Linking road safety management with road safety performance

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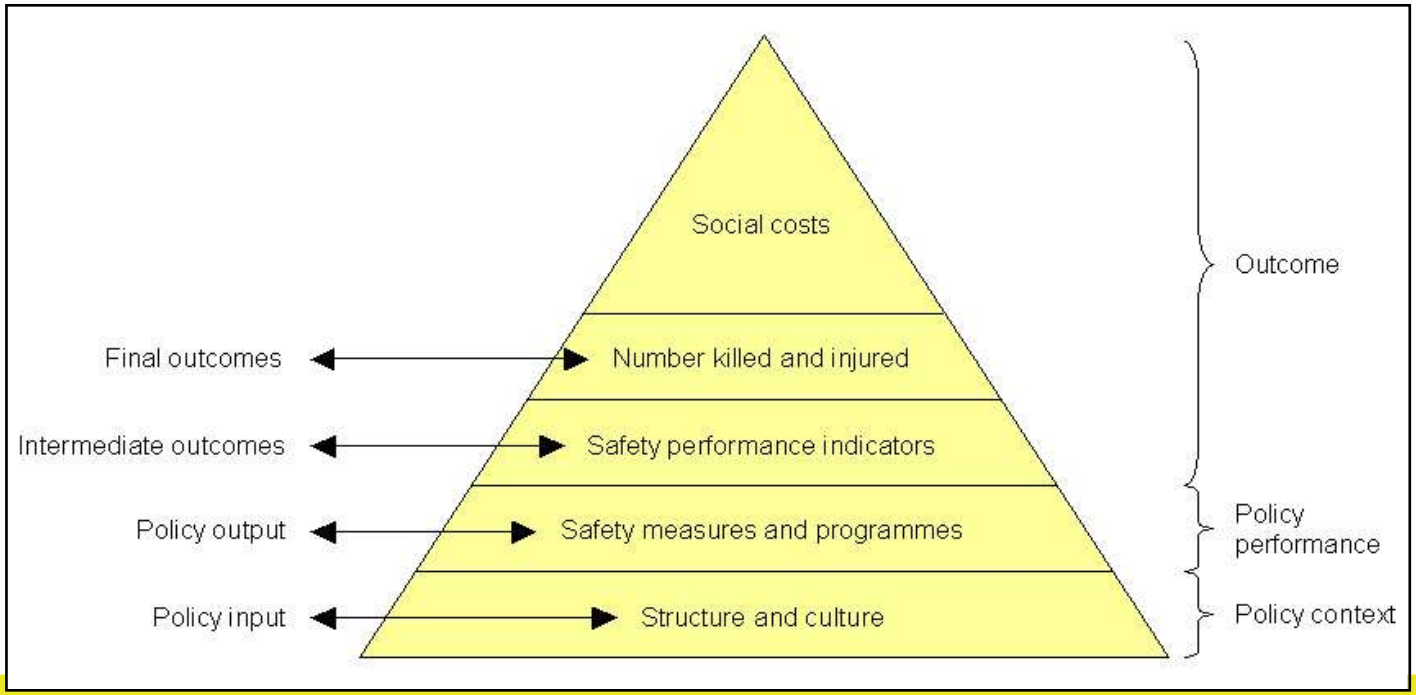
Background

- The road safety management 'footprint' of a country at a specific point in time can be described on the basis of the SUNflower pyramid
- The relationships suggested by the pyramid have not been adequately examined in the international literature *(Bax, 2012)*
- Few recent studies examined the relationship of road safety management level with road safety performance *(e.g. Elvik, 2012)*.



Objectives

The objective of this research is to identify road safety management components and to link those with road safety performance in the European countries within the framework of the SUNflower pyramid

Hypotheses tested

- RSM in a country can be described on the basis of a few indicators
- RSM is associated with road safety outcomes (fatalities, etc.)
- RSM is associated with ‘intermediate outcomes’ (SPIs)

- *Other factors need to be taken into account*

Data sources (1/2)

Background data: structure and culture

- Country grouping on the basis of the DaCoTA 'Benchmarking' work
- Two groups of countries on the basis of GDP per capita and level of motorisation
  - **Group 1** (10 countries): RO, BG, HU, SK, LV, PL, EE, PT, CZ, LT
  - **Group 2** (20 countries)

Road safety management data

- Common ETSC-PIN / Dacota questionnaire

  (18 questions, 29 countries)
  - National vision, strategy, targets (fatalities, serious injuries etc.)
  - National programmes & plans, budget
  - Lead Agencies for policy making and coordination
  - Monitoring and evaluation of road safety programmes, reporting, publication
  - Surveys on road user attitudes and behaviour

Data sources (2/2)

Performance indicators

- Composite SPI developed by the DaCoTA 'Benchmarking' group
  - Roadside police alcohol tests, percentage of drivers above legal alcohol limit
  - Daytime seat belt wearing rates on front and rear seats
  - Average percentage occupant & pedestrian protection score for new cars
  - Median age and renewal rate of passenger cars

Road safety outcomes

- Mortality and fatality rates
- Fatality reduction 2001-2010 (CARE & Eurostat)
- Composite outcomes index developed by the DaCoTA 'Benchmarking' group
  - Fatalities per million inhabitants, per million vehicle fleet, per 10 billion pkm
  - Annual average percentage reduction in fatalities, 2001-2008
  - Pedestrians, cyclists, motorcycle and moped fatalities as a % share of the total

RSM data handling

- The PIN/Dacota questionnaire includes 18 questions on RSM
  - Coding: yes / partially / no
- Data handling
  - Excluding ‘consensus’ questions
  - Excluding unusable questions (e.g. many missing values)

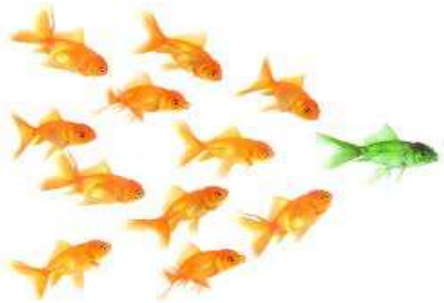
Question	count of "yes"	count of "partially"	count of "no"	count of "unknown"	sum of responses (excl. "unknown")
1_Vision	13	7	9	0	16,5
2_Strategy	20	4	5	0	22
3a_Target_fatalities	**26**	**0**	3	0	**26**
3b_Target_seriousinj	11	0	18	**0**	11
3c_Target_other	13	2	14	**0**	14
4_Programme_plan	**21**	**6**	2	0	**24**
5a_Budget	5	8	14	2	9
5b_Budget_adequate	5	7	4	**13**	8,5
5c_Budget_changes	6	1	11	**11**	6,5
6a_LeadAgency_PolicyMaking	**23**	**2**	4	0	**24**
6b_LeadAgency_Coordination	**21**	**4**	4	0	**23**
7a_Monitoring	**27**	**2**	0	0	**28**
7b_Monitoring_published	**23**	**3**	3	0	**24,5**
8_Evaluation	10	11	8	0	15,5
9_Reporting	15	8	6	0	19
10a_Attitudes_measures	10	12	5	2	16
10b_Attitudes_behaviour	11	10	6	2	16
10c_Behaviours	17	8	4	0	21
unusable questions					
consesnus questions					

Estimation method of RSM indicators

- Eight variables from the PIN/Dacota questionnaire were tested

- Three dimension reduction methods were tested
  - RSM variables correlations
  - Principal Component Analysis (PCA)
  - Categorical Principal Component Analysis (CATPCA)

- All three methods provided the same solution in terms of the number of RSM 'dimensions'



- The CATPCA country scores on RSM were selected for further analysis
  - Optimal scaling technique, taking into account the ordinal nature of the data

Results on RSM dimensions

- **Dimension 1**: Systematic measurement of road user attitudes and behaviour.
- **Dimension 2**: Dedicated budget for road safety, regular evaluation and reporting on programmes and measures.
- **Dimension 3**: National vision and strategy of road safety.
- *These 3 Dimensions explain 77% of the variation in the responses*

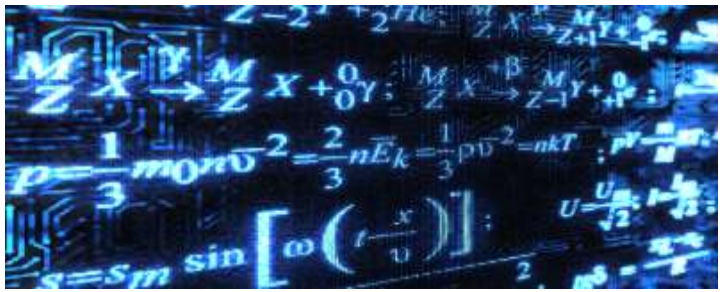
Development of models linking RSM with road safety performance

Dependent variables

- Mortality and fatality rates 2010
- % reduction in fatalities 2001-2010
- Composite index of RS outcomes
- Composite index of SPI

Explanatory variables

- Background characteristics
- RSM ‘dimensions’
- Composite index of SPI



Modelling techniques

- Standard GLM (preliminary analysis)
- Quasi-Poisson regression models when the dependent variable is a rate (e.g. mortality and fatality rates)
- Beta regression models when the dependent variable lies within the unit interval [0,1] (e.g. percentage reduction in fatalities, composite road safety outcomes index)

Overview of modelling results

Dependent variable	Fatalities per million inhabitants	Fatalities per million passenger-kilometres	% reduction in fatalities 2001-2010	Composite index of road safety outcomes	Composite index of SPIs
Dependent variable type	rate	rate	percentage	Values within [0,1]	Values within [0,1]
Model	Quasi-Poisson	Quasi-Poisson	Beta regression	Beta regression	Beta regression
Dispersion	Fixed	Fixed	Fixed	Fixed	Variable
Explanatory variables	• Background indicator • Composite SPI • RSM Dimensions	• Background indicator • Composite SPI • RSM Dimensions	• Background indicator • Composite SPI • RSM Dimensions	• Background indicator • Composite SPI • RSM Dimensions	• Background indicator • RSM Dimensions
Significant effects	✓ Background indicator ✓ Composite SPI	✓ Background indicator	None	✓ Background indicator	✓ Background indicator ✓ **RSM Dimensions**

RSM does not appear to affect road safety outcomes, but appears to affect 'intermediate outcomes' (SPIs - the operational level of safety)

Results of the best performing model

- Economically stronger countries have a higher composite SPI.
- Countries with regular measurement of road safety attitudes and behaviours have a higher operational level of road safety.
- Countries with dedicated road safety budget, systematic evaluation of measures and reporting, have a higher operational level of road safety.
- Countries with a road safety vision and strategy have a lower operational level of road safety.
  - the presence of a “vision” may take a long time to show effects
  - the “presence” of a strategy may not necessarily imply *implementation* of that strategy

Conclusions

- Variation in RSM systems can be adequately described by 3 ‘dimensions’
- RSM indicators do not directly affect road safety outcomes.
- However, they do affect the operational level of road safety, as reflected by the SPIs.
- This is what is in fact suggested by the SUNflower pyramid.

- A dedicated budget for road safety, the systematic evaluation of the results of road safety programmes and the related reporting, as well as the regular measurement of road user attitudes and behaviour, correspond to better operational level of road safety.
- The presence of a national vision and strategy is not sufficient alone for a better operational level of road safety.

Discussion (1/2)

- The results are indicative of a relationship between RSM and the operational level of road safety - however, they are not sufficient to support a strong relationship.

- Particular emphasis was put in dealing with the small sample size:
  - Applying advanced statistical techniques (and testing different techniques)
  - Selecting a minimum number of appropriate explanatory variables
  - Still, there may be other factors which have not been accounted for (e.g. mobility, economy, long traditions, weather etc.).

Discussion (2/2)

- European countries do not exhibit very big differences in road safety performance or RSM overall (a minimum acceptable level exists).
  - Including developing countries in the analysis might reveal stronger relationships.

- A ‘snapshot’ of the road safety system on 2010

  - the evolution of the road safety management system may be a stronger determinant of road safety performance

  - the new visions, strategies and programmes may take several years to show effects

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