Towards a Complete Description of the Safe System

James Holgate

Integrated Road Safety Pty Ltd, New Gisborne, Victoria - AUSTRALIA

Abstract

The Safe System has been described in a range of strategies and other publications. Consistently, these describe a number of factors, typically infrastructure, speed, people and vehicles, to indicate that a safe or safer system will be achieved by actions across all of these. This paper examines an alternative model in which these "pillars" are not inputs to achieve safety but are outputs of the interactions within the system. Speed, vehicle and environment describe the system state for each individual. Some implications of describing system risk as a function of these three variables are also discussed.

Introduction

Common early representations of the Safe System, such as those originally included in Australia's National Road Safety Strategy, show the components of the system in ways that reinforce the linkages and interactions between them (ATC, 2009). More recently, these linkages have been simplified and adapted focus on the main "pillars" on which actions will be based. (ATC, 2011). It could be argued that this segmentation of the strategy into discrete actions is contradicts a view of the Safe System as a system.

This paper returns to a more system-based representation and goes further by proposing a model in which the original Safe System components of speed, infrastructure and vehicles are not areas of action but, instead describe the state of an individual within the system.

The paper is in two parts, the first describes a conceptual risk model to derive the risk for an individual in this system state. The second outlines a model of the system that indicates the actions and interactions that influence the speed, infrastructure protection and vehicle protection that represent the system state.

The risk model

If the system state of an individual can be described by their combination of speed (s), the road environment (e) and the vehicle (v), system risk can be described as a function R(s, e, v).

For the purpose of this model, it is further assumed that this function can be described as $R(s,e,v)=R_s.R_e.R_v$ or that the overall risk is the product of individual risks associated with each factor. For example, on a typical undivided rural highway, with current vehicles, the product $R_e.R_v$ remains high and the only way a safe system can be achieved is that by reducing R_s. In other words, by reducing travel speed to the safe system speed for that particular environment.

Hence the risk associated with the road system can be described as a four-dimensional function. More familiar relationships can be represented as cross sections through this function into two dimensions.

Figure 1 shows an example of this. Holding $R_e.R_v$ constant at values that represent a fleet and network average, yields the relationship of risk to speed as promoted in documents such as Wramborg, 2005. It can be noted in this figure that cross sections of the function at different values of R_v yield different overall risk, the curve for pedestrians, with little protection from vehicles, showing the curve as R_v approaches 1.

This model allows other relationships to be explored. Figure 1 also shows the result of projecting this function in another direction. The difference between pedestrian risk curve and the curves representing different levels of occupant protection provides an estimate of how R_v varies with speed. At low speeds, the protection is low as it is unused because R_s is low, at higher speeds, the performance limits of the vehicle are exceeded, which happens at a lower speed for side impacts. In other words R_v is a function of speed as well as of the individual vehicle, v.

Hence the individual risk factors are not independent and demonstrate the complex interactions between variables that need to be understood for a complete understanding of the Safe System

Describing the system

The paper explores the system interactions that determine s, e &v, from macro economic and social factors that determine road investment levels, to individual choice about vehicle, route and speed selection.

Conclusions

The model presented in this paper is incomplete and dependent on some very broad assumptions. However, it is presented to provide an alternative view of the Safe System and one that may assist practitioners in applying a Safe System approach to the development of effective policies and programs.

References

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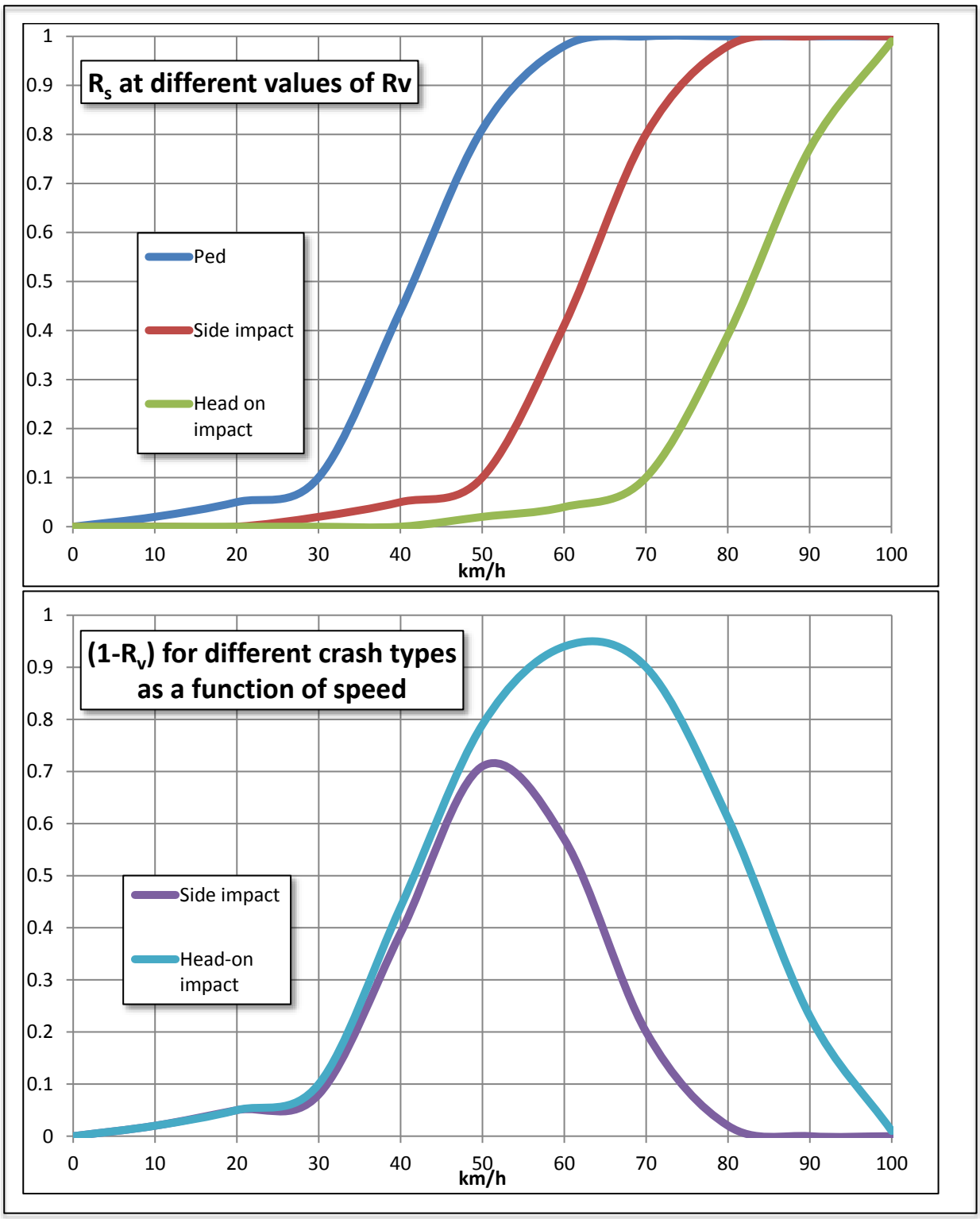

Figure 1. Various projections of the system risk function