Development of a Crash Modification Factors Model in Europe
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

• 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
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
  - Empirical-Bayes Before-After

- **Germany, two-way two-lane rural roads**
  - Traffic composition
  - Lane width
  - Horizontal curvature
  - Vertical gradient
  - Negative Binomial Models

- **England, two-way two-lane rural roads**
  - Traffic composition
  - Horizontal curvature
  - Vertical gradient
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)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Germany</th>
<th>England</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road width (RW) - metres</td>
<td>$e^{-0.17\Delta RW}$</td>
<td>-</td>
</tr>
<tr>
<td>Horizontal curvature (HC)</td>
<td>$e^{0.003\Delta HC}$</td>
<td>insignificant</td>
</tr>
<tr>
<td>Vertical gradient (V) - %</td>
<td>insignificant</td>
<td>$e^{0.09\Delta V}$</td>
</tr>
<tr>
<td>% HGV (HGV)</td>
<td>insignificant</td>
<td>$e^{-7.6\Delta HGV}$</td>
</tr>
<tr>
<td>% two wheel traffic</td>
<td>-</td>
<td>insignificant</td>
</tr>
</tbody>
</table>

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](http://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