JENSEN HUGHES

Advancing the Science of Safety

Panel “What’s Next for HRA?”

HRA SOCIETY OVERVIEW

A young professional society to promote the sharing of research, methods and data.

Members are regulator, research labs, consultants & utility staff.

Short history:

- Initial meeting in Seattle at PSAM'11 conference (2010)
- Follow-up meeting in Honolulu at PSAM'12 (2012)
- HRA Master Class in Paris last year, (2015)
  - Largest meeting, ~50 participants from 8 countries
  - Surveyed recent activities
  - Voted on new leadership
- *HRA Special Session at PSAM'13 (Seoul, 2016)*
- *PSAM HRA Topical Meeting (Munich, 2017)*

HRA SOCIETY VISION

- **Support Various Aspects of HRA – Research, Modeling, & Applications**
  - Human Reliability Analysis as part of PRA for Decision-Making
  - Human Factors
  - Human Error reduction programs
- **Improve Technical Bases**
  - HRA methods, models, data & guidance
  - HRA for Digital Control systems
  - HRA for increased PRA Scope such as External Hazards; Level 2 & 3
- **Support Expansion & Growth**
  - Support for emerging countries – Regulators & Utilities
  - Looking to expand with “regional” chapters such as USA, EU & Asia
  - Open to new members

COLLECTING HRA DATA

- **Address the "Elephant in the Room"**
  - **Which has been there for years.**

COLLECTING HRA DATA

- **Theme**

  What are the lessons learned from recent HRA data collection projects that can be used to support future HRA data development?

- **Building off (an onto) HRA meetings**
  - PSAM HRA Topical Meeting, June 2017
  - IAEA HRA workshop, November 2017
  - SACADA workshop, March 2018
  - Potential future meetings:
    - PSAM14 workshop, UCLA, September 2018
    - ANS PSA'2019, April 28 – May 3rd, 2019
    - Others like ESREL or ASHRAM?
- **Promoting the idea of improved data sharing**
  - What is needed to succeed?
  - What are the barriers to success?
  - Next steps?

Fostering Collaboration Through a Communication Framework
(PSAM HRA Topical Slide by Mary Presley, EPRI)

- **Need:** To *define*, *prioritize* and *track* status of HRA related research needs to:
  - Promote collaboration between research organizations
  - Reduce redundant efforts
  - Communicate advances in state of knowledge
  - Make systematic progress as an international community towards filling knowledge gaps
- **Proposal**: To create a common format to communicate state of HRA research gaps and ongoing efforts to address those gaps. Agree upon a forum which all organizations can provide their input (face-to-face meeting not necessary?)
- **Question**: In sharing data, how do we gauge applicability of data given the potential difference in plant operations between countries?

Discussion
(PSAM HRA Topical Slide by Mary Presley, EPRI)

- Are the needs captured?
- Data Analytics – can we pool data?
- Thoughts on HRA Communication Framework
  - Can we use a structure like an HRA matrix regularly across organizations?
  - Are the categories correct?
  - Can we start filling it out now?
- Other collaboration opportunities?
  - HRA Researcher Wiki?
  - Additional topical conferences with broader audience?

		[Type of human action]
Driving PSFs	State of knowledge	<describe state of knowledge>
	Reducible gaps	<list reducible gaps>
	Ongoing research	
	Irreducible gaps	<list irreducible gaps>
Parameter Estimation	state of knowledge	
	reducible gaps	
	Ongoing research	
	irreducible gaps	
Quantification	state of knowledge	
	reducible gaps	
	Ongoing research	
	irreducible gaps	
Technology Transfer	state of knowledge	
	Ongoing research	

[illegible]

It is an open issue how joint (nuclear industry wide) data collection and analysis could be arranged in a meaningful way.

- Examples and Insight from ICDE
- Organization of data projects requires technical and administrative considerations
  - Example ICDE Operation - OECD/NEA
- Technical
  - Format and structure, coding guideline, workshop?
- Administrative
  - Proprietary rights
  - In kind contribution/Exchange
- How to start, Initiation work shop
  - Need agreement on technical framework
  - Need “champions” to push the issue
- Role of HRA Society

HRA WORKSHOP AGENDA

Introductions – 35 participants from 11 countries

Workshop Concept / Overview

Selected Presentations

- ***SACADA Data Program***, James Chang
- ***Characteristics of the HuREX Framework as a Tool for HRA Data***, Yochan Kim
- ***MicroTasks and MicroWorld***, Andreas Bye and Ron Boring
- ***EPRI FLEX and MCR Abandonment***, Mary Presley & Kaydee Gunter

Discussion – Breakout Groups

- Group 1 - Data Collection
- Group 2 - Data Analysis
- Group 3 - Application of HRA Data in Decision-Making

Breakout Session Results

Closing

HRA WORKSHOP BACKGROUND

Issues considered during pre-meeting discussion

- **Started with Data Collection**
  - But "Data" can be different types & different sources:
    - Data from simulators, e.g. Human Error Probability measurement
    - Data from Expert Elicitation
    - Data impacting the Qualitative Analysis
      - Performance shaping factors
      - Timeline
    - Research on the different types of failure
  - Data sources: simulator, microtasks, operating experience (incident reports), design basis
- **Data, once collected requires Analysis**
- **Last, Application of the HRA data**
  - Applicability for sharing between countries or disciplines
  - Meeting end-user needs

WORKSHOP BREAKOUT (GROUP 1)

Group 1 - Data Collection – How can we improve or facilitate data sharing? (Mary Presley lead)

Suggested questions:

1. What kind of framework did you initially start with for the following:
   - Tasks – is this the lowest level of data collection?
   - Performance shaping factors – positive and negative
   - Objective vs. Subjective evidence – what measurements are taken
   - How does data collection identify and distinguish the Context?

2. What issues did you need to address, beyond those listed above and beyond IP/Privacy/Confidentiality? And how did you solve these?

[illegible]

- **Halden**
  - Collecting data for realistic scenarios with their procedures (CE, Westinghouse), but digital I&C (also at plant's simulator). PWR and BWR
    - More challenging than regular training scenarios (outside the basis of PRA?)
    - 3-4 hrs max
    - Working on SBO scenarios (2 crews)
    - Data stored at report, but working on moving them into a database (Katrina has loaded some into SACADA)
  - Micro-tasks
- **KAERI**
  - Advanced (fully digitalized) MCR; Only PWRs, full scope simulations
  - Data is database and 3 information gathering templates (plant scenario, time analysis, context information/PSFs).
  - OPERA database is operational experience data
  - Scenarios decided based on discussion with trainers and use PRA to help pick scenario (training data)
  - 50min-1hr
- **NRC**
  - SACADA training data (not exam data or e-plan scenarios)
    - 1-2hrs; conventional MCR
  - IDHEAS -> cognitive literature
  - Expert elicitation for FLEX
- **CREIPI**
  - HRA data collection is not yet in Japan
  - Human Factors Root Cause database for maintenance failures mostly
  - PWR and BWR training center has video recording and stuff, but not HRA data….not sure how they use that data
- **INL**
  - HERA – incident reports…no further work being done in that area
    - Can we use SACADA to collect incident reports
  - Validation studies for digital control upgrades
  - timing data based on operator logs (SBO to support dynamic HRA)
  - Microworlds to answer specific questions
  - Using data to bound human performance (distributions)…"what if"
- **NASA**
  - Space --- JSC Human and Performance Lab
    - Probability of operators hitting the launch abort button
    - Decision making when bad stuff happens in space
    - Data from shuttle, Apollo and ISS
    - Common matrix for the data
    - To support design decisions for Mars mission
  - Oil & Gas
    - Well incident report (like LARs)

- Exam security and E-plan (security)
- The more challenging scenario that you run the more trained the crew has to be
- Extra workload to training department needs to show big benefit to adopt
  - How do we communicate benefit to the plants so they adopt the data collection?
  - Putting the information into the software helps distill the training findings and common issues the various trainers see and make them visible
  - Linking to utility need (regulator and/or risk drivers)
- HUREX monthly workshop key to keep data collection consistent and learnings passed on.
- Training can be very different from country to country
- How can we share data? Particularly with other industry (e.g., NASA, oil/ gas)
  - 3rd party clearing house

WORKSHOP BREAKOUT (GROUP 2)

Group 2 - Data Analysis (Katrina Groth lead)

Suggested questions:

1. Did you need to revise an underlying taxonomy that is used to categorize, parse and understand the data?
2. How is the data analyzed?
   - Direct HEP
   - Factors that impact the HEP
   - Bayesian-belief network
   - New causes of error?

Main takeaways (1): Do you need to use an underlying taxonomy to categorize, parse and understand the data (i.e., beyond that in a data source)?

- **"YES. This is essential."**
  - To enable consistent interpretation of the data
  - To map across different data collection activities
  - To map data across industries
  - To enable using multiple data sources (similar data types or different)
  - To capture causes and effects beyond a single data source;
  - To incorporate qualitative information
  - To enable text mining & automated data extraction
- **"YES but.."**
  - These is a tradeoff between comprehensiveness of the taxonomy and data quantity.
  - We need multiple taxonomies: PSFs, task types, error types, database types – "HRA data" is uniquely multifaceted.
  - This requires a serious investment

Main takeaways (2) How is the data analyzed (why did you choose this approach)?

- **Multiple types of HRA data & multiple goals for data analysis - lends itself to a variety of analytical approaches.**
  - Several groups directly quantify HEP and/or PSF->HEP effect using statistical techniques on the data
  - Several groups use BNs (either with or without causal maps)
- **Considerations that led to the choices of modeling framework:**
  - Need to capture data/information beyond what exists in a single source
  - Need to combine data from different sources & accommodate data together with industry-specific expert judgment;
  - Need to combine both data and scientific process models; enables consistent use of multiple types of data; enables handling differences with simulator
  - Cannot alter aspects of the data (whether that be the simulator environment or the observed accident data); so we can't fully decouple HEP effect from the context.
  - Can't directly assess a "nominal" HEP without considering the context (i.e., a large set of PSFs which need to be mapped onto HEP)
  - Treatment of PSF interdependencies -- potential combinatorial explosion of PSF states dependencies.
  - Potential for controlled PSF->HEP experiments
  - Secondary benefits beyond HRA – i.e., influence training

WORKSHOP BREAKOUT (GROUP 3)

Group 3 - Application of HRA Data in Decision-Making (Kaydee Gunter lead)

Suggested questions:

1. How do you ensure your data collection and/or analysis supports the end-user needs?

2. How does your data provide insights and support to decision-making?

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- Data development teams carry out case studies by comparing collected data to existing HRA methods such as CREAM.
  - Verification activity
  - Question applicability of another country's data
- UK – not collecting enough data to support end users.
  - Lots of opportunity but need to define the studies.
- From applications side - need to review key qualitative factors and compare to insights from the existing data sets.
- Start with feasibility and identify qualitative insights of applications align with data insights.
- Availability of data is a tough issue
  - Use of expert judgement
- Adapted THERP to have plant specific factors.

[illegible]

- Different levels of applications require different scope of data
- To answer this question we need to first list what the applications are.
  - Applications can include
    - HRA model and methods development.
    - Human error mitigations
      - Procedure updates – Formatting and content
      - Training
      - Control room design
        - New digital I&C
    - Plant design changes
    - Organizational changes

HRA WORKSHOP CONCLUSION

The workshop concluded with:

- Presentation of Breakout Group results

- Short discussion of the Next Steps
  - Collect and distribute workshop materials to participants
  - Dialogue continues with PSAM14 HRA Data Analysis sessions on Tuesday

  - Recommendation to continue the discussion during PSAM and in PSA'2019 (as a minimum)

FUTURE OF HRA (1 OF 2)

- **Data Collection**
  - Trending up
    - Simulator data at the task level (Korea) and the training objective level (USA); both more than 20,000 data points
    - MicroTasks and MicroWorlds to complement simulators
    - End-user, plant data such as FLEX and MCRA
  - Did not discuss Operating Experience as a data source
    - EPRI Pre-Initiator
    - ICDE CCF Data is 30-50% HRA
  - Not sure – Dependency data?
- **Data Analysis**
  - Needs a theoretical framework
  - Link to Context or de-couple
  - Ability to correlate PSF?
  - Finding new failure modes

FUTURE OF HRA (2 OF 2)

- **Application of Data**
  - Identify gaps, is data being collected to fill?
  - Consider:
    - Changes in plant design beyond Digital Controls such as Small Modular Reactors with multiple cores
    - Changes in Hazards (e.g. new information such as consequential or combination hazards like seismic-fire)
    - Changes in models/methods (PRA, HRA, HF)
- **Next Steps**
  - Establish a taxonomy and guidelines that relates the different types of data and different levels
  - Identify current research and current gaps
  - Need champions/sponsors

Bottom line – lots of current activity, the time is now to synchronize activities, but needs continued pressure such as elevating to a project.

QUESTIONS?

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