Idaho National Laboratory

LESSON 2

Introduction to Human Reliability Analysis (HRA)

Study Guide

Topic: Introduction to Human Reliability Analysis (HRA)

Purpose: Provide foundational understanding of HRA that will be needed for future lessons

Objectives: At the completion of this session, students will be able to:
- Recall the assumptions, requirements, data sources, and uses of HRA
- Describe, generally, the history of HRA

Resources: Reason, Chapter 2; Gertman and Blackman, Chapters 2-3

Assessing Risk in the Old Days Without Risk Assessment/HRA:

Review from Lesson 1: Risk

Definition: ***The probability of an incident multiplied by its consequences***

Assessment Approaches

- *Qualitative – analyst identifies possible human and hardware failure conditions*
- *Quantitative – analyst calculates probabilities of those failure conditions*

Often you see:

hardware error + human error = total system failure

This is imprecise because a synergy exists between the human and the hardware. Human actions and decisions can either impede or aid hardware recovery.

Goal of Risk Assessment is to Identify:

- ***the potential hazards,***
- ***the likelihood that they will occur, and***
- ***the resulting consequences***

The ultimate goal of risk assessment is risk management

Review from Lesson 1:

Human Reliability Analysis (HRA) Defined

The use of systems engineering and behavioral science methods in order to render a complete description of the human contribution to risk and to identify ways to reduce that risk

History of HRA: 1950 - 1970

1950s - *1st HRA, Sandia Natl. Lab. - studied human error in aircraft weapons systems; Sandia continued HRAs within nuclear weapons manufacturing & handling*

1962 - *1st human reliability data bank – American Institute of Research Data Store; 1st presentation of HRA to Human Factors Society*

1964 - *1st HRA Symposium, Albuquerque*

1967 - *HRA technique accounts for dependencies between operators or tasks*

1969 - *US Air Force developed technique to model probability of error as a function of time, etc*

History of HRA: 1970 - 1990

1970s - *Development of THERP (Note: HRA methods to be explicated later in course); new HRA simulation models; continued discussion about validity and appropriate uses of HRA methods*

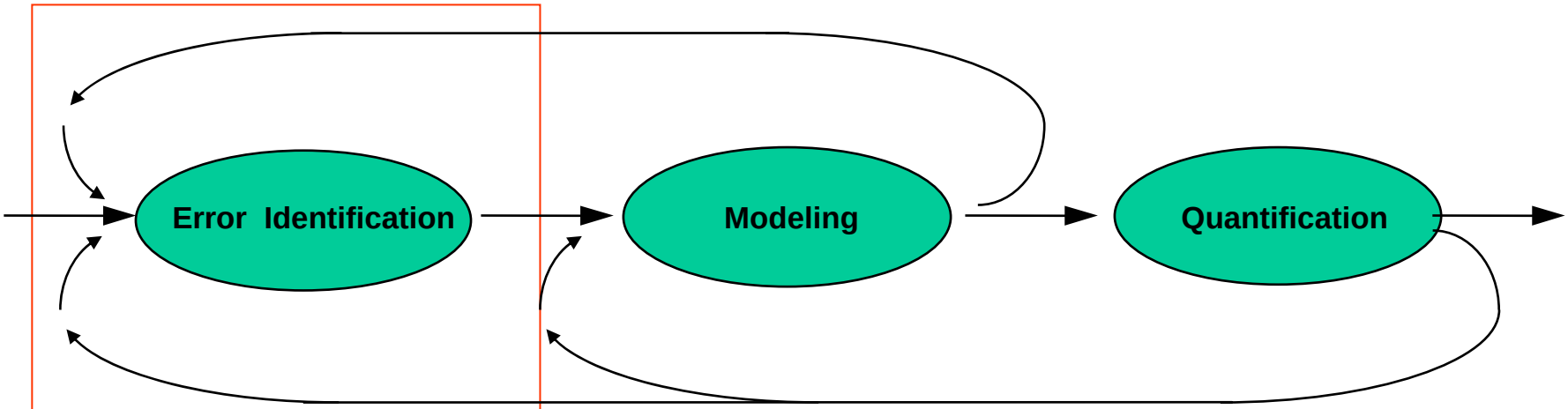
1980s - *THERP revised, ASEP produced; new simulation models; concern over safety & reliability of nuclear power industry (e.g., TMI); standardized HRA process; new HRA databases; new expert estimation techniques; increasing integration of HRAs into Risk Assessments. Chernobyl typifies the role of human error in disaster. Recovery addressed. Modeling frameworks—Rasmussen: S, R, and K; Reason: slips, lapses and mistakes; Time reliability correlation; Performance Shaping Factors (PSFs) introduced*

History of HRA 1990 - present

1990s - *Consideration of management and organizational factors heightened, development of SPAR-H HRA method, development of additional cognitive-oriented models including ATHEANA, CREAM, CAHR, HEART, MERMOS, HRA calculator, the investigation of work process (WPAM). IEEE STD 1082 (1997).*

2000s - *Compilation of HRA datasets for nuclear industry, aviation, and aeronautics. UK NARA effort. Application of HRA in support of NASA exploration. Human Event Repository and Analysis (HERA) database.*

Requirements for Human Reliability Assessment: A Phased Approach



task analysis
error taxonomies
context
performance shaping factors
errors of commission

dynamic event trees
fault trees
event trees
generic error models

data availability
data bases
simulation
empirical approaches
consensus expert
judgment

Assumptions of HRA:

- ***Human error can be identified***
- ***Human error can be modeled***
- ***Performance Shaping Factors (PSFs) affect task performance***
- ***Human behavior can be described by cognitive models***
- ***Interdependency of tasks and task parameters exist***
- ***Human systems interaction(s) are important***
- ***Different types of errors exist***
- ***Human performance is probabilistic in nature***
- ***Human error can be quantified***

Sources of HRA Data

HRA has gathered information from the behavioral sciences and industry to provide a mechanism for understanding and estimating human failure likelihood. Data are compiled from:

- *Laboratory studies*
- *Field studies*
- *Naturalistic observation*
- *Operational experience*
- *Plant databases*

Beneficial Uses of HRA

- *Systematic HRAs allow logical examination of human-machine relationships, potential errors, and estimates of task frequencies*

- *Human reliability estimates for subtasks are combined mathematically into overall error probabilities*

- *When combined with a system's reliability analyses, HRAs assess the detrimental effects human errors have on the system*

Specifically, HRA Can Be Used To:

- *Compare alternate design configurations*
- *Predict the relative human performance expected of a system*
- *Diagnose factors in the system leading to undesirable human performance*
- *Identify improvements in human performance resulting from design changes or proposed tradeoffs*

#1 Class Exercise

Define risk

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_____

Define human error

_____

_____

Define HRA

_____

_____

Lesson Summary

Key Points

Originating in the 1950s, HRA has gathered information from the behavioral sciences and industry.

When combined with a system's reliability analyses, HRAs assess detrimental effects human errors have on the system.

HRA involves error identification, modeling, and possibly quantification.

HRA enables analysts to diagnose factors in the system leading to undesirable human performance.