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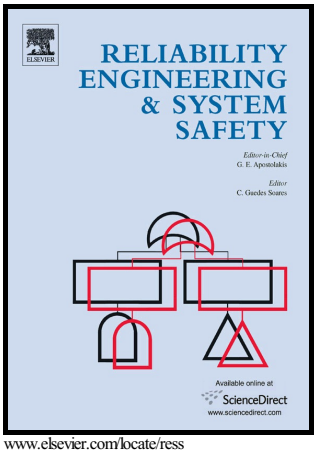

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Capturing cognitive causal paths in human reliability analysis with Bayesian network models

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Abstract

In the last decade, Bayesian networks (BNs) have been identified as a powerful tool for human reliability analysis (HRA), with multiple advantages over traditional HRA methods. In this paper we illustrate how BNs can be used to include additional, qualitative causal paths to provide traceability. The proposed framework provides the foundation to resolve several needs frequently expressed by the HRA community. First, the developed extended BN structure reflects the causal paths found in cognitive psychology literature, thereby addressing the need for causal traceability and strong scientific basis in HRA. Secondly, the use of node reduction algorithms allows the BN to be condensed to a level of detail at which quantification is as straightforward as the techniques used in existing HRA. We illustrate the framework by developing a BN version of the *critical data misperceived* crew failure mode in the IDHEAS HRA method, which is currently under development at the US NRC (Xing et al., 2013). We illustrate how the model could be quantified with a combination of expert-probabilities and information from operator performance databases such as SACADA. This paper lays the foundations necessary to expand the cognitive and quantitative foundations of HRA.

Keywords: HRA; Bayesian networks; Bayesian updating; cognitive factors; causal paths

Acronyms

ACRS	Advisory Committee on Reactor Safeguards
ATHEANA	A Technique for Human Event Analysis
BN	Bayesian Network
CFM	Crew Failure Mode
CPT	Conditional Probability Table
DAG	Directed Acyclic Graph
DT	Decision Tree
HEP	Human Error Probability