. The network-screening tool focuses on identifying spot locations and short segments with potential for safety improvements. The network-screening tool can also identify large sections of roadway.

SafetyAnalyst closely refers to the Highway Safety Manual (HSM) and the FHWA's Interactive Highway Safety Design Model (IHSDM). All three tools extensively use safety performance functions (SPFs) and accident modification factors (AMFs) to predict crash frequency and severity (Hardwood et al. 2010a). SafetyAnalyst was created to improve effectiveness in decision-making and to strengthen support for the decisions made. Long-term viability of SafetyAnalyst is determined by continuous software enhancements to meet users' evolving needs (Hardwood et al. 2010a).

FHWA GIS and HSIS

In 1999, the FHWA integrated GIS capabilities with the HSIS to create a crash analysis tool. The integrated system used traditional GIS features to spatially located crash locations and information using crash analysis tools. The tools allow engineers to evaluate crashes at a user designated spot, crashes along a segment, crashes near a certain roadway feature, and crashes along a specified corridor (FHWA 1999).

Road Assessment Programs

In 1999, the road assessment program known as EuroRAP was created. The program analyzes specific information on roadway viewable physical characteristics. The characteristics range from vertical and horizontal alignment to objects near the roadway that could be struck by a motorist who leaves the roadway. Different values are assigned to the characteristics and used by the software to calculate a risk. Once the risks have been calculated, the software applies a benefit-cost ratio to different countermeasures and suggests countermeasures to be analyzed by an engineer (Harwood et al. 2010b).

Run-Off-Road Model

Gao, Kan, Li, and Pang (2008) developed a run-off-road (ROR) prediction model using roadway geometry, traffic volume, crashes, roadside hardware, and features from 31 rural two-lane highways totaling 704 km. Road data were categorized into more than 900 sections in order to analyze the collected data. The model predicted ROR accident frequency, fatality, and injury using four statistical distributions: Poisson, negative binomial, zero-inflated Poisson, and zero-inflated negative binomial. Because ROR crashes occur infrequently, the researchers used zero-inflation distributions. They concluded that horizontal curves, vertical grade, traffic volume, and proportion of trucks were primary factors in ROR crashes. However, it was found additional research is needed to improve the ROR prediction models.

Road Safety Audit

A roadway can also be analyzed using a road safety audit (RSA). An RSA is a formal safety evaluation of an existing road or intersection conducted by an independent team of highway engineers and traffic safety experts. The ideal team consists of a road safety specialist, a traffic operations engineer, a road design engineer, a local contact person, and additional experts depending on the size and complexity of the project.

Once an RSA team is formed, a formal meeting is conducted to set the context of the audit and review the project information. The RSA team must then conduct a field investigation. Two approaches are typical for the field review. For the first approach, each individual member of the RSA team independently conducts a review of the roadway and then come together as a team to review each identified issue. The second approach requires the RSA team to review the site as a group and note each issue the team encounters. After reviewing all issues, the RSA team finalizes the findings and develops possible solutions (FHWA 2006).

RESEARCH OBJECTIVES

The primary objective of this research project was to demonstrate the effectiveness of the United States Road Assessment Program (usRAP) as a systemic safety tool for rural highways and paved secondary roads in Kansas. The goal was to determine if usRAP and its outputs beneficially help Kansas counties identify high-risk roadway segments without using historical crash data at each corridor. Secondary objectives included determining if usRAP was a viable tool to include in state and county level safety planning and seek feedback on the usRAP outputs by the local road engineer of the Kansas Association of Counties.

EMPIRICAL SETTING

Study Corridors

Three study corridors in Kansas were selected for evaluation in this study to represent three common roadways found in Kansas: a U.S. highway, a Kansas highway, and a rural secondary road. All three roads were two-lane undivided roadways outside of incorporated areas. The roadways were selected based on driving experience and visual investigation. Crash data were not used to identify roadways evaluated in this study

The first corridor selected was US-40 from Topeka to Lawrence. US-40 serves as a commuter route that has an annual average daily traffic (AADT) of 5,000 vehicles (KDOT n.d.). The study segment had a length of 19 miles and a posted speed limit of 60 mph. The research team conducted a speed study and found the average speed of vehicles was 61 mph with an 85th percentile speed of 64 mph. During the study, crash data from 2010 – 2014 were collected. There were a total of 236 crashes with one resulting in a fatality and six resulting in a disabling injury.

The second corridor selected was K-5 between Kansas City and Lansing. The corridor was unique because of several horizontal curves (left and right) and vertical curves (up and down) that produced multiple blind spots in both directions of travel. K-5 had an AADT of 2,500 vehicles with a posted speed limit of 55 mph. A speed study conducted by the research team found the average speed to be 51 mph with an 85th percentile speed to be 57 mph. The study team hypothesized the average speed was lower because drivers on K-5 are aware of the constant changes in horizontal and vertical alignment. Crash data between 2010 and 2014 showed there was a total of 75 crashes with three resulting in a disabling injury crash.

The final corridor selected for this study was RS 20 and RS 25 between Lancaster and Effingham. At the intersection of RS 20 and RS 25, there is a horizontal curve that connects the two roads to bypass a four-way stop. RS 20 and RS 25 have an AADT of 750 and 850, respectively, and both roads have a posted speed limit of 55 mph. A speed study conducted by the research team found the average speed to be 57 mph with an 85th percentile speed of 61 mph. To determine the number of crashes along the route, data were manually extracted from county crash records. From 2010 to 2014, there were a total of 35 crashes resulting in one disabling injury crash.

usRAP Calibration

To achieve the most accurate results, a calibration using local data (crash costs/frequency and countermeasure costs) is required. In Kansas, the cost of a crash varies with the severity. A property damage only crash has an estimated cost of $3,200, while a fatal crash would have an estimated cost of $4,159,950. These values are used in estimating the benefit portion of the benefit-cost ratio.

To calibrate the crash frequency used by the software, crash information for U.S. highways in Kansas and Kansas highways was collected. For U.S. highways in Kansas, there were 21,305 crashes between 2010 and 2014 resulting in 264 fatal and 455 disabling injury crashes (KDOT 2014). Kansas highways had a total of 15,048 crashes between 2010 and 2014 resulting in 162 fatal and 353 disabling injury crashes (KDOT 2014). KDOT had limited crash data outside of incorporated areas. Therefore, for this study, default calibration parameters were used based on AADT, roadway type, and posted speed limit.

The usRAP software incorporates 192 built-in countermeasures for urban and rural environments. These countermeasures range from low cost to high cost, which may range from signs to large reconstruction projects, respectively. Each countermeasure has a low, medium, and high cost that can be adjusted prior to software coding. Of the 192 possible countermeasures, the research team selected 70 countermeasures that were applicable to Kansas rural environments. The research team then met with KDOT's Bureau of Local Projects to verify countermeasure costs. All countermeasure costs provided by KDOT were considered to be medium costs, and the low and high costs for each countermeasure were determined by a percentage decrease or increase, respectively.

CODING METHODOLOGY

Prior to coding the three Kansas corridors, the research team participated in a two-day training administered by a private consulting firm. The private consulting firm team, consisting of experts in the development, testing, and implementation of usRAP and iRAP, presented a manual that explained each variable the research team was to code. The usRAP software relies on a visual inspection of the roadway and judgment by the research team, so examples presented by the private consulting firm team ranged from open space to dense vegetation. Based on previous studies, a coding time of 30 minutes per one mile was estimated for this project.

The coding environment for the usRAP software involved using two monitors displaying the coding screen and a view from Google Street View, as shown in Figure 1. The research team coded each variable based on a 100m segment of the roadway. For each variable, there was a drop-

Figure 1: Example Display of Monitors During Coding Process

down menu with options to best describe the roadway characteristics. For example, roadside object severity could range from a cliff or tree in the most severe case, to no object within range of a driver that has left the roadway. After all variables for a segment have been coded, the variables can be carried through to the next segment. This allowed the research team to cut down on the total time spent on each segment. For consistency in coding the roadway, the direction of coding was in the direction of increasing milepost markers.

To assure the highest quality results, three stages of quality assurance/quality control (QA/QC) were completed. The first stage took place during the initial coding of the variables. The research team worked in groups of two to discuss which variables would be the most appropriate for the given segment. After completion of a roadway, the code was sent to the principle investigator (PI) to verify the coded variables for half-mile intervals. If a disagreement was found between coded variables, the PI would adjust the segment and surrounding segments to better match the roadway segment's characteristics. Finally, the coded variables were sent to a private consulting firm to ensure each segment was coded accurately before data were uploaded to the usRAP website for analysis.

RESULTS OF SELECTED KANSAS CORRIDORS

usRAP

Using the coded data and operational characteristics for each corridor, the usRAP program determines a road protection score for each segment of the roadway using built-in modeling algorithms. The road protection score is based on coded variables having a known impact or relationship with crash occurrence and the probability a segment would have high risk of a serious injury or fatal crash. Determination of risk is translated into a star ranking (AAA 2012 and Knapp et al. 2014). The star ranking is a color coded and numerical ranking (1 to 5, with 1 being the highest risk) indicator of risk for a segment of roadway.

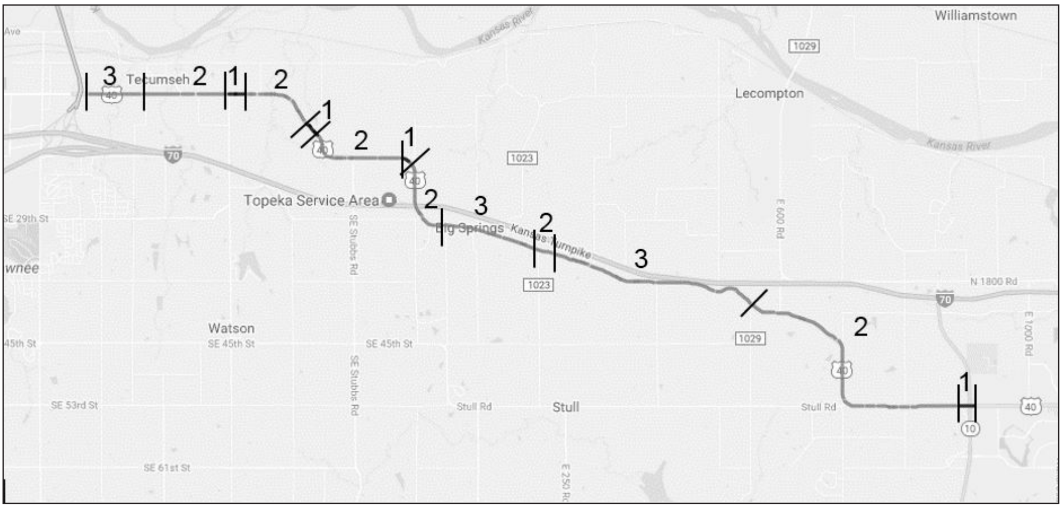
The usRAP program also generates a Safer Roads Investment Plan, which provides information on countermeasures previously selected that could be implemented to reduce the probability of there being a fatal or serious injury crash on a certain segment. The Safer Roads Investment Plan also provides a benefit cost ratio, location, and total length for each countermeasure selected, and a total benefit cost ratio if all countermeasures selected were implemented. Most countermeasures dictate which side of the road on which to implement the countermeasure using the terms driver side or passenger side. The driver side and passenger side are representative of the direction of coding of the roadway. For example, if the coding direction was east, the driver side would be on the north and passenger side would be on the south. For this study, the Safer Roads Investment Plan only showed countermeasures with a benefit cost ratio greater than 1.

Star Rating and Safer Roads Investment Plan

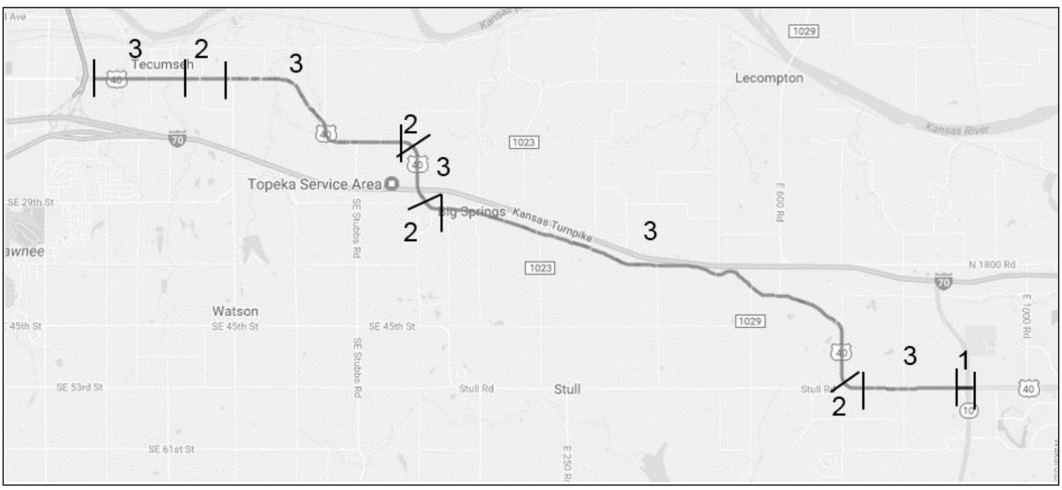
Figure 2 through 4 show the star ratings for the three corridors selected in this study. Each delineated segment shown has a number that corresponds with its star rating. The usRAP program generates a star rating map for vehicle occupants, motorcycles, bicycles, and pedestrians. However, the analysis showed minimum change in those areas. The usRAP website overlays the results on top of Google Maps, allowing users to zoom in to specific roadway segments and view attributes and nearby physical features.

Figures 2a and 2b show the star rating before and after countermeasure implementation, respectively, of US-40. As shown in Figure 2a, approximately 67% (19.4km) of the corridor was considered 2 stars or lower. Lower star ratings (labeled with the number 1) occurred around horizontal curves and on segments of roadways containing differing roadway geometry and entrances to businesses.

Figure 2: Before and After Star-Rating for US-40



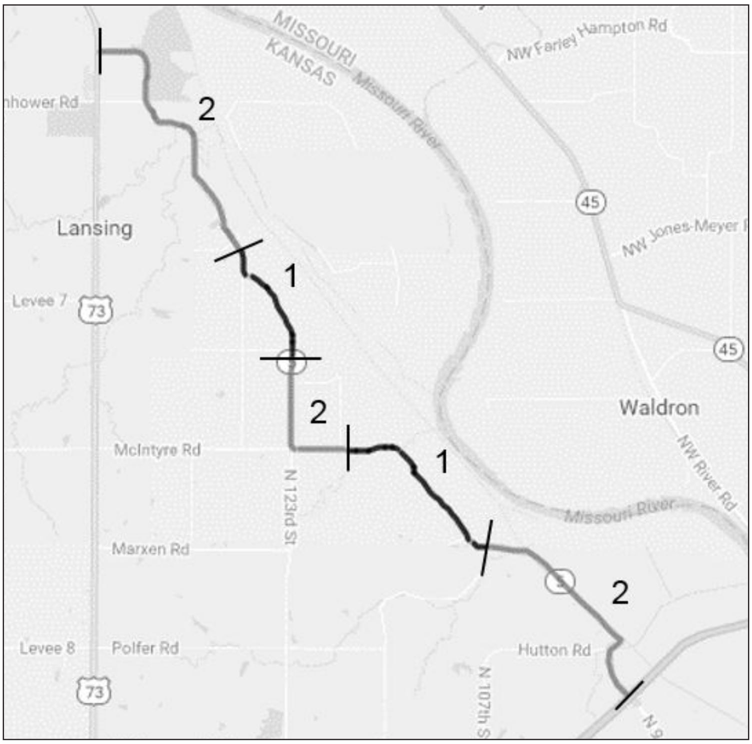
a) Before Countermeasures



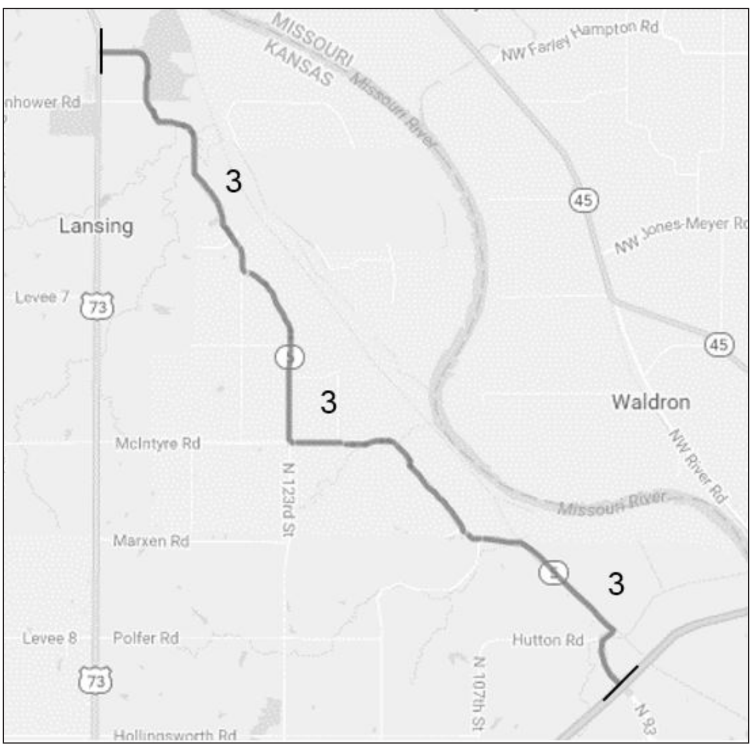
b) After Countermeasures

To increase the star rating and reduce the number of fatal and serious crashes on the corridor, the usRAP Safer Roads Investment Plan suggested 10 different countermeasures. Each countermeasure suggested shows the number of suggested sites (represented by length), total number of fatal or serious injury (FSI) crashes saved (over a 20-year period), benefit, estimated cost, cost per FSI crash saved, and total benefit cost ratio. For example, the countermeasure with the highest benefit cost ratio was to clear roadside hazards on the passenger side. The usRAP program estimated there was 13.60km (136 100-meter segments as shown in Figure 5) where implementation of the countermeasure would prevent five FSI crashes over a 20-year period. Figure 2b shows the star rating of US-40 if all countermeasures suggested by Safer Roads Investment Plan were implemented. After countermeasure implementation, approximately 12% (3.2km) of the corridor was considered 2 stars or lower. The usRAP program estimated the total cost to implement all suggested countermeasures to be $870,987; however, the total estimated benefit was $3,747,370 and a total benefit cost ratio of approximately 4.

Figure 3: Before and After Star-Rating for K-5

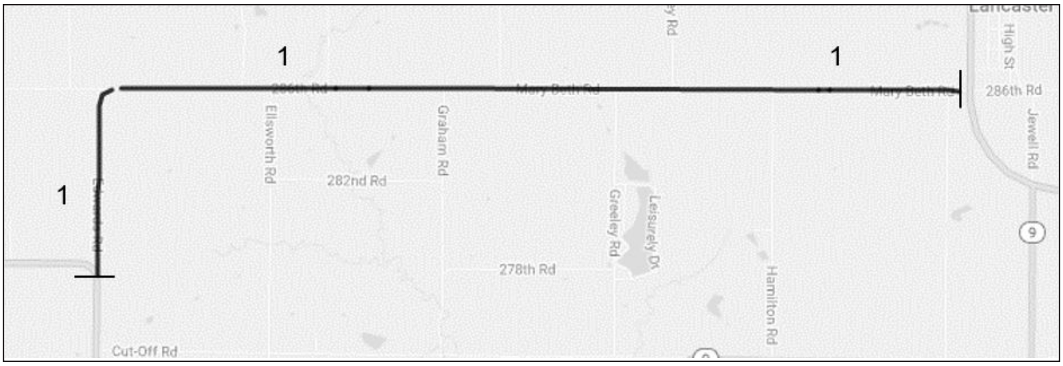


a) Before Countermeasures

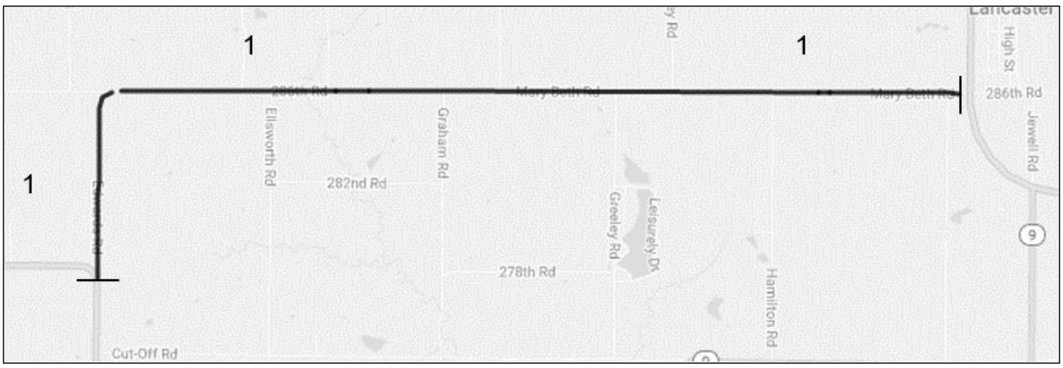


b) After Countermeasures

Figure 4: Before and After Star Rating for RS 20 and RS 25



a) Before Countermeasures



b) After Countermeasures

Figures 3a and 3b show the star rating before and after counter implementation, respectively, of K-5. As shown in Figure 3a, 100% (16.2km) of the corridor was considered 2 stars or lower (2 being second highest risk). A 1-star rating (1 on figures) represented areas with combined horizontal and vertical curves that produced areas with limited sight distance.

The Safer Roads Investment Plan for K-5 suggested 13 different countermeasures to reduce the total number of FSI crashes. The countermeasure with the highest benefit cost ratio was to improve roadway markings (delineation) on two curves. The usRAP software estimated the total cost to improve the delineation to be $6,046 but have a benefit of $76,040, resulting in a benefit cost ratio of approximately 13. One of the curves suggested for improved curve delineation had a slight vertical curve reducing sight distance as shown in Figure 6. Figure 3b shows the star rating of K-5 if all countermeasures suggested were implemented. If all countermeasures are implemented, 100% of the roadway would have a 3-star ranking and an estimated 11 FSI crashes would be prevented over a 20-year period. The implementation of all countermeasures would cost an estimated $1,182,692, but would have a total estimated benefit of $3,449,729 and have a benefit cost ratio of 3.

Figures 4a and 4b show the star rating before and after countermeasure implementation, respectively, of RS 20 and 25. As shown in Figure 4a, 100% (9.8km) of the corridor was considered to be 1-star. RS 20 and 25 is a rural secondary road with no delineation on the roadway and little to no shoulder before the drop off into the ditch along the roadway.

The Safer Roads Investment Plan for RS 20 and 25 suggested five different countermeasures. The countermeasure with the highest benefit cost ratio was improved curve delineation at the intersection of RS 20 and 25. However, on both RS 20 and 25, there were several large culverts

Figure 5: Recommended Locations of "Clearing Roadside Hazard – Passenger Side" for US-40

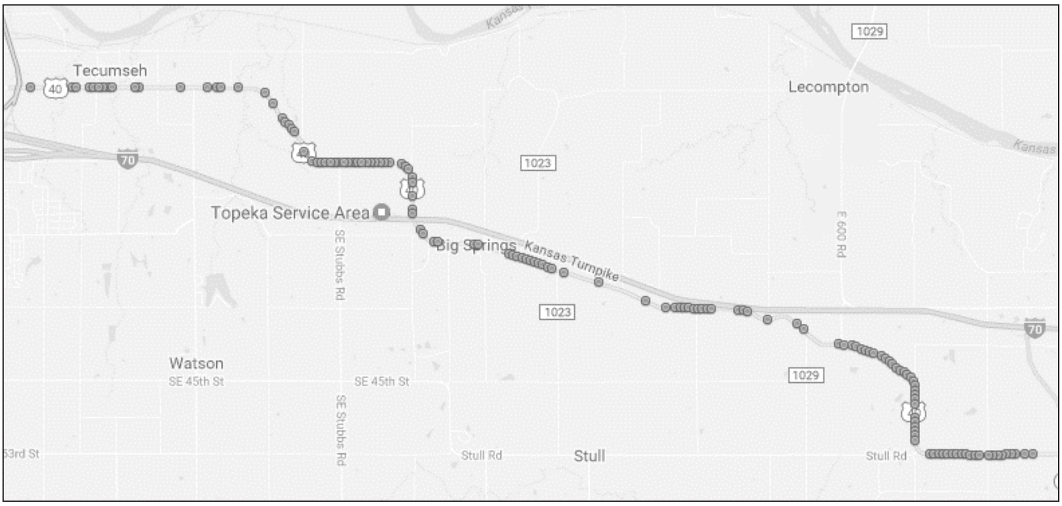
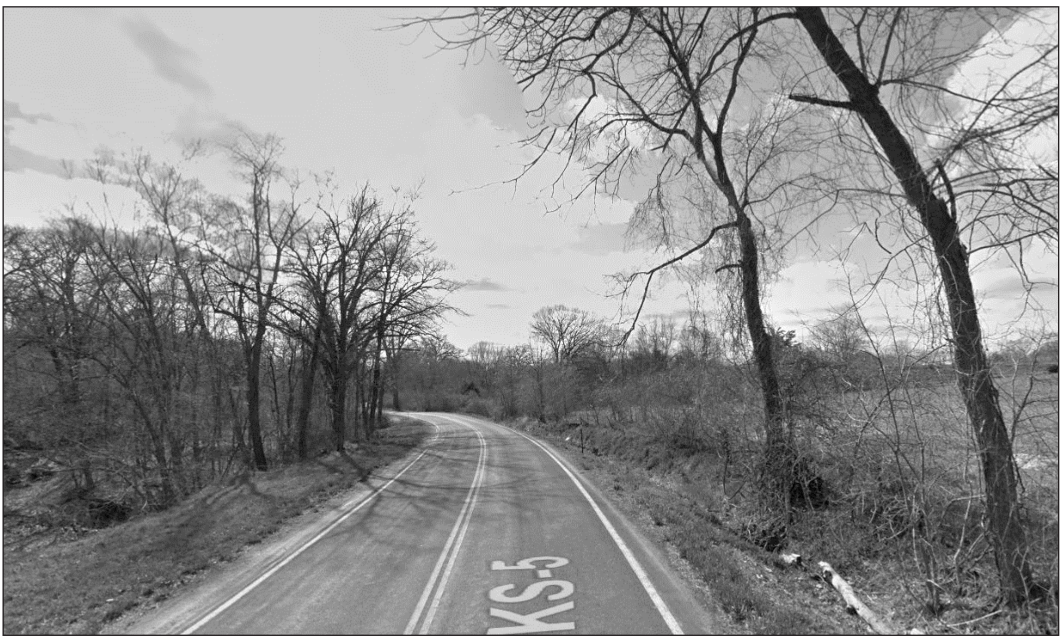


Figure 6: Google Street View of the Curve Selected for Improved Delineation



(greater than 10-feet tall) that did not have a barrier and had a drop-off less than three feet from the edge of the roadway. The usRAP's Safer Roads Investment Plan suggested implementing a roadside barrier on both sides of that roadway at the culverts. The roadside barriers would prevent an estimated two FSI crashes over a 20-year period. Figure 4b shows the star rating of RS 20 and 25. After implementation of all suggested countermeasures, 100% of the roadway remains a 1-star rating. However, the star rating for this particular roadway can be misleading. If all countermeasures were implemented, a total of three FSI crashes could be prevented with a total benefit cost ratio of 2. The star rating map suggests the roadway would need to be completely upgraded to the standards of a two-lane highway or higher to enhance the star ratings.

The usRAP results for RS 20 and 25 were validated by comparing the results to a road safety audit (RSA) conducted by KDOT on May 12, 2014. The RSA and usRAP software identified areas, including the need for improved curve delineation and a roadside barrier. However, the usRAP program was not able to identify specific areas found during the RSA. For example, a failed wing wall section on a box culvert was not identified. There are two significant factors for not identifying specific areas. The usRAP program is designed to identify potentially high-risk areas based on characteristics of the roadway such as geometry, markings, and roadside hazards such as fixed objects. The other factor is the limited field of view by Google's Street View camera and its field of vision.

DISCUSSION

Understanding the safety risks of rural highways and paved secondary roadways is critical in Kansas because a significant percentage of roadways are rural centerline miles. However, allocation of funding for roadway improvements and determination of locations in need of improvements can be difficult due to limited data, limited expertise, and sometimes-unknown areas that pose a significant risk to drivers. A systematic tool that utilizes limited information (specifically historical crashes) to identify high risk areas can greatly benefit a local jurisdiction or the State of Kansas if even one life is saved or one serious injury is prevented.

The research team selected three corridors to test the usRAP software: A U.S. highway, a Kansas highway, and a paved rural secondary road. US-40 between Topeka and Lawrence, K-5 from Kansas City and Lansing, and RS 20 and 25 between Lancaster and Effingham, were selected based on previous driving experience and visual inspection from the research team. The amount of available data (crash or otherwise) were not used in the selection of the three corridors.

The usRAP program is a free software program that requires extensive data entry based on Google Street View or manual data collection for 100m intervals. Corridor baseline data are needed for system calibration (type of highway or roadway), including AADT, posted and 85th percentile speed, system-wide centerline miles for each roadway type, system-wide historical crash analysis for types of transportation modes, and typical countermeasure costs. A significant advantage of the usRAP program is that the program does not require historical crash data for the road segment or corridor of interest. The usRAP software analysis is based on roadway characteristics directly related to crashes.

The usRAP software outputs provide valuable information that can be easily interpreted for most levels of roadway design and/or supervision. Outputs include a star rating for each corridor every 100m and a Safer Roads Investment Plan for each corridor. The usRAP software is not designed to replace a required engineering study before implementation of any major roadway countermeasure or geometric change. Rather, the usRAP software output identifies potentially risky areas of a corridor to help guide a transportation study.

The star ratings developed for the three corridors provide a visualization of potential risky areas for each corridor. Each of the three corridors selected had 3-star or lower segments for the entirety of the corridor because the roads were not interstates or divided highways. The three corridors also exhibited vast differences in horizontal and vertical alignments, in which these corridors were narrow with fixed objects near the roadways. This led to different star ratings for the three roadways.

The Safer Roads Investment Plan shows different countermeasures that can be implemented along with the estimated cost, the estimated benefit, the benefit-cost ratio, and an estimate of the number of fatal or serious crashes prevented over a 20-year period for each countermeasure. The usRAP software benefits counties with limited resources to invest in a countermeasure because it narrows down the location of countermeasure implementation and reduces the time, money, and initial investigations required for engineering studies.

Finally, the usRAP software predicted a star rating for each corridor if all countermeasures above a benefit-cost ratio of 1 were implemented. Although substantial improvements were predicted for US-40 and K-5, RS 20 and RS 25 were predicted to remain constant because substantial reconstruction was needed to upgrade the safety of the corridor. However, upgrading certain areas on the corridor may not bring the segment to a 2-star or higher rating, it could save a life or prevent a serious injury.

References

American Automobile Association (AAA) Foundation for Traffic Safety. *Guide to Using usRAP Star Ratings and Safer Roads Investment Plans.* Washington, D.C.: Federal Highway Administration, 2012.

Federal Highway Administration. *FHWA Road Safety Audit Guidelines.* Washington, D.C.: Federal Highway Administration, 2006.

Federal Highway Administration. *GIS-Based Crash Referencing and Analysis System.* McLean, VA: Turner-Fairbanks Highway Research Center, 1999.

Gao, H., W. Kan, C. Li, and C. Pang. "Run-Off-Road Accident Prediction Model for Two-Lane Highway." *Journal of Highway and Transportation Research and Development* 3(1), (2008): 110-115.

Harwood, D.W., D.J. Torbic, K.R. Richard, and M.M. Meyer. *Safety Analysis: Software Tools for Safety Management of Specific Highway Sites.* Washington, D.C.: Federal Highway Administration, 2010a.

Harwood, D.W., D.K. Gilmore, K.M. Bauer, R.R. Souleyrette, and Z.N. Hans. *U.S. Road Assessment Program (usRAP) Pilot Program – Phase III.* Washington, D.C.: American Automobile Association Foundation for Traffic Safety, 2010b.

Kansas Department of Transportation (KDOT). *Kansas Traffic Accident Facts Book.* Topeka, KS: Kansas Department of Transportation, 2014.

Kansas Department of Transportation (KDOT). *District Traffic Count Maps,* n.d. Accessed November 2, 2015 ksdot.org/burtransplan/maps/MapsTrafficDist.asp.

Knapp, K.K., S. Hallmark, and G. Bou-Saab. *Systemic Safety Improvement Risk Factor Evaluation and Countermeasure Summary* (Report No. WBS: 25-1121-0003-140). Lincoln, NE: Mid-America Transportation Center, 2014.

National Highway Traffic Safety Administration (NHTSA). *Traffic Safety Facts: 2012 Data Rural/Urban Comparison.* Washington, D.C.: United States Department of Transportation, 2014.

Tan, C.H. *Highway Safety Information System (HSIS): The Essential Information System for Making Informed Decision about Highway Safety.* Washington, D.C.: Federal Highway Administration, 2011.

United States Census. *2010 United States Census. Population, Housing Units, Area, and Density: 2010 – State – Place and (in Selected States) County and Subdivision, 2010.*

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