Human Factor Engineering Road Map in Safety Case

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Safety Case Symposium 2018 Singapore

Where we need Human Factor Engineering

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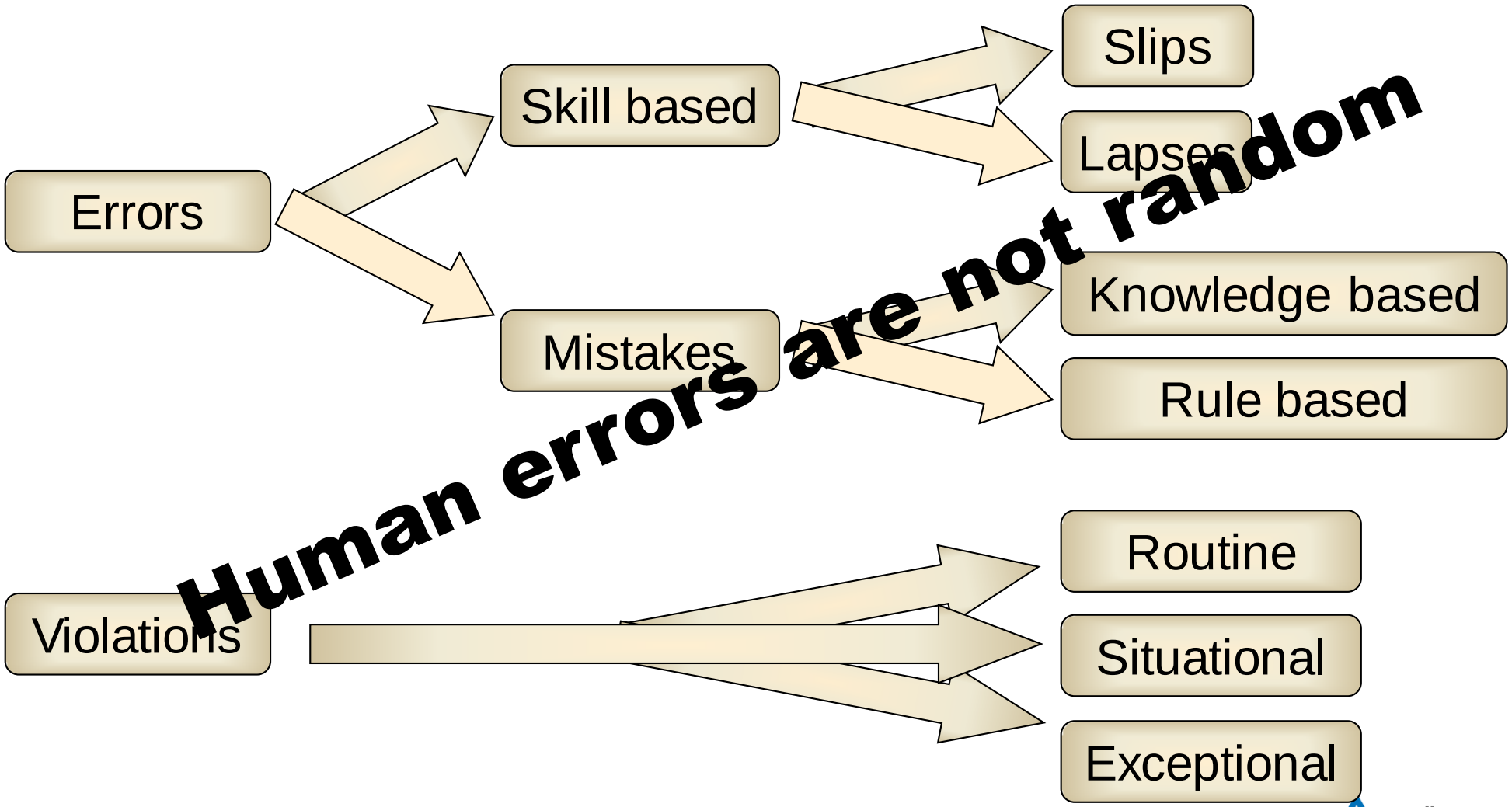
Understanding Human Failure

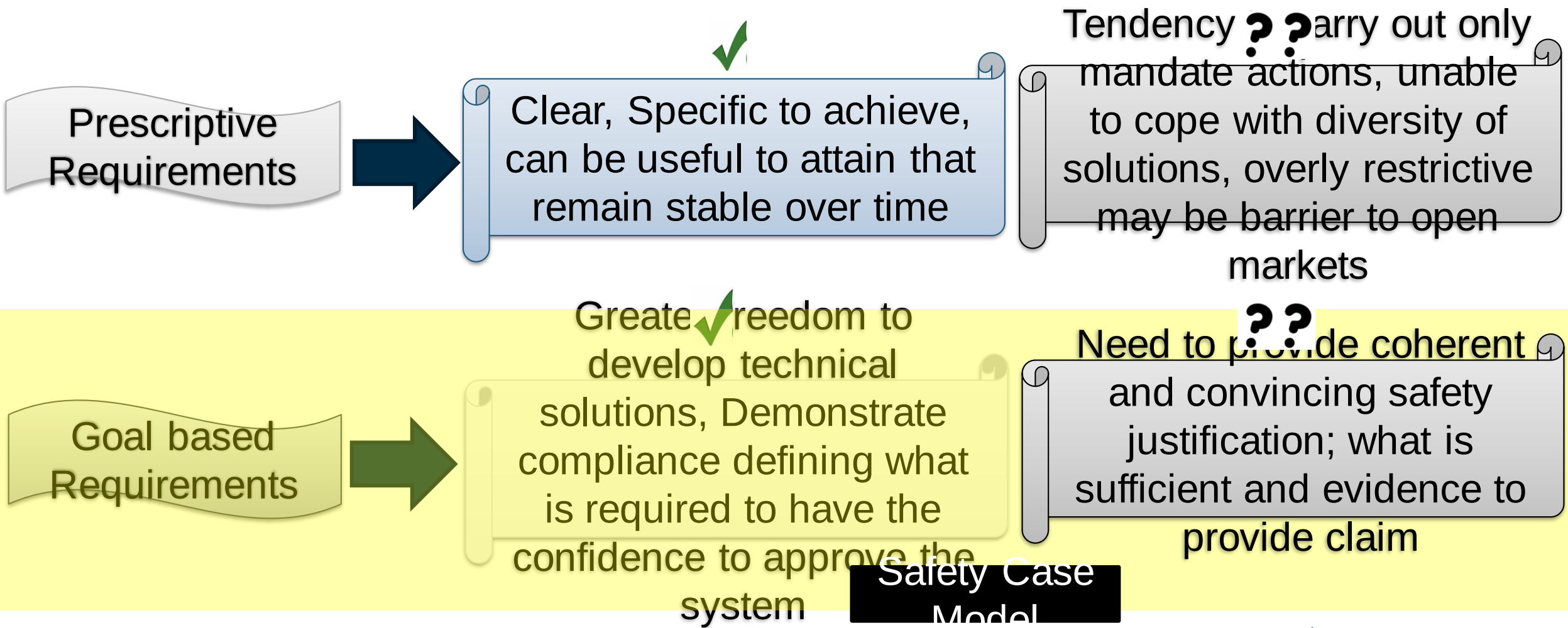


Definition of Human Factors

"Human factors is a professional discipline concerned with improving the integration of human issues into the analysis, design, development, implementation, and the operational use of work systems."

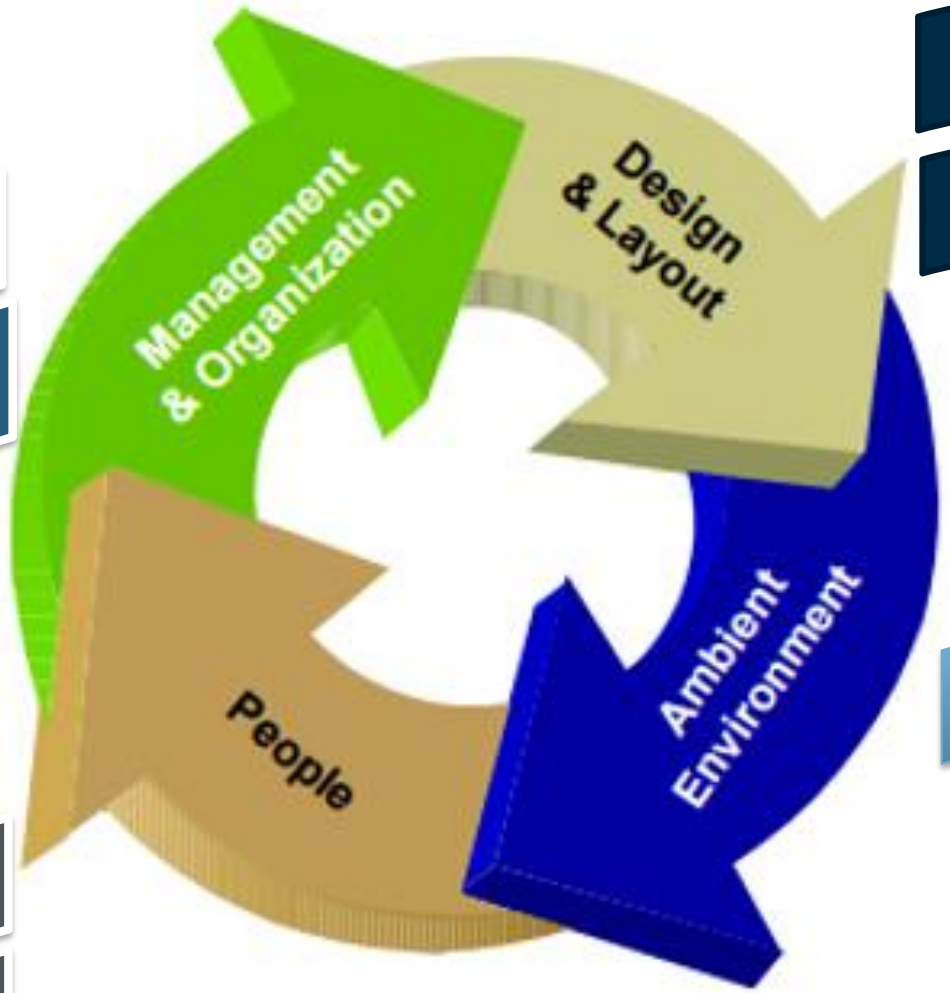
From the NAC first report, June 2000

Different HFE Requirements



Human Factor Engineering/Ergonomic Model

Management System
Organizational
Framework-
Competence etc.



Design of Plant and Equipment
Analysis, Reviews and Studies

Monitoring and Control

Work hours and Restitution
Human Machine Interface

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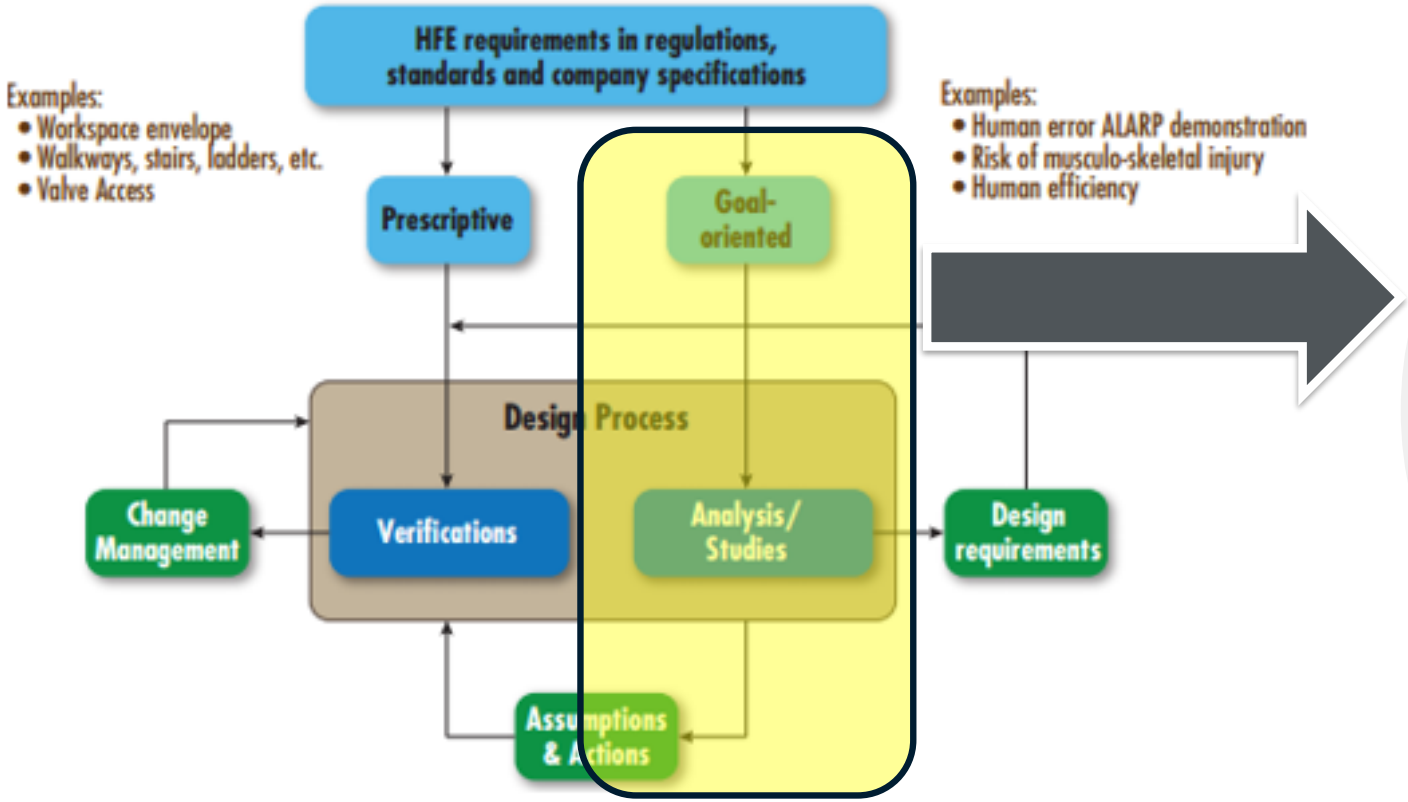
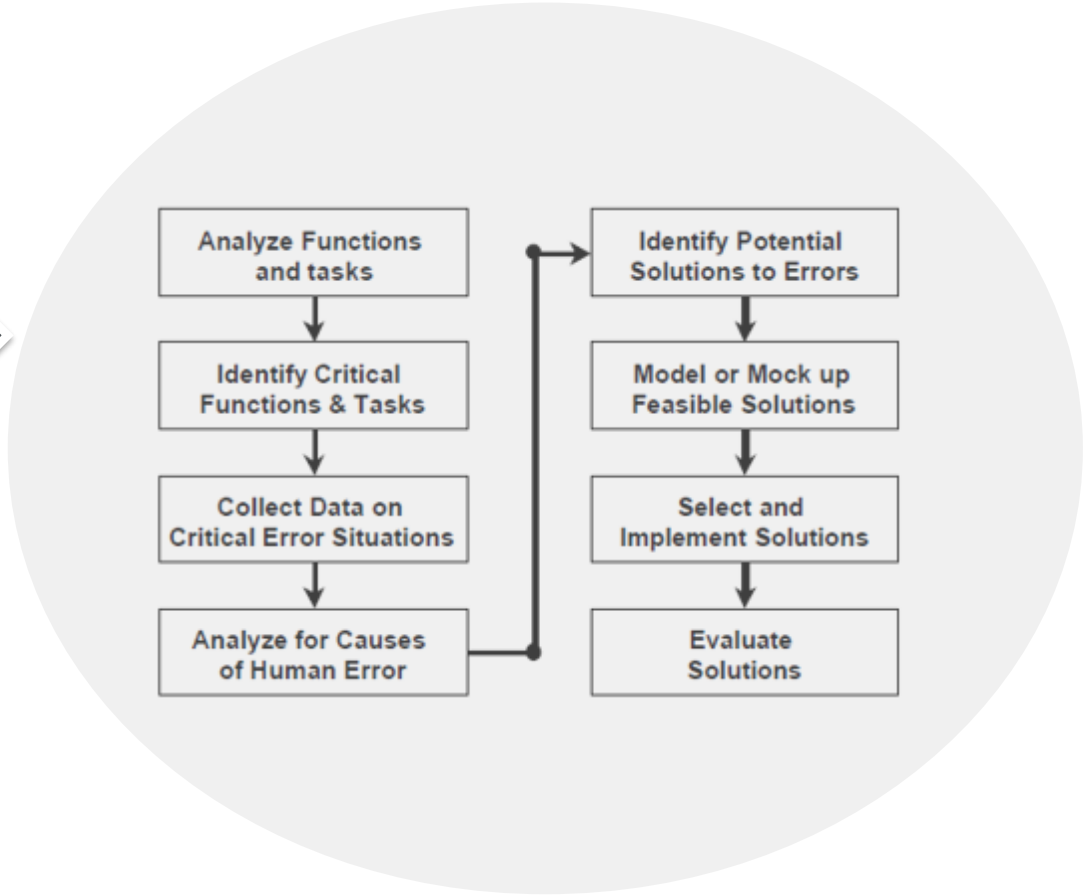
HFE- Simple Steps to integrate in Project





HFE- Simple Steps to integrate in Project

	Project Phase					
HF Activity	Concept	Select	FEED	Detailed Design	Construction	Operations
Write project HF strategy	x		x			
HF screening	x	x				
Review project standards		x				
Deliver HF awareness training			x	x	x	x
Document, track, and closeout HF issues			x	x	x	x
Generate HF design aides and specifications			x	x		
Task analysis			x	x		
Safety-critical task inventory analysis			x	x		
Valve criticality analysis			x	x		
Control room design assessment			x	x		
Facility layout reviews			x	x	x	
Evaluate human-computer interfaces			x	x		
Review accommodation design			x	x		
Assist material handling study			x	x		
Evaluate noise and vibration			x	x		
Evaluate crane operations			x	x		
Review alarm systems			x	x		
Conduct computer aided design reviews				x		
Vendor package screening				x	x	
Prepare procedures, manuals and labels				x	x	
HF in construction – monitoring and testing					x	
Follow-up evaluation						x

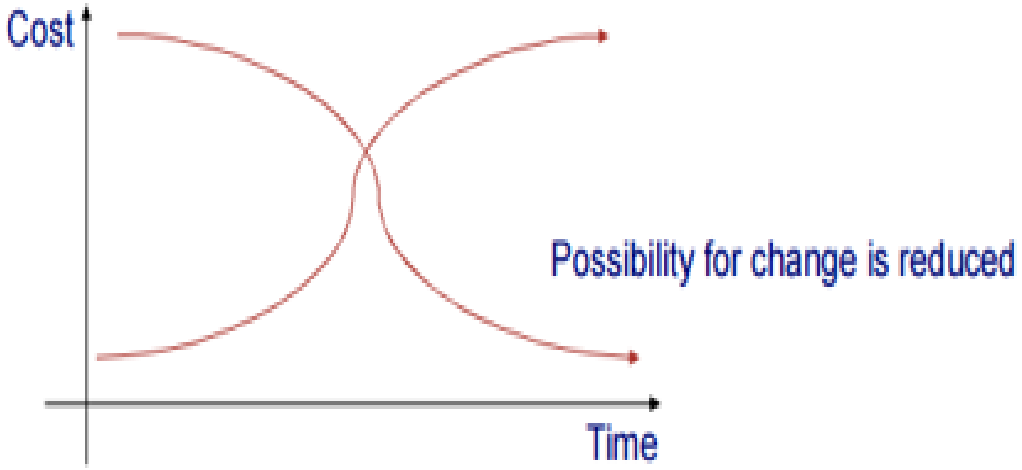
[Adapted from Robb & Miller (2012)]

Application of Human Factors- When?

Early in the Concept and Planning Stage and throughout the Project

Late participation results in costly changes and reluctance in changing design

Note: *However, it is **never too late** in working on optimizing these interactions even in older systems and learning from design problems for future applications*



How to consider Human Factors in Safety Case

Demonstrate Systematic approach to manage Human Performance

Demonstrate Risk Control Measures and the supporting MAPP & SHMS

Provide how HF have been accounted in MAH Risk Assessment

How HF have been accounted for Design of Equipment

How Human interactions have been designed for the user

Suitable evidence to support the demonstration of Human Factors

Technical Guide for HF reflection in Safety Case

Technical Criteria	HF Reflection
MAPP and SHMS aspects	
8.1.1 Resources The safety case shall show how MHI allocates resources to implement the MAPP.	i. Staffing levels ii. Management of Shift Work
8.1.2 Personal Performance The safety case shall show that the performance of people having a role to play in the management of MAHs is measured and that they are held accountable for their performance.	i. Supervision ii. Procedures Compliance
8.1.3 Internal Communication The safety case shall show that the MHI has arrangements for communicating information important for the control of MASs within the MHI's organisation.	i. Shift handover ii. Remote Communications iii. Procedures Compliance

Technical Guide for HF reflection in Safety Case- contd.

Technical Criteria	HF Reflection
MAPP and SHMS aspects	
8.1.4 Investigation and Corrective Action The safety case shall show that the MHI has adopted mechanisms for investigating and taking corrective action: a) in cases of the proactive performance standards showing a deterioration in risk control measures; and b) in relation to any incident or event with potential to cause a MAS.	SS506: Part 3 stated investigation shall consider human factors • Why human failure occurs • Identify Immediate and latent human failures • Identify contributing factors in individual and organizational level

Technical Guide for HF reflection in Safety Case- contd.

Technical Criteria	HF Reflection
General Principles	
8.3 The safety case shall demonstrate how the measures taken will prevent foreseeable failures which could lead to major accidents and limit their consequences.	
Design Considerations	
8.3.1.1 The safety case shall show that the installations have been designed to an appropriate standard. **8.3.1.2** The safety case shall show that the layout of the plant limits the risk during operations, inspection, testing, maintenance, modification, repair and replacement.	**HUMAN FACTORS IN DESIGN** This criterion is particularly relevant for new projects. However for existing MHIs, this criterion should be raised for on-site verification.

Technical Guide for HF reflection in Safety Case- contd.

Technical Criteria	HF Reflection
Design Considerations	
8.3.1.3 The safety case shall show that utilities that are needed to implement any measure defined in the safety case shall have suitable reliability, availability and survivability.	**Example:** a) UPS systems provide sufficient time to enable orderly shutdown and/or evacuation; b) Adequate emergency lighting to carry out relevant shutdown tasks
8.3.1.4 The safety case shall show how safety-related control systems have been designed to ensure safety and reliability.	How the potential for human failure is identified and systematically treated in the design of safety-related control systems (e.g. safety instrumented systems)

Technical Guide for HF reflection in Safety Case- contd.

Technical Criteria	HF Reflection
Design Considerations	
8.3.1.5 The safety case shall show how systems which require human interactions have been designed to take into account the needs of the user and be reliable.	I. Manual Control of Systems II. Control Room and interface design III. Alarm handling
Modifications and Decommissioning	
8.3.2 The safety case shall describe the system in place for ensuring modifications are adequately designed, installed and tested.	The demonstration could include a specific example (through involvement of end user, HF experts, Training, Task analysis etc.)

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Technical Guide for HF reflection in Safety Case- contd.

Technical Criteria	HF Reflection
Risk Assessment and Risk Reduction Measures	
8.4 The safety case shall clearly describe how MHIs use risk assessment to help make decisions about the measures necessary to prevent major accidents or to mitigate their consequences.	RRM implemented to reduce or remove the likelihood of human failure are: a) matched to the human failure types identified; and b) where necessary, optimise the local performance influencing factors that make the error more likely.

Phased HF implementation Plan

S/No	Topic	SC Submission Cycle			Remarks
		Cycle 1	Cycle 2	Cycle 3	
1	**Human Failure Prevention**				
1.1	**Task & Human Failure Analysis of human actions for Safety Critical Tasks**				
1.1.a	Initiation	Y	Y	Y	
1.1.b	Prevention		Y	Y	
1.1.c	Mitigation			Y	
1.2	**Maintenance Activities**		Y	Y	
2	**Ergonomics Design of Facilities, Working Environment and Tasks**				
2.1	HF integrated in MHI's MOC and design processes		Y	Y	Cycle 1 implementation for major modifications/ new projects
2.2	HF in work environment design		Y	Y	
2.3	Alarm handling		Y	Y	
3	**Optimisation of Organisational Performance Influencing Factors**				
3.1	Management of Organisation Change		Y	Y	Cycle 1 implementation for major modifications/ new projects
3.2	Shift Staffing level		Y	Y	
3.3	Fatigue Management		Y	Y	
3.4	Communication & Shift Handover	Y	Y	Y	
3.5	Site supervision		Y	Y	
3.6	Incident investigation covering Human Factors		Y	Y	

Any questions?

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