Evaluation of Systemic Safety Methodologies on Low-Volume Rural Paved Roadways

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Introduction

Problem Statement
- Crash fatalities along secondary paved rural roadways in Iowa accounted for more than 70 percent in 2012.
- Vast majority of rural roadways experience low volume traffic and crashes occurring on them are widespread in nature.
- Traditional "hot-spot" approach – versus – proactive "systemic" methodology,
- Identify and evaluate one systemic tool for the thesis research project.

Objectives
- Summarize the research of several systemic safety methodologies for rural paved roadways then evaluate and compare these tools.
- Select one systemic tool and apply it on a sample of roadway mileage.
- Evaluate the selected systemic tool through a sensitivity plan and measure significance of the sensitivity analysis through a statistical assessment.

Literature Review

The following tools systemic tools/methodologies were identified and summarized as part of this project:
1) Minnesota County Roadway Safety Plan (CRSP)
2) Federal Highway Administration (FHWA) Systemic Safety Project Selection Toolkit
3) United States Roadway Assessment Program (usRAP) Safer Road Investment Plans
4) Roadway Departure Crashes at Bridges in Salem County, New Jersey
5) SafetyAnalyst

Factors considered for tool selection:
- General Availability
- Level of Input Data Required
- Ease of Use
- Basis of Prioritization
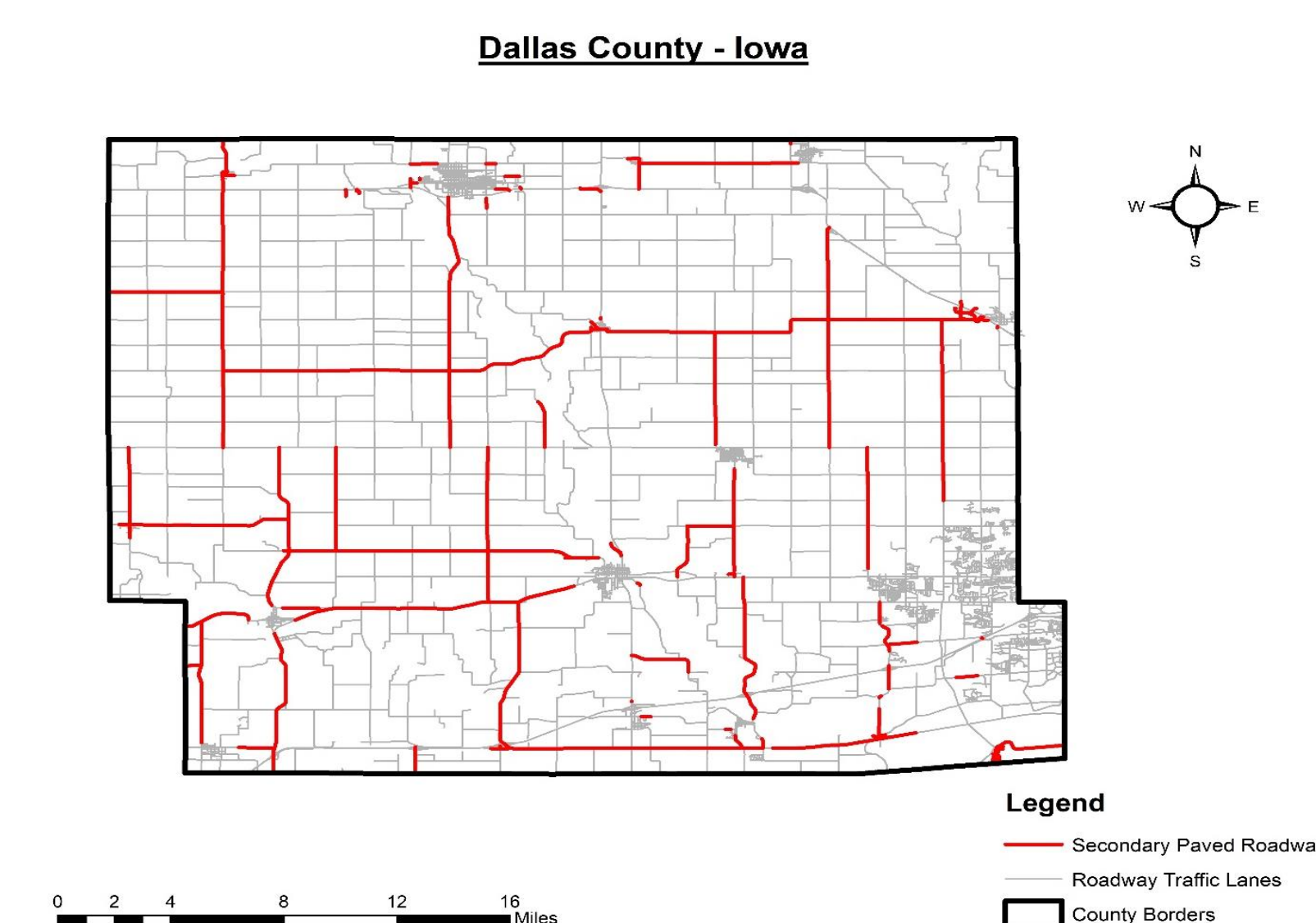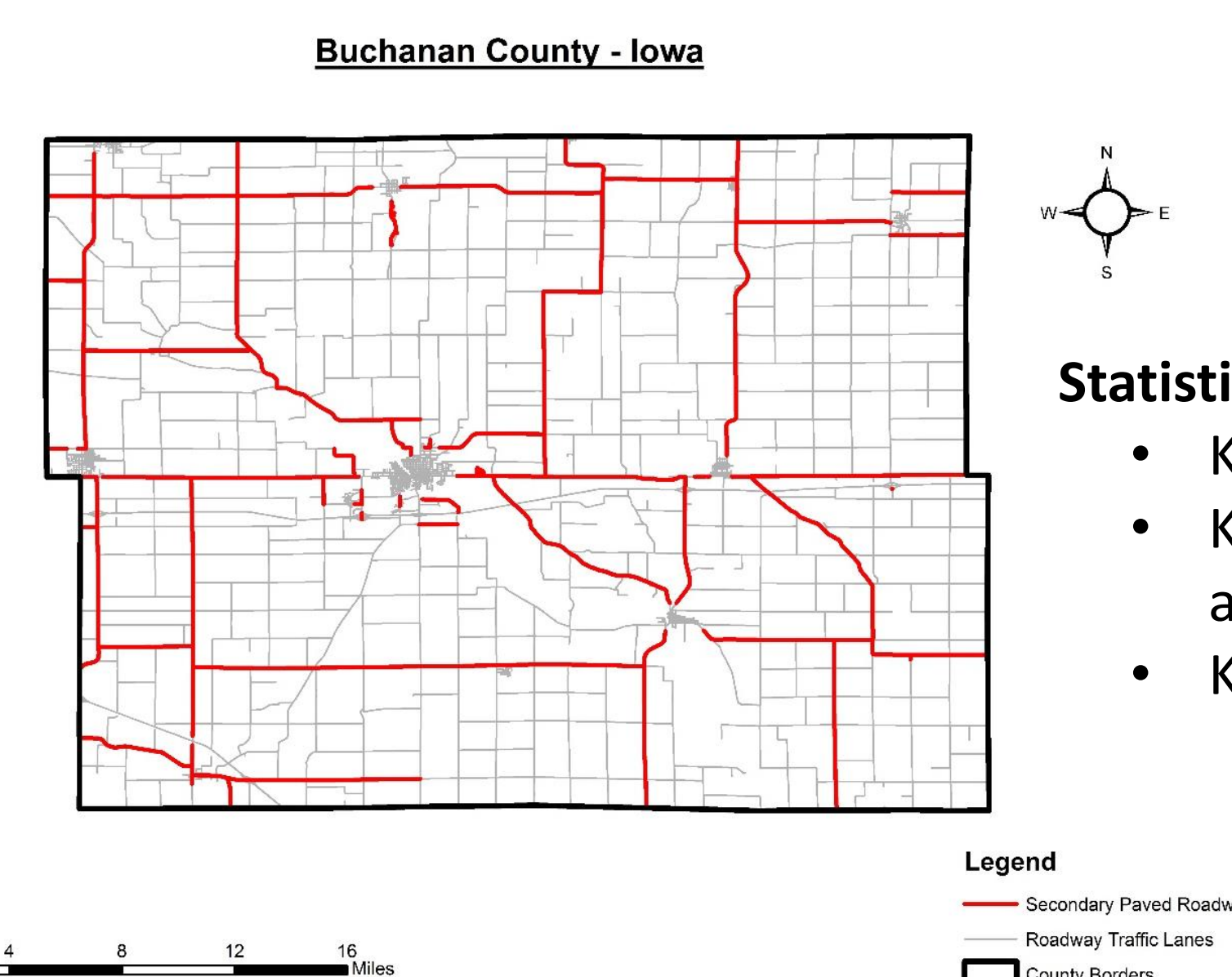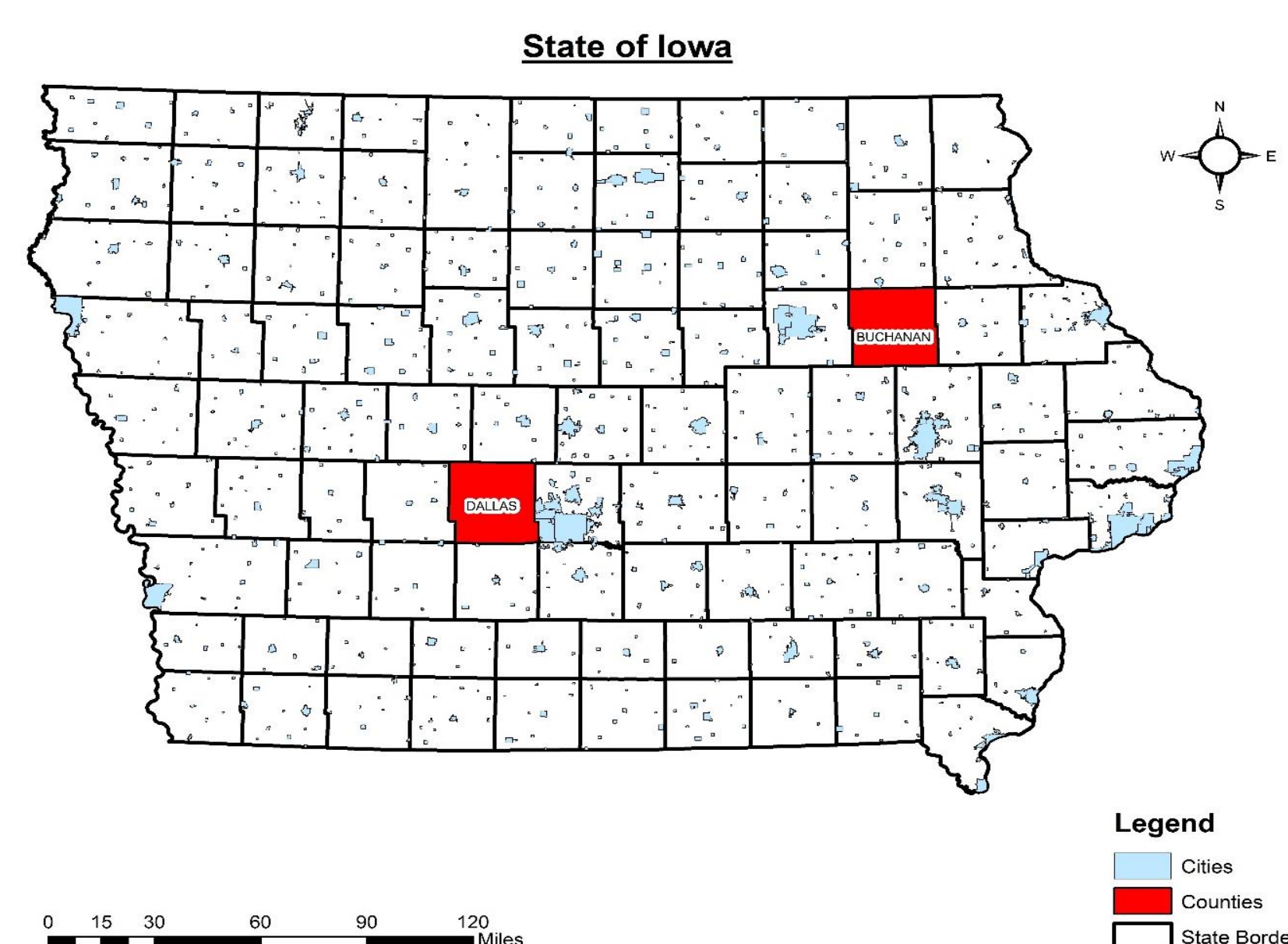- Potential for Sensitivity Analysis Insight

Minnesota CRSP Approach

Minnesota CRSP Approach (1)

- Objective of this approach was to identify and prioritize three main transportation elements along county roadway systems:
  1) Rural Horizontal Curves
  2) Stop-Controlled Intersections
  3) Rural Segments
- These elements were considered because they consisted of the greatest number of crashes.
- Implement low-cost safety improvement projects to reduce fatal and major injury crashes.
- Evaluation of risk at each location was based on risk factors/roadway features.

Data Collection Summary

Site Selection
- County engineers of Buchanan and Dallas counties agreed to collaborate with the project.
- Two main considerations for the selection of these two counties:
  1) Availability of required data in the electronic database
  2) Availability of visualization tools such as Google StreetView Maps and ArcMap 10.1
- Data collection was completed along secondary paved rural roadways with StreetView images.
- Roadway network consisted of 197 miles in Buchanan County and 156 miles in Dallas County.
- Data was collected on both district and county level.

State of Iowa

Buchanan County - Iowa

Dallas County - Iowa

Rural Horizontal Curves Input Data
- Buchanan/Dallas County = 82/83 rural horizontal curves were identified.

Stop-controlled Intersections Input Data
- Buchanan/Dallas County = 52/47 stop-controlled intersections were identified.

Rural Segments Input Data
- Buchanan and Dallas Counties = 58 rural segments were identified.

Prioritization Results
- Locations with a total star rating of three or more were considered higher priority locations.
- Low average star rating and standard deviation values denoted that the roadway network in both counties were consistent and in good condition.

Sensitivity Analysis and Statistical Evaluation

Importance of Conducting a Sensitivity Analysis
- Each risk factor in the initial assessment and prioritization was weighted equally.
- Measure whether a change in the weight/coefficient of risk factors in the Minnesota CRSP approach would have a significant change in the ranking of sites.

Statistical Test Selected
- Kendall Rank Correlation Test (non-parametric)
- Kendall's tau coefficient is used as a measure of association between two measured quantities.
- Kendall Tau-b Coefficient

Sensitivity Analysis Approaches
- Three sensitivity analysis approaches were designed:
  1) Sensitivity Analysis Approach 1: Basic Application
  2) Sensitivity Analysis Approach 2: Engineering Judgment and Point System
  3) Sensitivity Analysis Approach 3: Variable Data Input and Point System
- Weights of risk factors were changed from one to two in most cases.

Statistical Results
- Shift in ranking of sites was not statistically significant.
- Third sensitivity analysis approach generated the lowest tau values.

Top "20" Shift Analyses
- Statistical results were insignificant, thus performed basic descriptive statistics.
- Computed percentage of sites that shifted from the list in comparison to the initial ranking.
- More than 85 percent of locations shifted by less than 25 percent .

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1. *Otter Tail County Roadway Safety Plan*. Minnesota Department of Transportation, August 2011.

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