Performance-based Decision-Support Framework for Developing Grade Separation Program in Southern California

presented at

2014 Global Level Crossing Safety & Trespass Prevention Symposium, Urbana, IL

presented by

Chiranjivi S Bhamidipati, Gill V Hicks, and Andreas Aeppli

August 4, 2014



Outline

- Objectives
- Background
- Overview of Performance-based Decision-Support Framework
- Data and Models for At-Grade Crossing Performance Evaluation
- © Criteria and Considerations for Grade Separation Program
- Application to Southern California
- Conclusions
- Future Work



Objectives

Describe a performance-based decision-support framework that can:

- » Evaluate Performance of At-Grade Crossings
- » Select At-Grade Crossings for Grade Separation Program
- Describe "Train Builder" model and "At-Grade" model that constitute framework; and
- Present Case Study Results Southern California



Background

- Issues with grade separation investments
 - Growing rail and highway traffic increases at-grade crossing conflicts
 - » Grade separation projects are costly, requiring major financial commitments
 - Funding for grade crossing separations and other improvements beyond automated equipment is scarce
 - » On a purely economic basis, grade separations are difficult to justify





Background

Common methodologies for evaluating grade separation projects

- Focus primarily on safety-related aspects (U.S. DOT's Accident Prediction Model and Field Diagnostics)
- » Multiple measures analysis
 - Benefit-cost analysis (FRA's GradeDec.NET)
 - Performance-based but with scoring or ranking (Riverside County Transportation Commission's Grade Separation Strategy)
 - Performance-based but without scoring or ranking
- » Do not readily incorporate effects of alternative scenarios for future rail traffic development



Overview of Performance-based Decision-Support Framework



Data and Assumptions for At-Grade Crossing Performance Evaluation

Data

- » Average annual daily vehicular traffic
- » Time of day distributions
- » Daily train volumes by train length and type
- » Truck percentages
- » Accident data
- » Average idling emission rates
- Forecasting Assumptions



Models for At-Grade Crossing Performance Evaluation

© "Train Builder" Model

- » Dynamically estimates train volumes based on traffic projections and train operating characteristics
- » Current capability Intermodal train volumes in Southern California





Models for At-Grade Crossing Performance Evaluation

© "At-Grade" Model

- » Incorporates highway and rail traffic data to estimate impacts of rail-highway traffic conflicts
- » Current capability At-Grade Crossing Delays in Southern California – LA to Barstow in North & Indio in East



$$V = \left(\frac{1}{2}\right) \frac{qT_G^2}{(1-q/d)}$$



Example Criteria for Grade Separation Program

Performance Measure	Criterion or Threshold Value for Each At-Grade Crossing
Min. Average Annual Daily Traffic	I,000 vehicles / day
Min. Daily Train Volumes	10 trains / day
Current Daily total vehicular delays	25 Vehicle-hours / day
Future Daily total vehicular delays	50 Vehicle-hours / day
Crash rate	5 crashes per 100 million vehicle- train conflicts per year
Current Annual Emissions related Damage Costs (in 2010\$) for Criteria Pollutants (NOx, ROG, PM2.5 and CO)	\$500 / year
Current Annual Emissions related Damage Costs (in 2010\$) for Criteria Pollutants (NOx, ROG, PM2.5 and CO)	\$1,000 / year



Other Considerations for Grade Separation Program

- Proximity to noise-sensitive receptors and emergency responders
- Engineering feasibility and costs
- © Equity
- Local factors



Application to Southern California



Application to Southern California

- About 2,360 public at-grade crossings
- Roughly only 20% of these meet the minimum traffic criteria
- On 5 freight rail mainlines, about 90 satisfy the minimum traffic criteria as well as one of the other selection criteria, benefits of grade separating these 90 at-grade crossings
 - » ~2,000 daily veh-hrs of delay can be avoided in 2010
 - » ~7,800 daily veh-hrs of delay reduction by 2035
 - » ~77 highway-rail accidents between 2006-2010 could have been avoided
 - » ~\$211,000 emissions related damage cost reduction by 2035



Application to Southern California

 Grade Separation
 Program in the 2012-2035 RTP/SCS
 consists of 71
 crossings –
 completed prior to
 full framework
 development

So of the crossings satisfy the set criteria and rest cannot be evaluated





Conclusions

- Multiple measures based framework developed for evaluation of at-grade crossings performance and selection for grade separation program, but done without ranking
- Implemented "Train Builder" and "At Grade" models to compute vehicle hours of delay at all at-grade crossings between downtown Los Angeles and Barstow to the north and Indio to the east for 2010 and 2035
- Framework can be readily adapted to other regional and local transportation plans after data acquisition



Future Work

Incorporate a risk based model for safety

Develop and integrate estimation of non-intermodal and passenger train volume forecasts within the "Train Builder" model

Develop and incorporate prioritization or ranking procedure

