Accident modelling: from symptom to system

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Abstract

A series of surveys on accident investigation models show a wide variety of models, dedicated to specific industrial applications, domains and investigation aspects. In particular the investigation of human factors is exposed to a wide diversity of models. In reviewing such models, the majority proves to be a derivate from the Reason's Swiss Cheese causation model or the Rasmussen model on system hierarchy. Most of the models origin from the process industry and the energy sector. Application in the aviation industry has revealed their conceptual limitations. Due to their simplifications and lay interpretations, their intervention potential in practice is limited to linear solutions. In order to cope with socio-technological interactions in a multi-actor perspective, a full systems engineering design approach should be applied in a mission specific operating envelope. Such an approach is submitted to three paradigmatic shifts in investigation methodology. First; disengagement is required between event modelling and systems modelling. Second; a distinction in two design classes is required. A distinction is made between linear interventions within the existing design envelope and second order interventions focusing on expansion of the design solution space. Third; designing safer solutions in a multi-actor systems environment requires prototyping, virtual system model simulation and testing of limit state scenarios. Based on these constraints, a framework for safety enhancement is described, derived from experiences in the aviation industry itself. This framework is based on a new view on human error, a dynamic systems engineering design approach, analytical forensic abilities and institutional conditions for independent and qualified accident investigations.

Accidents and causation

Although accident models have been applied on a large scale in practice, a reflection on their methodological assumptions, scope and deficiencies reveals several schools of modelling. Several surveys indicate consecutive generations of models, their poor methodological basis, absence of a systems approach and a focus on the application of models by lay people (Benner, 1975, 1985, 1996, 2009; Sklet, 2004; ESReDA, 2005). The first accident causation models as derived by Heinrich in the 1930's referred to accident analysis by metaphors, such as the Iceberg Principle and Domino Theory. In a second generation of the 1970's Bird and Loftus applied a linear causality, while Kjellen introduced the deviation concept. Multi-causality was

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