

# Looking to the Future: HRA Needs and Ways Forward

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# Fostering Collaboration Through a Communication Framework

- **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?

# HRA Needs Matrix – Proposed Structure

Are these the  
right types  
to consider?

		[Type of human action]	
Driving PSFs	state of knowledge	<describe state of knowledge>	<b>Type of Human Action</b>  Evaluate gaps for each characteristic of various Human Actions modeled in PRA, regardless of where or what type of PRA it may be manifest.  (see list on next slide)
	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		

## Notes from 3/14/20 discussion

- Capture boundary conditions of applicability/underlying assumptions (e.g., because of plant operations have these characteristics, we haven't included that as a driving PSF – e.g., command and control in MCRA, FLEX)
- Level of granularity for different users, examples (HF, operations/training)

# Types of Human Actions

Nationality?

Conventional  
v. Analog?

Are these the  
right types  
to consider?

<b>Proceduralized/ Skill of Craft</b>	Actions that are in a clear, structured procedure or are clearly skill-of-craft, requiring little decision making beyond following the directions (e.g., emergency operating procedure, normal operating procedure, etc.)
<b>Long-term/ Non-proceduralized</b>	Actions that are weakly proceduralized (or have many paths the operator could take), not proceduralized, have a knowledge-based component or there is extended time available for recovery. (e.g., some LPSD actions, some SAMG actions, etc.)
<b>Multi-Organization Response/Distributed Decision Making</b>	Response actions that require coordination between organizations, may have distributed decision making attributes (e.g., preemptive actions for external flooding, phase 2 FLEX actions, SAMGs for multi-unit accident, MCR abandonment, etc.)
<b>Multi-Objective Decision Making</b>	Non-procedure driven decision making where multiple objectives have to be balanced or multiple options exist all with negative consequences (e.g., management of spent fuel pool and core; some SAMG actions; Level 2 or 3)
<b>Execution: highly complex, involving a team of people</b>	(e.g., preemptive actions for external flooding, complicated FLEX actions, etc.)
<b>Execution: Portable/Temporary Equipment</b>	Deployment, installation and operation of temporary equipment once on site
<b>Execution: Ex-CR External Events</b>	Additional factors to consider for ex control room actions during severe external events (e.g., flood, high winds, seismic, fire, etc.)
<b>Execution: Long Term Control Actions</b>	(e.g., F&B, depressurization, etc.)
<b>Multiple Spurious Operations</b>	Evaluation techniques to identify and evaluate human actions when there is a potential for multiple spurious operation of I&C (e.g., fire, relay chatter in seismic, etc.)
<b>Dependency</b>	Dependency between multiple human actions (same person, same crew, between crews)

# HRA Needs Matrix -- Structure



## Portion of Analysis

Evaluate gaps for stage of analysis for each action type, such as:

- Do we have a good understanding of what the relevant PSFs are for that type of action?
- Are there clear criteria to estimate the level of the PSFs (i.e., “workload” is a PSF, but what is *high* workload??)
- Is there a good basis for the quantitative values?
- Technology Transfer: Does the state-of-practice reflect the state-of-the-art?

***This evaluation is not based on methods, but on state of knowledge, which may or may not be reflected in the methods used.***

	[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	

# HRA Needs Matrix -- Structure

Is this helpful to categorize research needs?

## Gap Definition

Evaluate gaps using the following criteria:

- Describe the state of knowledge
- Define the specific gaps (these would be in enough detail to allow research questions to be formulated to fill the gap).
- Describe ongoing research in the area
- Differentiate between “reducible” knowledge gaps that can be eliminated via further research and “irreducible” gaps that require alternate techniques to address

## Color Coding

- Inadequate understanding to model in PRA; no consensus model
- Models available, but refinements needed
- Sufficiently good understanding of issues that little or no further work needed
- n/a

	[Type of human action:]	
Driving P&Fs	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	

# HRA Needs Matrix – Draft Example

<b>Proceduralized/Skill of Craft</b> Actions that are in a clear, structured procedure or are skill-of-craft, requiring little decision making beyond following the directions (e.g., emergency operating procedure, normal operating procedure, etc.)		
<b>Driving PSFs</b>	state of knowledge	Literature review underlying the IDHEAS model provides an updated cognitive basis for HFE evaluation. THERP still sufficient for execution actions? Other models (e.g., HCR/ORE/CBDT, SPAR-H, ASEP etc.) exist that provide "reasonable" results, and it is fairly well understood how and when these models can be used.
	reducible gaps	- research on HMMI for Digital Control Rooms -effect of time/time margin vs. other PSFs (can time critical actions be highly reliable? If so, under what conditions?)
	Ongoing research	-implementation of IDHEAS; role of communication tree
	irreducible gaps	
<b>Parameter Estimation</b>	state of knowledge	For IDHEAS and CBDT/THERP there is supplementary guidance (e.g., the stress decision trees) to help analysts evaluate the level of various parameters required by the method (e.g., branch points of decision trees).
	reducible gaps	
	Ongoing research	
	irreducible gaps	-analysts/operators are poor at estimating time it takes to complete a set of actions
<b>Quantification</b>	state of knowledge	For all methods, cognitive HEPs are based on expert elicitation with little data to calibrate experts. For execution, THERP is based on actual failure data from other industries in the 80's and earlier.
	reducible gaps	-credit for recovery
	Ongoing research	-SACADA collecting training data to inform IDHEAS -UJV collecting training data to inform their decision trees -- is this translatable to inform IDHEAS?
	irreducible gaps	-Data to support low HEP values due to available recovery (e.g., 1E-4 range)
<b>Technology Transfer</b>		Methods for these actions are fairly mature. However, due to the nuanced nature of the scenarios, much relies on analyst ability to fully understand the scenario and prepare a good qualitative analysis. Guidance is available, but too voluminous and too general for new users to implement practically. Additionally, technical basis documents exist for IDHEAS and the EPRI Methodology, but no comprehensive user's guide to aid analysts.
	state of industry	Room for improvement on technology transfer, including course on "nuts and bolts" of how to do good qualitative analysis.
	Ongoing research	-2014 Halden report on best practices for qualitative analysis



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