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How to Select Simple-Yet-Accurate Model of Bridge Maintenance?

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How to Select Simple-Yet-Accurate Model for Bridge Maintenance?

Akshay Kale, Yonas Kassa, Brian Ricks, and Robin Gandhi

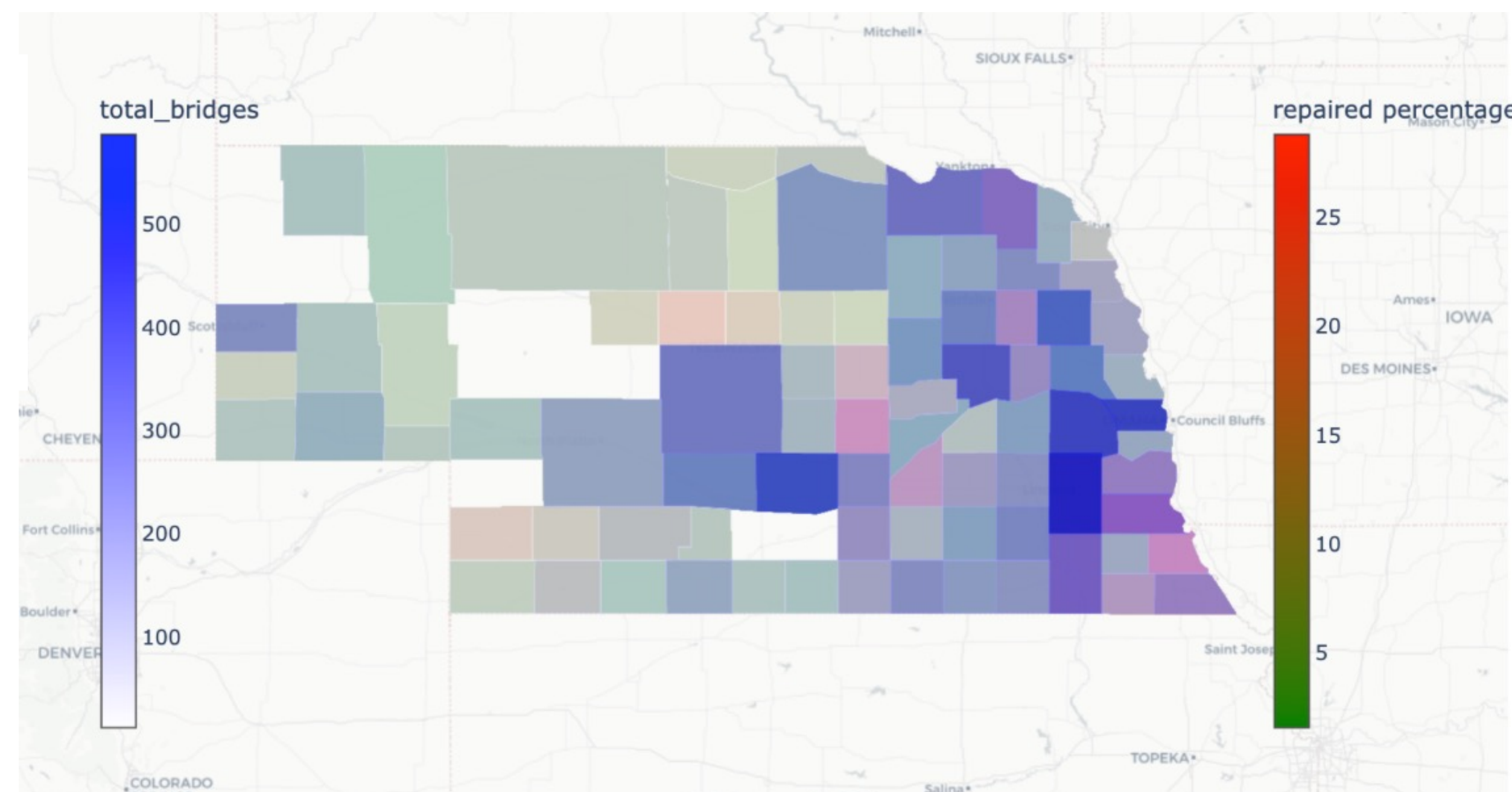
Background

15,376 Bridges

NBI and LTBPP

28 Bridge Features

8 ML Algorithms



Summary of Bridge Deck Repair by County

Image Credit: Akhil Kodali

Challenge

Challenge 1: Explainability is inversely proportional to accuracy
Challenge 2: Every model tells a different story about bridge health

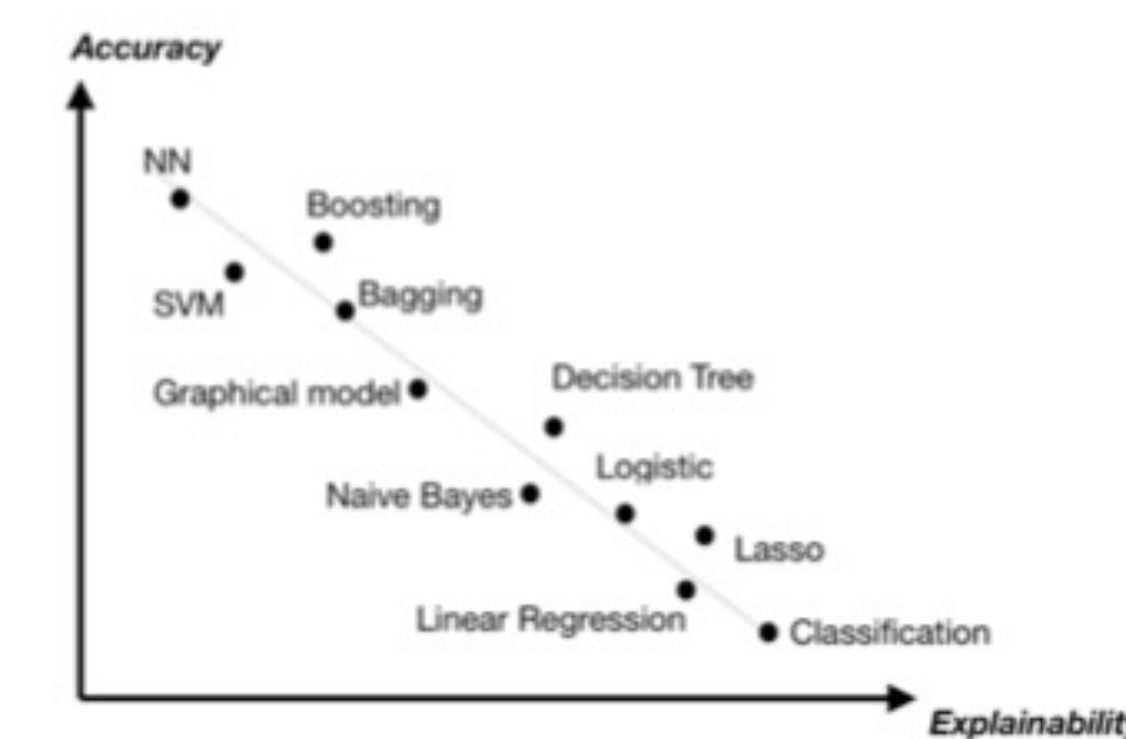


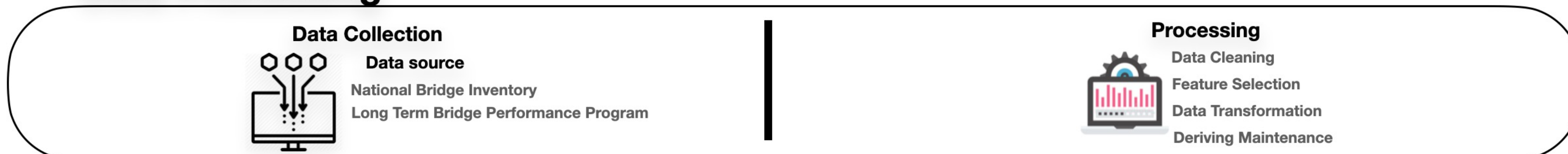
Table 12. Comparison of influential factors identified throughout literature

Method	Physical	Region	Structural and material	Environmental	Service
Case-based reasoning (Morcos et al. 2002)	✓	—	✓	—	✓
Cox hazards model with LASSO a and stepwise regression (Wetach-Glosser et al. 2020)	✓	—	✓	—	✓
Linear regression and Monte Carlo simulation (Hasan and Elwakil 2020)	—	✓	✓	—	✓
Bayesian survival analysis (Fleischacker et al. 2020)	✓	—	✓	—	✓
Artificial neural network and k-nearest neighbor (Ahsand and El-adawy 2020)	✓	—	✓	—	✓
Logistic regression and classification tree (Chang et al. 2019)	✓	—	✓	—	✓
Ordered probit model (Saeed et al. 2017)	✓	✓	✓	—	—
Multiple regression and GIS (Kim and Yoon 2010)	✓	✓	✓	—	✓
Baseline difference score	✓	✓	✓	—	✓

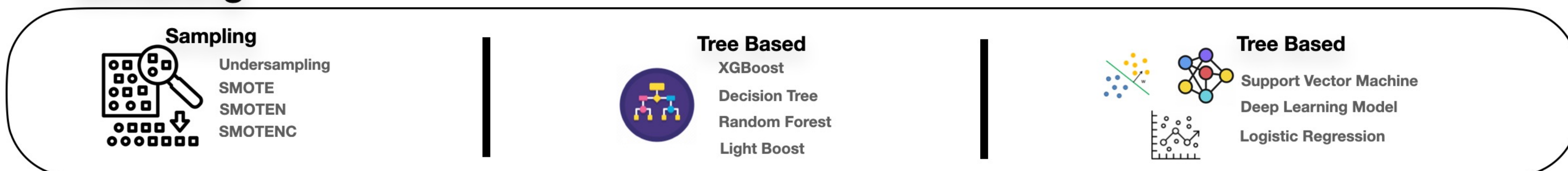
Note: A check mark indicates factor category tested, an asterisk indicates the factor category found to be influential. The text with the bold font is the proposed method in this manuscript.

Methodology

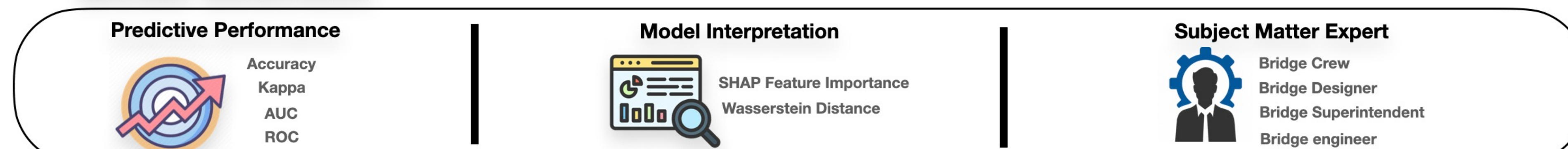
Data Processing



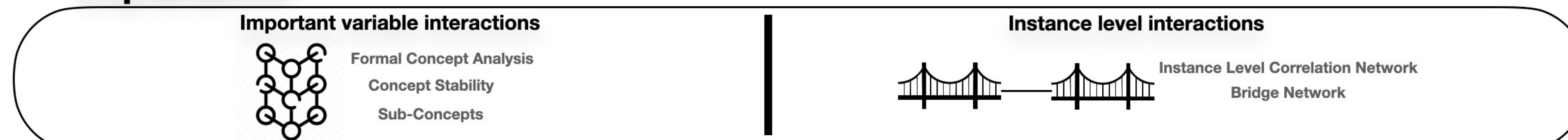
Modeling



Model Selection

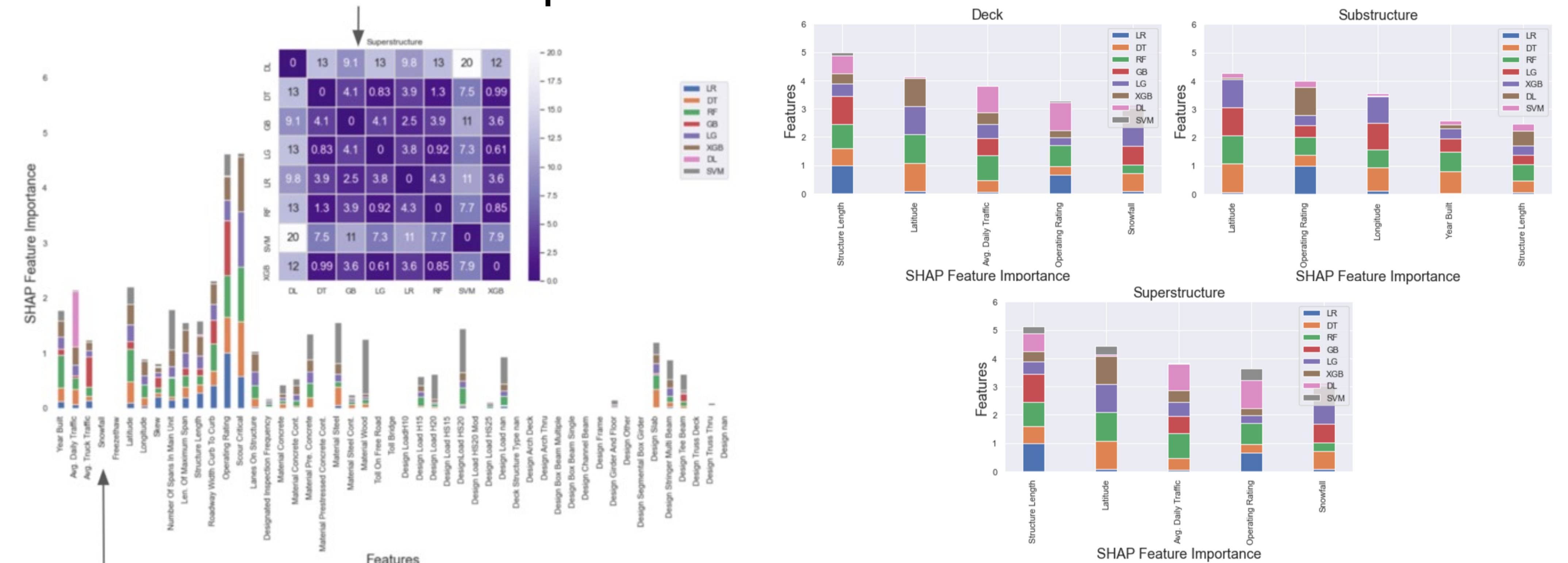


Explanation



Results

The Similarity between model explanation using Wasserstein distance between all implemented models



Distribution of SHAP Feature importance of all implemented models
Top five influential factors across all bridge components



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