pract

CEDR
Conférence Européenne
des Directeurs des Routes
Conference of European
Directors of Roads

Development of a Crash Modification Factors Model in Europe

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European Union Road Federation ERF

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Structure of the presentation

1. The PRACT Project

2. CMF Development: Motivation and Contribution

3. Methodology and Key Results

4. Conclusions

1. The PRACT Project

Key Objective

- The PRACT project **aimed to develop a practical guideline and a user friendly tool** that will allow the different road administrations to:
    - **adapt the basic APM function to local conditions** based on historical data
    - **identify the CMFs that could be relevant** for the specific application
    - **verify if the selected CMFs are transferable** to the specific condition
    - **apply the calibrated model** to the specific location to be analysed.

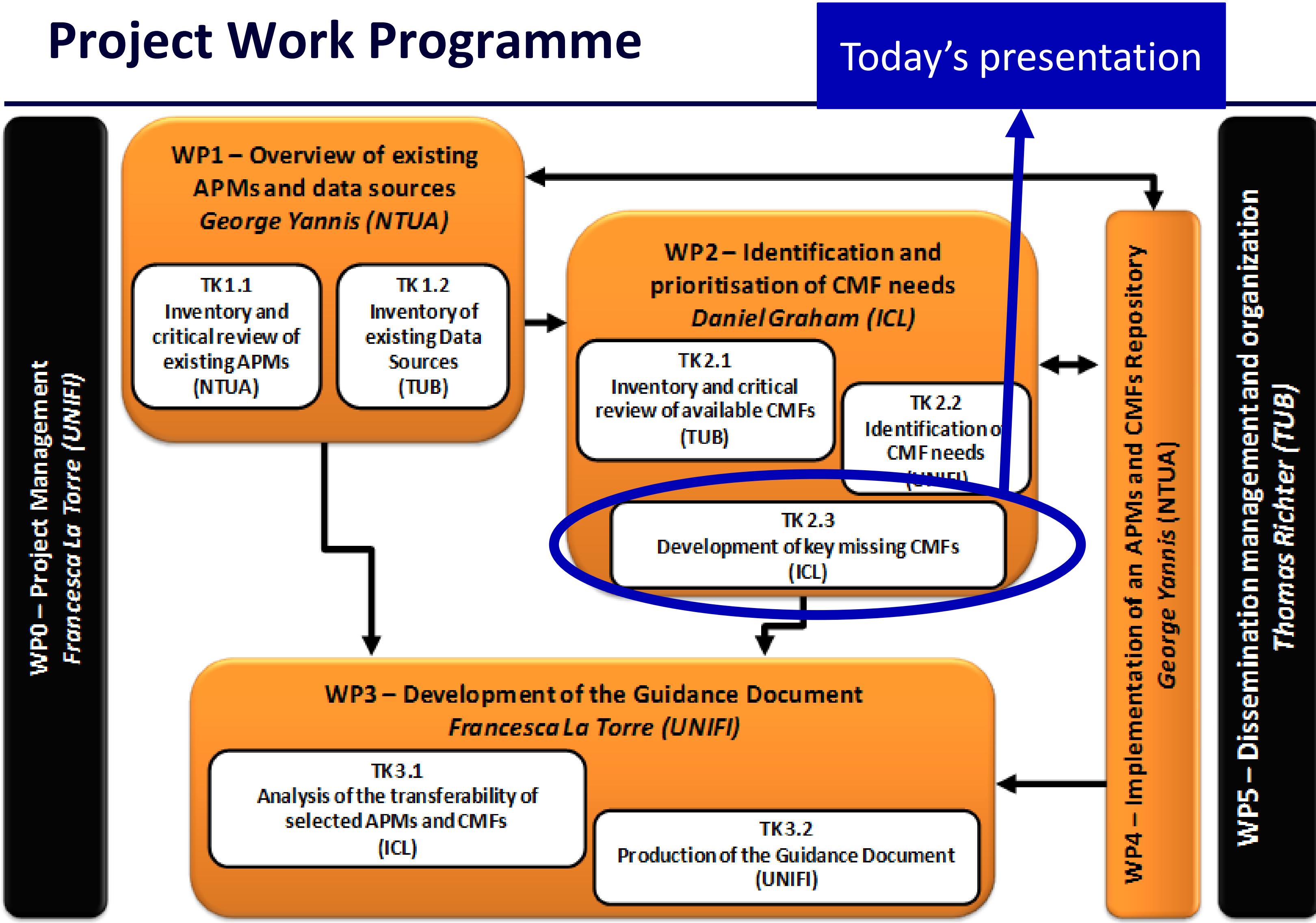
The Consortium

with the support of

With the support of:

- Project Manager: Elizabeth Mathie, Highways Agency - UK
- Funded by the national road authorities of Germany, Ireland, UK and Netherlands within the CEDR 2013 Call Safety

Project Work Programme



- Two year project that ended in June 2016. Final workshop: Manchester 3rd June 2016
- Project outputs available at www.practproject.eu
- Repository available at www.pract-repository.eu

2. CMF Development: Motivation and Contribution

Motivation and Contribution

- There is a lack of CMF estimates based on European data
- A questionnaire survey of worldwide National Road Agencies and a comprehensive review of existing literature on CMFs for 92 countermeasures/road features helped identify CMF needs
- Within PRACT, new CMFs were estimated to fill some of these needs
- Estimation of new CMFs was somewhat constrained by data availability

CMFs developed within PRACT

- Italy, rural motorways
  - Work zones
  - Speed enforcement (section control)
  - High friction wearing course
- Germany, two-way two-lane rural roads
  - Traffic composition (% HGV)
  - Road width
  - Horizontal curvature
  - Vertical gradient
- England, two-way two-lane rural roads
  - Traffic composition (% HGV, % two-wheel motor vehicles)
  - Horizontal curvature
  - Vertical gradient

These are CMFs that

- were identified as highly desirable and often lacking based on survey & lit. review
- for which suitable data for estimation were available

3. Methodology and Key Results

Methodologies used for CMF development

- Italy, rural motorways
  - Work zones
  - Speed enforcement (section control)
  - High friction wearing course
- Germany, two-way two-lane rural roads
  - Traffic composition
  - Lane width
  - Horizontal curvature
  - Vertical gradient
- England, two-way two-lane rural roads
  - Traffic composition
  - Horizontal curvature
  - Vertical gradient

Italy: Empirical-Bayes Before-After

Germany and England: Negative Binomial Models

Methodologies used for CMF development

- Empirical-Bayes Before-After
  - Controls for the effects of regression to the mean which can arise when countermeasures are implemented at accident blackspots
  - Requires data on the year/date of treatment/countermeasure implementation, and on accident rates and traffic flow both before and after implementation
- Negative Binomial models
  - Suitable for CMF estimation for road features or countermeasures that are independent of accident rates
  - Advantage: can provide CMF estimates as a function of the countermeasure of interest

Key results (I)

Presence of a work zone	• Presence of a work zone increases accidents by 33% • Some work zone layouts are more dangerous than others: A partial diversion of flow in 2-lane carriageways, with a single lane not diverted, increases accidents more than threefold (compared to no works at all). • Some work zone layouts appear not to affect accidents (e.g. closure of emergency or slow lane in 3-lane carriageways)
Speed enforcement (section control)	• 0.52 - 1.55 depending on injury/ crash type and traffic flow • In the range 0.81 - 0.92 in most cases • Larger effect when traffic flow is high (0.5 - 0.6 for multi-vehicle crashes when AADT ≥ 55,000 veh/day) • No effect in some cases - most importantly no effect on single vehicle fatal and injury crashes irrespective of AADT • No effect on multi-vehicle PDO crashes & low AADT (< 25,500 veh/day)
High friction wearing course	• CMF = 0.27 for fatal and injury run-off-road crashes on wet pavements

Key results (II)

Variable	Germany	England
Road width (RW) - metres	$e^{-0.17*\Delta RW}$	-
Horizontal curvature (HC)	$e^{0.003*\Delta HC}$	insignificant
Vertical gradient (V) - %	insignificant	$e^{0.09*\Delta V}$
% HGV (HGV)	insignificant	$e^{-7.6*\Delta HGV}$
% two wheel traffic	-	insignificant

Results obtained from the two models are not comparable. Could be due to:

- CMFs not being transferable between countries
- Slight differences in variable definition (e.g. horizontal curvature)
- Data used in estimation (e.g. German dataset includes relatively flat roads – not much variability in vertical gradient in the sample could lead to insignificant result)

4. Conclusions

Conclusions and future research directions

- Gaps exist in the CMF literature. There is a lack of European estimates.
- Gaps are difficult to fill due to a lack of suitable data for estimation.
- Within PRACT, CMFs for 8 countermeasures/road features were estimated to fill some of these gaps. CMF development was constrained by data availability.
- Increased data availability could allow the use of advanced causal methods to estimate CMFs (e.g. propensity score).
- More information on PRACT activities can be found at www.practproject.eu

New CMFs: Key conclusions reached

- The effect of road characteristics and traffic composition on accident rates could depend on the road network under consideration
- High friction wearing course can reduce run-off-road crashes on wet pavements by 73%
- A 10 - 20% decrease in accidents can be expected with speed enforcement (section control), but this may depend on the level of traffic flow and the type of crashes
- In general, the presence of work zone increases accidents by 33%; the effect can vary depending on the layout from no effect to up to a threefold increase