INTRODUCTION TO STATISTICAL STUDY OF BUS ACCIDENT
ARE THE BUSES SAFE OR NOT?

GRSG, 109th session

Presented by
Dr. MATOLCSY Mátyás
Expert of Hungary
CONTENT OF THE STUDY

INTRODUCTION

COLLECTION AND EVALUATION OF ACCIDENT INFORMATION
   Different ways and goals
   Demand of the international regulatory work
   Collection of large data set
   Set up of statistical samples from data set
   Evaluation of safety level
   Categorization of casualties

GENERAL PICTURE ABOUT THE LARGE DATA SET

HUNGARY AS A „REFERENCE” REGION

OVERVIEW OF DIFFERENT ACCIDENT CATEGORIES
   Rollover
   Frontal collision
   Rear and side collision
   Bus fire
   Combined accident
   Collision with train
   Special bus accident

SUMMARY
The total number of bus occupant casualties is small in the casualty statistics of road accidents compared to the car, motorcycle, etc. casualty figures. Does it mean that the buses are safe? No, the reason of the small bus occupant casualty figures is the small number of bus accidents in the total road accident statistics.
THE BUS ACCIDENTS ARE RARE, INFREQUENT

1. Dynamic „picture”
   German statistics: running vehicles were counted on highways during one day
   daily average, percentage of buses: 0,4%

2. Static „picture”
   In registered national road vehicle fleet (8 European countries)
   average ratio of buses: 0,25-0,3%

Therefore it is difficult to get reliable bus accident information for the international regulatory work
SOLUTION

– collect large data set from around the world, including all kind of bus accidents
  • continues data collection
  • electronic data base
  • using all kind of data sources

– set up statistical samples from the large data set
  • based on the principles of mathematical statistics
  • sampling according to the studied problem
  • safety level evaluation based on casualty figures
Possible, considerable sources of bus accident information:

- police reports
- bus manufacturers collections
- insurance company’s data
- fire brigade reports
- ambulance team (medical) reports
- media reports (radio, TV, newspapers, etc.)
- internet
- etc.
Some principles, definitions of mathematical statistics

- **Event**: individual element of the data set (bus accident) with the belonging information
- **Sample**: collection of events having certain common feature, group of bus accidents
- **Sampling parameter**: the basis of selecting events from the data set (bus category, type of accident, region, etc.)
- **Homogeneous sample**: in which the events were selected strictly by the same sampling parameter
- **Representative sample**: homogeneous sample with large sample size.

ONLY THE REPRESENTATIVE SAMPLE PROVIDES VALID, ACCEPTABLE CONCLUSION
Some words about the **Data set**, which is the basis of this study:

- Information collection started 15 years ago with rollover of large buses
- The „subject” was later, step by step extended (small buses, frontal collision, all kind of accidents, etc.)
- The information sources were also extended step by step
- The Data set is „paper-based”, not computerized
- Today the number of events in the Data set exceeds 1550 (accidents) together with the belonging information
### General overview about the Data set
(at the end of 2014)

<table>
<thead>
<tr>
<th>Region</th>
<th>Type of accident</th>
<th>Rollover</th>
<th>Frontal collision</th>
<th>Rear and side collision</th>
<th>Direct fire</th>
<th>Combined accident</th>
<th>Collision with train</th>
<th>Special accidents</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hungary</td>
<td>R</td>
<td>176</td>
<td>335</td>
<td>28</td>
<td>65</td>
<td>11</td>
<td>6</td>
<td>19</td>
<td>645</td>
</tr>
<tr>
<td>Europe</td>
<td>FC</td>
<td>168</td>
<td>96</td>
<td>7</td>
<td>13</td>
<td>28</td>
<td>12</td>
<td>5</td>
<td>324</td>
</tr>
<tr>
<td>World</td>
<td>RSC</td>
<td>201</td>
<td>124</td>
<td>2</td>
<td>20</td>
<td>146</td>
<td>15</td>
<td>17</td>
<td>525</td>
</tr>
<tr>
<td>Σ</td>
<td></td>
<td>545</td>
<td>555</td>
<td>37</td>
<td>98</td>
<td>185</td>
<td>33</td>
<td>41</td>
<td>1494</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bus category</th>
<th>R</th>
<th>FC</th>
<th>RSC</th>
<th>F</th>
<th>CA</th>
<th>CT</th>
<th>S</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I City</td>
<td>9</td>
<td>81</td>
<td>5</td>
<td>41</td>
<td>4</td>
<td>-</td>
<td>11</td>
<td>151</td>
</tr>
<tr>
<td>Class II Interurban</td>
<td>84</td>
<td>139</td>
<td>14</td>
<td>21</td>
<td>30</td>
<td>8</td>
<td>11</td>
<td>307</td>
</tr>
<tr>
<td>Class III Tourist</td>
<td>205</td>
<td>99</td>
<td>6</td>
<td>19</td>
<td>43</td>
<td>4</td>
<td>4</td>
<td>380</td>
</tr>
<tr>
<td>Double decker (DD)</td>
<td>29</td>
<td>12</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>53</td>
</tr>
<tr>
<td>Small bus (SB)</td>
<td>88</td>
<td>150</td>
<td>10</td>
<td>2</td>
<td>18</td>
<td>8</td>
<td>4</td>
<td>280</td>
</tr>
<tr>
<td>Other</td>
<td>23</td>
<td>18</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>4</td>
<td>1</td>
<td>67</td>
</tr>
<tr>
<td>Not known</td>
<td>107</td>
<td>56</td>
<td>1</td>
<td>8</td>
<td>71</td>
<td>8</td>
<td>5</td>
<td>256</td>
</tr>
<tr>
<td>Σ</td>
<td>545</td>
<td>555</td>
<td>37</td>
<td>98</td>
<td>185</td>
<td>33</td>
<td>41</td>
<td>1494</td>
</tr>
</tbody>
</table>
EXAMPLE: STATISTICAL ANALYSIS IN ROLLOVER-I.

Sampling parameter:
Sub categories of rollover
All kind of buses

->
All large buses

->
Tourist coaches

->
HD and DD tourist coaches

Turn on side

Rolling down (max. 2 rotations)

Severe rollover (more than 2 rotations)
### Proving the effectiveness of Reg.66:
**strong superstructure (intact SS)**
**week super-structure (damaged SS)**

### Example: Statistical Analysis in Rollover-II

<table>
<thead>
<tr>
<th>Rollover subcategory</th>
<th>Casualty rates</th>
<th>Number of events</th>
<th>Accident casualty rates (ACR&lt;sub&gt;x&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fatality rate (R&lt;sub&gt;F&lt;/sub&gt;)</td>
</tr>
<tr>
<td><strong>All PRA (a+b)</strong></td>
<td>413</td>
<td>5,5</td>
<td>16,1</td>
</tr>
<tr>
<td><strong>Intact survival space (SS)</strong></td>
<td>123</td>
<td>0,9</td>
<td>11,8</td>
</tr>
<tr>
<td><strong>Damaged survival space (SS)</strong></td>
<td>188</td>
<td>13,8</td>
<td>12,9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rollover subcategory</th>
<th>Casualty rates</th>
<th>Number of events</th>
<th>Accident casualty rates (ACR&lt;sub&gt;x&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fatality rate (R&lt;sub&gt;F&lt;/sub&gt;)</td>
</tr>
<tr>
<td><strong>a) turn on side</strong></td>
<td>196</td>
<td>1,8</td>
<td>13,7</td>
</tr>
<tr>
<td><strong>b) rolling down</strong></td>
<td>217</td>
<td>8,8</td>
<td>17,5</td>
</tr>
<tr>
<td><strong>c) severe rollover</strong></td>
<td>132</td>
<td>16,5</td>
<td>13,7</td>
</tr>
<tr>
<td><strong>all rollover together</strong></td>
<td>545</td>
<td>11,0</td>
<td>14,1</td>
</tr>
<tr>
<td><strong>combined rollover</strong></td>
<td>116</td>
<td>21,7</td>
<td>7,4</td>
</tr>
</tbody>
</table>
EXAMPLE: STATISTICAL ANALYSIS IN FRONTAL COLLISION

**Data set 1494 events**

**Frequency**

<table>
<thead>
<tr>
<th>Subcategories of bus frontal collisions</th>
<th>Number of events</th>
</tr>
</thead>
<tbody>
<tr>
<td>All small bus (SB) frontal collisions</td>
<td></td>
</tr>
<tr>
<td>Full frontal collision</td>
<td>150</td>
</tr>
<tr>
<td>on service door side</td>
<td>77</td>
</tr>
<tr>
<td>on driver side</td>
<td>42</td>
</tr>
<tr>
<td>full width, but limited height</td>
<td>34</td>
</tr>
<tr>
<td>with pole-like object</td>
<td>6</td>
</tr>
<tr>
<td>with small partner, object</td>
<td>147</td>
</tr>
<tr>
<td>not known, not specified above</td>
<td>81</td>
</tr>
<tr>
<td>Σ</td>
<td>555</td>
</tr>
</tbody>
</table>

Full frontal  | Partial, door side  | Partial, driver side  | Small and large bus
EXAMPLE: STATISTICAL ANALYSIS OF REAR AND SIDE IMPACT

Casualty rates

Data set 1494 events

<table>
<thead>
<tr>
<th></th>
<th>Number of events</th>
<th>Accident casualty rate (ACR_x)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fatality</td>
</tr>
<tr>
<td>Rear impact</td>
<td>25</td>
<td>1,5</td>
</tr>
<tr>
<td>Side impact</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

Low frequency
Low casualty rates
Less important issue in international regulatory work

Rear impact
Side impact
SPECIAL BUS ACCIDENTS

To have a complete picture, the special bus accidents shall be also considered. (Number of events in the Data set: 41)

After this boring statistical presentation, just to wake up the audience, some funny, unbelievable special accidents are shown:

Road pavement broke in under the bus (after long heavy rain the running water undermined the ground)
Falling down from a bridge: is it rollover or frontal collision?
Unbelievable! Unnameable accident!
Strong tree branch scalped the DD city bus
SPECIAL BUS ACCIDENTS

Finally an unwanted „passenger”, a deer through the broken windscreen
SUMMARY

– The international regulatory work needs reliable bus accident information
– The bus accidents are rare in consequence of the small ratio of buses in the complete road vehicle fleet
– Using all possible data sources large data set can be collected from around the world
– From the data set different statistical samples can be set up and analysed, reaching useful information and strong evidences.
– This paper shows the method generally and gives some examples based on an existing Data set containing around 1500 bus accidents with the belonging information.
– Today all the technical background, conditions are given to collect and build up efficient data sets.

THANK YOU FOR YOUR ATTENTION