A geospatial approach to understanding factors for suicides at stations and level crossings

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What is the GeoSRM?

- Output from *T972: Piloting a geo-referenced safety risk model for the rail network in Great Britain.*
- Making network-wide safety improvements is not reasonably practicable.
- Now need to understand localised risk profiles.
- Identify areas where safety measures are disproportionate to the risk they are mitigating.
- Identify areas where safety measures could be improved and justified on a location specific basis.
GeoSRM web based tool

- Allows users to filter display
- Calculates risk distributed across network
- Uses local asset and timetable data
- Compare results and breakdown of risk by person type
- Allows interrogation of contributory factors
- Allows users to pan, zoom in and out
- Calculates risk distributed across network
Scope of the pilot

Geographical:

- ~10% network
- 193 stations
- 1755 km track
- 44 million passenger train km/year

Risk areas:

- Suicides
- Slips, trips and falls at stations
- Derailments

Locations:

- London
- Exeter
- Southampton
The data

- **Station**: 162 (63%)
- **Level crossing**: 35 (14%)
- **Bridge**: 24 (9%)
- **Tunnel**: 2 (1%)
- **Other**: 33 (13%)

Suicides 2003-2013
Attempted & completed
### The data

<table>
<thead>
<tr>
<th>Location type</th>
<th>Event count</th>
<th>Site count</th>
<th>Events:Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stations</td>
<td>162</td>
<td>193</td>
<td>1 : 1.2</td>
</tr>
<tr>
<td>Level crossings</td>
<td>35</td>
<td>211 (346)*</td>
<td>1 : 6</td>
</tr>
<tr>
<td>Bridges</td>
<td>24</td>
<td>3204</td>
<td>1 : 134</td>
</tr>
<tr>
<td>Tunnels</td>
<td>2</td>
<td>96</td>
<td>1 : 46</td>
</tr>
<tr>
<td>Other</td>
<td>33</td>
<td>10000s</td>
<td>&gt; 1 : 300</td>
</tr>
</tbody>
</table>

* Crossings at stations excluded as site type not distinguishable from station, hybrid crossings count as one site
The modelling

Number of locations

Number of events

- Actual data
- Poisson
- Negative Binomial
The modelling

• Generalised linear model (GLM) can be used to estimate the number of events at a location.

• The GLM is made up of:
  – A base rate
  – A number of explanatory factors that influence the rate

• Fitted against the Negative Binomial distribution

• Factors are tested for significance (5%) for incorporation into the GLM
Processing the data

Population data:
- age, gender
- commuting by rail
- deprivation indices

Station features:
- staffed/CCTV
- line speeds
Suicides at stations

Generalised linear model: base rate and explanatory factors

- Number of entrances and exits
- Percentage non-stopping trains
- Station type
- Percentage tracks with adjacent platforms
- Percentage season ticket holders

Number of entrances and exits
Percentage non-stopping trains
Station type
Percentage tracks with adjacent platforms
Percentage season ticket holders
Suicides at stations

Generalised linear model: discounted factors

- Train speed
- Population age profile
- Population gender split
- Population density
- Deprivation measures
- CCTV
- Ticket barriers
- Vicinity of mental health clinics
Suicides at stations results – top 100

Station 045
Station 069

Count of events in 11 years
Stations (in decreasing order of predicted values)
95% confidence limits
Observed events
Predicted events
Suicides at level crossings

Generalised linear model: base rate and explanatory factors

- Number of trains
- Surroundings: urban / suburban / rural
- Crossing type: full barrier / automatic / passive
- Interval between trains: frequent / infrequent
Suicides at level crossings

Generalised linear model: discounted factors

- Train speed
- Warning / sighting time
- Train moment / user census
- Vicinity of mental health units
- Population age profile
- Population density
- Population gender split
- Deprivation indices
Conclusions

- GLMs show promise, although with limited data it is tricky to identify the explanatory factors.

- Lengthening the data analysis period:
  - more data points
  - features change

- The results of the model provide a different insight into suicide locations.

- Match pair analysis may lead to identify
  - further explanatory factors
  - mitigations
Next steps

• We are in the process of briefing this out to our industry partners for user testing.

• We envisage the suicide modelling within the GeoSRM to be used inform decisions and understanding of risk:
  – Do they agree with the risk predictions, if not why?
  – Help facilitate with driver route learning, through identification of hotspots
  – Help support driver rostering

• Feedback from the user testing will be used to decide the future of the GeoSRM.
Acknowledgements

Thank you for listening

Thanks to **SOUTH WEST TRAINS** and **NetworkRail** for their support

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*T972 Piloting a geo-referenced safety risk model for the rail network in Great Britain*