Identification of Hazardous Spots and Recommendation of Remedial Measures on Selected Rural Roads in Ghana

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Project Objectives

- The overall study objective was to develop an Accident Blackspot Management System (ABMS) for Department of Feeder Roads (DFR), Ghana.
- The ABMS was to help manage road traffic crash database for systematic safety investments on the rural road network in Ghana, to reduce road traffic crashes and casualties.
- The other objectives encompass research, capacity building, uptake and embedment.
Project Team and Study Area

Project Team

- **CSIR-Building and Road Research Institute (CSIR-BRRI), Ghana**, carried out the study in collaboration with **Transport Research Laboratory (TRL), UK**.
- TRL, UK, reviewed all the technical documents, installed iMAAP and also offered training for DFR staff in the use of the iMAAP facilities.

Map of Study Area
Project activities

- Literature review
- Stakeholder workshops
- Progress reporting
- Crash data collection
- Geo-referencing of crash locations using strip maps and GPS
- Installation of iMAAP and crash data entry

- In-depth analysis of crash data to identify and rank hazardous locations
- Preparation of training manuals
- Training of Department of Feeder Road (DFR) staff
Definition of Hazardous Road Section

- A location on the roadway noted for a high number (frequency) of traffic crashes
- In literature, it has been variously referred to as: “High risk accident location”; “hot spot”; “accident blackspot” or “accident-prone location”
- ‘Hazardous road location’ and ‘accident blackspot’ have been used interchangeably in this study
Features of an effective Accident Blackspot Management System (ABMS)

To ensure an effective ABMS, Best International Practice requires inter-linkages between the ff:

- **Institutional arrangements**: – requiring a Lead Agency; staff trained in road safety management; Road safety research organisations; etc

- **Effective technical arrangements**: facilities for crash data collection, analysis and reporting, and

- **Funding** of blackspot improvement activities to improve road safety
A Functional ABMS Framework for DFR, Ghana

Institutional Arrangement:
(A committed Road Safety Unit working in collaboration with the NRSC, the lead agency)

Technical Measure (Accident Data Management System)
- data collection, coding, analysis, etc.
- iMAAP database
- Road safety research
- Accident report dissemination

Funding-
for implementation of Blackspot Program & Research
Flow chart for Accident Blackspot Management

Collect Accident Data to Create a Database

Identify Hazardous locations and Rank by Severity

Analyse & Diagnose hazardous locations

Propose Countermeasures for each Hazardous location

Evaluate Countermeasures using FYRR and Rank locations for treatment

Adapted from Sorensen (2007)
Step 1: Create a crash database

Traffic Crash Database Development

- We collected road traffic crash data for 5 years (2011-2015) from the Police
- Crash locations were geo-referenced using Strip maps and GPS
- Used iMAAP cloud software for database development and management.
- Crash data was coded and keyed into the iMAAP database for storage and further analysis.

NB: iMAAP= internet-based Microcomputer Accident Analysis Package developed by TRL, UK.
Step 2: Identify and rank blackspots

**Blackspot identification process – criteria followed:**

- **No. of years of crashes:** 5 years
- **Non-statistical model:** Blackspots based on crash frequency. This is simple and globally used
- **Crash number and road section length criteria:** Sites with 5 or more crashes for a fixed rural road length of 5 km were considered as blackspots

**Ranking of Accident Blackspots**

- Firstly **by crash frequency**
- Then, **by weighted crash severity score** based on the adapted Belgian formula for determination of blackspots
The adapted **Belgian formula** used crash numbers and the relative crash severity weightings for ranking the hazardous locations.

The formula computes a ‘**P**’ score as follows:

\[ P = 5(X) + 3(Y) + Z \]

where

- **X** = total no. of fatal crashes
- **Y** = total no. of serious crashes
- **Z** = total no. of slight/PDO crashes

**Weightings for crashes:** *Fatal*=5; *Serious*=3; *Slight/property damage only (PDO)*=1

A site is said to be **hazardous location** when the **crash severity score** (**P**), calculated using the formula above, equals 20 or more. The sites were then ranked for further in-depth analysis.
Step 3: In-depth analysis and diagnosis

Aim:
- To identify traffic crash patterns and associated risk factors (i.e. why the crashes occurred and why they became serious).

Diagnosis Using:
- **Stick diagram analysis**
- **Collision diagram analysis**
- **Road site inspections**

- Stick diagram analysis- to identify key contributing factors using iMAAP software.
- Collision diagram – Graphical representation of all registered road traffic crashes at hazardous sites.
- Site inspections to identify environmental factors such as road defects, drainage conditions, poor signage or markings, overgrown vegetation, etc.
### Step 4: Select Effective Countermeasures

Countermeasures were selected based on their safety potential for a location.  

#### Typical countermeasures for treatment of crash types

<table>
<thead>
<tr>
<th>General Safety Problem</th>
<th>Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slipperiness/Skidding</td>
<td>Restore surface texture; Resurfacing; Improve drainage</td>
</tr>
<tr>
<td>Collision with roadside objects</td>
<td>Remove objects; Better delineation; Install crash barrier or fencing with delineators</td>
</tr>
<tr>
<td>Pedestrian vehicular/ Crashes</td>
<td>Speed controls (speed humps) in settlement areas; signing and/or marking of pedestrian crossings; Walkways; Pedestrian guardrails</td>
</tr>
<tr>
<td>Loss of Control (run-off)</td>
<td>Speed controls; Crash barriers; Improved alignments; drainage; Bigger or better signs</td>
</tr>
<tr>
<td>Night-time crashes</td>
<td>Better delineation; Reflective road markings; Street lighting; Realignment; Improve sightline</td>
</tr>
<tr>
<td>Head-on</td>
<td>Provide curve ahead signs; Trim or remove vegetation; improve sightlines; Repair potholes or failed sections</td>
</tr>
</tbody>
</table>
Step 5: Use FYRR to Prioritise Sites

- First Year Rate of Return (FYRR) was computed and used as an economic indicator in prioritising the hazardous locations for treatment.
- FYRR was calculated as follows:

\[
FYRR = \frac{\text{expected savings gained from proposed countermeasures}}{\text{estimated total implementation cost}}
\]

- Based on the FYRRs the locations were again ranked as candidates for treatment. Locations with higher values are more cost-beneficial and must be prioritised for treatment.
Results

- 14 sections were identified as hazardous sites
- 80% of the crashes were either ran-off-road, head-on or pedestrian-vehicle crashes
- Estimated total economic benefits in the first year after construction of engineering solutions was GHS863,700 (US$215,930) compared to
- Total cost of treatment of identified hazardous locations of GHS173,200 (US$43,300)
- Overall FYRR was greater than 450%
Training, Challenges and Way Forward

Training

- 8 DFR staff members, with minimum of first degree qualifications, were trained in the iMAAP applications for blackspots analysis.

Challenges

- A reliable, regular high speed internet connectivity is needed for the iMAAP system, since the system is internet based.
- Power outages could affect the planned use of iMAAP.

Way Forward

- DFR should have a reliable internet service for the iMAAP.
- Funds should be provided for the implementation, monitoring and evaluation of the identified hazardous locations to establish effectiveness of countermeasures.
Conclusions

- A methodology has been developed for the identification, ranking and recommendation of remedial measures for hazardous sites on rural roads in Ghana which is applicable to other African and developing countries.
- The proposed blackspot improvement schemes are highly cost-beneficial.
- The country stands to save significant costs in road traffic crashes if a rural road safety improvement programme is implemented nationwide.
Recommendations

- The DFR, Ghana, should be provided with funds to treat the 14 identified hazardous locations and to expand this systematic approach nationwide.

- The ABMS model developed in this study should be applied in other developing countries, particularly those in sub-Saharan Africa, to reduce traffic crashes on rural roads in a more systematic and effective manner.
Thank you for your attention

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