Chapter 27
The HRA-Based Road Crash Data:
A Methodology for Crash Investigation and Distribution Characteristics of Driver's Failure Rate

Khashayar Hojjati-Emami
University of Ottawa, Canada

Balbir S. Dhillon
University of Ottawa, Canada

Kouroush Jenab
Embry Riddle Aeronautical University, USA

ABSTRACT

Human error has played a critical role in the events precipitating the road accidents. Such accidents can be predicted and prevented by risk assessment, in particular assessing the human contribution to risk. As part of the Human Reliability Assessment (HRA) process, it is usually necessary not only to define what human errors can occur, but how often they will occur. Lack of understanding of the failure distribution characteristics of drivers on roads at any given time is a factor impeding the development of human reliability assessment and prediction of road accidents in order to take best proactive measures. The authors developed the complete investigation methodology for crash data collection. Furthermore, they have experimentally tested the proposed predictive behavioral characteristics of drivers in light of their instantaneous error rate over the course of driving period to assist processing and analysis of data collection as part of risk assessment. The findings of this research can assist road safety authorities to collect the necessary data, to better understand the behavioral characteristics of drivers on roads, to make more accurate risk assessments and finally to come up with right preventive measures.

DOI: 10.4018/978-1-5225-8356-1.ch027

1. INTRODUCTION

The failures in transportation systems impact on the economy, environment and people's life (Dhillon, 2011). Around 0.8 million fatalities and 20–30 million injuries occur each year in the globe as the result of road accidents (Pearce et al., 2000; Jacobs et al., 2000). It is projected that the road casualties, due to growth in global population and subsequently a denser traffic will rise by about 65% over the next 20 years unless there is an increased commitment to prevention (Peden et al., 2004).

Human error is now considered as the most significant source of accidents or incidents in safety critical systems (Kim et al., 2010). It has been estimated in various surveys that human error is the primary cause of 60 to 90 percent of major accidents in complex systems such as nuclear power, process control, aviation, sea, rail and Roads (e.g., Rouse et al., 1983; Trucco et al., 2008).

Human error is defined as the failure to carry out a specified task (or the performance of a forbidden action) that could result in disruption of scheduled operations or damage to property and equipment (Dhillon, 1990). Human Reliability Assessment (HRA) aims to assess and reduce human error potential in a system (Swain et al., 1983). However, human-error data collection, which should arguably underpin the whole approach to HRA, has generally been an unfruitful area (Taylor-Adams et al., 1997). HRA has three basic functions including the identification of human errors, prediction of probability or likelihood of human errors (HEPs) and the reduction of their likelihood if required (Kirwan, 1996). The ideal sources of HE data for these HRAs are empirical studies on human performance and accidents but there is limited availability of such data (Kirwan, 1994). This has led to reliance on assessments by experts solely and/or with use of probability compounding methods which are based on expert judgement and original data from fields and experiments (Svenson, 1989). However, several problems are associated with expert judgment and compounding methods (e.g., HEART, THERP) for HRA including inconsistencies of judgments and the difficulty in systematically considering performance shaping factors (PSFs), which are factors that influence human performance (Swain et al, 1983; Kirwan et al., 2008).

The recognition that human errors affect competitiveness, customer satisfaction, safety and incurring costs to society has persuaded auto companies and the transportation authorities across the globe to dedicate programs to the systematic reduction of human errors (Lasla, 2009). Concurrent with the increase in size and complexity on road transportation systems, there has been an increased risk associated with drivers on roads (Taylor-Adams et al., 1997).

The authors have highlighted in this research the significance of human reliability on roads and proposed the types of data needed for a systematic human reliability assessment in a car crash caused by a driver and developed the procedure for road accident investigation and the data collection. Furthermore, the validity of the proposed distribution characteristics for drivers' instantaneous failure rate on roads was experimentally tested to pave the way for more accurate data collection and processing as part of risk assessments. The authors expect that the findings of this research would assist the road safety researchers and authorities in their investigation and assessment processes and subsequently to enhance the safety of roads with taking more suited proactive measures using right data and assessments.