Developing and testing a system-based framework for analysing road accidents: Analysis of three accident types

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Background

Vision Zero Safe System approach to road safety has indicated the importance of system factors for road safety, indicating that individual road user behaviour and accidents, must bee understood in light of a wider societal context. This is particularly important when understanding accidents across different national and regional, socio-economic and cultural contexts like high income countries and low and middle income countries.

Aims

The aim of the study are to:

1) Develop a system based framework for analysing road accidents.
2) Analyze three types of road accidents (Motorcycle collision, Pedestrian accidents and Serious head-on collisions) in three African countries (Zambia, Tanzania, Ghana), and three European countries (Norway, Sweden, Netherlands), to identify formal and in-formal system factors influencing crash outcomes.

Method

We use two types of data to collect information about the accidents. The first data type is a systematic literature review of studies of road accidents in the studied countries. This data type was chosen to provide research-based information about the accident types. The second data is semi-structured interviews, mainly focus group interviews, with 73 people working with road safety in the six countries. We also use data from follow up discussions in focus groups in the

three African countries (n=40 participants). This data source is used to shed light on system factors influencing crash occurrence.

Results

The approach that we use to analyze the three types of accidents (Motorcycle, pedestrian, head-on collisions) is based on a system-based approach to accidents and safety in high-risk organisations (e.g. aviation, oil and gas, the nuclear sector). The approach is system-based, as it draws on high-risk organisations research by e.g. Reason (1997) Rasmussen (1997) and Safe System pillars. We also build on previous studies, which have applied approaches combining these lines of research (e.g. Hirsch et al 2018; Raja et al 2023). Our approach for analysing motorcycle accidents in the three African countries are exemplified in the table.

Road safety aspects	**Active failures**	**Latent factors**	
Safe System pillars	**Direct causes**	**RSM factors**	**Societal factors**
Road user	**Risky behaviour**: Speeding, being in a hurry, lacking helmet use, low compliance with traffic rules, poor knowledge of traffic rules, overloading	Insufficient training, licensing and enforcement	**Economy. Social conditions**: provide jobs for young men. **Lack of a viable organized public transport system.** **Negative traffic safety culture**, other road users' attitudes. **MC-taxies fulfil a need for the population.**
Vehicle	Not underlined by participants.		
Speed	Excessive rider speed	Lacking enforcement and speed management	**Insufficient implementation of Safe System principles.** Economy, corruption
Road/roadside		Insufficient separation between MCs and other modes	Insufficient implementation of Safe System principles in road infrastructure. Economy could be an important reason.

When we use our system-based model to analyse the three types of accidents, results indicated that the level of Safe System implementation in the African countries is influenced by several society level factors (e.g. national economy, poverty, corruption). Our analyses show that when it comes to risky MC rider behaviour (MC-taxi, "boda-boda"), societal factors can be negative traffic safety culture, which is related to risky behaviour, insufficient public transport system, which contributes to a high use of MC taxis, poverty, which means that there are many young men in need of jobs (provided by MC-taxis), poor economy, which may lead to lacking enforcement by the police. Our analyses of pedestrian accidents also point to the importance of societal factors. Creating a pedestrian friendly infrastructure is for instance also influenced by economy and social factors. We heard examples that hawkers and street vendors may use newly established roads as a place to sell their products, dramatically altering the planned road user conditions on the road. In the same manners as the motorcycle rider example, this indicates that the level of fulfilment of Safe System road criteria are influenced by factors extending further than the Safe System pillars. As a consequence of poverty, people may create the road system into a marketplace, influencing the level of road safety in manners unforeseen by road designers. Thus, system factors at different levels influence road safety.

Conclusion

- Our analyses indicate that road safety and Safe System implementation is contingent on wider societal framework conditionsm which differ in the European and African contexts.
- This indicates the importance of system based models.