Enhancing the Scalability of iRAP Road Safety Assessments in Low- and Middle-Income Countries: Evidence from an AI-Supported Pilot Study in Kenya

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Keywords: Automation, iRAP, Road Safety, AI, Low Cost, Coding.

Background

Road traffic injuries remain a leading cause of death in low- and middle-income countries (LMICs), particularly in Sub-Saharan Africa. Infrastructure-related risk plays a major role in crash occurrence and severity, yet proactive road safety assessments are often limited by resource constraints, fragmented datasets, and labour-intensive methodologies. The International Road Assessment Programme (iRAP) provides a globally recognised framework for assessing the inherent safety of road infrastructure through Star Ratings and fatal and serious injury (FSI) estimates. However, traditional iRAP workflows rely heavily on manual coding of road attributes from video surveys, which can be time-consuming, costly, and difficult to scale across extensive road networks. These challenges can delay decision-making and restrict the use of iRAP in countries where rapid, cost-effective safety diagnostics are most needed.

Recent advances in computer vision, artificial intelligence (AI), and web-based geospatial platforms offer new opportunities to automate parts of the road assessment process, potentially improving efficiency, consistency, and affordability. This study examines the practical implications of integrating AI-supported tools into the iRAP coding workflow in an African context.

Aim

The aim of this study is to evaluate the effectiveness of an AI-supported road attribute extraction and coding approach, compared with the traditional manual iRAP methodology, in terms of productivity, consistency, and scalability when applied to Kenya's national road network while maintaining alignment with iRAP coding standards.

Method

An AI-based pilot study was conducted on approximately 138 km in Kenya, traversing both urban and rural settings. The findings were compared against manually conducted assessment covering approximately 676 km, which traversed diverse geographical and traffic contexts across the Rift Valley, Nyanza, Central Kenya, and Coastal regions. The assessment focused on two parallel workflows:

1. **Conventional iRAP workflow**, in which trained coders manually reviewed video imagery, extracted road attributes, populated spreadsheets, and uploaded results to the ViDA platform.
2. **AI-supported workflow**, using AssetMAPPER Roads, which integrates computer vision algorithms, geo-referenced imagery, and a collaborative web-based interface to automatically detect a subset of iRAP road attributes while enabling simplified manual validation and completion of remaining attributes.

Key metrics analysed included coding time, kilometres coded per week per coder, consistency of attribute identification, and overall effort required to complete the assessment. The study also explored how the automated outputs could be combined with crash data to support network-level risk analysis and prioritisation.

Methodological considerations included ensuring traceability of automated detections, maintaining transparency in attribute derivation, and preserving compatibility with iRAP Star Rating calculations (AiRAP accreditation).

Results

Under the conventional approach, four (4) trained iRAP coders required approximately ten (10) weeks to code the 676 km network, with an average productivity of 17 km per coder per week. The AI-supported workflow reduced total coding time by approximately 75%, enabling the same network to be processed within a substantially shorter timeframe.

Automation of 30 key iRAP road attributes significantly reduced repetitive manual tasks, lowered coder fatigue, and improved consistency across sections and coders. Extrapolation of the results indicates that, using the AI-supported approach, road networks up to four (4) times larger could be assessed with the same human resources. In addition, the integration of automated attribute extraction with crash data enabled faster identification of high-risk sections and facilitated more targeted analysis of potential countermeasures.

No fundamental incompatibilities with iRAP Star Rating calculations were observed, provided that human validation and quality assurance steps were retained for critical attributes.

Conclusions

- The study confirms that **human validation remains essential** for quality assurance, but can be refocused on analytics/countermeasures rather than full manual coding.
- Automating the detection of a defined subset of iRAP road attributes significantly improves **productivity, consistency, and coder efficiency.**
- The Kenya pilot demonstrates that AI-supported automation can reduce iRAP road attribute coding time by approximately **75%** compared with traditional manual workflows.
- The integration of automated road attributes with crash data allows **faster identification of high-risk sections.**
- Overall, the pilot indicates that AI-enhanced iRAP workflows offer a **practical and scalable solution** for accelerating proactive road safety assessments in low- and middle-income countries.