World Academy of Science, Engineering and Technology
International Journal of Transport and Vehicle Engineering
Vol:16, No:12, 2022

Assessment of Taiwan Railway Occurrences Investigations Using Causal Factor Analysis System and Bayesian Network Modeling Method

Authors : Lee Yan Nian

Abstract : Safety investigation is different from an administrative investigation in that the former is conducted by an independent agency and the purpose of such investigation is to prevent accidents in the future and not to apportion blame or determine liability. Before October 2018, Taiwan railway occurrences were investigated by local supervisory authority. Characteristics of this kind of investigation are that enforcement actions, such as administrative penalty, are usually imposed on those persons or units involved in occurrence. On October 21, 2018, due to a Taiwan Railway accident, which caused 18 fatalities and injured another 267, establishing an agency to independently investigate this catastrophic railway accident was quickly decided. The Taiwan Transportation Safety Board (TTSB) was then established on August 1, 2019 to take charge of investigating major aviation, marine, railway and highway occurrences. The objective of this study is to assess the effectiveness of safety investigations conducted by the TTSB. In this study, the major railway occurrence investigation reports published by the TTSB are used for modeling and analysis. According to the classification of railway occurrences investigated by the TTSB, accident types of Taiwan railway occurrences can be categorized into: derailment, fire, Signal Passed at Danger and others. A Causal Factor Analysis System (CFAS) developed by the TTSB is used to identify the influencing causal factors and their causal relationships in the investigation reports. All terminologies used in the CFAS are equivalent to the Human Factors Analysis and Classification System (HFACS) terminologies, except for “Technical Events” which was added to classify causal factors resulting from mechanical failure. Accordingly, the Bayesian network structure of each occurrence category is established based on the identified causal factors in the CFAS. In the Bayesian networks, the prior probabilities of identified causal factors are obtained from the number of times in the investigation reports. Conditional Probability Table of each parent node is determined from domain experts’ experience and judgement. The resulting networks are quantitatively assessed under different scenarios to evaluate their forward predictions and backward diagnostic capabilities. Finally, the established Bayesian network of derailment is assessed using investigation reports of the same accident which was investigated by the TTSB and the local supervisory authority respectively. Based on the assessment results, findings of the administrative investigation is more closely tied to errors of front line personnel than to organizational related factors. Safety investigation can identify not only unsafe acts of individual but also in-depth causal factors of organizational influences. The results show that the proposed methodology can identify differences between safety investigation and administrative investigation. Therefore, effective intervention strategies in associated areas can be better addressed for safety improvement and future accident prevention through safety investigation.

Keywords : administrative investigation, bayesian network, causal factor analysis system, safety investigation
Conference Title : ICREM 2022 : International Conference on Railway Engineering and Management
Conference Location : Cairo, Egypt
Conference Dates : December 15-16, 2022