

Comparative Study of Performance Influencing Factors in IDHEAS-G and SPAR-H

Korean Nuclear Society Autumn Meeting 2023

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1.0 Introduction

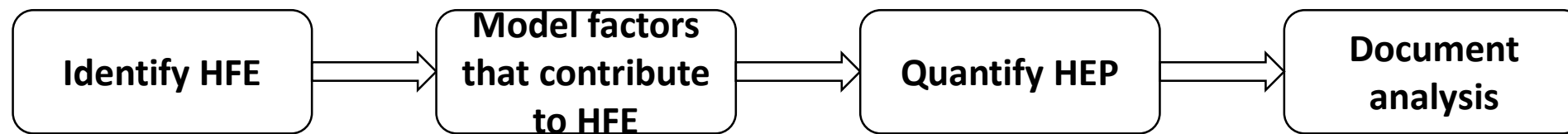


1.1 Purpose of this study

- SPAR-H is a widely used Human Reliability Analysis methodology in the US while IDHEAS-G is a relatively new method developed by the US NRC to replace HRA methodologies.
- This study aims to conduct a comparative analysis between these two methods to generate a PIF mapping that can be applied to human error probability quantification (HEP).

1.2 Purpose of HRA

- Evaluating **human failure events (HFE)** and providing **human error probabilities (HEP)**.



HRA Process

1.0 Introduction



1.3 PIF in HRA

- PIFs are **contextual factors** that affects human performance by enhancing or **degrading it**.
- The PIF could be **internal** or **external**.
- PIFs have **different definitions** in each methodology and could cause **HEP variability**.

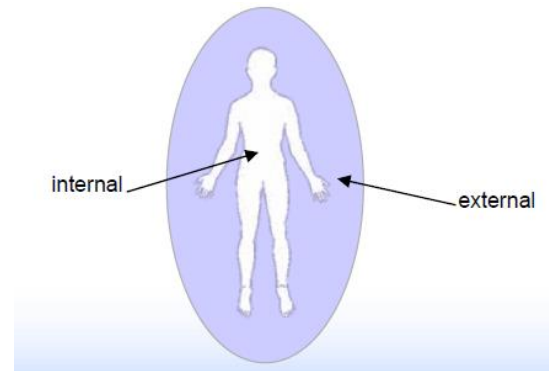


Figure 1 - Internal and external PIF [1]

2.0 HRA Methodology



2.1 PIF in SPAR-H

The SPAR-H PIFs are listed below:

- a. Available time
- b. Stress/Stressors – Mental and physical stress, heat, noise, radiation.
- c. Complexity – Multiple equip. unavailable, parallel task, large number of actions required.
- d. Experience/Training – Familiarity with the event and systems.
- e. Procedures – Formal operational procedure.
- f. Ergonomic/HMI – Displays and controls layout, quality and quantity of information available from instrumentation.
- g. Fitness for duty - Physical and mental fitness.
- h. Work Processes - Inter-organizational, safety culture, work planning, communication, and management support and policies.

2.0 HRA Methodology



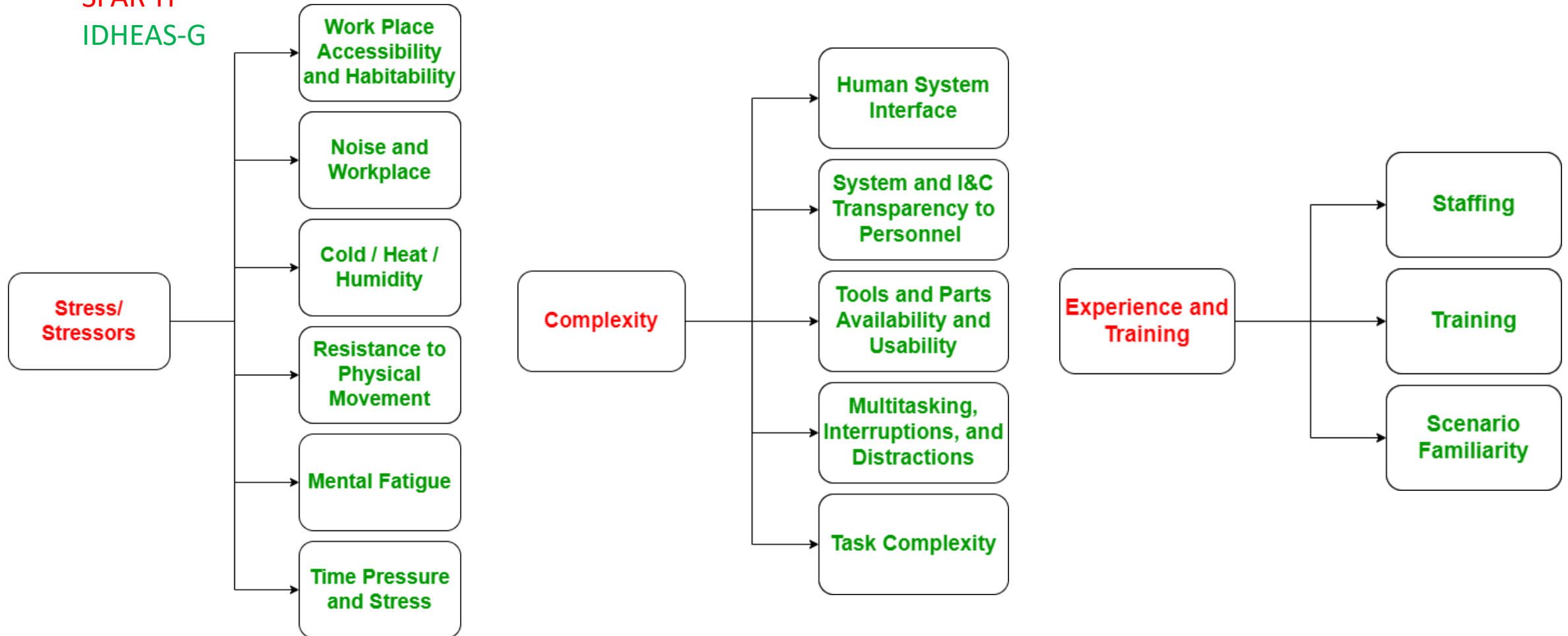
2.2 PIF in IDHEAS-G

Environment and Situation	System	Personnel	Task
<ul style="list-style-type: none">• Work location accessibility and habitability• Workplace visibility• Noise in workplace and communication pathways• Cold/heat/humidity• Resistance to physical movement	<ul style="list-style-type: none">• System and I&C transparency to personnel• Human-system interfaces• Equipment and tools	<ul style="list-style-type: none">• Staffing• Procedures, guidelines, and instructions• Training• Teamwork and organizational factors• Work processes	<ul style="list-style-type: none">• Information availability and reliability• Scenario familiarity• Multi-tasking, interruption, and distraction• Task complexity• Mental fatigue• Time pressure and stress• Physical demands

3.0 PIF Mapping



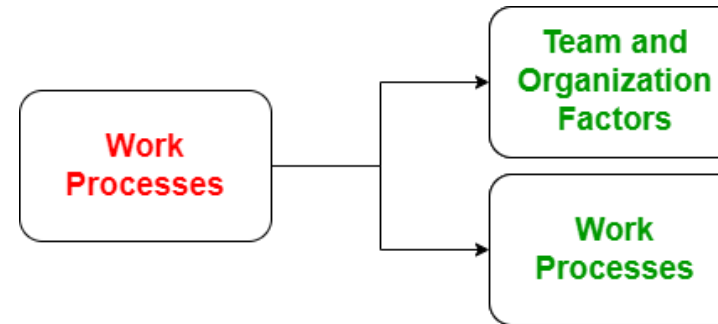
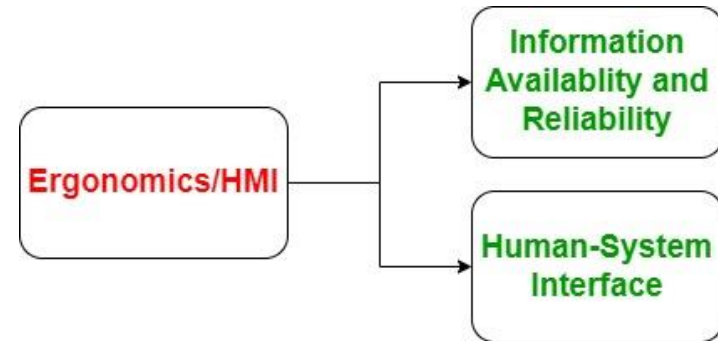
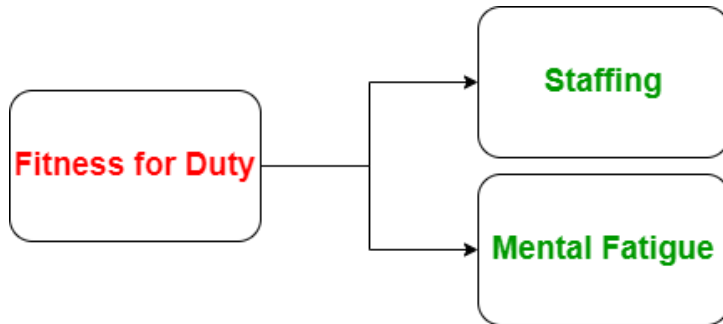
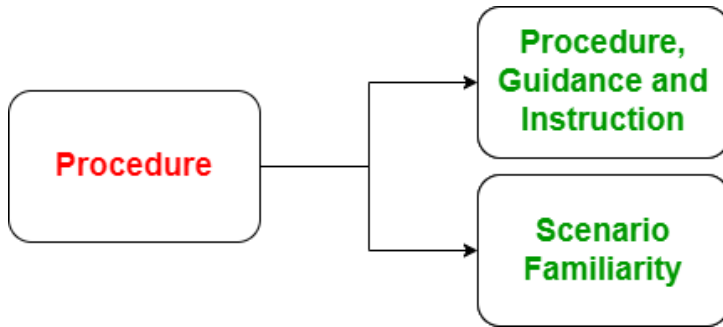
SPAR-H
IDHEAS-G



3.0 PIF Mapping



SPAR-H
IDHEAS-G

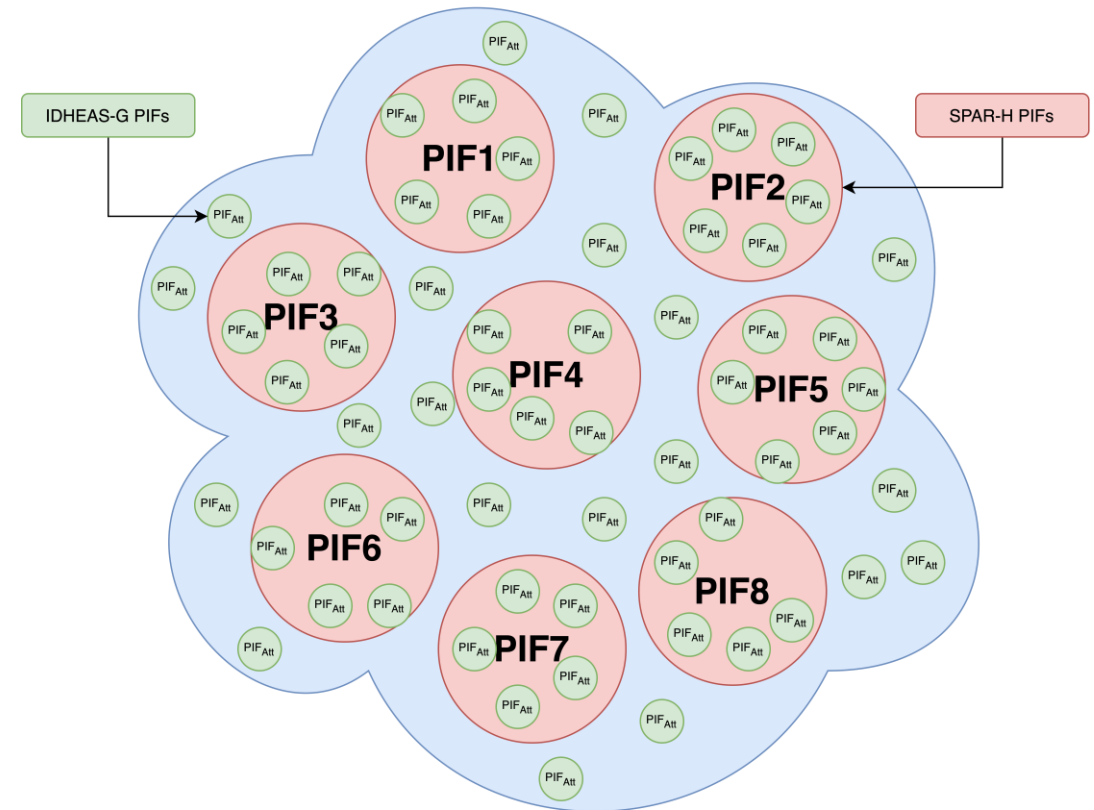


4.0 PIF Mapping

PIF Mapping Table

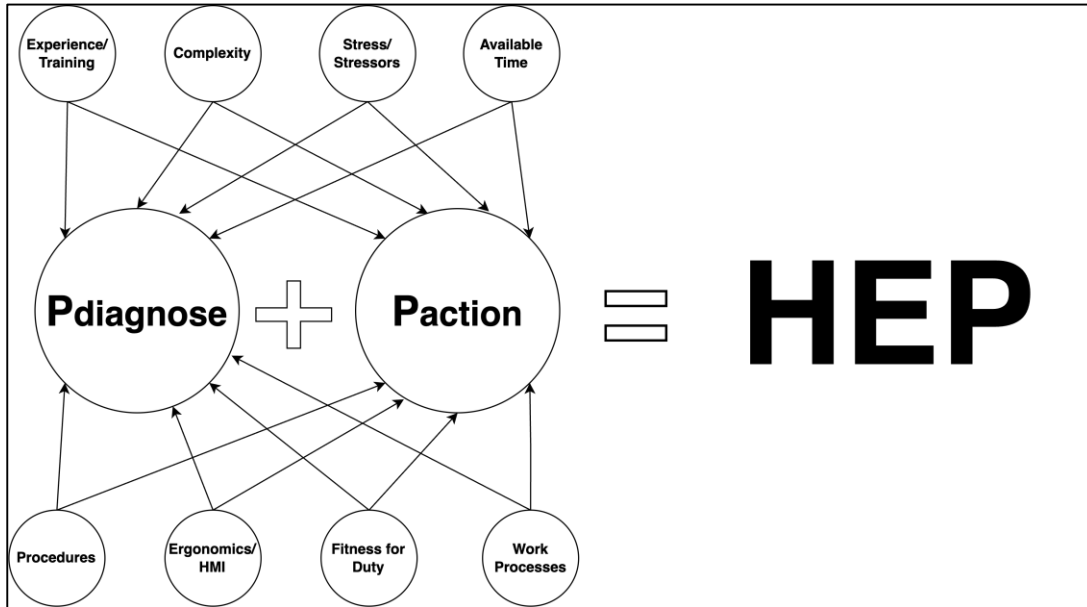
PIF n#	IDHEAS-G	SPAR-H	
1	Workplace Accessibility and Habitability	Stress/Stressors	*
2	Workplace Visibility	*	*
3	Noise in Workplace	Stress/Stressors	*
4	Cold/Heat/Humidity	Stress/Stressors	*
5	Resistance to Physical Movement	Stress/Stressors	*
6	System and I&C Transparency to Personnel	Complexity	*
7	Human-System Interface	Complexity	Ergonomics/HMI
8	Tools and Parts Availability and Usability	Complexity	*
9	Staffing	Experience/Training	Fitness for Duty
10	Procedures, Guidance, and Instructions	Complexity	Procedures
11	Training	Experience/Training	*
12	Team and Organization Factors	Work Processes	*
13	Work Processes	Work Processes	*
14	Information Availability and Reliability	Ergonomics/HMI	*
15	Scenario Familiarity	Experience/Training	Procedures
16	Multitasking, Interruptions, and Distractions	Complexity	*
17	Task Complexity	Complexity	*
18	Mental Fatigue	Stress/Stressors	Fitness for Duty
19	Time Pressure and Stress	Stress/Stressors	*
20	Physical Demands	*	*

Event Context

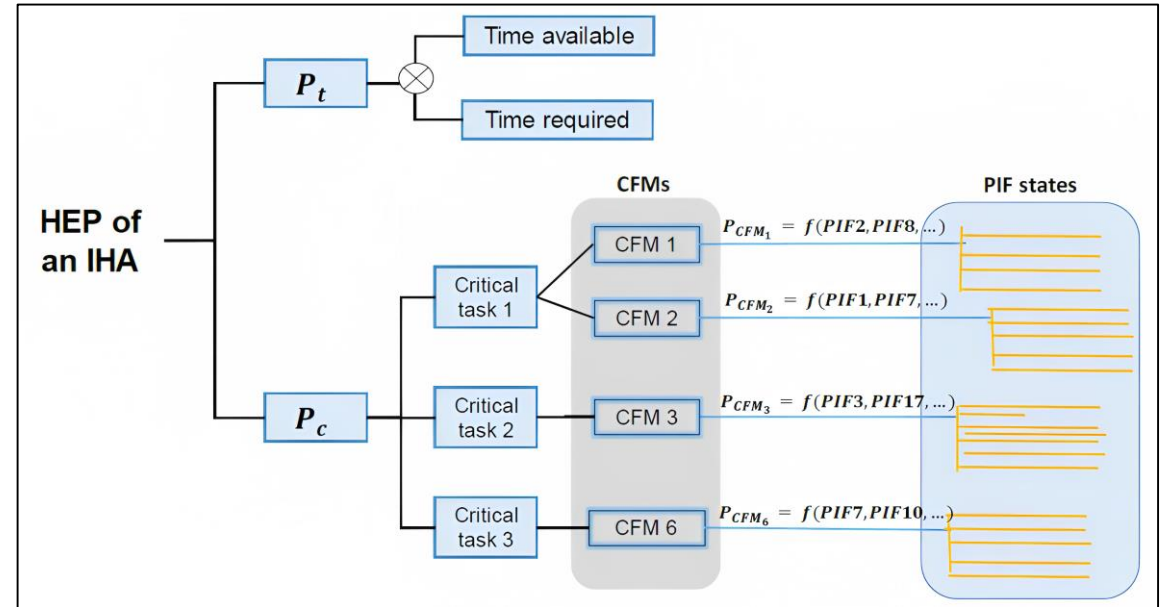


5.0 Connection of PIF for HEP quantification

SPAR-H



IDHEAS-G



6.0 Conclusion



- IDHEAS-G has 20 PIFs with each PIF having different attributes
- On the other hand, SPAR-H uses 8 PIFs to assess event context.
- The mapping of the PIFs carried out for IDHEAS-G and SPAR-H shows that the PIFs in SPAR-H are broadly defined while that of IDHEAS –G are more specific.
- This differences could result to different HEPs computations for the same human failure event.

References

- [1]. Boring, Ronald L., Candice D. Griffith, and Jeffrey C. Joe. "The measure of human error: Direct and indirect performance shaping factors." *2007 IEEE 8th Human Factors and Power Plants and HPRCT 13th Annual Meeting*. IEEE, 2007.
- [2]. Pan, Xing, and Zekun Wu. "Performance shaping factors in the human error probability modification of human reliability analysis." *International Journal of Occupational Safety and Ergonomics* 26.3 (2020): 538-550.
- [3]. Gertman, D., et al., NUREG/CR-6883-The SPAR-H method. Washington, DC: US Nuclear Regulatory Commission, 2005.



Thank you!



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