



HRA Method Analysis Criteria

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Outline

- Background and objective
 - SRM (Staff Requirements Memorandum)
 - Towards the IDHEAS method
- Desiderata for the method (outcome)
 - Thoughts on the attributes
- Review of existing methods (and their elements) vs. desiderata
- Conclusions: influence on IDHEAS development

IDHEAS - Integrated Decision-Tree Human Event Analysis System

Background

- Staff Requirements Memorandum (SRM M061020) from US NRC to ACRS

*“work with the staff and external stakeholders to
evaluate the different human reliability models
in an effort to propose a single model
for the agency to use or
guidance on which model(s) should be used in specific circumstances”*

- NRC’s Office of Research (RES) and Electric Power Research Institute (EPRI) working together to address the SRM (under an MOU)

Understand Current State of HRA

- To decide how to respond to SRM, need to understand current practices within HRA and identify technical gaps (if any)
- Two tasks to gain understanding:
 1. Group of experts in HRA convened to develop list of criteria that should be addressed within HRA
 2. Compare several methods against this list

HRA Desirable Attributes

- Experts in field of HRA developed list of attributes based on their understanding of the HRA needs and experience with existing methods and implementation practices
- Identified attributes:

- ☐ Content Validity
- ☐ Reliability
- ☐ Construct Validity
- ☐ Empirical Validity

- ☐ Traceability
- ☐ Adaptability
- ☐ Usability

Content Validity

- Context characteristics including addressing average crew performance, plant characteristics as scenario evolves, and performance shaping factors (PSFs)
- Cognition and diagnosis as well as execution should be covered
- PSF interactions should be accounted for
- Ability to identify, characterize and quantify errors of commission and errors of omission

Content Validity (con't)

- Dependency between HFEs should be covered
- Recovery within an HFE (vs. cutset recovery) should be included for both diagnosis and execution
- Failure mechanisms should be identified in the qualitative analysis
- Ability to address uncertainty and provide uncertainty bounds
- Defined level of granularity and help analyst determine level of decomposition for the HFE

Reliability

- Reproducibility – if analysts make the same assumptions, will they get the same answer?
- Consistency – will analysts choose the same PIFs and assume the same influence level?
- Testing reliability – Inter- and Intra-rater (analyst) reliability

Traceability and Validity

- Traceability – ability to reverse engineer the analyst's work mathematically and conceptually
- Validity
 - Construct validity – method measures what it states to be measuring
 - Empirical validity – method has an empirical basis

Adaptability and Usability

- Adaptability / Scalability – the method can be adapted to different application domains and levels of analysis in a consistent manner
- Usability – method provides a practical tool without compromising the technical integrity of the analysis

Method Comparison to Criteria

Methods included in comparison

ATHEANA	A Technique for Human Error Analysis
CBDT	Cause-Based Decision Tree
SPAR-H	Standardized Plant Analysis Risk HRA
THERP	Technique for Human Error Rate Prediction
ASEP	Accident Sequence Evaluation Program

ATHEANA

- Strengths
 - Strong qualitative analysis
 - Fairly comprehensive coverage of content validity elements
- Weaknesses
 - No readily traceable mathematical account of the quantification
 - Lacks standardization in its application
 - Subject to producing inconsistent results with reliance on expert judgment for quantification

CBDT

- Strengths
 - Structured approach providing standard format allowing for traceability of the HEP calculation
 - Reliability high (dependent on level of qualitative analysis)
- Weaknesses
 - Qualitative analysis lacks full coverage of content validity elements
 - Does not include EOCs
 - No guidance on task decomposition

SPAR-H

- Strengths
 - Fairly traceable and easy to use
 - Simplicity in limited number of PSFs evaluated
- Weaknesses
 - Mainly quantification tool– variability associated with different assumptions made for a given human action
 - Reliance on expert judgment about the choice and effect of PSFs
 - Needs additional technical basis and guidance for scaling the PSFs
 - Likely misses addressing key contextual elements of the scenario

ASEP

- Strengths
 - Relatively easy to use and less resource intensive
 - Easier to understand, interpret, and review
- Weaknesses
 - Its strengths are also its weaknesses!
 - Potentially misses or incorrectly treats many PSFs

THERP

Lessons Learned Elsewhere

- Other sources of information for lessons learned
 - Good Practices in HRA (NUREG-1792 and 1842)
 - International and US Domestic Empirical Studies
- Limitations in many methods
 - Lack of emphasis on need to use a multi-disciplinary team to perform HRA
 - Lack of guidance and emphasis on use of walkdowns, talk-throughs, and simulations
 - Variability on what PSFs are explicitly treated and how to address diagnosis errors

Summary

- These investigations provide a basis for determining how to move forward with the work addressing SRM M061020
- Identified features needed in a HRA method
- Suggests the need for a integrated approach that captures the positive elements in current HRA methods and addresses the identified weaknesses

QUESTIONS