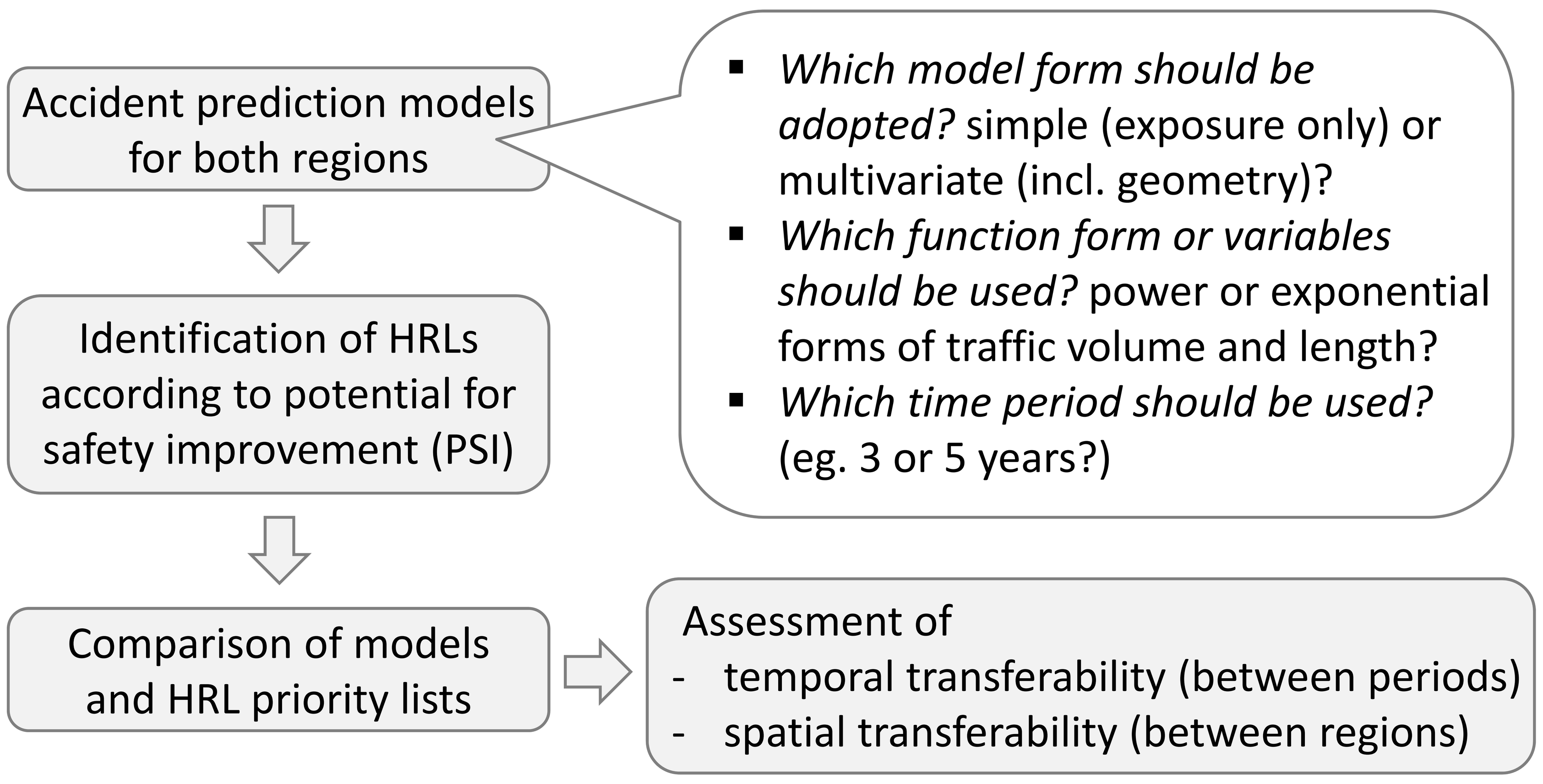
A FEASIBILITY STUDY FOR DEVELOPING A TRANSFERABLE ACCIDENT PREDICTION MODEL FOR CZECH REGIONS

Jiří Ambros, CDV – Transport Research Centre, Czech Republic
Jiří Sedoník, CDV – Transport Research Centre, Czech Republic

INTRODUCTION

- **Hazardous road locations (HRL)** = the locations (segments or intersections) with insufficient level of safety, which should be investigated and treated.
- They are identified through **network safety ranking (NSR)** = the method for identifying, analysing and classifying parts of the existing road network according to their potential for safety development and accident cost savings → a priority list of road sections where an improvement of the infrastructure is expected to be highly effective.
- The **empirical Bayes (EB)** approach using accident prediction models is recommended for NSR → demands on road agency?
- **The transferable model would ease up on demands on data collection and modelling efforts and thus increase effectiveness of the network safety ranking process.**
- The presented feasibility study was conducted on national road network (1st class roads) in two adjacent regions in the southeast of the Czech Republic (South Moravian region and Zlín region).



The objectives:

1. **To decide on appropriate model form, function form, and time period for both regions.**
2. **To decide on feasibility of transferring those two models in time and space.**

DATA PREPARATION

- National road network in regions South Moravia (**SM**) and Zlín (**ZL**)
- Only **rural undivided**, excl. intersections, were selected for this study
- Between 200 and 300 km in each region

- **Segmentation:** creation of homogeneous segments with respect to AADT, speed limit reduction, road category, number of lanes, paved shoulder. In order to obtain segment lengths practical for follow-up safety inspections, segments longer than 500 m were divided into 250 m parts.

  ⇒ ~ 1200 segments in each region with average length 200 m

- **Variables:** response variable (8-year injury accident frequency) and explanatory variables (AADT, length, curvature change rate, intersections with minor roads, roadside facilities, road width category, paved shoulder, number of lanes, speed limit reductions, tree alleys).

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DEVELOPMENT AND COMPARISON OF MODELS

Negative binomial prediction model of accident frequency (N):

$$N = \beta_0 \cdot AADT^{\beta_1} \cdot \exp\left(\sum_{i=2}^{n} \beta_i \cdot x_i\right)$$

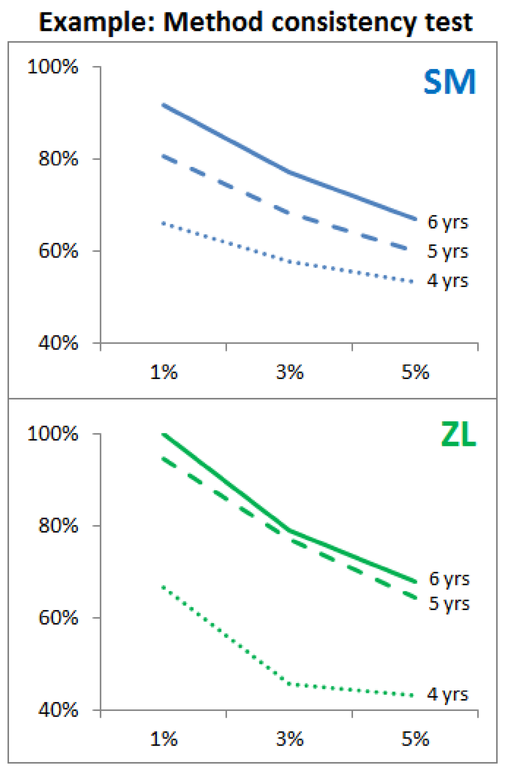
x_i – explanatory variables
β_i – estimated regression coefficients

- several model variants were developed
- significance of explanatory variables tested for all variants of 4, 5, 6-year models
- function form suitability compared with respect to proportion of explained systematic variation (%SV)
- from descending values of PSI, three upper tails were selected: 1% (12 segments), 3% (35 segments), 5% (58 segments)
- three consistency tests were used: site consistency test, method consistency test, epidemiological diagnostic test
- test of model transferability in time (between time periods) and across space (between the two regions), i.e. from condition i to i+1
  - using regression coefficients from i to predict accident frequencies in i+1
  - re-scaling of predicted values through multiplication by calibration factor (sum of recorded accidents / sum of predicted accidents)
  - comparison of original accident frequencies with calibrated predictions
- assessment of transferability success with mean square prediction errors (MSPE) and cumulative residuals (CURE)

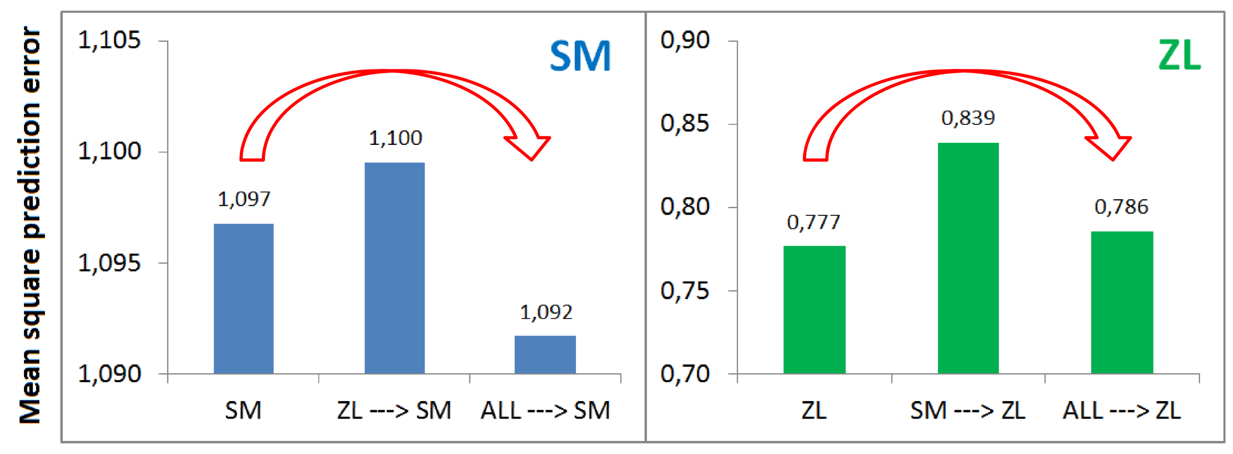
RESULTS

- Simple models comparable to multivariate
  ⇒ simple models
- Exponential form of AADT did not have statistically significant influence
  ⇒ power form of AADT
- Models with exponential form of length had lower values of %SV
  ⇒ power form of length
- 5-year model results close to 6-year
  ⇒ 5 years as acceptable compromise

Example: Method consistency test



- Temporal transferability of models was tested between all 5-year variants
  ⇒ virtually the same results
- Spatial transferability was tested between regions (SM → ZL, ZL → SM) and also with a model, developed with combined data (ALL → SM, ALL → ZL)



⇒ It was not beneficial to apply models across different regions
⇒ But using combined models, which accumulate data from both regions, seems not to decrease the model performance

CONCLUSIONS

1. To decide on appropriate model form, function form, and time period for both regions. 5-year accidents, AADT, length, curvature

$$N = \beta_0 \cdot AADT^{\beta_1} \cdot L^{\beta_2} \cdot \exp(\beta_3 \cdot CCR)$$

2. To decide on feasibility of transferring those two models in time and space.

- The models are not transferable between regions. But when using data from both regions, models become comparable to original models or even better.

⇒ In time, as data are accumulated through developing models also for other Czech regions, combined model will become better alternative than using individual regional models. Such model will then be truly transferable and will fulfill the tasks of effective country-wide network safety ranking.

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