

HERA for Supporting HRA Data Exchange

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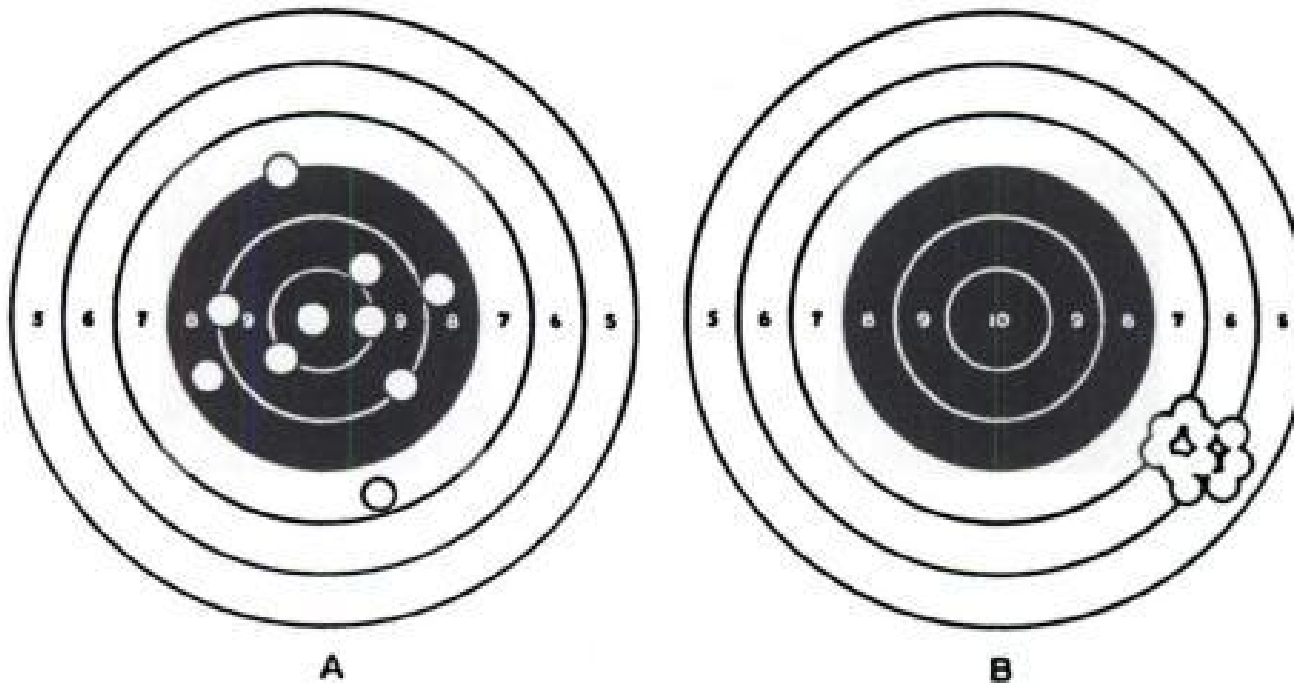
Presentation Outline

- **HRA data needs in NRC**
- **Considerations for HRA data exchange**
- **A data framework to support HRA applications**
- **Current status and outlook**
- **Conclusion**

HRA Data Needs in NRC

- **Support estimates of HEPs in PRA context**
- **Applications:**
 - Significance determination program (SDP)
 - Plant modifications
 - New plants licensing
 - Others (e.g. Yucca Mountain application)
- **Issues**
 - Variations in HEP predictions among HRA methods
 - Error of commission

Expectations on Data



Considerations for HRA Data Exchange



- **Consider all data sources and types**
 - Event analyses and event statistics
 - Nuclear (At-power, LPSD, Fire) and other industries
- **Clarify the approach**
 - Data driven HEP predictions
 - Inform HRA methods (HRA empirical study, EDF FH6)
- **Specific on the information to be collected**
- **Gain supports of other stakeholders**
- **A platform tool to facilitate data exchange**

A Data Framework to Support Data Exchange



- **Objective**

- Data-based HEP predictions

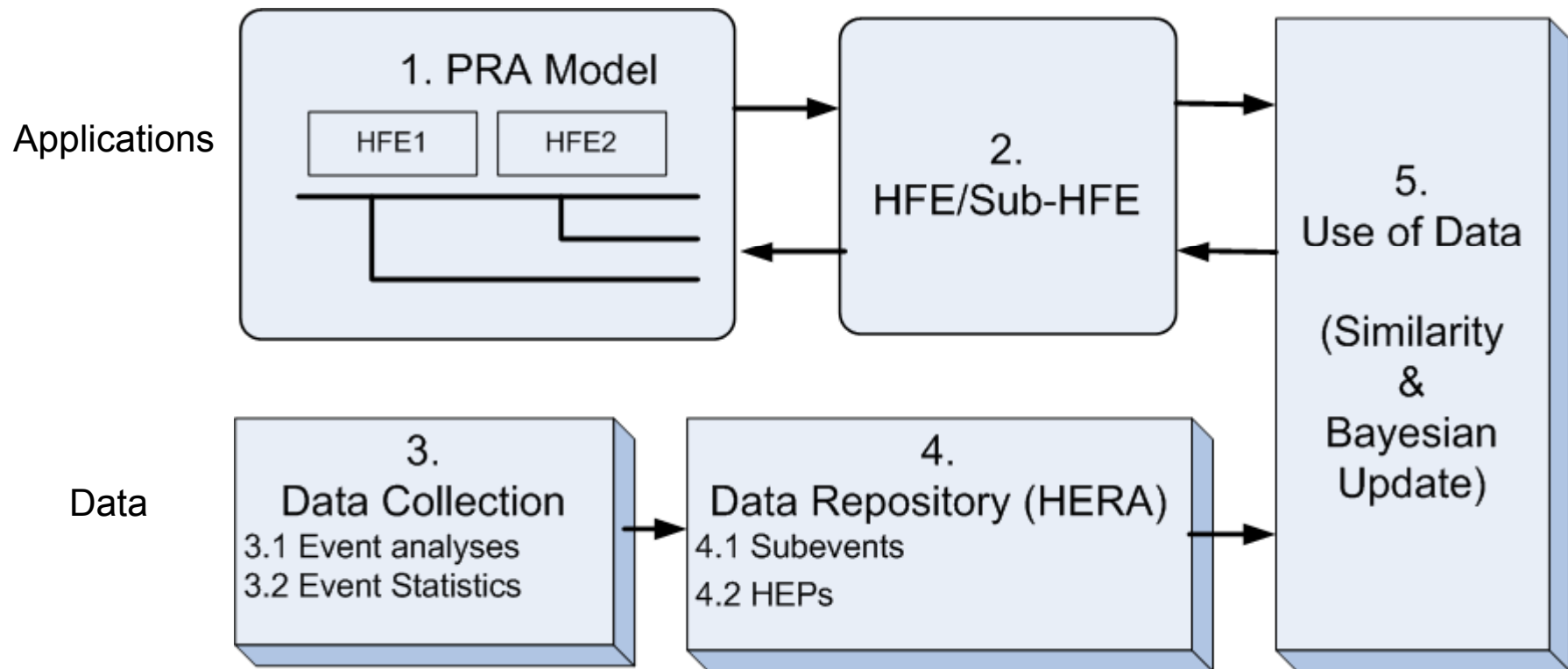
- **Scope**

- Predict the HEPs of HFEs that have been identified

- **Three key elements**

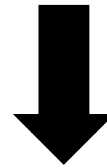
- Data sources
 - Data repository
 - Use of data

HERA-Based Data Framework



Conceptual Approach

$$\text{HEP} = \frac{\# \text{Failure}}{\# \text{Response Opportunity}} = \frac{\# \text{Failure}}{\# \text{Success} + \# \text{Failure}}$$



$$\text{HEP}(\text{HFE} | \text{PPI}) = \frac{\# \text{Failures}(\text{PPI})}{\# \text{Successes}(\text{PPI}) + \# \text{Failures}(\text{PPI})}$$

HEP: Human Error Probability
PP: Performance Profile

Key Technical Challenges

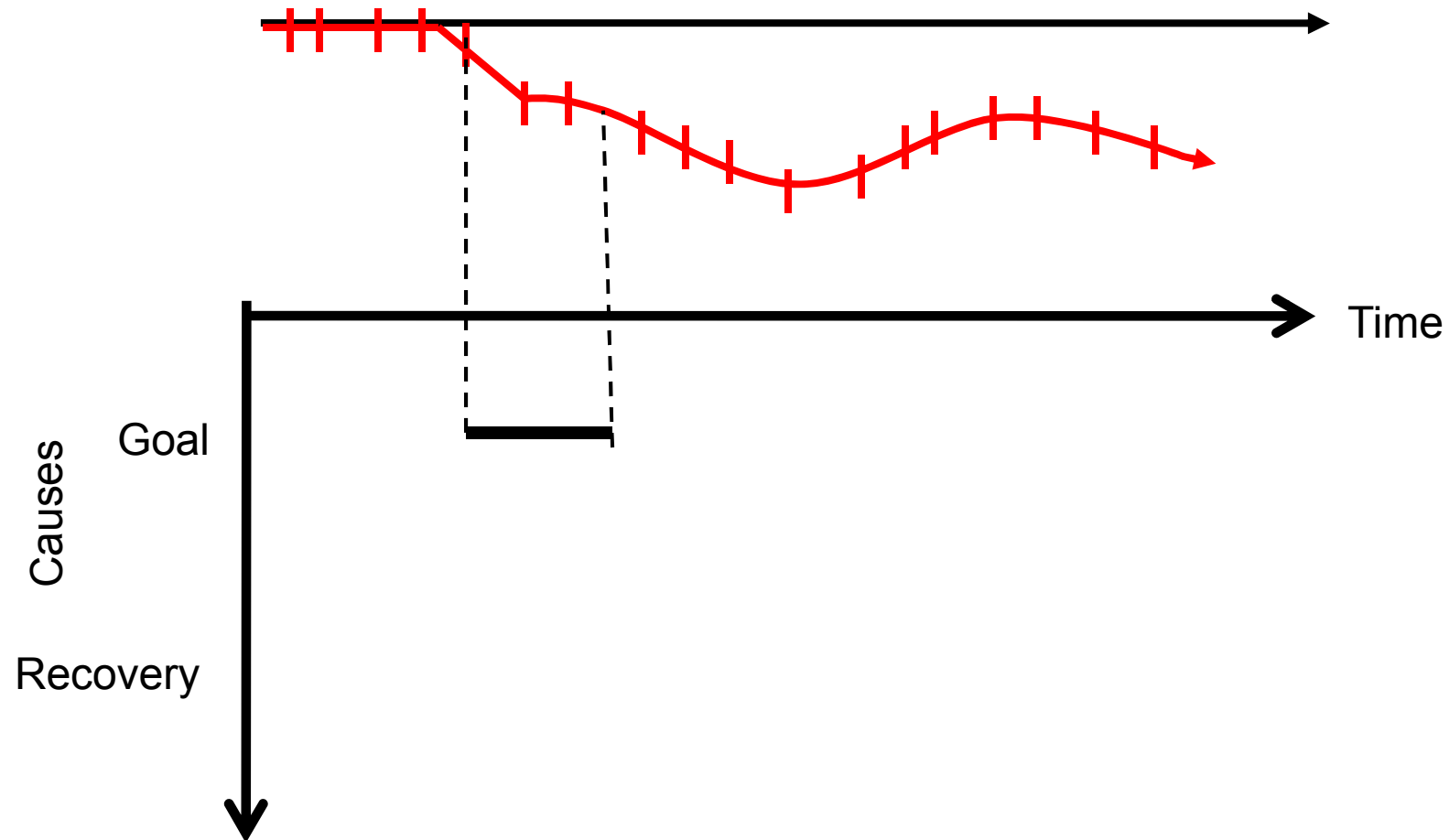
- 1. Define the unit of measurement**
- 2. Specify performance profile**
- 3. Handle incomplete data**

Define Unit of Measurement – HERA Approach



- Use same parsing rules for
 - Event analysis
 - PRA/HRA HFEs
- Include both success and failure responses
- Optimal cut-off level
- Two-dimension concept

Concept on Defining Unit of Measurement



Specify Performance Profile

- **Activity/Error types, e.g.,**
 - SPAR-H & CBDT: Diagnosis vs. action
 - THERP: e.g., Performed rule-based actions when written procedures are available
 - NARA: e.g., Carry out simple single manual action with feedback. Skill-based and therefore not necessarily with procedure.
 - CREAM: e.g., coordinate, communicate, diagnosis
- **Error mechanisms, e.g.**
 - CBDT: failure of plant information – operator interface
 - IDA: Under development
- **Performance shaping factors**

Handle Incomplete Data

- **Bayesian update**
 - Data from the analyses of individual events
 - HEPs available
- **HEPs from the analyses of individual events**
 - May not have correct counts of successes and failures
 - Bayesian methods to obtain creditable HEPs

Human Event Repository and Analysis (HERA)



- **Bridge the gap between HRA data and applications**
 - Provide HEP references points (short term)
 - Data-based HEP predictions (long term)
- **Current state**
 - Data taxonomy developed (NUREG/CR-6903, Vol. 2)
 - WWW-based database software implemented
 - Segregated into a number of sub-databases for accessibility control
 - About 30 events loaded
 - Demonstrations of the use of HERA data
 - UMD and Jan Kubicek
- **Significant enhancements underway**
 - Improve usability and capabilities
 - Streamline data collection and analysis
 - Support stakeholders beyond HRA needs

Data-Based PSFs Grouping

UMD's 9-Bubble PSFs

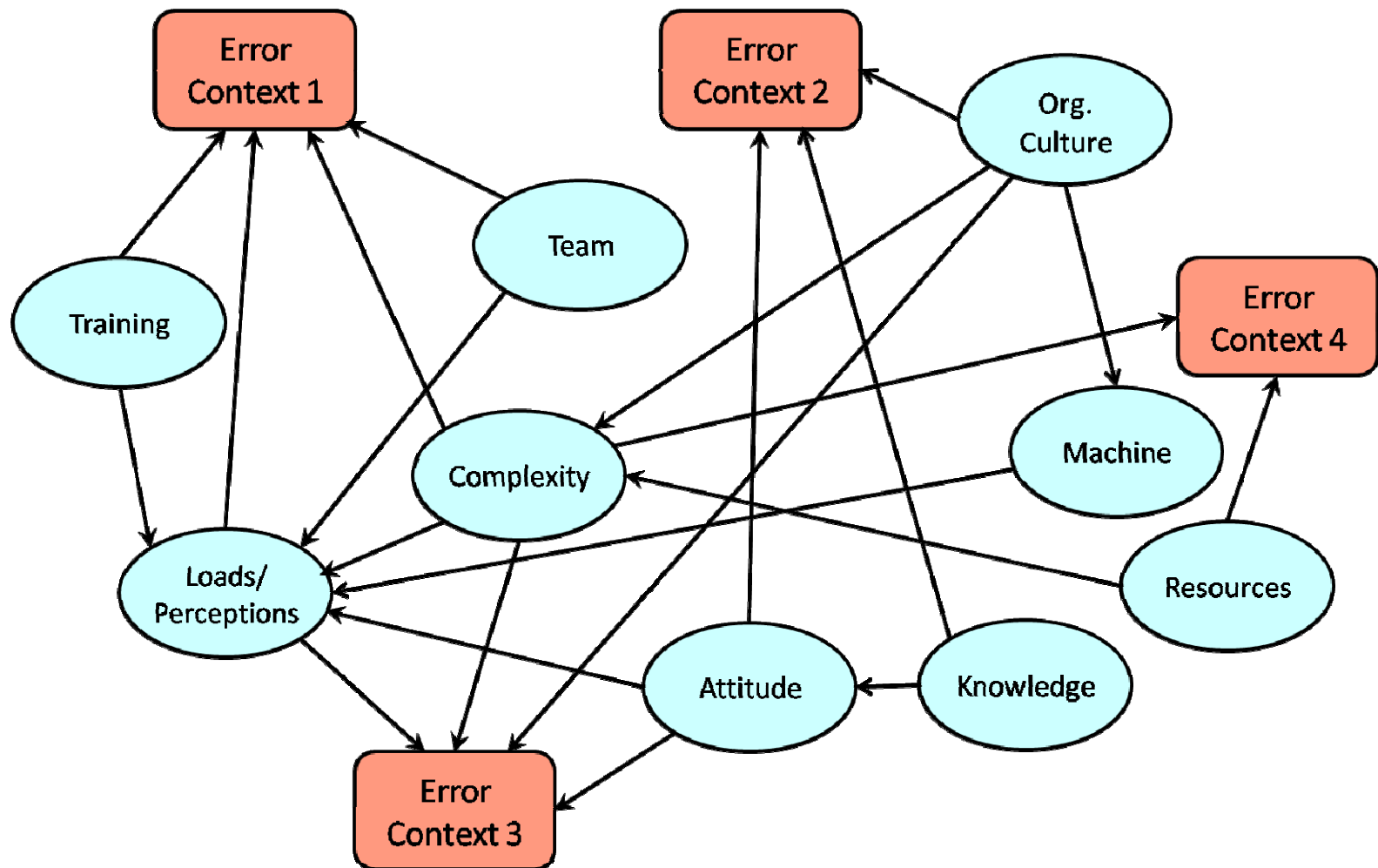
Model node	Included PSFs
Training	Training Program
Org. Culture	Management Behaviors, Safety Culture, Corrective Action Program
Resources	Procedures, Tools, and Necessary Information
Team	Team Coordination, Team Cohesion, Role Awareness, Direct Supervision. Communication
Attitude	Bias, Attention, Morale/Motivation/Attitude
Knowledge	Knowledge & Experience, Skills, Physical & Psychological Abilities, Familiarity with Situation,
Machine	HSI, System Responses
Loads/Perceptions	Task Load, Time Load, Other Loads, Perception of Severity, Perception of Urgency, Perception of Decision Impact
Complexity	Complexity, Hardware & Software Conditions

UMD: University of Maryland

9-Bubble Correlations

	Training	SCMgmtCAP	Resources	Team	Attitude	KnowSkillPPA	HSISysResp.	Loads/Percept	EventComplex
Training	1								
SCMgmtCAP	0.151	1							
Resources	0.274	0.029	1						
Team	0.373	-0.025	0.094	1					
Attitude	0.036	0.152	0.006	0.094	1				
KnowSkillPPA	0.042	-0.116	-0.086	-0.073	-0.434	1			
HSISysResponses	0.089	-0.384	-0.029	0.179	0.004	0.072	1		
LoadsPercept	0.514	-0.254	0.17	0.449	0.305	0.076	0.319	1	
EventComplex	0.331	-0.319	0.343	0.354	0.082	0.100	0.205	0.463	1

9-Bubble Model



Conclusions

- **Simulator data exchange within a broader data exchange framework**
- **Be specific on type of information to be collected**
- **Be specific on how data will be used**
- **Engage other stakeholders**
- **Need a platform for data exchange**
 - HERA is a good candidate
 - Key technical challenges to be overcome
 - Undergoing major revision